DRAFT ENVIRONMENTAL ASSESSMENT (EA)

FOR

NON-NATIVE AND NOXIOUS PLANT SPECIES MANAGEMENT ON BEALE AIR FORCE BASE AND LINCOLN RECEIVER SITE, CALIFORNIA

PREPARED BY:

Department of the Air Force

15 April 2021

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DRAFT FINDING OF NO SIGNIFICANT IMPACT (FONSI)

AND

FINDING OF NO PRACTICABLE ALTERNATIVE (FONPA)

NON-NATIVE AND NOXIOUS PLANT SPECIES MANAGEMENT

Beale Air Force Base and Lincoln Receiver Site, California

Pursuant to provisions of the National Environmental Policy Act (NEPA), Title 42 United States Code (USC) §§4321 to 4347, implemented by the Council on Environmental Quality (CEQ) Regulations, Title 40, Code of Federal Regulations (CFR) Parts 1500-1508, and 32 CFR Part 989, *Environmental Impact Analysis Process*, the U.S. Air Force (Air Force) assessed the potential environmental consequences associated with non-native and noxious plant species management using manual and mechanical control, chemical treatments, prescribed burning, and livestock grazing, at Beale Air Force Base (AFB), Yuba County, California, and at the Lincoln Receiver Site, Placer County, California. Pursuant to the California Code of Regulations (Title 14, §15220 and following) the Central Valley Regional Water Quality Control Board intends to rely on the EA and FONSI/FONPA in the place of a mitigated negative declaration and believes that the federal documents meet regulatory requirements. This EA is incorporated by reference into this finding per 40 CFR 1508.13 and 40 CFR 1502.21.

The purpose of the Proposed Action is to manage plant species on Beale AFB and the Lincoln Receiver Site in order to reduce the prevalence of non-native and noxious vegetation to protect and preserve the military mission, ecosystem function, and valued resources and programs. The need for the Proposed Action is to address the threats of numerous non-native and noxious plant species on Beale AFB and the Lincoln Receiver Site. There is a need to eliminate or control known priority infestations, and to prevent the establishment of new infestations of invasive plants. If allowed to spread unchecked, non-native and noxious plant species would degrade the remaining native habitat; interfere with management of sensitive resources, economic activities, and quality of life; and may impede the military mission.

The Environmental Assessment, incorporated by reference into this finding, analyzes the potential environmental consequences of non-native and noxious plant species management actions on Beale AFB and the Lincoln Receiver Site and provides environmental protection measures to avoid or reduce adverse environmental impacts from those actions.

The EA considers all potential impacts of Alternative 1 (No Action Alternative) and Alternative 2 (Comprehensive Control). The EA also considers cumulative environmental impacts with other projects within the Region of Influence.

ALTERNATIVE 1 (No Action Alternative)

Under the No Action Alternative, the action alternatives would not occur and current management activities would continue. Current control includes limited, small-scale manual/mechanical plant removal and chemical applications. Grazing would continue on existing pastures, but there would not be the option to expand operations into new areas, change stocking rates, or vary residual dry matter targets in accordance with annual weather variability or specific non-native and noxious plant species control objectives. Sporadic prescribed burning activities would continue to occur on a limited scale. Under the No Action Alternative management activities would lack a programmatic, cohesive approach and long-term strategy; would not utilize the most effective treatment methods; would not consider the most current science, data and analyses, and management recommendations; and would not fully address current Integrated Natural Resources Management Plan and associated program management goals.

ALTERNATIVE 2 (Comprehensive Control)

Under Alternative 2, non-native and noxious plant species would be managed to reduce their prevalence using an efficient, sustainable, and long-term strategy that incorporated a programmatic, adaptive approach, and maximized opportunities for stewardship of sensitive resources. Alternative 2 would utilize a varied toolkit of control methods including manual/mechanical removal, chemical applications, livestock grazing, and prescribed burning. The Beale AFB Invasive Plant Species Management Guidelines, Grazing Management Guidelines, and Wildland Fire Management Plan would provide the basis for this alternative. Alternative 2 would allow for more effective non-native and noxious plant control than the other alternatives because it would include a variety of control methods, allow for control anywhere on the base with the implementation of environmental protection measures, allow for livestock grazing in more areas and with greater management flexibility, and more acres would be burned annually.

SUMMARY OF FINDINGS

The analyses of the affected environment and environmental consequences of implementing Alternative 2 presented in the EA concluded that by implementing standing environmental protection measures and operational planning, the Air Force would be in compliance with all terms and conditions and reporting requirements for implementation of the reasonable and prudent measures stipulated by applicable Agencies. Agencies include the United States Fish and Wildlife Service (USFWS), the National Oceanic and Atmospheric Administration Marine Fisheries Service (NMFS). Additional conditions are stipulated in the State Historic Preservation Officer (SHPO) concurrence, the Aquatic Pesticide Application Plan for the Statewide General National Pollutant Discharge Elimination System (NPDES) Permit for Residual Aquatic Pesticide Discharges to Waters of the United States (WoUS) from Algae and Aquatic Weed Control Applications, Water Quality Order 2013-0002-DWQ, and requirements of Feather River and Placer County Air Quality Districts' burn permits and Smoke Management Plans.

The General Conformity Rule applies to actions in air quality nonattainment or maintenance areas and considers both direct and indirect emissions. The rule applies only to federal actions that are considered "regionally significant" or where the total emissions from the action meet or exceed the de minimis thresholds presented in 40 CFR §93.153. Beale AFB is within a maintenance area for PM2.5. The additional emissions from Alternative 2 would not result in an exceedance of General Conformity thresholds.

The Air Force has concluded that no significant adverse effects would result to the following resources as a result of Alternative 2: Air Installation Compatible Use Zones (AICUZs), noise, socioeconomic resources and growth-inducing impacts, environmental justice, aesthetics, agricultural and forest resources, recreation, wildfire, land use, air quality, water resources, safety and occupational health and public services, hazardous materials/waste, biological/natural resources, cultural and tribal cultural resources, earth resources, utilities and infrastructure, transportation and traffic, energy resources, and climate change. No significant adverse cumulative impacts would result from activities associated with Alternative 2 when considered with past, present, or reasonably foreseeable future projects.

Air Installation Compatible Use Zones (AICUZs) – There would be no effects to the base AICUZs. All land uses would be compatible with the Beale AFB use zones. Prescribed burns would be scheduled so as to avoid impacts to visibility and flight capabilities near the air field.

Noise – Only minimal, short-term changes to ambient noise levels would occur as a result of implementing the Proposed Action. All activities would be conducted during business hours in areas where there is existing noise from aircraft, vehicle traffic, and occasional heavy equipment use.

Socioeconomic Resources and Growth-Induced Impacts – Grazing expansion under the Proposed Action would increase the number of acres available to be leased for grazing. This would have a direct, permanent beneficial effect for both the USAF, in the form of increased revenue, and the lessees, in the form of available land. Other activities would have no impact on socioeconomic resources. The Proposed Action would not contribute to changes in socioeconomic resources, such as impacts on housing availability, employment, community resources or local population. Leases are awarded in a competitive bid process that would be open to any interested parties. Grazing leases do not affect properties outside of the base. Finally, the Proposed Action would not lead to unplanned population growth and would not displace any people or housing; invasive species control is not related to human population growth. Therefore, there would be no adverse impact to socioeconomic resources as a result of the Proposed Action. The No Action alternative would result in no changes to current socioeconomic conditions.

Environmental Justice - Schools, childcare centers, and youth centers on Beale AFB are all located in the cantonment or housing areas, which are the center for residential and commercial facilities on the base. Only very temporary, intermittent impacts would occur as a result of the Proposed Action. None of these facilities is located in an area that would experience disproportionately high and adverse impacts. Treatments would not be conducted on the aforementioned sites. If treatments were conducted near these facilities, it would be during weather conditions that minimize smoke or herbicide drift. There are no senior facilities located on the base. Treatments would occur solely on the base and would not affect off-base populations. Due to the type of fuels on Beale AFB (annual grasses) smoke output would be relatively low and would disperse quickly. Prescribed burns are only permitted on days that the local air quality board determines there would not be an adverse impact on human health. Herbicide would be applied during appropriate weather conditions to avoid off-base drift. The Proposed Action would not include any activities that would discriminate in any way on the basis of race, color, national origin, age, or income.

Aesthetics – The Proposed Action would not have an adverse effect on scenic vistas, would not damage scenic resources, and would not degrade the existing visual character or quality of public views. The Proposed Action would not create a new source of substantial light or glare. While vegetation removal would occur under the Proposed Action, those species removed would be invasive species that currently impede the visual character of the landscape. The project would not change rural and undeveloped landscapes to an urban appearance. Many projects would not be within public view. While the project includes prescribed burns, which do change the visual character of a vista from brown grasses to black soil, the change would not be considered adverse given that prescribed burns help prevent more catastrophic wildfires, visual impacts are temporary as grasses and wildflowers germinate and provide green cover in the early fall, and because of the resulting improvement of the visual character and quality of the view after fire primarily due to increased quantity of wildflowers.

Agricultural and Forest Resources – As the Proposed Action aims to improve native landscapes, grazing lands and forested landscapes would be maintained. Effects are expected to be beneficial. The Proposed Action would not convert farmland to another use, would not conflict with existing zoning for agricultural use, and would not conflict with existing zoning for or cause rezoning for forest lands or timberlands. Prescribed burns are conducted in a way that protect oaks if woodlands are targeted for burning, which they typically are not. Oak trimming (i.e. removing low branches) may be undertaken as a fuels reduction practice, to help reduce the possibility that oak trees would burn during a wildfire. Oaks are a valuable part of the natural flora, and their protection, not removal, would occur under the Proposed Action.

Wildfire - Beale AFB is surrounded on three sides by moderate fire hazard severity zones as well as several small sections of very high fire hazard severity zones. While invasive species activities may increase vehicle or ATV traffic on little used, dirt and gravel roads as well as some off-road travel, thereby increasing the risk of fire, all staff follow fire precautions. The Proposed Action would not impair emergency response or evacuation plans, does not exacerbate wildfire risk, does not include installation of equipment such as utility lines that exacerbate wildfire risks, and would not be expected to expose people or structures to downstream flooding or landslides as a result of runoff or post-fire slope instability. Overall, the Proposed Action would have a beneficial impact on wildfire severity as it would expand prescribed burning, grazing and mowing practices which reduces fuel loads and fire risk.

Land Use – There would be no irreversible effects to land use, or changes to land use designation as a result of the Proposed Action. Any land improvements or infrastructure installed for livestock grazing expansion could be removed if mission requirements change. Any other effects to land use would be minor and temporary.

Air Quality – Negligible to moderate adverse effects to air quality may result from prescribed burns. The effects would be temporary, localized, and mitigated by the implementation of a Smoke Management Plan, and therefore would not be significant. Emissions resulting from construction equipment, vehicles, mowers, and hand-held equipment would not affect regional air quality attainment status. Grazing lessees and construction projects would be required to comply with standard mitigation measures and fugitive dust control mitigation measures to minimize air quality impacts. None of the active herbicide ingredients proposed for use are subject to the California Department of Pesticide Regulation’s nonfumigant volatile organic compounds regulations. Herbicides with the potential to emit volatile organic compounds or to create drift would not be applied under conditions when volatilization or drift are likely to occur.

Water Resources – Under the Proposed Action no significant effects to water resources would occur. Livestock would either be excluded from aquatic resources, or would be closely managed in areas where they could access aquatic resources. Vegetated buffers would be used to protect aquatic resources from erosion resulting from prescribed burns. Herbicide-specific application buffers would be implemented around aquatic resources to prevent contamination. Any herbicide application in or adjacent to aquatic resources would be done using aquatic-approved herbicides and would follow the Aquatic Pesticide Application Plan best management practices and monitoring requirements. Erosion control measures would be implemented for large areas of exposed ground to reduce the potential for erosion and water contamination. Work conducted in wetlands and 100-year floodplains would be anticipated to have overall beneficial impacts by improving water flow and wetland hydrology. Ground disturbance within wetlands and floodplains would be minimized to the greatest extent possible, including limiting firebreak creation to non-soil disturbing methods. A Notice of Intent to prepare an EA for Proposed Actions that would occur in floodplains and may affect wetlands was published in the Marysville Appeal-Democrat newspaper, soliciting public comments on 2 and 6 October 2019. The notice invited the public to provide comments on the proposal and any practicable alternatives that may reduce impacts by 31 October 2019. No comments were received.

Safety and Occupational Health and Public Services – Effects on occupational health and safety would not be expected, but adverse effects could occur if appropriate safety procedures were not followed. Individual prescribed fire plans would be prepared for prescribed burns, which would contain applicable safety measures to be followed and required personal protective equipment. Exposure to toxic levels of herbicides would be avoided by following applicable state and federal laws, label instructions, DoD requirements, and best management practices included in the EA. Herbicide would only be applied by California or DoD qualified or certified applicators. Appropriate personal protective equipment would be worn when using manual or mechanical equipment, and Air Force safety protocols would be followed. Finally, invasive species control activities would not result in adverse physical impacts to government facilities, would not require new or altered government facilities in order to maintain service ratios, and would not alter response times of any public service offered on Beale AFB.

Hazardous Materials/Waste – Minor effects from hazardous materials and hazardous waste generation could occur as a result of the Proposed Action. There are Environmental Restoration Program Sites throughout Beale AFB. Environmental Baseline Surveys would be conducted for these areas prior to pasture construction to identify any risks to humans or livestock. Personnel would be trained to identify and avoid unexploded ordinances during prescribed burns and other soil disturbing activities. Hazardous waste would be generated in the form of herbicide containers; these would be disposed of at appropriate facilities on or off Beale AFB.

Biological/Natural Resources – The effects of the Proposed Action on biological resources would be largely beneficial. Non-native and noxious plant species often out compete native plant species leading to lower plant biodiversity and degraded fish and wildlife habitat. Negative effects to biological resources are possible but would be minimized with the implementation of Avoidance and Minimization Measures and Best Management Practices in this EA. Herbicides would be used in accordance with label instructions and applicable federal, state, and DoD regulations in addition to requirements in this EA. These are designed to prevent toxic effects to nontarget vegetation, fish, and wildlife. Species-specific and aquatic resource herbicide buffers would minimize the risk of exposure to special status species. Protective buffers and firebreaks that do not require soil disturbance would be used to avoid effects to special status plants and animals, and their habitat during prescribed burns. Livestock grazing would be carefully managed and monitored to avoid negative effects from overgrazing. Beale AFB has consulted with the USFWS to identify measures that would be implemented to protect special status species.

Cultural and Tribal Cultural Resources – No impacts to cultural or tribal cultural resources would occur. Adverse effects from livestock would be avoided by coordinating the location of livestock-holding areas, water sources, and mineral supplements with the base Cultural Resources Manager and placing them outside of cultural resource site boundaries. The location of any soil-disturbing invasive plant treatments would be approved by the Cultural Resources Manager and earth disturbing equipment would not be used within cultural resource site boundaries. If needed, excessive plant biomass would be removed by hand prior to prescribed burns in order to prevent extreme heat affects to cultural resources. Restoration treatments in areas with sensitive cultural resources would be limited to re-seeding and other activities that would not require soil disturbance.

Earth Resources – The Proposed Action does not have the potential to alter or otherwise affect geology or topography or minerals. The effects of the Proposed Actions on soils would be largely beneficial. Invasive plants can increase the risk of soil erosion and alter soil chemical composition, so controlling these plants would indirectly benefit soils. Restoration treatments would benefit soils by restoring native vegetation, increasing vegetative cover and soil moisture retention, and reducing soil erosion. Cattle and other livestock could directly and indirectly, adversely, temporarily or permanently impact soils. However, with routine rangeland monitoring and carefully managed grazing effects to soil would be negligible to minor. Prescribed burns would be conducted in ways that limit fire intensity and would not result in a severe fire that could negatively impact the physical and chemical properties of the soils. Adverse effects to soils and soil biomes from herbicide would be avoided by adherence to the herbicide application Best Management Practices.

Utilities and Infrastructure – The Proposed Action would have an overall benefit to utilities and infrastructure. Expansion of the grazing program would benefit utilities and infrastructure by maintaining roads and waterlines, adding fencing, and reducing fire risk. Chemical treatments would have no effect on utilities and infrastructure. Overall, prescribed burns would have beneficial effects on infrastructure by reducing fuel loads, but could negatively affect utilities and infrastructure if they got out of control. Negative effects would be avoided through the implementation of a Prescribed Fire Plan for each burn. Manual, mechanical and restoration treatments may involve excavation and could harm utilities and infrastructure if lines or pipes were broken. This would be avoided by obtaining the proper clearance prior to earth disturbing work.

Traffic and Transportation – The Proposed Action would have minor impacts to transportation during grazing infrastructure construction, prescribed burns, chemical treatments, and mechanical treatments. During these activities, an increase in traffic would be expected by contractors through the Wheatland Gate for large equipment and would include light construction vehicles and personal vehicles through the Wheatland or Vassar Lake gates. Construction vehicles on these roadways could disrupt traffic speeds and increase gate delays. Impacts would be short term in nature and localized. Smoke from prescribed burns could have temporary adverse effects on transportation and traffic by obscuring visibility for drivers. Prescribed fire signs would be posted along roadways and Security Forces would conduct traffic control as needed.

Energy Resources – The use of energy resources associated with the increased effort to control invasive species would be minor and would not be wasteful, inefficient or unnecessary. All energy use would be for temporary weed control projects and would not use energy continuously over time. Besides the energy resources consumed during transportation to and from field sites, mechanical equipment would use oil and gasoline. Little electricity would be used during the course of invasive species management activities and those activities that would require it, such as watering equipment for grazing and habitat enhancement projects, would typically source it from renewable solar power. Overall, the project would have negligible impacts to local and regional energy supplies.

Climate Change – Greenhouse gas (GHG) emissions for the Proposed Action's maximum expected annual activity, which would include 4,500 acres of prescribed burns, by far the largest contributor of GHGs. Emissions could range between 1,316 to 4,200 metric tons of carbon dioxide equivalent per year. These emissions would not exceed threshold limits for stationary, operational-related activities or construction-related activities and would be in line with the Feather River Air Quality Management District's guidelines, which has not set thresholds for GHG emissions. While the Proposed Action would result in GHG emissions during implementation, it would not conflict with any applicable plan, policy or regulation adopted for the purpose of reducing the emissions of GHGs. In fact, it's been widely recognized that the use of prescribed fire needs to increase in California to help address and prevent the catastrophic wildfire events that have occurred over the past several years in California; fires that impact 25% of the state's population who live in high-risk fire areas. CAL FIRE identifies five forestry strategies for reducing GHGs which includes fuels reduction practices. In 2020, wildfires burned over 1,000 acres at Beale AFB, which could have been reduced with strategic prescribed burns. Given the variability of fuel load conditions and the unlikely scenario that Beale AFB burns 4,500/acres per year, reaching projected levels of GHG emissions is unlikely. The largest annual total acreage of prescribed burns at Beale AFB since 2013 was only 800 acres, for instance. The climate change impact from the Proposed Action would, therefore, be minor and temporary, and not would not be significant.

FINDING OF NO PRACTICABLE ALTERNATIVE (FONPA)

Executive Order (EO) 11990, *Protection of Wetlands*, (24 May 1977) directs agencies to avoid to the extent possible the long- and short-term adverse impacts associated with the destruction or modification of wetlands and to avoid direct or indirect support of new construction in wetlands wherever there is a practicable alternative. Federal agencies are to avoid new construction in wetlands, unless the agency finds there is no practicable alternative to work within wetlands and the proposed projects incorporate all possible measures to limit harm associated with work done in wetlands. Agencies should use economic and environmental data, agency mission statements, and any other pertinent information when deciding whether or not to build in wetlands. EO 11990 directs each agency to provide for early public review of plans for construction in wetlands. In accordance with EO 11990 and 32 CFR Part 989, a Finding of No Practicable Alternative (FONPA) must accompany the Finding of No Significant Impact (FONSI) stating why there are no practicable alternatives to development within or affecting wetland areas.

Similarly, EO 11988, *Floodplain Management* (May 24, 1977), requires Federal agencies to avoid to the extent possible the long and short-term adverse impacts associated with the occupancy and modification of floodplains and to avoid direct and indirect support of floodplain development wherever there is a practicable alternative. If it is found that there is no practicable alternative, the agency must minimize potential harm to the floodplain and circulate a notice explaining why the action is to be located in the floodplain prior to taking action. Finally, new construction in a floodplain must apply accepted flood proofing and flood protection to include elevating structures above the base flood level rather than filling in land. In accordance with EO 11988, a FONPA must accompany the FONSI stating why there are no practicable alternatives to development within or affecting floodplains.

Wetlands: There is no practical alternative to conducting the Proposed Action in wetlands, because many of the targeted plants grow in wetlands. The Proposed Action would include all practicable measures to minimize harm to wetlands. Wetland impacts would be reduced to the maximum extent possible through project design and implementation of environmental protection measures. Pursuant to §404(b)(1) of the CWA, wetland impacts must be avoided to the greatest extent practicable. A Preliminary Jurisdictional Determination from U.S. Army Corps of Engineers concurred that there are approximately 3,089 acres of wetlands, including vernal pools, and/or other water bodies present within Beale AFB and 40 acres of the Lincoln Receiver Site that are potential WoUS regulated under §404 of the CWA, as depicted in the 23 February 2010 Beale AFB Wetland Delineation drawings. These drawings would be used to identify wetlands within an area before implementing control activities. Any necessary agency coordination and required permits would be acquired prior to commencing any activities. Measures to minimize wetland impacts may include site plan reconfiguration, installation of buffer areas along the perimeter of wetlands, or erosion controls to prevent sedimentation in adjacent wetlands. Activities associated with these projects would be conducted in accordance with the California General National Pollutant Discharge Elimination System permit and its associated procedures as detailed in the Aquatic Pesticide Application Plan.

As noted in the attached EA, there are no practicable alternatives to the Proposed Actions that would avoid all impacts or further minimize impacts to wetlands because the objectives sought by these projects preclude the selection of any practicable alternatives due to mission requirements, installation layout constraints, and the nature of proposed projects. Taking all the environmental, economic, and other pertinent factors into account, pursuant to EO 11990, the authority delegated by Secretary of the Air Force Order 791.1, and taking into consideration the submitted information, I find that there is no practicable alternative to this action and the Proposed Action includes all practical measures to minimize harm to the environment.

Floodplains: There is no practical alternative to conducting the Proposed Action in floodplains, because many of the targeted plants grow in floodplains. All invasive plant control is anticipated to have direct and indirect beneficial impacts to floodplains. The invasive plant treatments would reduce the hazard and risk of flood loss by improving water flow and floodplain functionality by controlling invasive vegetation growing in waterways and floodplains. Successful invasive plant control and revegetation of floodplains with native plant species would help to reduce the impact of floods on human safety, health, and welfare. If this work is not conducted in floodplains, invasive plants currently degrading floodplains and water ways would not be controlled, which would lead to increased risk of flood damage and reduced floodplain functionality and biodiversity. Impacts to floodplains related to the Proposed Actions would, in general, be minimized through implementation of an approved avoidance and minimization measures, best management practices, and other appropriate environmental protection measures; and through adherence to the Statewide General National Pollutant Discharge Elimination System Permit for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications, Water Quality Order 2013-0002-DWQ and Beale Air Force Base specific Aquatic Pesticide Application Plan. The Proposed Action would not lead to loss of, or long-term impacts to floodplains and would be largely beneficial.

As noted in the attached EA, there are no practicable alternatives to the Proposed Actions that would avoid all impacts or further minimize impacts to floodplains because the objectives sought by these projects preclude the selection of any practicable alternatives due to mission requirements and the nature of proposed project. Project alternatives were evaluated throughout the base using the selection criteria identified in the EA. The remaining projects that would impact floodplains are constrained to their proposed locations due to the nature of the projects. Taking all the environmental, economic, and other pertinent factors into account, pursuant to EO 11988, the authority delegated by Secretary of the Air Force Order 791.1, and taking into consideration the submitted information, I find that there is no practicable alternative to this action and the Proposed Action includes all practical measures to minimize harm to the environment.

FINDING OF NO SIGNIFICANT IMPACT (FONSI)

Based on my review of the facts and analyses presented in the attached EA, I conclude that the Proposed Actions would not have a significant impact on the natural or human environment either by itself or cumulatively. The requirements of NEPA and the CEQ's regulations have been fulfilled. An Environmental Impact Statement is not required and will not be prepared.

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DEE JAY KATZER, Colonel, U.S. Air Force Chief, Date

Civil Engineer Division HQ Air Combat Command (ACC/A4C)

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GLOSSARY OF ABBREVIATIONS AND ACRONYMS

§(§)	Legal Section(s)
9 RW	9th Reconnaissance Wing
9 CES	9th Civil Engineer Squadron
ACAM	Air Conformity Applicability Model
ae/ac	acid equivalent/acre
AFB	Air Force Base
AFI	Air Force Instruction
AFOSH	Air Force Occupational and Environmental Safety, Fire Protection, and Health
AFPD	Air Force Policy Directive
AFMAN	Air Force Manual
ai/ac	active ingredient/acre
AICUZ	Air Installation Compatible Use Zone
AMMs	Avoidance and Minimization Measures
ATV	All-Terrain Vehicle
AUM	Animal Unit Month
BAAQMD	Bay Area Air Quality Management District
BASH	Bird/wildlife Aircraft Strike Hazard
BEE	butoxyethyl ester
BMPs	Best Management Practices
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CEIE	(9 CES) Environmental Element
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CESA	California Endangered Species Act
CFR	Code of Federal Regulations
CNPS	California Native Plant Society
CWA	Clean Water Act
DoD	Department of Defense
DoDI	Department of Defense Instruction
EA	Environmental Assessment
EIAP	Environmental Impact Analysis Process
EIS	Environmental Impact Statement
EO	Executive Order
EFH	Essential Fish Habitat
EPA	Environmental Protection Agency
ERP	Environmental Restoration Program
ESA	Endangered Species Act
°F	degrees Fahrenheit
FONPA	Finding of No Practicable Alternative
FONSI	Finding of No Significant Impact
FRAQMD	Feather River Air Quality Management District
GHG	Greenhouse gases
GMG	Grazing Management Guidelines
HQ	Hazard Quotient
ICRMP	Integrated Cultural Resources Management Plan

IICEP	Interagency/Intergovernmental Coordination for Environmental Planning
INRMP	Integrated Natural Resources Management Plan
IPMP	Installation Pest Management Plan
IPSMG	Invasive Plant Species Management Guidelines
lbs	pounds
LRS	Lincoln Receiver Site
MBTA	Migratory Bird Treaty Act
mg/kg/bw	milligrams per kilogram of bodyweight
mgd	million gallon per day
MMRP	Military Munitions Response Program
MRS	Munition Response Site
na	not applicable
NEPA	National Environmental Policy Act
NMFS	National Oceanic and Atmospheric Administration’s National Marine Fisheries Service
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NRM	Natural Resources Manager
PAVE PAWS	Precision Acquisition Vehicle Entry Phased Array Warning System
PCAPCD	Placer County Air Pollution Control District
PCE	tetrachloroethene
PM2.5	particulate matter less than or equal to 2.5 microns in aerodynamic diameter
PM10	particulate matter greater than 2.5 and less than 10 microns in aerodynamic diameter
POEA	polyethoxylated tallowamine
PPE	Personal Protective Equipment
ppm	parts per million
RCRA	Resource Conservation and Recovery Act
RfD	Reference Dose
RDM	Residual Dry Matter
ROI	Region of Influence
SR	State Route
TCE	Trichloroethene
TCP	3,5,6-trichloro-2-pyridinol
TEA	triethylamine acid
TPH-D	total petroleum hydrocarbons as diesel
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USC	United States Code
USFWS	United States Fish and Wildlife Service
UXO	Unexploded Ordnance
VOC	Volatile Organic Compound
WFMP	Wildland Fire Management Plan
WoUS	Waters of the United States

1.0 PURPOSE OF AND NEED FOR ACTION

This Environmental Assessment (EA) has been prepared by Beale Air Force Base (AFB) to evaluate potential environmental, cultural, and socioeconomic impacts associated with the implementation of non-native and noxious plant species management actions on Beale AFB and the Lincoln Receiver Site (LRS), a geographically separate unit managed by Beale AFB, California. Invasive plant species are those species that are spreading outside their native range, transported to a new region by people either unwittingly or deliberately (Beale AFB 2017a). In their native habitat, these species often have natural predators and competitors that control population size. When introduced into new areas and in the absence of their natural controls, non-native plants can spread quickly, often resulting in monocultures that alter vegetation recovery with changes to species diversity, soil processes, and natural disturbance patterns such as frequency and intensity of wildfires. Within the state of California, displacement of native plant species by invasive plant species has impacted wildlife habitats, fire regimes, recreation opportunities, forage production, and scenic beauty.

The term “invasive species” is commonly used and is defined by the U.S. Department of Agriculture as species that are not native to the ecosystem and whose introduction causes or is likely to cause economic or environmental harm or harm to human health (Executive Order [EO] 13112). Noxious weeds, defined by the California Department of Food and Agriculture as pests by law or regulation, are considered threats to the well-being of the state or country, plants are listed as such if they are expected to be “troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species, and difficult to control or eradicate” (CDFA 2020). In this EA, the term “invasive species” is intended to be inclusive of all of the terms defined above.

This EA has been prepared in accordance with the National Environmental Policy Act of 1969 as amended (42 United States Code [USC] 4321-4347) (NEPA), §102(2)(C); the President’s Council on Environmental Quality (CEQ) Regulations for Implementing the Procedural Provisions of NEPA, 40 Code of Federal Regulations (CFR) Parts 1500-1508; 32 CFR Part 989, Department of Defense Instruction (DoDI) 4715.9, *Environmental Planning and Analysis* (DoD 1996a); and Air Force Instruction (AFI) 32-7064, *Integrated Natural Resources Management* (USAF 2014a).

Federal agencies are required under NEPA to consider the environmental consequences of Proposed Actions in the decision-making process. Education, prevention, inventory, and monitoring aspects of this Proposed Action do not require environmental analysis, but containment/control and habitat enhancement elements do. This EA serves as a planning document to evaluate environmental impacts, consider alternatives and mitigation measures, and allow for agency and public participation.

1.1 INTRODUCTION

On Beale AFB and the LRS, a long-standing and entrenched suite of invasive plant species threatens sensitive resources, the accomplishment of military objectives and missions, and other environmental and human values. More than 50 species of invasive plants have been identified on the base, and an extensive watch list of species that have not been found but could spread to the base because of geographic proximity has been developed (see Appendix A). Species present on the base, and of particular concern are barbed goatgrass (*Aegilops triuncialis*), giant reed (*Arundo donax*), Himalayan blackberry (*Rubus armeniacus*), medusahead (*Elymus caput-medusae*), and yellow starthistle (*Centaurea solstitialis*). Appendix A also contains a table of high-priority species present on the base showing threats to the mission, past and ongoing control, current status, and management goals; and a map showing infestation locations on the base. The LRS has not been mapped for invasive species; however, the species list and watch list for Beale AFB would be similar to the LRS since the two locations are just 15 miles apart and share a common ecological setting.

Non-native plant species at Beale AFB and the LRS have been managed since 2010 in accordance with the Beale AFB 2010 Invasive Species Management Plan (EM-Assist 2010), which was developed to implement recommendations from a 2004 Invasive Species Management Analysis (EDAW 2004). Since that time, the installation Integrated Natural Resource Management Plan (INRMP; Beale AFB 2019a), the chief planning tool for managing installation ecosystems and natural resources, as well as several management plans associated with invasive plant species management (i.e., Invasive Plant Species Management Guidelines [IPSMG; Beale AFB 2017a; Appendix B], Grazing Management Guidelines [GMG; Beale AFB 2017b; Appendix C], Wildland Fire Management Plan [WFMP; Beale AFB 2018a; Appendix D], Installation Pest Management Plan [IPMP; Beale AFB 2018b]) have been updated. New science and information pertaining to recommended invasive plant species management, results of invasive species mapping surveys at the installation (CEMML 2017; H.T. Harvey & Associates 2015a), and recommendations for enhancing the invasive species management program from a review of the program by the California Invasive Plant Council (Cal-IPC 2015a), have all become available. Additionally, infestation conditions are continually changing as a result of ongoing management actions as well as environmental factors. For these reasons, invasive plant species management at Beale AFB and the LRS has been reevaluated, and the Updated IPSMG was developed. The IPSMG addresses holistic, base-wide invasive species control with an appropriate scale of effort, prompting the development of this EA. Implementation of the IPSMG across all annual grasslands, riparian, wetland, and oak woodland habitats on Beale AFB and the LRS is the basis for this Proposed Action as described in Sections 1.2 and 1.3. Chapter 2 of this EA provides detailed descriptions of the Proposed Action and alternatives.

Following is a brief overview of the installation location, setting, and mission.

1.1.1 Location

Beale AFB encompasses approximately 23,000 acres in Yuba County, California, in the northeastern portion of the Sacramento Valley, at geographical coordinates 39º08º N and 121º26º W (Figure 1.1). The installation is about 40 miles north of Sacramento, 25 miles south of Oroville, 8 miles east of Marysville, and 20 miles west of Grass Valley. The LRS encompasses about 235 acres in Placer County, approximately 15 miles south of Beale AFB and 5 miles west-southwest of Lincoln, California (Figure 1.1) (Beale AFB 2019a).

Beale AFB is in the ecological and geographic transition zone between the flat agricultural lands of the Sacramento Valley and the foothills of the western slope of the Sierra Nevada. The Yuba and Bear rivers are north and south of the installation, respectively. The base is in the Bear River watershed, and three named tributaries to the Bear River (Reeds, Hutchinson, and Dry creeks) run through the base (Beale AFB 2019a).

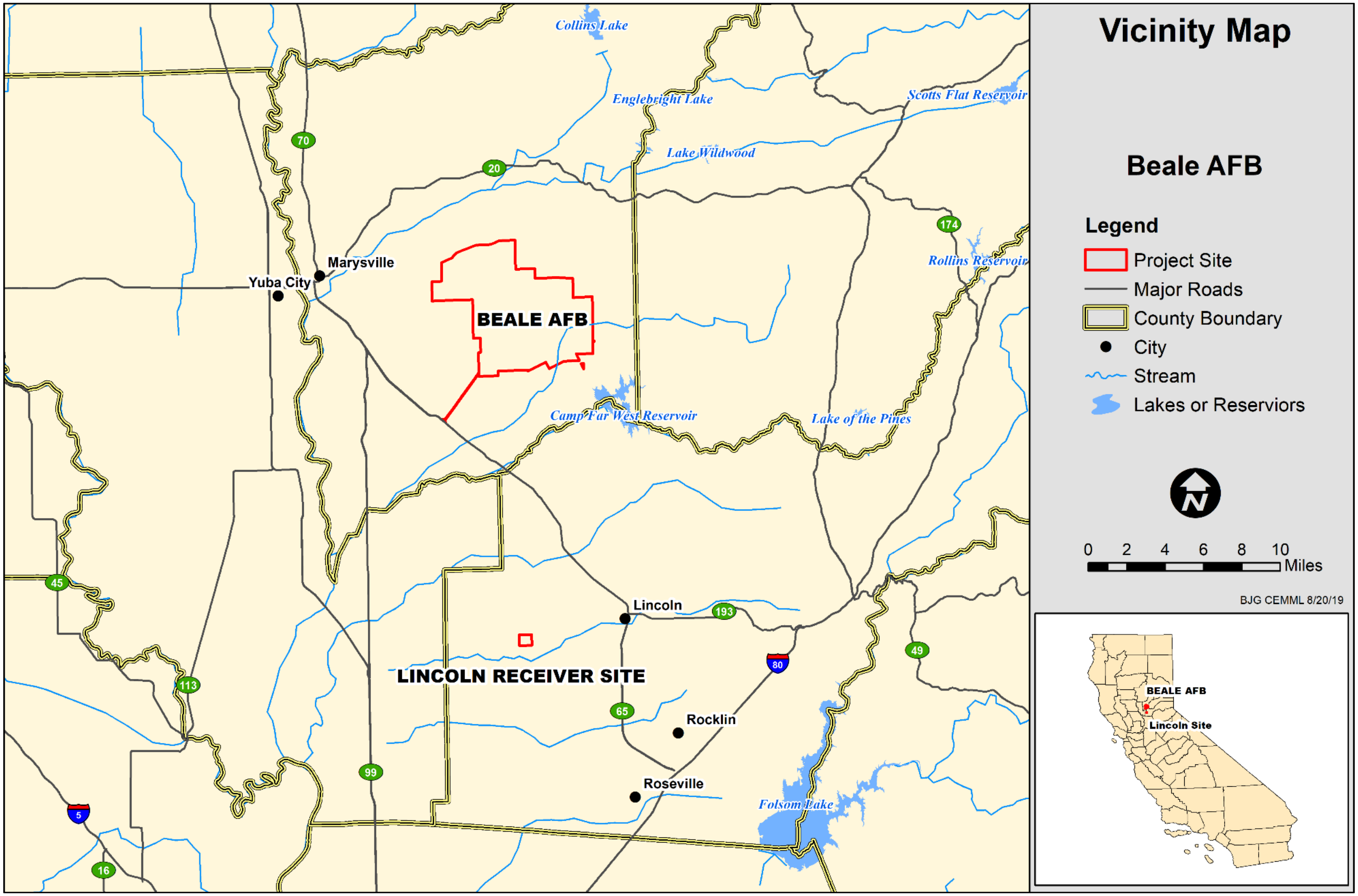


Figure 1.1. Location of Beale AFB and Lincoln Receiver Site.

Land use in the Sacramento Valley near Beale AFB is primarily agriculture, rural-residential, and industrial. Several aggregate extraction operations are located north of Beale AFB. Along the eastern boundary of the base, where the valley begins to rise into the Sierra Nevada foothills, is the larger of two parcels that constitute the Spenceville Wildlife Area managed by the California Department of Fish and Wildlife (CDFW). Three conservation easements border the installation to the northeast (Beale AFB 2019a).

The regional climate around Beale AFB and the LRS is Mediterranean subtropical, created by the location in the interior valley between the coast and Sierra Nevada mountain ranges. The valley experiences hot, dry summers and cool, wet winters. The region effectively has two seasons: a dry season lasting from May through October and a wet season lasting from November through April. The average annual high temperature is 74 degrees Fahrenheit (°F), and the average annual low temperature is 50 °F. Summer high temperatures can be extreme, reaching as high as 113 °F and persisting above 100 °F for many days at a time. The relative humidity is variable, with an annual average of 61%. The mean annual precipitation at Beale AFB is 21.9 inches with almost 95% of all rainfall occurring from October through April. Annual precipitation fluctuates significantly, with only seven out of the last 60 years experiencing actual rainfall between 21 and 23 inches. Average temperatures and weather patterns at the LRS are similar to Beale AFB. Additional information can be found in the installation INRMP (Beale AFB 2019a).

1.1.2 Mission

The mission of Beale AFB is to train, deploy, and employ Airmen and assets to deliver combat power and globally integrated intelligence, surveillance, and reconnaissance in support of national objectives. This mission is accomplished through a fleet of U-2 Dragon Lady, T-38 Talon, and RQ-4 Global Hawk aircraft operated by the 9th Reconnaissance Wing (9 RW). Beale AFB also supports an air refueling wing and various tenant units (Beale AFB 2019a).

The 9 RW, Beale AFB’s host wing, comprises more than 4,500 personnel in four groups on the base: 9th Operations Group, 9th Maintenance Group, 9th Mission Support Group, and 9th Medical Group. The 9 RW is responsible for providing national and theater command authorities with timely, reliable, high-quality, high altitude reconnaissance products. To accomplish this mission, the wing is equipped with the nation's fleet of U-2 Dragon Lady and RQ-4 Global Hawk reconnaissance aircraft and the associated support equipment. The wing also maintains a high state of readiness in its expeditionary combat support forces, which may be deployed to support operations overseas. The 9 RW is assigned to Air Combat Command and is part of the Twenty-Fifth Air Force.

Beale AFB hosts four major tenants: the 940th reserve air refueling wing contingent with aerial refueling tankers (KC-135), the 7th Space Warning Squadron, the 548th Intelligence Group, and the 372nd Training Squadron Detachment 21. Additional tenants include: USAF Office of Special Investigations Detachment 218, Air Combat Command Training Support Squadron Detachment 11, 53rd Test and Evaluation Group Detachment 2, 195th Wing California Air National Guard, 713th Combat Operations Squadron Patch, 13th Reconnaissance Squadron Patch, and the Pacific Liaison Region Civil Air Patrol Detachment 8. As of 2017, there were approximately 11,541 assigned personnel and dependents at Beale AFB. The employee population was approximately 4,423 active-duty military personnel, 31 USAF Reserve/Air National Guard, 1,006 non-extended duty Air National Guard, and 1,422 civilians. Housing facilities are provided for officers and enlisted families, and dormitories for enlisted and transient personnel (Beale AFB 2019a).

Beale AFB manages the LRS, located roughly 15 miles south of the installation. The site is part of the High Frequency Global Communications System and serves as a receiving site for communication between aircraft in flight and ground control systems. The site is remotely operated by Andrews AFB, but owned and maintained by Beale AFB (Beale AFB 2019a).

1.2 PURPOSE OF THE ACTION

The purpose of the Proposed Action is to manage invasive plant species on Beale AFB and the LRS to reduce the prevalence of invasive vegetation in order to protect and preserve the military mission, ecosystem function, and valued resources and programs.

1.3 NEED FOR THE ACTION

The need for the Proposed Action is to address the threats of numerous invasive plant species on Beale AFB. There is a need to eliminate or control known priority infestations, and prevent the establishment of new infestations of invasive plants. If allowed to spread unchecked, invasive plant species would degrade the remaining native habitat; interfere with management of sensitive resources, economic activities, and quality of life; and impede the military mission.

Threats associated with invasive vegetation on Beale AFB and the LRS include:

- Increased fire risk, which would impede the military mission.
- Increased fuel load, which would contribute to a higher burn severity and increased damage to natural/cultural resources.
- Added habitat for birds and other undesirable wildlife near the airfield, increasing bird/wildlife aircraft strike hazard (BASH) potential.
- Deteriorated native vegetative communities, restricting desired wildlife habitat and biodiversity.
- Altered vernal pool hydrology, water quality, and biomass levels, threatening the vernal pool ecosystem and associated listed species.
- Degraded aquatic and riparian habitats (e.g., changes in streamflow, bed and bank levels) threatening the associated ecosystems, native and listed species, and recreational fishing.
- Impaired wetlands and associated vegetation communities (e.g., reduces native plant species), threatening the ecosystem and associated plant and animal species.
- Diminished forage quality and quantity through reduced palatable forage species, threatening the existing grazing program and associated fuels reduction.
- Toxic effects on humans and pets, degrading outdoor activity and quality of life.
- Growth on roads, sidewalks, trails, and parking areas reducing visibility, increasing erosion and flooding potential, degrading aesthetics and recreational opportunities, and contributing to the spread of undesirable species.
- Reduced open space, degrading quality of life and recreational opportunities.
- Invasion of decorative landscaping.
- Allowed to spread unchecked, degradation escalates.

A recent report by 16 federal agencies states that, "Invasive species pose one of the greatest ecological threats to America's lands and waters. Their control can be complex and expensive and is often conducted in perpetuity; their harm can be irreversible… If left to spread, invasive species cost billions of dollars to manage and can have devastating consequences on the Nation's ecosystems" (U.S. DoI 2016). In a widely-cited article, Pimentel et al. (2005) calculated that invasive plants and animals cost the United States economy $120 billion per year in losses and damage and in control costs. They also estimated that 42% of the nation's federally listed threatened and endangered species are at risk primarily because of the impacts of invasive species. For rangelands and pastures specifically, Pimentel et al. (2005) estimated national forage loss due to invasive plants at $1 billion per year and invasive plant control costs at $5 billion per year (Beale AFB 2017a). These figures apply do to both invasive plants and animals, however the Proposed Action would target invasive plant species.

Legislation invoked to justify federal invasive species control programs includes NEPA, the ESA, the Federal Noxious Weed Act (PL 93-629; 7 USC §2801 et seq.; 88 Stat. 2148, amended 1990), and EOs that explicitly direct federal agencies to control invasive species, such as EO 13112, *Invasive Species* (1999) and EO 13751, *Safeguarding the Nation from the Impacts of Invasive Species* (2016). EO 13751 states that United States policy is "to prevent the introduction, establishment, and spread of invasive species, as well as to eradicate and control populations of invasive species that are established" and acknowledges the harm that invasive species cause to "the environment and natural resources, agriculture and food production systems, water resources, human, animal, and plant health, infrastructure, the economy, energy, cultural resources, and military readiness," almost all of which are relevant to natural resources management at Beale AFB.

AFI 32-7064, *Integrated Natural Resources Management* (USAF 2016, Section 3.8.4), provides the following instruction regarding invasive species: "Develop and implement management strategies oriented toward the control of exotic and invasive species when practical and consistent with the military mission." The current Beale AFB INRMP (Beale AFB 2019a) includes goals, objectives, and projects to guide the management of invasive species on the installation. This EA addresses the implementation of these strategies.

A comprehensive, adaptive management plan is needed in order to implement a physically effective, cost effective, and efficient invasive plant management program. The plan should include elements to prevent new infestations, eradicate infestations when practicable, and control/contain existing infestations for which eradication is not practical or possible.

1.4 DECISION TO BE MADE

NEPA is a federal statute requiring the identification and analysis of potential environmental impacts associated with proposed federal actions before those actions are taken. The intent of NEPA is to help decision-makers make well-informed decisions based on an understanding of the potential environmental consequences, and take actions to protect, restore, or enhance the environment. NEPA established CEQ, which was charged with the development of implementing regulations and ensuring federal agency compliance with NEPA. Air Force Policy Directive (AFPD) 32-70, *Environmental Quality*, states that the USAF will comply with applicable federal, state, and local laws and regulations, including NEPA.

State and local agencies are required to assess the impacts of activities that are legally defined as a project or action, and to avoid or mitigate those impacts where feasible. Projects are defined as activities undertaken by a public agency or a private activity that must receive some discretionary approval (meaning the agency has the authority to deny the requested permit or approval) from a government agency which may cause either a direct physical change in the environment or a reasonably foreseeable indirect change in the environment. The CEQ regulations mandate that all federal agencies use a prescribed, structured approach to environmental impact analysis. This process evaluates potential environmental consequences associated with a Proposed Action and considers alternative courses of action.

CEQ regulations (40 CFR Parts 1500−1500) ensure compliance with NEPA. These regulations dictate that an EA be prepared to provide evidence for determination of a Finding of No Significant Impact (FONSI) and a Finding of No Practicable Alternative (FONPA), or if an Environmental Impact Statement (EIS) is needed. The EIAP (32 CFR Part 989, as amended) outlines the process for implementing NEPA. AFI 32-7064, *Integrated Natural Resources Management,* outlines the policy and procedure for implementation of a FONSI or FONPA. If the selected alternative must be located in a wetland or floodplain, and no practicable alternative exists, then a FONPA must be prepared that discusses why no other practicable alternative exists to avoid impact to the wetland or floodplain. The FONPA is a statement included in the FONSI that states there is no practicable alternative to that which is selected. The analysis in the EA must support this finding.

The lead agency conducts an EA to assess the environmental effects of a proposed project. Depending on the potential effects, a further and more substantial review may be conducted in the form of an Environmental Impact Statement. A project may not be approved if there is another alternative that meets the Purpose and Need and has less significant environmental effects. In addition, a project could be approved if mitigation is proposed to lessen the environmental effects to an insignificant level.

Per NEPA, upon completion of the EA review and consultation process, the project sponsor (USAF) will determine whether the Proposed Action would result in significant impacts to environmental or other resources. If it is found that no significant impacts would occur as a result of the Proposed Action, the USAF can move forward with the Proposed Action as such once it publishes a FONSI/FONPA.

1.5 AGENCY AND INTERGOVERNMENTAL COORDINATION/ CONSULTATIONS

1.5.1 Interagency and Intergovernmental Coordination and Consultations

Federal, state, and local agencies with jurisdiction that could be affected by the alternative actions were notified and consulted during the development of this EA. Appendix E contains the list of agencies consulted during this analysis and copies of correspondence.

The Beale AFB INRMP (Beale AFB 2019) is prepared in cooperation with the USFWS and the CDFW, and is signed by representatives of both agencies indicating mutual agreement concerning the conservation, protection, and management of the fish and wildlife resources addressed in the INRMP. The activities proposed in this EA are based on goals and objectives listed in the INRMP. Beale AFB is in consultation with the USFWS in accordance with legal requirements set forth under regulations implementing §7 of the Endangered Species Act (ESA) (50 CFR 402; 16 USC 1536 (c)) to address activities proposed in this EA. All agreed upon Avoidance and Minimization Measures (AMMs) would be implemented.

Beale has concurrence from USFWS regarding ongoing invasive plant control effort as described in *Informal Consultation on the Proposed Invasive Weed Control on Reeds Creek at Beale Air Force Base, Yuba County, California* dated 8 October 2015 (Appendix F). This is a letter from USFWS in response to the request for informal consultation under §7 of the ESA on the Proposed Action described by the base in *Invasive Weed Control on Reeds Creek at Beale Air Force Base,* *California* dated September 2015. The proposed project was to apply herbicide to resprouts over 13.1 acres where Himalayan blackberry had been masticated/mown in June 2015. The goal of this treatment was to reduce BASH concerns by reducing potential nesting bird habitat near the flightline. The letter concurs that with adherence to AMMs during project implementation, the proposed project "may affect, but is not likely to adversely affect" species listed under the ESA. The letter concludes that "…unless new information reveals effects of the proposed project that may affect listed species in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed project, no further action under the Act [ESA] is necessary".

Pursuant to 50 CFR 402.12(j), Beale AFB submitted a *Biological Assessment for Invasive Plant Species Management* dated February 2020 for review by USFWS and requested concurrence that the proposed project may affect, but was not likely to adversely affect the vernal pool fairy shrimp, the vernal pool tadpole shrimp and the yellow-billed cuckoo. It was expected that the proposed project was "likely to adversely affect" the valley elderberry long-horn beetle. The proposed project would not occur within designated or proposed critical habitat for any federally-listed species. Although not yet listed the Biological Assessment also considered the monarch butterfly, currently under federal review for listing. The document was returned with the comment that it did not have enough information to support the determination of "likely to adversely affect" valley elderberry longhorn beetles. The USFWS recommend that Beale re-evaluate the proposed project effects on valley elderberry longhorn beetles and submit a revised letter and Biological Assessment addressing the issues. USFWS provided suggestions for changing the determination to "not likely to adversely affect" valley elderberry longhorn beetles with the addition of species-specific AMMs. A *Biological Assessment for Invasive Plant Species Management* dated June 2020 was submitted to USFWS, who concurred that the proposed project was "not likely to adversely affect" any listed species on Beale AFB. The updated Biological Assessment, the concurrence letter and communication emails are included in Appendix F.

On 9 September 2020, the National Oceanic and Atmospheric Administration's National Marine Fisheries Service (NMFS) received a request From Beale AFB for a written concurrence that the activities described in the informal consultation titiled *Non-Native and Noxious Plant Species Management at Beale AFB* (Appendix F) are not likely to adversely affect species listed as threatened or endangered or critical habitats designated under the ESA. Beale AFB also requested consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855(b)) for this action. However, the base determined that the Proposed Action would have "no adverse effects" on EFH, and neither the EFH consultation provisions of the Magnuson-Stevens Fishery Conservation and Management Act nor NMFS EFH guidelines have any provisions regarding concurrence with a "no adverse effects" determination. Therefore, NMFS is not required to provide concurrence. Beale AFB, as the lead Federal action agency, must make the initial determination of whether the action may adversely affect EFH, and then proceed with consultation if, in Beale AFB's view, the project may adversely affect EFH. Because Beale AFB determined that the action would not adversely affect EFH, then it had no statutory obligation to consult pursuant to the MSA EFH consultation requirements.

On September 11th, 2020, NMFS staff discussed the Proposed Action with staff at Beale AFB, concluding that more information was needed to assess the potential impacts. NMFS staff followed this discussion with a written (email) request for more information. On October 6th, 2020, Beale AFB staff sent additional information regarding the potential impacts of the Proposed Action and its relation to the larger Integrated Natural Resource Management Plan to manage invasive species at Beale AFB. On November 30th, 2020, Beale AFB staff sent additional information regarding monitoring reporting associated with the Proposed Action. With receipt of the additional, complete information, consultation was initiated. On December 16th, 2020, Beale AFB staff provided new information clarifying project elements related to the revegetation of disturbed project sites and the timing of requests to extend the seasonal "Limited Operations Period" (or "work-window"). Initiation date was modified to this date to accommodate new information. On 22 January 2021 NMFS sent a letter of concurrence, that the Proposed Action is not likely to adversely affect the subject listed species. A copy of the consultation and associated communications is in included in Appendix F.

Formal Consultation is in progress with the California Office of Historic Preservation (Appendix F). This Consultation is being conducted as required by §106 of the National Historic Preservation Act (1966 as amended) and its implementing regulations (36 CFR Part 800). For the current undertaking, Beale AFB has determined that the proposed undertaking would have No Adverse Effect on cultural resources. Beale AFB requested the SHPO to review and comment on that finding and the identification of the area of potential effects. After reviewing the information submitted by the USAF, the SHPO had the following comments: 1) The SHPO has no objections to your identification and delineation of the area of potential effects pursuant to 36 CFR Parts 800.4 (a)(1) and 800.16(d); 2) The SHPO request the BAFB to provide to the SHPO copies of any pertinent comments it receives regarding this proposed undertaking and; 3) The SHPO does not object to the Finding of No Adverse Effects to Historic Properties, as described above, pursuant to 36 CFR Part 800.5(d)(1).

1.5.2 Government to Government Consultations

The National Historic Preservation Act and its implementing regulations at 36 CFR Part 800 require federal agencies to consult with Native American tribal governments that attach religious and cultural importance to properties eligible for the National Register of Historic Places. To comply with legal mandates, federally recognized tribes that are affiliated historically with the Beale AFB geographic region will be invited to consult on all proposed undertakings that have a potential to affect properties of cultural, historical, tribal or religious significance to the tribes. The tribal coordination process is distinct from NEPA consultation or the Interagency/Intergovernmental Coordination for Environmental Planning (IICEP) processes and requires separate notification of all relevant tribes (Appendix E) and California Assembly Bill 52 for tribal cultural resources. The timelines for tribal consultation are also distinct from those of intergovernmental consultations. The Wing Commander is responsible for all government-to-government consultations with Native American tribes. The Cultural Resources Manager is responsible for tracking government to government consultations, following with responses, and requesting additional information as needed. The Beale AFB point-of-contact for consultation with the Tribal Historic Preservation Officer and the Advisory Council on Historic Preservation is the Cultural Resources Manager.

Beale AFB routinely contacts nine Native American groups as part of §106 consultations (CFR 800.2(c)(2)(ii). Consultations consist of an initial letter, and if needed telephone calls are extended as a follow-up. For the current undertaking, consultation was completed, and Beale AFB would continue consultation with the tribes for the life of the undertaking. Substantive comments received will be brought to the attention of the Office of Historic Preservation.

The Native American tribal governments that were consulted with regarding this action are listed in Appendix F.

1.6 PUBLIC AND AGENCY REVIEW OF EA

A Notice of Intent (NOI) to prepare an EA for Proposed Actions that would occur in floodplains and may affect wetlands was published in the newspaper of record (listed below), soliciting public comments on 2 and 6 October 2019. The NOI invited the public to provide comments on the proposal and any practicable alternatives that may reduce impacts. The public comment period ended on 31 October 2019. The NOI and public and agency comments are provided in Appendix E.

The NOI was published in the: Appeal-Democrat, Marysville, California (CA).

A Notice of Availability (NOA) of the Draft EA was be published in the newspapers/news web sites of record announcing the availability of the EA for review for 30 days from the date of the NOA publication. The NOA invited the public to review and comment on the Draft EA during this 30-day period. Public and agency comments are provided in Appendix E. The NOA was published in the following outlets: Appeal-Democrat, Marysville, CA; Lincoln News Messenger, Lincoln, CA.

Copies of the NOA and EA and FONSI/FONPA were made available for review at the following location: Beale AFB direct link: https://www.beale.af.mil/Library/Units/Environmental-Information/

1.7 KEY DOCUMENTS

Key documents are sources of information incorporated into this EA. Documents are considered to be key because of similar actions, analyses, or impacts that may apply to this Proposed Action. CEQ guidance encourages incorporating documents by reference. Documents incorporated by reference in part or in whole include:

- *9th Reconnaissance Wing Installation Pest Management Plan for Beale AFB, California* (Beale AFB 2018b). This plan provides a full description of the base integrated pest management program, with a primary purpose of effective control of listed pest species such as insects, rodents, mammals, birds, and invasive plants. Efficient, economically feasible, and environmentally sound control procedures are outlined in accordance with applicable laws and regulations.
- *Aquatic Pesticide Application Plan, Beale Air Force Base, CA* (Beale AFB 2018c; Appendix F). This plan was prepared to satisfy a general requirement for coverage under the Statewide General National Pollutant Discharge Elimination System (NPDES) Permit for Residual Aquatic Pesticide Discharges to Waters of the United States (WoUS) from Algae and Aquatic Weed Control Applications, Water Quality Order 2013-0002-DWQ from the California State Water Resources Control Board. It describes three proposed aquatic herbicide applications for the control of aquatic invasive plants on Beale AFB: (1) giant reed control, (2) mission-related control of invasive plants and vegetation in and along waterways as needed, and (3) mission-related control of Himalayan blackberry along Reeds Creek near the flightline. The plan describes need, applications, Best Management Practices (BMPs) to prevent water quality impacts, and monitoring protocol.
- *Cattle Distribution Plan at Beale Air Force Base, California* (ManTech SRS Technologies, Inc. 2017). This plan provides detailed recommendations for installation of three solar wells, and potential trough/well locations that would support and contribute to future cattle distribution management decisions in existing and proposed cattle pastures. Trough locations are based on potential grazing expansion areas identified in *Potential Grazing Expansion at Beale AFB* (H.T. Harvey & Associates 2015b).

- *Draft Beale Air Force Base Wildland Fire Management Plan* (Beale AFB 2018a; Appendix D). This plan provides guidance for the suppression and prevention of wildfires on Beale AFB and associated geographically separate units, and for implementation of ecosystem management and fuels reduction goals using mechanical fuels treatments and prescribed fire. It supports the installation INRMP in the implementation of fire-related resource management and mission support objectives.
- *U.S. Air Force Integrated Natural Resources Management Plan, Beale Air Force Base, Lincoln Receiver Site* (Beale AFB 2019). The base INRMP documents and recommends natural resource management. Its implementation helps ensure that Beale AFB lands continue to support present and future mission requirements while preserving, enhancing, and restoring ecosystem integrity.
- *Grazing Management Guidelines, Beale Air Force Base, California* (Beale AFB 2017b; Appendix C). These guidelines drive the livestock grazing management activities on Beale AFB to meet INRMP natural resource management goals. They address goals and mission support functions of the grazing program, grazing conditions, leases, land use rules, management recommendations, monitoring, and adaptive management.
- *Invasive Plant Treatment Monitoring 2018, Beale Air Force Base, California* (CEMML 2018). This report describes the results of monitoring efforts to assess invasive plant control treatments implemented from 2015 – 2017 on Beale AFB. The results help assess treatment efficacy in the short and long term and whether objectives are being met. The report includes monitoring methods and results, treatments, management goals, and recommendations.
- *Invasive Species List 2019*. This list contains information on all invasive plant species known on Beale AFB (see Appendix A).
- *Potential Grazing Expansion at Beale AFB*, (H.T. Harvey & Associates 2015b). Letter from H.T. Harvey & Associates to Charles Carroll describing a strategy for managing livestock grazing in areas not traditionally part of the grazing program at Beale AFB and the LRS, with the intent of meeting one of three potential management goals: firebreak maintenance, invasive plant control, or basic resource protection and enhancement.
- Invasive plant species mapping spatial data (H.T. Harvey & Associates 2015a). Spatial data created from a 2015 invasive species mapping effort of portions of Beale AFB. There is no report associated with this effort, only maps and GIS data.
- *Updated Invasive Plant Species Management Guidelines, Beale Air Force Base, California* (Beale AFB 2017a; Appendix B). These guidelines present a sustainable long-term strategy for managing vegetation at Beale AFB to maximize opportunities for stewardship of sensitive species and natural resources and to reduce the prevalence of undesirable non-native plants. They are informed by a prior invasive species management analysis and plans and a recent review of invasive species management at Beale AFB by Cal-IPC and recent baseline invasive plant surveys.
- *Weed Mapping Survey Results at Beale Air Force Base* and associated spatial data (CEMML 2017). This report provides Beale AFB land managers with a comprehensive invasive plant mapping survey of Beale AFB, showing the location and density of 14 invasive plant species. It discusses the invasive status of the mapped plants and provides information on the locations, density, and extent on Beale AFB. It also includes description of the species with invasiveness ranking, reproductive habits, and methods for control.

2.0 DESCRIPTION OF THE PROPOSED ACTION AND ALTERNATIVES

This chapter describes the Proposed Action and reasonable alternatives for implementation. The Proposed Action was developed in accordance with the objectives listed in Chapter 1, Purpose and Need for Action. The purpose and need set forth a rational context in which to analyze the viability of potential alternatives.

2.1 PROPOSED ACTION

Beale AFB proposes to manage invasive plant species on the installation and at the LRS geographically separate unit in order to satisfy resource management goals outlined in the installation INRMP (Beale AFB 2019) and other installation management plans. Implementation of a procedural approach incorporating an integrated pest management process would reduce the negative effects of these species under a manageable annual scope of work. Treatments could include but are not limited to broad-scale actions such as grazing, grazing infrastructure creation, and prescribed fire; targeted treatments including manual/mechanical and chemical applications; habitat enhancement activities; and actions to prevent the introduction and spread of new invasive plants. The annual scope of work presented for each alternative and associated BMPs allow for predictable reduction of invasive plant species and inform the associated effects analyses presented in Chapter 4, *Environmental Consequences*.

The current installation INRMP includes several goals, objectives, and projects that provide explicit drivers for invasive plant species management, framed in terms of conserving and benefiting sensitive, threatened, and endangered species and their habitats; reducing the potential for BASH incidents; and maintaining a sustainable rangeland ecosystem that reduces fire hazard and supports the Beale AFB livestock grazing program. Over the past several years, new invasive plant management science and recommended methodologies have become available; invasive species mapping surveys have been performed; and local sensitive and invasive species data have been collected and analyzed. Beale AFB proposes to satisfy invasive plant species and resource management goals as outlined in the INRMP and other installation management plans in accordance with current available data and information, in the safest, most cost effective, efficient, and effectual way possible.

2.2 SELECTION STANDARDS

NEPA and CEQ regulations mandate the consideration of reasonable alternatives for the Proposed Action. "Reasonable alternatives" are those that also could be utilized to meet the purpose of and need for the Proposed Action. Per the requirements of the USAF EIAP regulations (32 CFR Part 989), selection standards are used to identify alternatives for meeting the purpose and need for the USAF action. The Proposed Action alternatives must meet the following selection standards:

- Satisfy resource and management goals as defined in the current installation INRMP (Beale AFB 2019) and associated management plans,
- Minimize negative effects to the environment,
- Align with accepted BMPs,
- Utilize the most current available information and science,
- Optimize costs, efficacy, and efficiency,
- Utilize only approved methods and practices, and
- Comply with all federal, state, and agency regulations.

2.3 SCREENING OF ALTERNATIVES

The following potential alternatives that might meet the purpose and need for invasive plant species management were considered:

1) Alternative 1 (No Action) – Maintain current management activities, which include limited and small-scale manual/mechanical control and chemical applications; grazing without the ability to expand operations into new areas, change stocking rates, or vary residual dry matter (RDM) targets (a measure of consumed vegetation that is dependent on stocking rates) in accordance with annual weather variability or specific invasive species control goals; and sporadic burning activities. Current management activities lack a programmatic, cohesive approach and long-term strategy; don't utilize the most effective treatment methods; don't consider the most current science, data and analyses, and management recommendations; and don't fully address current INRMP (Beale AFB 2019) and associated program management goals.

2) Alternative 2 (Comprehensive Control) – Manage invasive plant species in order to reduce their prevalence using an efficient, sustainable, and long-term strategy that incorporates a programmatic, adaptive approach, maximizes opportunities for stewardship of sensitive resources, and utilizes a varied toolkit of control methods including manual/mechanical activities, chemical applications, grazing, and burning. The IPSMG (Beale AFB 2017a; Appendix B), GMG (Beale AFB 2017b; Appendix C), and WFMP (Beale AFB 2018a; Appendix D) and INRMP provide the basis for this alternative.

3) Alternative 3 (Limited Control) – The same as Alternative 2, excluding the use of chemical applications.

The selection standards described in Section 2.2 were applied to these alternatives to determine which alternative(s) could be effective in managing invasive plant species and would fulfill the purpose and need for the action (see Table 2.1 below).

2.4 ALTERNATIVES ELIMINATED FROM FURTHER CONSIDERATION

The following alternative has been eliminated from further consideration because it would not meet the purpose and need:

Alternative 3 (Limited Control – Same as Alternative 2 Excluding Chemical Treatments)

This alternative would not meet the purpose and need because many invasive species cannot be controlled without chemical treatments (i.e., herbicide applications). Manual and mechanical treatments would be too costly for large infestations, and other control methods are not effective on certain species. This alternative does not satisfy current INRMP (Beale AFB 2019) and other management goals and does not optimize cost, efficacy, and efficiency. This alternative is not carried forward for analysis in this EA.

Table 2.1. Screening of Alternatives.

Alternative Descriptions	Selection Standards						
	Satisfies INRMP and Other Management Plan Goals	Minimizes Negative Environmental Effects	Aligns with BMPs	Utilizes Current Science and Information	Optimizes Cost, Efficacy, and Efficiency	Utilizes Only Approved Practices	Complies with Regulations
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Alternative 1 – No Action (Maintain Current Management)	No	No	Yes	No	No	Yes	Yes
Alternative 2 – Comprehensive Control	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Alternative 3 – Limited Control – Same as Alternative 2 Excluding Chemical Treatments	Partly	Partly	Yes	No	No	Yes	Yes

Green – meets selection standard
Red – does not meet selection standard
Yellow – partially meets selection standard

2.5 DETAILED DESCRIPTION OF THE ALTERNATIVE(S)

Two alternatives: Alternative 1 (No Action), and Alternative 2 (Comprehensive Control), are fully analyzed. Table 2.2 shows a proposed annual scope of work indicating maximum potential activity under Alternatives 1 and 2. Actual scopes of work would be developed on a seasonal basis in accordance with changing needs and conditions.

Table 2.2. Proposed Annual Scope of Work at Beale AFB and the LRS.

Activity	Alternative 1 No Action*	Alternative 2 Comprehensive Control
Grazing land available	12,800 acres	16,000 acres
Grazing capacities and stocking rates	Existing ceiling	Ceiling adjustable to meet resource objectives
Grazing management strategies	Limited by ceiling	Adjustable
Prescribed burns (including hand torching/flaming methods)	Historical average 2001-2015 = 622 acres annually. No prescribed burns in 2016 & 2018. One 20-acre burn in 2017. No use of torching/flaming methods.	4,500 acres maximum burned annually to achieve fuels treatment goals outlined in the WFMP. Include torch/flaming methodology.
Herbicide use	90 acres	2,000 acres
Manual/Mechanical control	less than 50 acres	2,000 acres
Habitat enhancement	less than 5 acres	300 acres

*No invasive species control work using any method is currently ongoing at the LRS so this column only reflects current work (Alternative 1 - No Action) at Beale AFB. Alternative 2 – Comprehensive Control includes acre estimates for both Beale AFB and the LRS combined.
WFMP = Wildland Fire Management Plan (Beale AFB 2018a; Appendix D)

2.5.1 Alternative 1 (No Action)

The No Action Alternative is required by law to be analyzed fully and serves as a baseline for comparison with the action alternatives. Under the No Action Alternative, current management activities would be maintained, including manual/mechanical activities, chemical applications, grazing, and burning. Implementation of these activities would lack a programmatic, cohesive approach and long-term strategy, and would not assimilate the most current science, effective treatment methods, or integrated approaches. While measures under this alternative would help slow the spread of invasive plant species, they are not enough to prevent the expansion of infestations.

Current management addresses approximately 742 acres a year on average (excluding grazing operations), which is less than 3% of the base, and therefore achieves little, if any, net gain in control, conservation benefit, or mission support since invasive vegetation continually re-invades when seed sources are not adequately controlled. Specifically, it allows Containment Stage species to expand base-wide (Table 2.3), reaching the Asset-Based Protection Stage, and gives Eradication Stage species the opportunity to reach Containment Stage within 10 years (see Section 2.4.2.1. *Framework*, for explanations of the invasion stages).

Current management activities include limited and small-scale manual/mechanical control, chemical applications, cattle grazing, and prescribed burning (Table 2.2). Manual and mechanical treatments typically cover less than 50 acres annually. Chemical applications include the use of back-pack or ATV-mounted spray equipment to apply glyphosate to approximately 13 acres of Himalayan blackberry and 75 acres of yellow starthistle in locations in and around the airfield where the plants attract birds and create a BASH concern. Small, individual habitat enhancement sites, typically less than 5 acres, have been created and maintained. Under the No Action Alternative sites must be prepared without the use of herbicide to suppress weeds. Current grazing operations include approximately 12,800 acres within 36 pastures that have been grazed for 30+ years, without the ability to expand grazing operations to new areas, change stocking rates, or vary RDM targets to adjust to annual weather variability or specific invasive species goals. The current grazing program is described in detail in Section 3.0, *Affected Environment, General Land Use*. Prescribed burning has been sporadic, averaging 622 acres between 2001 and 2015, but often limited to less than 100 acres. Current prescribed burn practices are described in relevant subsections of Section 3.0, *Affected Environment*. Staging and maintenance areas are designated as needed. Environmental impacts for these activities are analyzed on an inefficient project-by-project basis using the USAF EIAP.

The current limitations on grazing locations and a limited ability to vary grazing management techniques (i.e., targeted prescriptions, RDM, and stocking rates), together with currently limited fire management activities, create negative impacts on ungrazed wildlands, which are highly invaded, and perpetuate current problems such as the high cover of medusahead in current pastures. According to Jeremy James the Director of the University of California Sierra Foothill Research and Extension Center, the cover of medusahead at Beale AFB is the worst he’s ever seen at any location in northern California. Medusahead cover is equally bad or worse on the LRS.

As discussed in Section 2.3, Alternative 1, No Action Alternative does not meet the purpose and need of the Proposed Action.

Table 2.3. Summary of Acres of Infestations under Alternative Management Scenarios.

Stage	Mapped Acres 2016	No Control		Alternative 1 (No Action Alternative)		Alternative 2 (Comprehensive Control)	
		Acres Controlled /Year	Infested Acres after 10 Years [1]	Max Acres Controlled / Year	Infested Acres after 10 Years [2]	Max Acres Controlled / Year	Infested Acres after 10 Years [2]
Unmapped/ EDRR [3]	0	0	100	0	100	50	0
Eradication Stage	212	0	1,310	26	661	279	0
Containment Stage	2,753	0	17,046	7.5	16,859	1,525	0
Asset-Based Protection [5]	31,338	0	194,037	703	176,491	24,346	0 [4]
Habitat Enhancement	NA	0	NA	5	NA	300	NA
TOTAL[5]	34,303	0	212,392	837	194,010	26,150	0

[1] Acreage calculated based on an annual expansion rate of 20% over the ten years since weeds were mapped in 2016. The 20% expansion rate is the same used in USDA (2013) based on Asher and Dewey (2005) who documented rates of noxious weed spread varying from 10 to 24%.
[2] Assumed 20% annual growth minus the number of acres controlled annually for 10 years.
[3] New infestations discovered and proposed for treatment under EDRR estimated at 10 acres per year.
[4] Infested acres under Alternative 2 would never reach 0 but cover should be markedly lower in areas treated, depending on the method of treatment.
[5] Totals exceed total acreage of Beale AFB due to overlap in infestations and/or the rate of expansion (20%/year) results in the complete infestation of the base within 10 years.
EDRR = Early DetectionRapid Response, Max = Maximum, NA = Not Applicable

2.5.2 Alternative 2 (Comprehensive Control)

Alternative 2, Comprehensive Control, is to manage invasive plant species to reduce their prevalence using an efficient, sustainable, and long-term strategy that incorporates a programmatic, adaptive approach, maximizes opportunities for stewardship of sensitive resources, and utilizes a varied toolkit of control methods including minimal manual/mechanical activities, chemical applications, grazing, and burning. The current Beale AFB INRMP (Beale AFB 2019) contains several goals, objectives, and projects that provide explicit drivers for invasive species control. The IPSMG (Beale AFB 2017a; Appendix B) and GMG (Beale AFB 2017b; Appendix C) were developed to guide their achievement. The WFMP (Beale AFB 2018a; Appendix D) includes guidance for invasive plant control using prescribed burning. The IPSMG is based on the current science, data, and recommendations, and designed to be reviewed and updated regularly as conditions, science, and drivers change. The IPSMG provides the foundation for this alternative. It is intended to be used by Beale AFB Natural Resources staff and contractors who manage vegetation on the installation. Beale AFB has managed both sensitive species and invasive species for many years, but a concerted effort to manage both together is more effective and is the approach adopted in the IPSMG.

Successful containment/control often requires multiple years of treatment, and sometimes requires multiple treatments per year involving a combination of methods. To increase the likelihood of successful long-term control, invasive plant management experts often recommend combining several management methods tailored to situation-specific goals, constraints, and opportunities. Treatments are tailored based upon:

- The target invasive plant species and its biology (e.g., mode of reproduction),
- Population size and density,
- Site type (e.g., disturbed roadside, riparian, upland), and
- Prior treatments and their efficacy.

The IPSMG includes protocols for preventing the spread of existing invasive plant species and the introduction of new species, methods for controlling specific invasive species, and general management strategies for the sensitive species and habitats on the installation. For certain species and situations, asset-based work plans are advantageous. Mechanical and manual methods, chemical treatments, grazing, and burning are all effective treatment methods for specific species in specific situations. For all control methods, timing treatment to coincide with the vulnerable phenological stage of the target species is an essential consideration (Beale AFB 2017a). The IPSMG includes specific situational and species work plans.

While Alternative 2 is designed to reduce overall invasive plant cover, it also simultaneously aims to improve forage quality for grazing animals, as grazing is the primary tool for controlling invasive species biomass. Improving forage quality equates to maintaining or increasing certain desirable non-native species, often referred to as naturalized species (normally annual grasses and forbs) that have been on the landscape for decades or centuries (e.g., *Erodium* sp.). Such species are too ubiquitous to warrant control, do not threaten the ecosystem like non-natives that are targeted for control, and provide a benefit, by supporting cattle grazing operations, which provide other invasive species control benefits.

A USAF form 103, Work Clearance Permit would be required for activities conducted under Alternative 2. The USAF form 103 application is a work clearance coordination process. A USAF form 103 is required before beginning any type of work that may impact or alter an area, including interior work. This process allows different subject matter experts, shops, and sections of 9th Civil Engineer Squadron (9 CES) to screen the work site for potentially sensitive natural or cultural resources and/or health hazards (e.g., asbestos, lead-based paint). This review is done within 30 days of a project start, and ensures all involved parties have the most up to date project information. Implementation of additional project-specific protective BMPs may be required for permit approval.

2.5.2.1 Framework

The IPSMG (Beale AFB 2017a; Appendix B) recommends a programmatic approach to invasive plant species control that is structured around the invasion curve concept (Rodgers et al. 2015) and the Cal-IPC ranking system for invasive species, which ranks each species based on ecological impacts, invasive potential, and ecological distribution (Cal-IPC 2019). Both of these tools are described in the IPSMG. The combined use of these tools yields management information which prioritizes species to treat and identifies the most effective treatment methods. This analysis technique is repeatable and would be revisited to inform adaptive management practices over time. Non-native plant species on Beale AFB have been put into one of five categories: prevention/early detection rapid response (EDRR) stage, eradication stage, containment stage, asset-based protection stage, and no treatment stage.

Prevention/Early Detection Rapid Response (EDRR)

Finding and eradicating new species while they are in the early stage of the invasion curve is typically limited to small populations that have not had the opportunity to establish substantial widespread seedbanks or alter ecosystems. For successful management at this stage of the invasive curve, especially on an installation the size of Beale and with its numerous potential pathways and vectors, an EDRR program to find and eradicate incipient infestations of new invasive species is essential. This is the most cost-effective stage at which to manage invasive plants. There are 14 species that are top EDRR priorities for Beale AFB. New species could be added at any time due to the nature of invasion and introduction, especially if prevention measures fail. Current EDRR species are:

- Alligator weed (*Alternanthera philoxeroides)*
- Downy brome, cheatgrass (*Bromus tectorum*)
- Spotted knapweed (*Centaurea stoebe* ssp. *micranthos*)
- Canada thistle (*Cirsium arvense*)
- Artichoke thistle (*Cynara cardunculus*)
- Brazilian egeria (*Egeria densa*)
- Water hyacinth (*Eichhornia crassipes)*
- Hydrilla (*Hydrilla verticillata)*
- South American spongeplant (*Limnobium laevigatum)*
- Perennial pepperweed (*Lepidium latifolium*)
- Purple loosestrife (*Lythrum salicaria*)
- Pennyroyal (*Mentha pulegium*)
- Red sesbania, scarlet wisteria (*Sesbania punicea*)
- Smallflower tamarisk (*Tamarix parviflora*)

Eradication Stage

Species that are well-established in small populations that have not yet spread over a wide area may be targeted for eradication, as long as resources are set aside for long-term monitoring of sites where they have been removed. Nine plant species on Beale AFB fall into this category (Appendix A); most of them have been definitively identified on the base but, based on the two recent invasive plant surveys, in a fairly limited number of locations and generally at low cover (H.T. Harvey & Associates 2015a; CEMML 2017). Two eradication stage species (water primrose and Russian knapweed) have potentially been observed on the base but were not definitively identified, so they are also included in the EDRR list.

Infestations of six eradication stage invasive plant species would be visited and treated each year until eradicated (Tables 2.4 and 2.5). The remaining three eradication stage species would be treated annually once positive identification and locations have been established. These species are documented as highly invasive with severe or substantial ecological impacts in California (Cal-IPC 2015a), and are currently limited in their distribution and abundance on Beale AFB making their eradication an achievable goal. Ninety known infestations, as well as newly discovered infestations of the species shown below would be treated and monitored annually to achieve the goal of eradication. In 2016 there were 212 acres mapped on the base that contained eradication stage plant infestations. Species from the EDRR stage would be added to this list if management actions fail to achieve the goals of the EDRR stage. Current eradication stage species are:

- Giant reed (*Arundo donax*)
- Tree-of-heaven (*Ailanthus altissima*)
- Bull thistle (*Cirsium vulgare*)
- Stinkwort (*Dittrichia graveolens*)
- Edible fig (*Ficus carica*)
- Black locust (*Robinia pseudoacacia*)
- Russian knapweed (*Acroptilon repens*) – positive identification and mapping needed
- Water primrose (*Ludwigia hexapetala* and *L. peploides*) – positive identification and mapping needed
- Indian toothcup (*Rotala indica*) – mapping needed
- Waxy mannagrass (*Glyceria declinata*) – mapping needed
- Common pokeweed (*Phytolacca americana*) – mapping needed

Table 2.4. Projected Future Acres Infested by Invasive Plants on Beale AFB with no Treatment.

	Common name	Scientific Name	Infested Acres by Location [1]						# of Sites Mapped [2]	Potential 10-year Expansion no Treatment [3]
			Airfield	Wildlife Exclusion Zone	Grazing Management Areas	Vernal Pool Conservation Areas	Riparian Conservation Area	Total Acres Mapped		
Eradication Stage	Black locust	*Robinia pseudoacacia*	0	8	5	0.6	0.6	10.5	15	65
	Bull thistle [4]	*Cirsium vulgare*	0	110	110	0	0	110	14	681
	Edible fig	*Ficus carica*	0	20	17	0.6	11	48	20	297
	Giant reed	*Arundo donax*	0	0	0	0	11	11	16	68
	Stinkwort [4]	*Dittrichia graveolens*	0	19	19	11	0	19	5	118
	Tree-of-heaven	*Ailanthus altissima*	0.6	8	0.6	0	4.3	13	20	80
	Unmapped/ Early Detection Rapid Response		unk	unk	unk	unk	unk	NA	NA	unk
	Total Eradication Stage [5]		**0.6**	**165**	**152**	**12**	**27**	**212**	**90**	**1,310**
Containment Stage	Barbed goatgrass	*Aegilops triuncialis*	129	302	290	12	7	502	203	3,108
	Blessed milkthistle	*Silybum marianum*	10	237	36	5	157	405	218	2,508
	Common St. John's wort	*Hypericum perforatum*	29	318	317	0	46	824	630	5,102
	Rush skeletonweed	*Chondrilla juncea*	14	117	221	0	57	570	402	3,529
	Vervain [4]	*Verbena* spp.	0	355	47	0	76	452	12	2,799
	Total Containment Stage [5]		**182**	**1,329**	**911**	**17**	**343**	**2,753**	**1,465**	**17,046**
Asset-Based Protection Stage	Black mustard	*Brassica nigra*	24	400	72	16	248	863	420	5,343
	Himalayan blackberry	*Rubus armeniacus*	0.6	154	120	4	261	596	198	3,690
	Italian thistle	*Carduus pycnocephalus*	150	1,145	223	12	335	2,611	857	16,167
	Yellow starthistle [5]	*Centaurea solstitialis*	606	4,823	2,416	281	579	6,815	904	42,197
	Medusahead [5]	*Elymus caput-medusae*	1,543	12,340	12,471	911	539	20,453	many	126,640
	Total Asset-Based Protection Stage [5]		**2,324**	**18,862**	**15,302**	**1,224**	**1,962**	**31,338**	**2,379**	**194,037**
	Total All Stages [5]		**2,506**	**20,356**	**16,365**	**1,253**	**2,332**	**34,303**	**3,934**	**212,392**

[1] Infested acres calculated using data from 2014-2016 invasive plant species mapping efforts on Beale AFB (H.T. Harvey & Associates 2015a; CEMML 2017). No data is available for the LRS. Weed data were collected as percent cover classes in 50m x 50m (0.6 acre) quadrats. For purposes of calculating infested acres, the entire 50m x 50m quadrat was included in the acreage estimate if an invasive plant species was present in any density. [2] Infested quadrats directly adjacent to other infested quadrats were considered a single contiguous infestation and counted as one site. [3] Acreage calculated based on an annual expansion rate of 20% over ten years. The 20% expansion rate is from USDA (2013), based on Asher and Dewey (2005) who documented rates of invasive plant spread varying from 10-24% for many of the species proposed for treatment. [4] Acreage reflects infestations mapped for treatment in 2017 (H.T. Harvey & Associates 2017). [5] Actual infested area is less than the sum of acres of all infestations because of overlapping infestations. Total open space mapped in 2016 was 20,767 acres and is considered the maximum area that can realistically be infested, but percent cover can increase

Table 2.5 Maximum Acres that would be treated under the Proposed Alternatives.

Species/Stage	Infested Acres 2016 [1]	Max Acres Treated Alternative 1 (No Action)					Max Acres Treated Alternative 2 (Comprehensive Control)				
		Manual/ Mechanical	Herbicide	Burning	Grazing	Total	Manual/ Mechanical	Herbicide	Burning	Grazing	Total
Unmapped/ EDRR[2]	NA	0	0	0	0	0	25	25	0	0	50
Black locust	10.5	0	0	0	0	0	5	10	0	0	15
Bull thistle [3]	110	15	0	0	0	15	50	50	0	50	150
Edible fig	48	0	0	0	0	0	5	50	0	0	55
Giant reed	11	1	0	0	0	1	5	15	0	0	20
Stinkwort [3]	19	10	0	0	0	10	5	5	9	0	19
Tree-of-heaven	13	0	0	0	0	0	5	15	0	0	20
Eradication	212	0	0	0	0	26	75	145	9	50	279
Barbed goatgrass	502	2.5	0	0	0	2.5	100	250	200	200	800
Blessed milkthistle	405	0	0	0	0	0	100	50	0	0	150
Common St. John's wort	824	0	0	0	0	0	100	200	0	0	300
Rush skeletonweed	570	0	0	0	0	0	50	25	0	50	125
Vervain [3]	452	5	0	0	0	5	100	50	0	0	150
Containment	2,753	7.5	0	0	0	7.5	450	575	200	250	1,525
Black mustard	863	0	0	0	0	0	20	50	100	100	270
Himalayan blackberry	596	0	13	0	0	13	20	100	25	0	145
Italian thistle	2,611	0	0	0	0	0	15	300	100	225	640
Yellow starthistle	6,815	15	75	0	0	90	300	300	1,750	2,500	5,600
Medusahead [4]	20,453	0	0	600	0	600	1,300	500	2,316	12,875	17,691
Asset-Based Protection [4]	31,338	15	88	600	0	703	1,655	1,250	4,291	15,700	24,346
Habitat Enhancement						5					300
Total [4]	**34,303**	**48.5**	**238**	**600**	**0**	**742**	**2,205**	**1,995**	**4,500**	**16,000**	**26,500**

[1] Infested acres calculated using data from 2014-2016 invasive plant species mapping efforts on Beale AFB (H.T. Harvey & Associates 2015a; CEMML 2017). No data is available for the LRS. Weed data were collected as percent cover classes in 50m x 50m (0.6 acre) quadrats. For purposes of calculating infested acres, the entire 50m x 50m quadrat was included in the acreage estimate if an invasive plant species was present in any density.
[2] EDRR = Early Detection Rapid Response.
[3] Acreage reflects infestations mapped for treatment in 2017 (H.T. Harvey & Associates 2017).
[4] Actual infested area is less than the sum of acres of all infestations because of overlapping infestations. Total open space mapped in 2016 was 20,767 acres, and is considered the maximum area that can realistically be infested, but percent cover can increase.

Containment Stage

Containment becomes the most cost-effective strategy once an invasive species establishes a viable population and begins to spread outward. At this stage, the focus would be on monitoring the original introduction site if known, curtailing spread from that site, and targeting any newly established satellite populations for immediate control. A portion of the mapped occurrences of five containment stage invasive plant species would be treated annually (Tables 2.4 and 2.5), focusing first on eradicating or containing the most isolated, outlying occurrences and, over time, reducing the footprint of larger, less isolated occurrences. Treatment would also be focused on areas within the wildlife exclusion zone around the airfield and vernal pool and riparian conservation areas. There are 1,465 containment stage infestations mapped occurring on 2,753 acres of the base (Table 2.4). Approximately 1,525 acres of containment stage infestations would be treated annually under Alternative 2 (Table 2.5). Current containment stage species are:

- Barbed goatgrass (*Aegilops triuncialis*)
- Rush skeletonweed (*Chondrilla juncea*)
- Klamathweed (*Hypericum perforatum*)
- Blessed milkthistle (*Silybum marianum*)
- Vervain (*Verbena litoralis* and/or *V. bonariensis*)
- Parrotfeather (*Myriophyllum aquaticum*) – control areas would be determined after mapping

Asset-Based Protection Stage

Asset-based protection-level species would be targeted for control when they directly threaten the base's resources, operation, or sensitive species, as they are very likely to continually reinvade any treatment site. These species would be controlled, if sufficient funds are available, when they occur in vernal pool or riparian conservation areas, or within the airfield fence and wildlife exclusion zone where they create an increased BASH risk. Other areas where these species threaten the base's assets and need to be controlled would be identified as needed. Medusahead has infested almost all open space on Beale AFB, and in most cases would not be targeted for individual treatment. It does, however, overlap infestations of many other species, meaning medusahead would be treated incidentally when other plants are controlled. Medusahead and yellow starthistle occur in most of the base's grazing management areas. Up to 12,900 acres of medusahead and 2,500 acres of yellow starthistle would be controlled via prescribed grazing (Table 2.5). Exact acreage would be determined through coordination between the Beale AFB Natural Resources Manager (NRM) and grazing lessees. There are 31,338 acres of asset-protection stage infestations mapped on the base (Table 2.4). Current asset-based protection stage species are:

- Yellow starthistle (*Centaurea solstitialis*)
- Medusahead (*Elymus caput-medusae*)
- Himalayan blackberry (*Rubus armeniacus*)
- Black mustard (*Brassica nigra*)
- Italian thistle (*Carduus pycnocephalus*)

No Treatment Proposed at this Time

An additional 28 invasive plant species have been documented on Beale AFB but would not be targeted for eradication or control at this time because they are too widespread to control and/or have limited ecological impact. Future analyses may target specific infestations where ecological or resource damage is observed. A list of these species is included in Appendix A.

2.5.2.2 Methodology

Employing invasive plant prevention measures such as implementing BMPs, enhancing education and awareness, and developing and maintaining an Invasive Plants Watch List would reduce the likelihood of new invasive plants being introduced onto Beale AFB.

The 2015 Cal-IPC report to Beale AFB recommended that the base develop an early detection-rapid response program (Cal-IPC 2015a). A work plan for such a program is included as an appendix to the IPSMG (Beale AFB 2017a; Appendix B). The work plan includes a decision-making framework and guidance on action steps that should be implemented to respond to newly invading plant species. Associated activities include monitoring, communication, assessment, and development of a response plan for eradication.

Containment/control is the most cost-effective strategy once an invasive species establishes a viable population and is spreading outward. An asset-based protection spatial analysis and work plan for certain species and situations is often needed. Several work plans were developed and are included as appendices to the IPSMG; more may be developed as new threats emerge.

To increase the likelihood of successful long-term control, invasive plant management experts recommend combining several management methods, tailored to situation-specific goals, constraints, and opportunities. The following methods and activities for invasive plant species containment/control are considered under this alternative:

- Continue and expand livestock grazing, including prescribed grazing management strategies and techniques, new grazing locations, and new infrastructure,
- Prescribed burns
- Manual/mechanical treatments
- Habitat enhancement treatments,
- Monitoring for treatment efficacy, effects of invasive species, and other relevant data,
- Surveying
- Tracking the invasive plant species control program
- Prevention measures.

Livestock Grazing

Grazing by domestic livestock, including cattle, sheep, goats, and horses, would be implemented as a method for controlling some invasive plant species and would be used to move plant community composition in a desired direction. While grazing alone would not eradicate invasive plant species, it would be effective in reducing infestations, slowing the spread of some undesirable species, and would make some plants more susceptible to herbicide application.

Under Alternative 2, the grazing program at Beale AFB and the LRS would be maintained in accordance with the Beale AFB GMG (Beale AFB 2017b; Appendix C), which helps guide livestock grazing management activities to meet INRMP goals. While the GMG does not currently include the LRS, all management prescriptions, goals, objectives, and BMPs in it apply to the LRS. The LRS is composed of the same habitat types (e.g., annual grassland, vernal pool grasslands) as Beale AFB with the same special status resources, which results in identical management decisions and thus identical environmental effects. Stocking rate calculations would need to be done for LRS but would follow the established methodology of the GMG. The GMG helps to ensure that the grazing program on Beale AFB and the LRS is implemented in the safest and most efficient and beneficial manner possible. The GMG addresses conditions affecting grazing, grazing leases, land use rules, grazing management recommendations including recommended actions and timelines, monitoring, and adaptive management, and the goals and mission support functions of the grazing program. The GMG is updated periodically to meet changing conditions, natural resource and conservation goals, and mission requirements.

The existing grazing program is described in the *Affected Environment* chapter, Section 3.2.2, *Land Use*. The GMG includes the consideration of expanding the existing grazing program based on a study by H.T. Harvey & Associates (2015b) which describes a strategy to expand into areas of Beale AFB and the LRS that have not been grazed in recent years in order to meet management goals including maintaining firebreaks, controlling invasive plants, and protecting and enhancing resources. The strategy identifies approximately 3,332 acres on Beale AFB and 210 acres on the LRS of land that could potentially be utilized for grazing, and discusses associated infrastructure, livestock species considerations, and other particulars. Beale AFB has identified 1,668 acres for permanent cattle grazing pastures on the main base and LRS (Figures 2.1 and 2.2). Areas proposed for grazing expansion are ecologically identical to currently grazed lands. The areas are predominantly California annual grassland, interspersed with vernal pool complexes, seasonal swales and tributaries, and riparian and oak woodland habitat.

Most of these areas do not currently have infrastructure to support livestock grazing, so improving fencing or adding fencing and developing water sources would be required before these areas could be grazed. Approximately 66,000 feet of linear fencing would be needed to enclose the proposed grazing additions. This would involve modifying existing fencing and installing new, permanent barbed wire fencing, and temporary electric fencing. No new access roads would be installed within the proposed grazing units, but existing access roads would be maintained. A Cattle Distribution Plan (ManTech SRS Technologies, Inc. 2017) was prepared that identified locations for new water troughs and wells in existing and proposed pastures. The plan identified four locations for wells/troughs in existing pastures, 39 trough locations in proposed grazing expansion pastures on Beale AFB, and two trough locations at the LRS. Twelve of the 39 troughs in proposed grazing areas would require solar wells to be installed, the rest could be tied into existing water lines. These are proposed locations, and it is unlikely all 39 trough locations would be needed. Staging areas would be designated for these projects on an as needed basis, and the locations reviewed and approved during the USAF Form 103 process.

The GMG includes a discussion of grazing capacity assessment and stocking rates for Beale AFB. Grazing capacity has been defined as the maximum number of animals in a given area that would produce a target level of production without ecosystem deterioration over a specific time period. It is more useful, however, to conceptualize grazing capacity as a range of values constrained by climatic characteristics of the area. Stocking rate is the actual number of animals in a defined area during a single grazing season. Stocking rates must be adjustable, especially in areas like Beale AFB where there are extreme fluctuations in production caused by California's highly variable annual weather patterns, in response to variations in forage production and the timing of actual use (Beale AFB 2017b).

Additionally, the GMG discusses various grazing management strategies that include continuous grazing, rotational grazing (moving animals between pastures, providing pastures a rest from grazing during the season), and short-duration high-intensity methods (mob grazing areas during specific timeframes to target vegetation for specific purposes like reduced seeding/maturation). All permanent grazing pastures may be grazed by cattle, horses, goats, and sheep. Grazing using goats and sheep would be used to control invasive plant species in areas where permanent enclosures and cattle grazing is impractical (e.g., small areas near facilities, road banks, and manmade impoundment structures). All fencing and infrastructure for goats and sheep outside of cattle pastures would be temporary (i.e., electrified fencing) and would be removed at the end of the grazing treatment. It is important for NRMs to have access to a variety of grazing strategies to meet invasive and native species management goals.

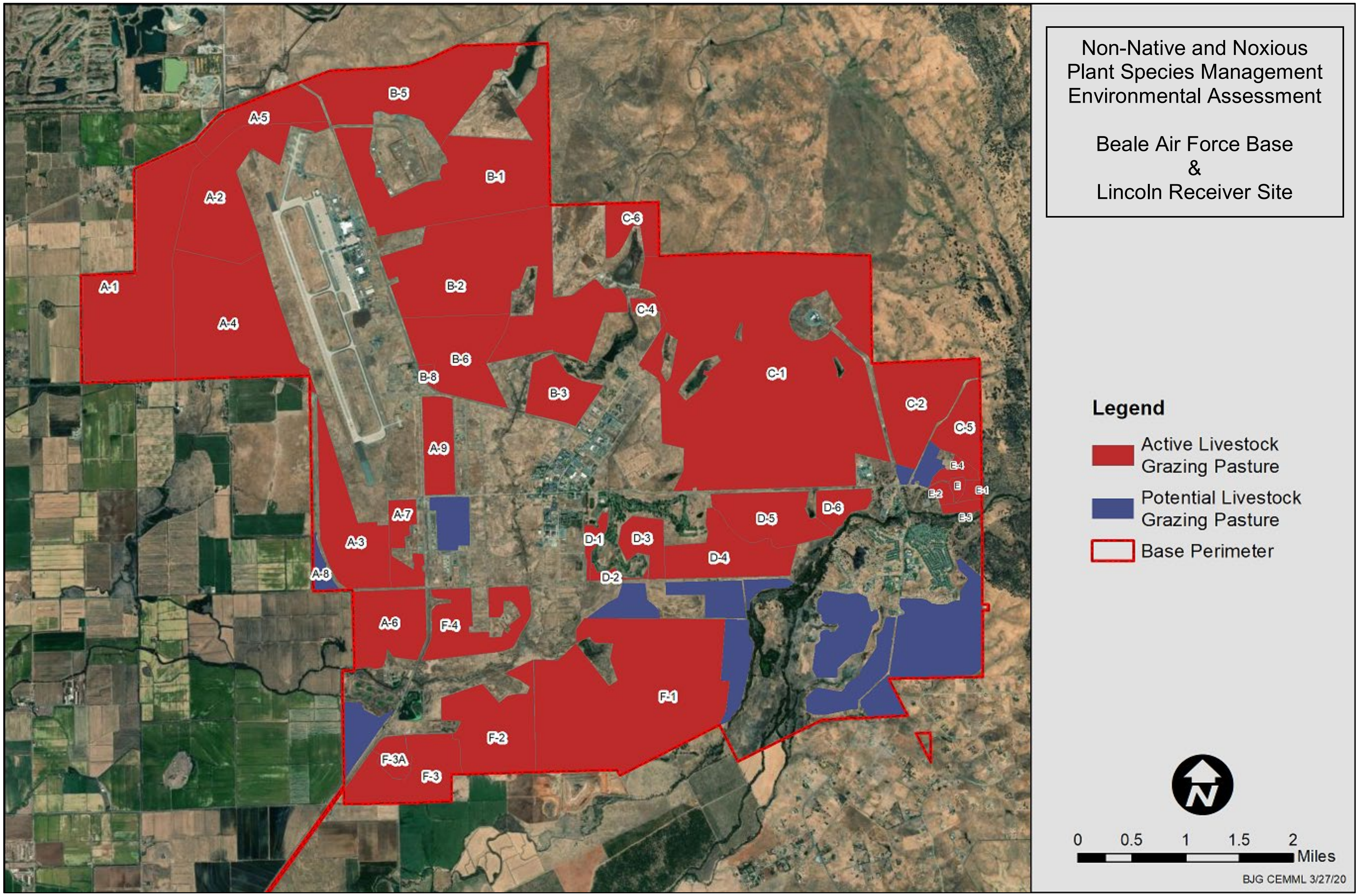


Figure 2.1. Current and Proposed Cattle Pastures on Beale AFB.

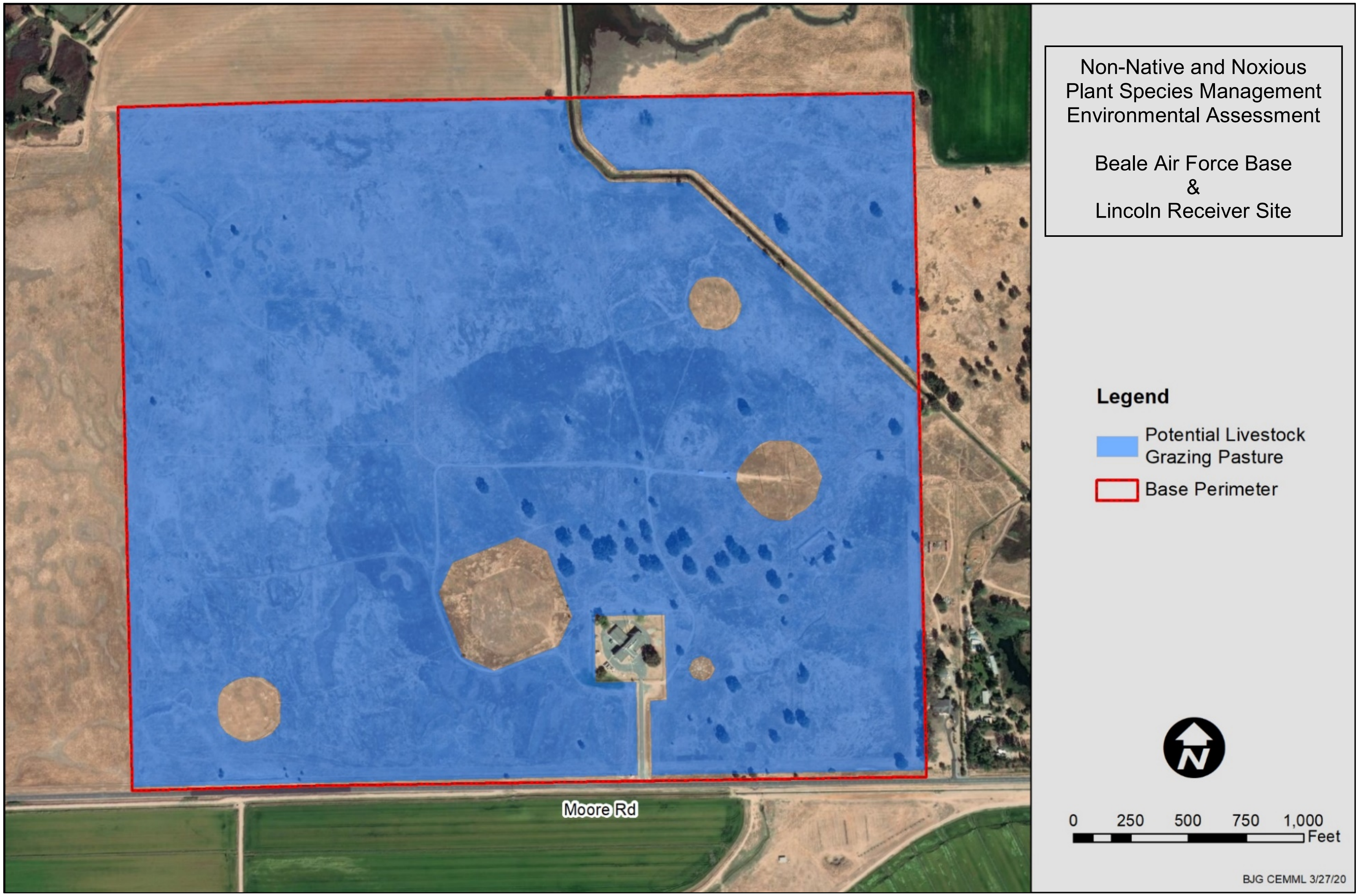


Figure 2.2. Proposed Cattle Pasture at Lincoln Receiver Site.

Prescribed Burns

Prescribed fire is defined as fire applied in a knowledgeable manner to fuels on a specific landscape under specific weather conditions to accomplish predetermined and well-defined management objectives. Invasive plant species management using prescribed fire would:

- Control certain invasive species, particularly those present over large areas (over 100 acres),
- Improve wildlife habitat by decreasing thatch, destroying seeds, reducing invasive plant cover, and increasing native species cover and diversity,
- Manage competing vegetation,
- Minimize the negative effects and severity of wildfires,
- Decrease BASH potential,
- Maintain open grasslands and vernal pools.

Under Alternative 2, prescribed fire may be utilized to control certain invasive plant species at Beale AFB and the LRS. Prescribed burns may not be feasible in some areas due to conflicts with mission-critical operations or other ecological goals.

Prescribed burns require careful planning, coordination, and implementation to be successful. Beale AFB has an existing prescribed fire program that serves to maintain and enhance habitat to support a multitude of grassland and woodland species. All prescribed burns are managed in accordance with the IPSMG, in addition to the WFMP (Beale AFB 2018a; Appendix D), which provides guidance for the suppression and prevention of wildfires as well as the implementation of ecosystem management and fuels reduction on Beale AFB. The WFMP addresses Beale AFB INRMP management goals and objectives, and complies with all applicable laws and regulations. It lays out responsibilities and procedures for prescribed fire management in a manner that is safe, efficient, effective, and highly professional. The WFMP addresses, among other things: prescribed fire planning, project implementation, operations, public notification, smoke management, management protocol, reporting requirements, asset protection, training and qualifications, and monitoring and evaluation.

According to the WFMP, the locations, plans, and staging areas for all prescribed fires in support of the goals and objectives of the INRMP would be approved by the Beale AFB NRM. The NRM alone would set prescribed fire priorities on the installation for the purpose of meeting Natural Resource Program goals, and would be consulted on all planned prescribed fire actions.

A prescribed fire plan would be developed for each burn to guide the implementation process. These plans are driven by the specific management goals and objectives of the burn, and address: smoke management, cultural and resource mitigation measures, personnel and public notifications, burn operations, pre and post monitoring requirements, safety and hazard mitigations, contingency protocol, resource and personnel requirements, and wildfire declaration protocol. All Prescribed Fire Plans are written and implemented in accordance with the National Wildfire Coordination Group: *Interagency Prescribed Fire Planning and Implementation Procedures Guide* (PMS 484; NWCG 2017a) and *Prescribed Fire Complexity Rating System Guide* (PMS 424; NWCG 2017b).

Burn Units have been identified for Beale AFB (Figure 2.3) and the LRS (Figure 2.4), which are areas defined by similar overall strategic fire management objectives with consideration for specific or dominant constraints, requirements, and guidelines for implementation. Unique characteristics (i.e., fuels, topography, natural resource concerns) are also considered. Prescribed fire is recommended for Burn Units, as described in the WFMP.

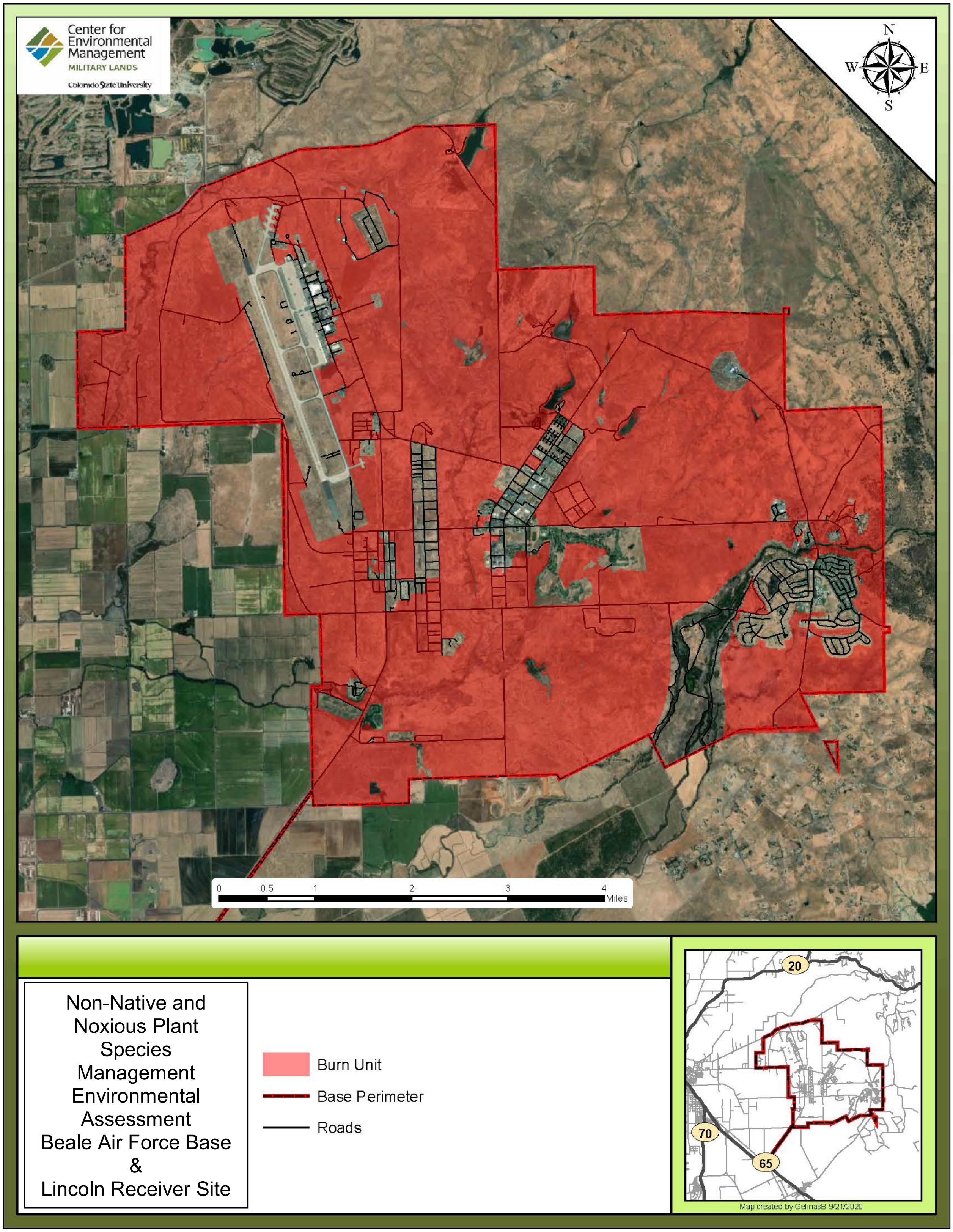


Figure 2.3. Beale AFB Burn Unit (19,273 acres).

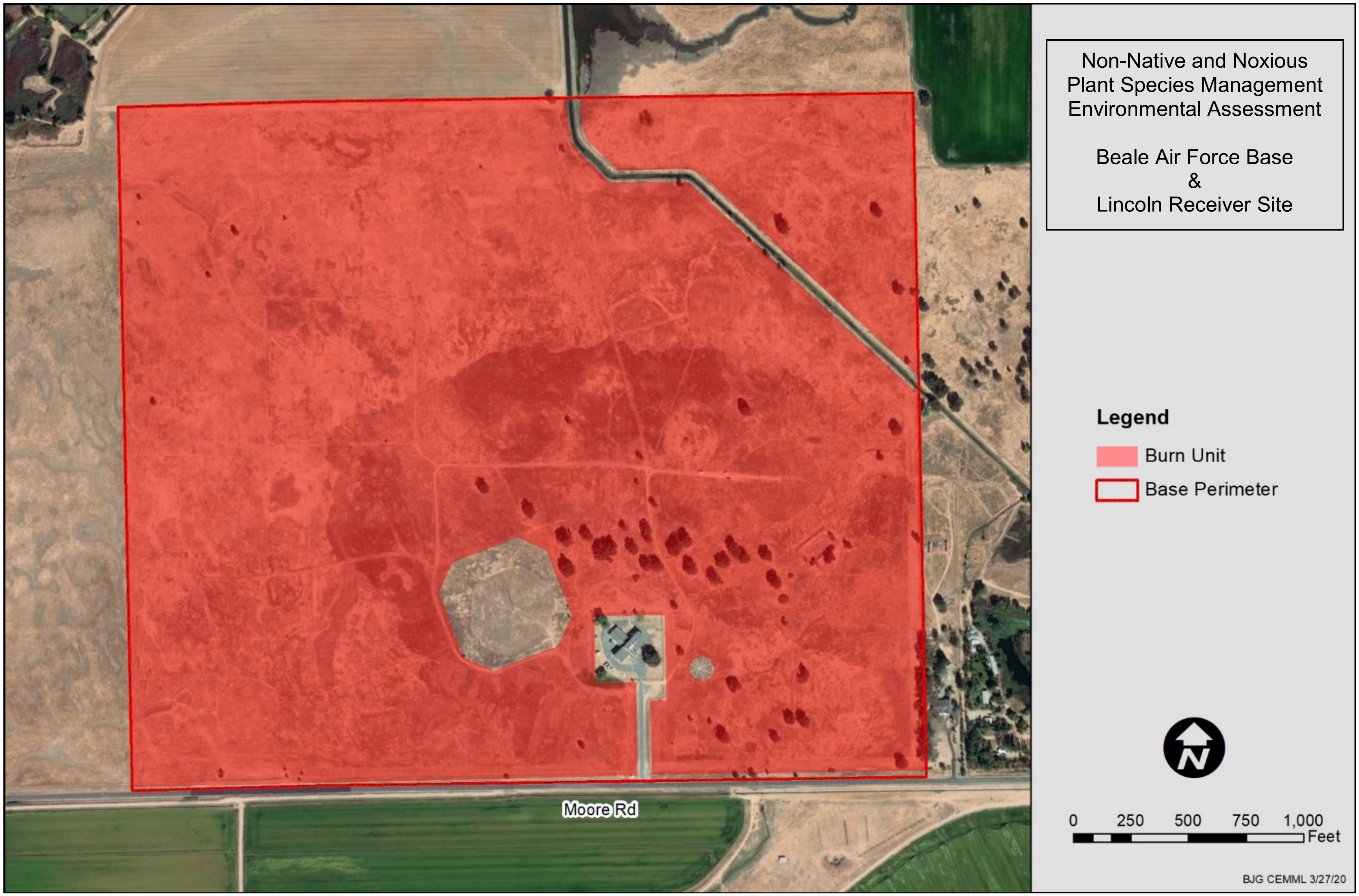


Figure 2.4. LRS Burn Unit (222 acres).

The WFMP suggests that the existing prescribed fire program could be enhanced by introducing prescribed fire to more areas on the installation to improve floral and faunal diversity, improve rangeland habitat quality, control certain invasive species, and reduce hazardous fuels that could increase wildfire intensity.

According to the current WFMP, the historic mean fire return interval for the dominant grassland areas on Beale AFB is about four years. The historic mean fire return interval for the oak woodland is about 12 years. Because increased native plant biodiversity has been documented to last greater than three years when prescribed fire is applied to vernal pools, the WFMP recommends that vernal pool habitat management follows the mean fire return interval prescribed for surrounding grassland areas. The WFMP includes a table of prescribed fire recommendations for the control of invasive species on Beale AFB, which is reproduced here in Table 2.6. Annual prescribed fire application on the installation would need to average 3,434 to 5,723 acres to achieve the goals identified in the WFMP. As with other invasive plant control methods, timing of treatment is critical.

“Black Lines” are narrow strips of burned vegetation along the perimeter of a planned prescribed fire project and/or along a pre-identified firebreak. They reduce the chances of slop-over and/or fire advancements outside of the desired burn perimeter. Black Lines would be used in conjunction with larger prescribed burns or used as stand-alone firebreaks in areas where soil disturbance could harm sensitive resources. This method reduces the chances of losing control of a prescribed burn and causing a subsequent wildfire. Black Lines are a non-destructive alternative to traditional firebreaks in areas where ground disturbance is restricted.

Torching, also known as flaming, would be effective in treating some invasive plant infestations. Torching is the use of handheld propane torches to treat seedlings. Timing, as with other methods, is critical. Torching is often used as a retreatment method to control small seedlings where an infestation was treated using another method during the prior year. It can reduce the seed bank in the soil by killing germinated seeds and preventing invasive plant reproduction that would lead to additional seed production during that year. Torching requires a relatively low level of effort and is a precise treatment.

The Beale AFB NRM was involved with the development of the WFMP to ensure that all planned actions that could affect natural resources are in line with and directly supportive of the current INRMP, and conversely, that relevant natural resource goals and objectives are represented in the WFMP. The WFMP undergoes a regular review process, with updates as needed, performed by the Fire and Emergency Services Fire Chief and Deputy Fire Chief, reviewed by the NRM, and approved by the Installation Commander.

The current WFMP formally establishes Fire and Emergency Services as the primary initial attack responder and establishes a Wildland Fire Program Coordinator, appointed by the Installation Commander or designee, to oversee the planning and implementation of wildland fire projects. The Wildland Fire Program Coordinator initiates, coordinates, and ensures appropriate installation engagement and timely completion of the WFMP and serves as the primary installation point of contact for the Wildland Fire fuels treatment implementation, data collection, large wildfire reporting, and reporting of significant fires. The Beale AFB 9 CES Fire and Emergency Services and the Wildland Fire Support Module are currently responsible for suppressing wildland urban interface fires and supporting natural resource suppression efforts during wildfires and prescribed fires.

Table 2.6. Beale AFB Prescribed Fire Recommendations for Control of Invasive Species.

Species Controlled	Prescribed Burn Recommendation
Barbed goatgrass (*Aegilops triuncialis*)	Early summer or late spring prescribed fire in 2 consecutive years.
Yellow starthistle (*Centaurea solstitialis*)	Early summer or late spring prescribed fire in 3 consecutive years. Repeat treatments may be necessary every 2-4 years.
Himalayan blackberry (*Rubus armeniacus*)	Prescribed fire at any time of the year with follow-up fall herbicide treatment of resprouts.
Medusahead (*Elymus caput-medusae*)	Late spring (after seedhead dispersal but before the seed moisture drops below 30%) prescribed fire followed by fall herbicide application. Repeat treatments may be necessary every 2-4 years.
Source: Beale AFB 2018a.	

Chemical Treatments

Under Alternative 2, chemical treatments in the form of herbicide applications would be utilized to control certain invasive plant species at Beale AFB and the LRS. Herbicides are most often used when other methods are not effective or feasible. Herbicides may be used to manage dense or large infestations or specific species that cannot be successfully controlled through other management actions. In a successful management program, the amount of herbicide used on a particular site would decrease over time as the invasive plant population declines.

Potential effects of herbicide use on surrounding vegetation, habitats, wildlife, and water resources would always be considered, as the purpose of the activity is to protect and benefit these resources. Selection of the herbicide to be used in any given situation is critical, with attention to toxicity, use restrictions, and timing of the application. In areas where aquatic resources are present, requirements of the General NPDES Permit for Residual Aquatic Pesticide Discharges and/or other required permits would be followed, which limit the types of herbicides that would be used.

Herbicides would always be applied in accordance with the IPSMG; the Beale AFB IPMP (Beale AFB 2018b); the USAF Pest Management Program; a General NPDES Permit for Residual Aquatic Pesticide Discharges (Appendix F); all applicable federal, DoD, USAF, State of California, and local directives and regulations; and label instructions. The DoD maintains a list of approved pesticides, the 2016 version of which is included as Appendix E in the IPSMG. Additionally, Cal-IPC (2015b) has produced a publication on the use of herbicides in wildlands, especially relating to minimizing impacts on wildlife, which would be consulted.

The Installation Pest Management Coordinator is in charge of approving and tracking use of chemical pesticides (herbicides) on the installation. Invasive plant control is generally managed by the Beale AFB NRM, but all herbicide use is reviewed, approved, and tracked by the Installation Pest Management Coordinator and implemented in accordance with the above guidance.

All individuals who apply herbicide must have either a DoD applicator’s license or a California Qualified Applicator License or Certificate. Pest Management tracks and reports all pesticide use on the installation, and maintains a record of Qualified Applicator Licenses and Certificates. All herbicide use on the installation is reported to the base Pest Management Shop, which reports it to the county.

Ten herbicides are proposed for use in invasive plant control (Table 2.7). The herbicide and application method used would depend on the target plant species (Table 2.8). Application methods that may be used are described below:

- Broadcast Spray (Boom): Spraying herbicide onto an entire infested area, rather than targeting individual plants using a regulated nozzle. This method uses a truck- or ATV-mounted boom sprayer and is limited to areas with moderate terrain. Broadcast methods are used for denser infestations where application to individual plants would not be feasible.
- Targeted Spray: Spraying herbicide onto the foliage of individual target plants. This is done using a regulated nozzle, which helps to concentrate application toward target plants. This method uses a backpack-mounted wand sprayer or a truck- or ATV-mounted hose sprayer. This is used for small infestations or in areas not accessible by vehicle.
- Pre-emergent Spray: Herbicide is applied directly to the soil in areas with known infestations to prevent seed germination or to otherwise inhibit development. Herbicide may be applied using backpack-mounted wand sprayer or a truck- or ATV-mounted hose sprayer. This method is best for large infestations and difficult-to-control species.
- Basal Bark: Basal bark herbicides are mixed with an oil carrier to penetrate the bark of the target plant. Herbicide is sprayed around the circumference of the base of the stem. This is used to control thin-barked plants less than 6 inches in basal diameter.
- Selective Application: Selective applications involves touching individual target plants with applicators containing herbicide. Because these methods involve direct application, there is a very low likelihood of drift, run-off, or accidental nontarget exposure. Specific methods include: hack-and-squirt, cut-stump, and wicking or wiping.
- Aquatic Applications: Herbicide is either applied directly to foliage growing at or above the water's surface or to the water column itself using hoses and weighted nozzles if plants are fully submerged. This method is generally restricted to large infestations of aquatic plants in non-moving water. Only herbicides approved for aquatic use may be applied using this method.

Table 2.7. Herbicides Proposed for Use Under Alternative 2.

Active Ingredient	Example Product Name (EPA Reg No.)	Type
Aminopyralid	Milestone (62719-519) [1]	Liquid concentrate
Aminopyralid and Triclopyr TEA	Capstone (62719-572) Milestone VM Plus (62719-572)	Liquid concentrate
Chlorsulfuron	Telar XP (432-1561)	Dry flowable
Glyphosate	Roundup Pro (524-475) [1]	Liquid concentrate
Glyphosate	Rodeo (62719-324) [1,2] Roundup Custom (524-475) [1]	Flowable concentrate
Imazamox	Clearcast (241-437) [2]	Emulsifiable concentrate
Imazapyr	Arsenal (241-346) [2] Habitat (241-426) [1,2]	Liquid concentrate
Sulfometuron methyl	Oust XP (432-1552) [1]	Dispersible granules
Triclopyr BEE	Garlon 4 Ultra (62719-527) [1]	Emulsifiable concentrate
Triclopyr TEA	Garlon 3 (62719-37) [2]	suspension

BEE = butoxy ethyl ester, EPA = Environmental Protection Agency, TEA = triethylamine salt
[1] Currently approved for use on USAF properties. All others require approval from ACC entomologist.
[2] aquatic approved formulation

Table 2.8. Proposed Herbicide Application Methods, Target Plant Species, and Application Rates.

Herbicide	Application Method	Target Species	Maximum Application Rate[1]	Maximum Treatments/ Year	Maximum Acres/ Year[2,3]
Aminopyralid	Target Spray	bull thistle, blessed milk thistle, skeletonweed, St. John's wort, Italian thistle, yellow starthistle, Indian toothcup, artichoke thistle, Canada thistle, Russian knapweed, spotted knapweed	0.11 (0.22 spot treatment)[4]	1	925
	Broadcast Spray	St. John's wort, yellow starthistle, medusahead	0.11	1	1,000
	Pre-emergent	Italian thistle, medusahead, spotted knapweed	0.11	1	525
Aminopyralid + Triclopyr	Target Spray	black locust, tree-of-heaven, Himalayan blackberry	0.11 + 1.12	1	125
Chlorsulfuron	Target Spray	bull thistle, blessed milk thistle, black mustard, yellow starthistle, perennial pepperweed, Canada thistle, Russian knapweed	0.122 (0.062 rangeland)	1	475
	Pre-emergent	black mustard		1	50
Chlorsulfuron + Sulfometuron Methyl	Pre-emergent	barbed goatgrass	0.062 + 0.375	1	250
Glyphosate	Target Spray	black locust, tree-of-heaven, giant reed, stinkwort, edible fig, barbed goatgrass, skeletonweed, St. John's wort, black mustard, Italian thistle, yellow starthistle, medusahead, perennial pepperweed, Canada thistle, cheatgrass, purple loosestrife, red sesbania, spotted knapweed, vervain	8.0	2	1,900
	Broadcast Spray	barbed goatgrass, medusahead, cheatgrass	8.0	2	775
	Cut Stump	black locust, giant reed	8.0	1	2.5
Glyphosate + Imazapyr	Target Spray	giant reed	8.0 + 1.5	1	15
Imazamox	Direct Aquatic	parrotfeather, water primrose, alligator weed, hydrilla, South American Spongeplant, water hyacinth	1.0	1	25
Imazapyr	Target Spray	bull thistle, skeletonweed, yellow starthistle, black locust, edible fig, tree-of-heaven, giant reed, vervain, perennial pepperweed, pokeweed, artichoke thistle, water primrose, parrotfeather, alligator weed, Canada thistle, cheatgrass, purple loosestrife, red sesbania, Russian knapweed, smallflower tamarisk, spotted knapweed, water hyacinth	1.5	1	540

Herbicide	Application Method	Target Species	Maximum Application Rate[1]	Maximum Treatments/ Year	Maximum Acres/ Year[2,3]
	Pre-emergent	skeletonweed		1	25
Sulfometuron Methyl	Target Spray	Himalayan blackberry, barbed goatgrass, pokeweed, vervain	0.375	1	375
	Broadcast Spray	medusahead, barbed goatgrass		1	750
	Pre-emergent	barbed goatgrass, black mustard, medusahead, perennial pepperweed, cheatgrass		1	825
Triclopyr	Target Foliar	Himalayan blackberry, barbed goatgrass, bull thistle, yellow starthistle, black locust, edible fig, black mustard, Italian thistle, stinkwort, perennial pepperweed, water-primrose, Indian toothcup, artichoke thistle, Canada thistle, pennyroyal, purple loosestrife, red sesbania, smallflower tamarisk	8.0/9.0 [5] (2.0 rangeland)	1	895
	Cut stump or basal bark	tree-of-heaven, edible fig		1	6.5

[1] Maximum lbs active ingredient or acid equivalent that can be applied per acre/per year on product label.
[2] Total acres per year that would be treated if the maximum proposed acreage for all species listed are treated using a single herbicide and single application method. This is not a likely scenario as a number of herbicides and methods are proposed for use, and the herbicide and method selected would depend on the plant species, location of infestation, and USAF herbicide use approval. More than one herbicide, or more than one application method would not be used for the same species in the same treatment area within a single year.
[3] Acres represent infested acres, so actual acres sprayed for target treatments is estimated to be 10-50% of the total.
[4] Cannot spot-treat more than 50% of an acre at this concentration.
[5] Triclopyr butoxyethyl ester (BEE)/ triethylamine acid (TEA).

Manual/Mechanical Treatments

Under Alternative 2, manual and mechanical treatments including mowing, hand-pulling, digging up with hand tools, and weed-whacking may be utilized to control certain invasive plant species at Beale AFB and the LRS. Heavy equipment including excavators and flail mowers or masticators may be used to control infestations of giant reed and Himalayan blackberry. Administration of these activities is the responsibility of the Beale AFB NRM.

Standard mowers may be used to control or suppress certain invasive species, particularly annual species. For treatments of annual invasive species, mowing would be carefully timed to coincide with target species' phenology. Mowing may also be used for perennial invasive species when removal of biomass is required (e.g., reduction of BASH hazards, preparation or maintenance of habitat enhancement sites). Regular mowing performed for fuels control and grounds maintenance does not apply as an effective invasive species control technique. Mowing may also be used in conjunction with prescribed fire in order to prepare the site for wet fire-lines. It reduces vegetation height and allows for installation of hose lays and wet lines in order to secure the prescribed burn perimeter, instead of using ground disturbing equipment. This is ideal for locations where ground disturbance is restricted (e.g., vernal pools). Table 2.9 provides relative benefits and downsides to mowing when compared to other manual/mechanical control methods.

Table 2.9. Manual and Mechanical Control Method Descriptions and Impacts.

Type	Tool/Method	Description of Technique	General Benefit	General Cons	BRC[1]	PGD[2]	LSI[3]	ID[4]	TS[5]	DoA[6]	T[7]
Manual (Conducted by hand or with non-mechanized hand tools)	Cut Stump with Hand Saws	Used to kill tree or shrub species unlikely to resprout or in conjunction with herbicide application	No herbicides, species specific	Generates biomass that may need to be removed	Low	Low	Small	Diffuse	High	High	Flat to mod
	Trim with Hand Sheers, Loppers, or Similar Tools	Used to remove portions of trees and shrubs without killing them	No herbicides, species specific	No kill, generates biomass that may need to be removed	Low	None	Small	Diffuse	High	High	Flat to mod
	Pull by Hand or Weed Wrenches	Used to remove small trees/shrubs and small or intermixed infestations of plants	No herbicides, species specific	Limited to a few species, generates biomass that needs to be removed, very labor/time intensive	Low	Low	Small	Diffuse	High	Mod	Flat to mod
	Excavate with Shovels or similar Tools	Used to dig up small patches of plants that are too difficult to pull by hand	No herbicides, species specific	Limited to a few species, minor soil disturbances, generates biomass that may need to be removed, very labor/time intensive	Low	Mod	Small	Diffuse	High	Mod	Flat to mod
	Mulch	Organic material (wood chips) used to suppress germination of invasive species	No herbicides, can be used in conjunction with restoration activities	Non-selective, only useful against seedlings, physically disruptive, labor intensive	None	None	Mod	Diffuse	Low	High	Flat
Mechanical	Cut Stump with Chain Saw or Similar Tool	Used to kill tree or shrub species unlikely to resprout	No herbicides, species specific	No kill, generates biomass that may need to be removed	Low	Low	Large	Dense	High	High	Flat to mod
	Trim with Chain Saws, Brush-cutters, or Similar Tools	Used to remove portions of trees and shrubs without killing them or in conjunction with herbicide application	No herbicides, species specific	Limited to few a species, generates biomass that may need to be removed	Low	None	Large	Dense	Mod	High	Flat to mod
	Remove Using Excavator or Back Hoe	Used to remove large rhizomatous species like Himalayan blackberry and Arundo	No herbicides, species specific	Limited to a few species, highly disruptive to soil	Low	High	Mod	Diffuse	High	High	Flat
Mowing	Mow using weed-whackers, riding mowers or similar equipment	Used to mow small infestations of annual invasive species or reduce biomass of perennial species	No herbicides, can cover significant areas	Limited to few species, non-selective, equipment must be cleaned to prevent spread of invasive species	Mod	Low	Large	Dense	Low	High	Flat

[1] BRC=Biomass Reduction Capability, [2] PGD= Potential for Ground Disturbance, [3] LSI= Landscape Scale of Infestation,[4] ID= Infestation Density, [5] TS= Target Specificity, [6] DoA= Detection of Application, [7] T= Terrain.

Manual removal methods or use of small hand-powered or hand-held equipment are often the first methods considered for removing small or new invasive plant infestations. Hand removal may also be a good option for containing the leading edge of an infestation where target plants are mixed with desirable native species. When employed, plant material left over would be collected and disposed of in a manner that prevents spread to other areas, unless the timing is such that there are no viable propagules and the species is not capable of vegetative reproduction. For perennial species, especially trees, hand removal would take the form of girdling if the species is incapable of resprouting below the girdling cut. Depending on the target species and environmental constraints, manual and mechanized removal would be used independently or in concert with herbicide application. Staging and maintenance areas would be designated as needed, and reviewed and approved through the USAF Form 103 process. Any in-house work would use existing 9 CES/CEIE equipment yard for maintenance purposes.

Habitat Enhancement Treatments

Under Alternative 2, habitat enhancement treatments may be utilized to control invasive plant species at Beale AFB and the LRS by replanting or reseeding with desirable species. Revegetating invasive plant treatment sites may be accomplished using a mixture of native grasses and forbs, and may include trees and shrubs if appropriate. Revegetating decisions would be compatible with future uses and management actions, and would consider suitability and cost of available options as well as the suitability of the site itself. Habitat enhancement guidance is provided in the IPSMG.

For reasons laid out in detail in Section 4.4 of the IPSMG including the lack of commercial availability and locally adapted genotypes, competitive disadvantages against invasive species, and poor site condition, using naturalized non-native species to revegetate treatment sites that are already surrounded by non-native species may be a cheaper, easier, and more successful strategy and shall be considered under Alternative 2.

Site preparation would not likely include disking but could, depending on overall project goals and location. Should disking be used, it would occur after herbicide treatment, manual removal, or prescribed burning has been conducted and in accord with other resource goals and protection measures. The most common restoration methods that may be used at Beale AFB include:

- Hand seeding: In very small (under 1/10th acre) upland disturbed areas, hand seeding with the base-approved native seed mix may be used to encourage recolonization by native vegetation.
- Drill seeding: A drill seeder with a row of small disks mounted on the front would be used to plant seeds. The seeder digs a 0.75 to 1-inch groove in which the seed is planted, and then the grove is closed behind the machine. Thatch reduction using grazing, prescribed burning, or mowing would be conducted prior to seeding to improve seed germination.
- Plug planting: A dibble tool would be used to poke a hole in the ground to a depth of about two to three inches. A small container plant would be placed in the hole and the top of the soil is closed around it to seal it in. Typically, these plugs would be planted every 1-3 feet. Thatch reduction using grazing, prescribed burning, or mowing would be conducted prior to planting seeding to improve plant survival.
- Container Planting: Hand tools would be used to dig holes in the ground for the installation of regionally native plants. Generally, container planting would be conducted using methods from the Restoration Plan for the Dry Creek Riparian Area (River Partners 2011).

Other Treatment Methods and Activities

Infestation area monitoring, invasive plant surveys, tracking of invasive plant populations and phenology information, and education are additional activities that may be utilized in the management of invasive plant species under Alternative 2. These activities, addressed in the IPSMG, are an important part of the adaptive, programmatic management process in guiding treatment plans, but do not themselves affect the environment.

2.5.2.3 Impact Avoidance and Minimization Measures and Best Management Practices

AMMs and BMPs define a set of conditions or requirements that an activity must meet to avoid or minimize potential effects on sensitive resources and to ensure consistency with the INRMP (Beale AFB 2019) and compliance with inter-agency consultations. AMMs involving herbicides are an added layer of caution to the already-regulated and approved use of these chemicals. AMMs are not optional and application of these measures is the basis for the effects analysis for this project.

The project AMMs and BMPs (Appendix G) are based on site-specific resource conditions within the project area, including, the current invasive plant inventory, the presence of sensitive species and their habitats, proximity to water and potential for herbicide delivery to water, and the social environment. For emphasis, some AMMs include herbicide label guidance, INRMP, IPMP (Beale AFB 2018b), or Aquatic Pesticide Application Plan (Beale AFB 2018c) standards. The AMMs listed are not an exhaustive list of all the base, DoD, or State rules and regulations, or label guidance; however, all applicable rules and regulations and herbicide label guidance would be followed in implementing Alternative 2. In general, all projects would employ the lowest impact methods for effective management of invasive plant species in areas with sensitive resources.

BMPs ranging from programmatic recommendations for how goals are accomplished to specific protocols for executing tasks are outlined in Section 5.2, *Best Management Practices for Weed Management* of the IPSMG (see Appendix B). These BMPs, in addition to the AMMs and BMPs described in Appendix G, would be made available to all contractors, residents, and installation divisions as appropriate. These measures would guide their work and reduce the possibility that projects would introduce, spread, or increase invasive plant species infestations, or harm sensitive resources.

2.5.3 Summary

Table 2.10 presents the threats associated with invasive vegetation on Beale AFB and the LRS as described in Section 1.3, along with the anticipated outcomes associated with each alternative for implementation of the Proposed Action.

Table 2.10. Threats Associated with Invasive Plant Species and Anticipated Outcomes of the Proposed Alternatives.

Invasive Plant Species Threats	Alternative 1 (No Action)	Alternative 2 (Comprehensive Control)
Increased fire risk, which can impede the military mission	Fire risk reduction would not meet current INRMP goals	Reduce fire risk in accordance with current INRMP goals and fire moving on/off the installation.
Provide habitat for birds and other undesirable wildlife near airfield creating BASH potential	BASH potential minimally reduced	Reduce BASH potential and minimize overall conflict between wildlife and military missions
Deteriorate native vegetative communities, restricting wildlife habitat and biodiversity	Minimal reduction in native community degradation, does not meet INRMP goals and objectives	Protect and enhance native vegetative communities that contribute to wildlife biodiversity
Alter vernal pool hydrology, water quality, and biomass levels, threatening ecosystem and listed species	Minimal protection for vernal pool ecosystems and associated species, does not meet INRMP goals and objectives	Protect the vernal pool ecosystem, improve habitat conditions for, and increase populations of associated special status species
Degrade aquatic and riparian habitats, threatening ecosystem, listed species, and recreational fishing	Minimal reduction in degradation, does not meet INRMP goals and objectives	Protect aquatic and riparian ecosystems, improve habitat conditions for associated listed and other species, and protect the recreational fishing program
Impair wetlands and associated vegetation communities, threatening ecosystem and associated species	Minimal reduction in wetland degradation, does not meet INRMP goals and objectives	Protect and manage wetlands and associated vegetation communities and wildlife
Diminish forage quality and quantity, threatening the existing grazing program	Forage quality continues to degrade, does not meet INRMP goals and objectives	Promote desirable (native and non-native) forage species to and protect and expand the grazing program
Toxic/irritating to humans and pets, degrading outdoor activity and quality of life	Outdoor activity and quality of life continue to degrade, does not meet INRMP goals and objectives	Enhance recreational opportunities
Growth on roads, sidewalks, trails, and parking areas reduces visibility, increases erosion and flooding potential, degrades aesthetics and recreational opportunities, and contributes to the spread of undesirable species	Growth minimally reduced, does not meet INRMP goals and objectives	Enhance visibility and recreational opportunity, minimize flooding and erosion potential, and minimize spread of undesirable plant species
Reduce open space, degrading quality of life and recreational opportunities	Open space continued to be reduced, does not meet INRMP goals and objectives	Maintain open space
Allowed to spread unchecked, degradation escalates	Degradation escalates	Prevent new infestations and control, contain, or eradicate existing infestations as practicable
Increased fuel load	Higher burn severity, increase cultural/resource damage	Reduced fuel load and fire intensity. Reduces cultural/resource damage.

3.0 AFFECTED ENVIRONMENT

The Region of Influence (ROI) for the Proposed Action is Beale AFB (Figure 3.1) and LRS (Figure 3.2), a geographically separate unit of Beale AFB.

3.1 SCOPE OF THE ANALYSIS

This chapter describes the current conditions of the environmental resources, either man-made or natural, that would be affected by implementing Alternative 2 or the No Action Alternative.

3.1.1 Resources Eliminated from Analysis

Based on the scope of the Proposed Action, resources with minimal or no impacts were identified through a preliminary screening process. The following describes those resource areas not carried forward for a detailed analysis, along with the rationale for their elimination.

Regardless of the alternative selected, the following resources would not be affected by the Proposed Action and are not discussed in detail in this EA:

3.1.1.1 Air Installation Compatible Use Zone

The Air Installation Compatible Use Zone (AICUZ) program is designed to assist local, regional, state, and federal officials in protecting and promoting public health, safety, and welfare by promoting compatible development within the AICUZ area of influence. It is also designed to protect USAF operational capabilities from effects of land uses that are incompatible with aircraft operations (USAF 1999). The AICUZ footprint defines the minimum recommended area within which land use controls are needed to enhance the health, safety, and welfare of those living or working near a military airfield, and to preserve the flying mission.

Per AFI 32-7063, *Air Installations Compatible Use Zones Program* (USAF 2015a), land uses that release any substance into the air that would impair visibility or otherwise interfere with operating aircraft, such as, but not limited to, steam, dust, and smoke are prohibited within the “Clear Zones” (the area closest to the runway end with the greatest accident potential). For this reason, prescribed burns would not be conducted within the Clear Zone. Prescribed burns in other locations would still have the potential to interfere with flying operations. Impacts to flying operations would be avoided by coordinating the timing of prescribed burns with the Beale AFB Flight Safety Office. Any effects on visibility resulting from smoke would be temporary. The No Action alternative would result in no changes to current AICUZ conditions. This includes the continuation of cattle grazing in Clear Zones and other Accident Potential Zones, which, Per AFI 32-7063, would be considered a compatible land use. There would be no impacts to the AICUZ from grazing expansion, chemical, or manual/mechanical invasive plant control measures under Alternative 2. Therefore, there would be no adverse impact to the AICUZ as a result of the Proposed Action.

3.1.1.2 Noise

Noise is an unwanted, disturbing, or annoying sound that interferes with normal activities and/or diminishes quality of life. Continuous, extended exposure to high noise levels can cause hearing loss but, the principal human response to noise is annoyance. Noise levels are measured in decibels. The Community Noise Equivalent Level is the energy-averaged sound level measured over 24 hours (Beale AFB 2005). Community Noise Equivalent Levels of 65 through 80 decibels characterize average sound levels. The main base and family housing functional areas have ambient noise levels below 60 decibels (Beale AFB 2019).

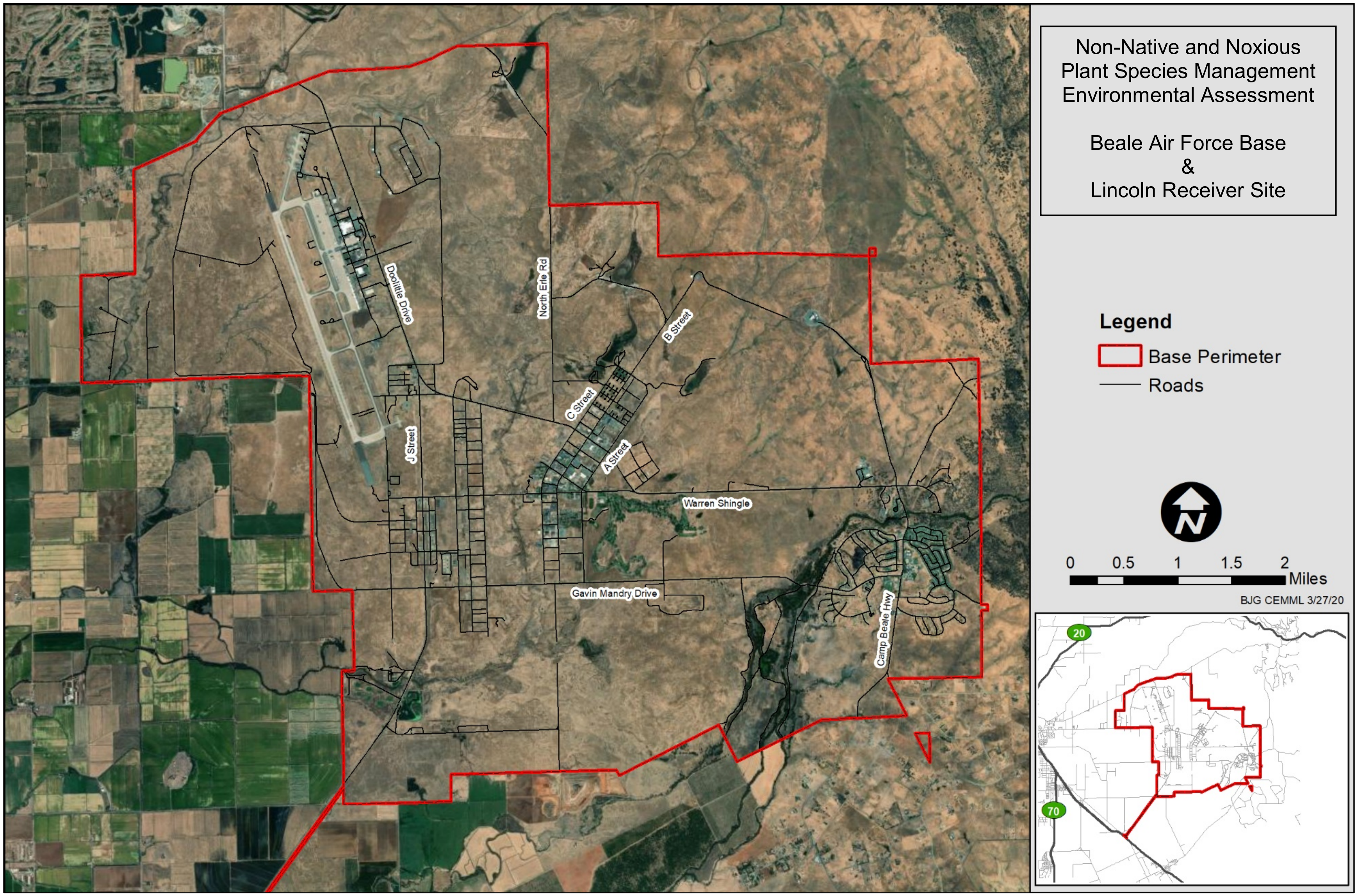
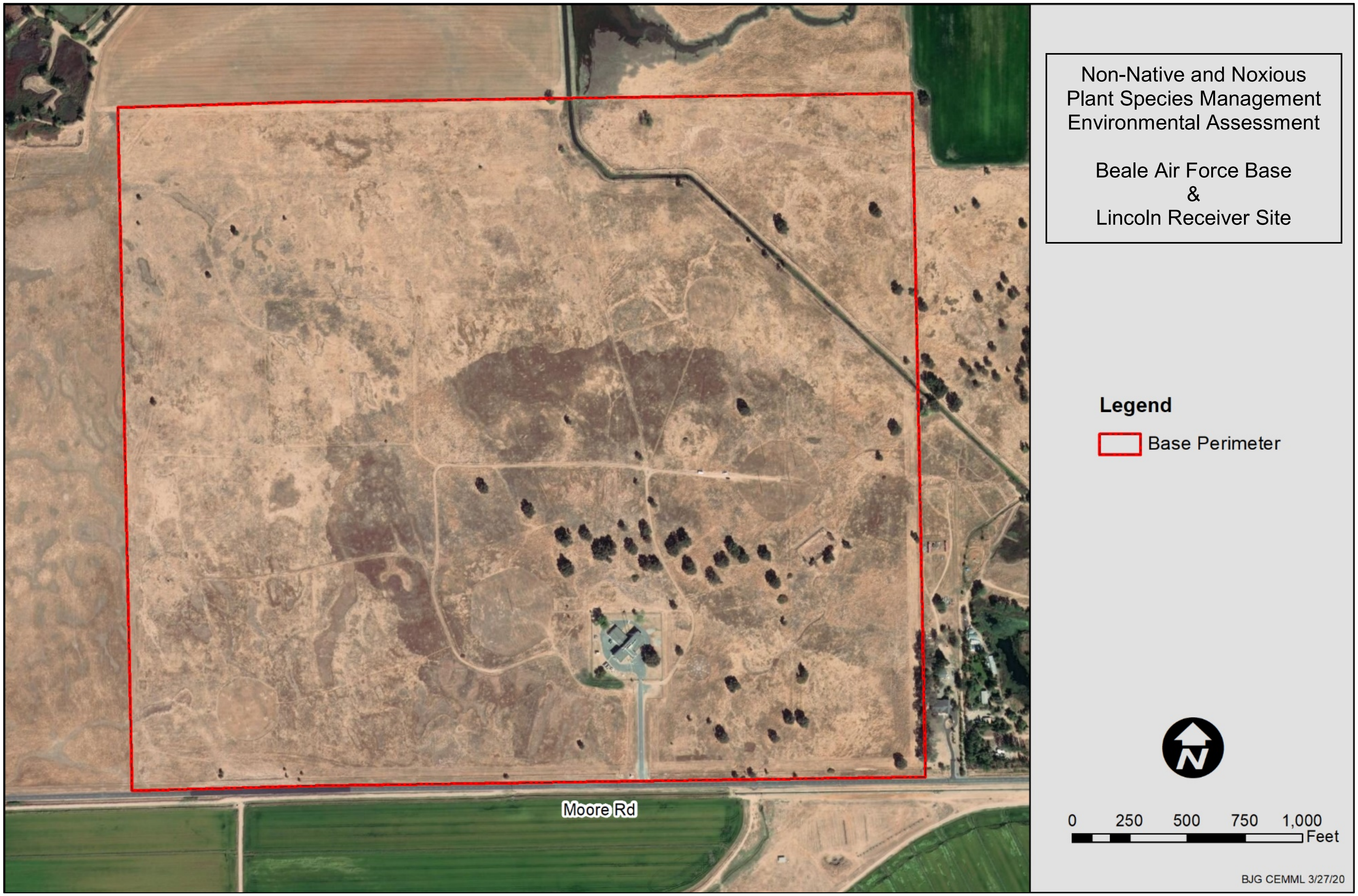


Figure 3.1. Beale Air Force Base.



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2 **Figure 3.2. Lincoln Receiver Site.**

Only minimal, short-term changes to ambient noise levels would occur as a result of implementing the Proposed Action. Heavy equipment utilized during grazing infrastructure development, and cattle loading and unloading could cause occasional, temporary, increases in noise levels. Prescribed burns could result in a temporary increase in vehicle traffic. ATVs would be used on an intermittent, short-term basis, for off-road large-scale herbicide application, causing minimal increases in noise levels. Hand-held gasoline-powered equipment, such as weed-whackers and chain saws, and larger equipment such as ride-on mowers would be used for some manual/mechanical control and restoration treatments and could result in temporary increases in noise levels. All activities would be conducted during business hours in areas where there is existing aircraft, traffic, and construction noise. Therefore, there would be no adverse impacts to ambient noise levels as a result of the Proposed Action.

3.1.1.3 Socioeconomic Resources and Growth-Inducing Impacts

Socioeconomics is typically defined as the relationship between economies and social elements, such as population and economic activity and represent a composite of several attributes. Factors that can be used as indicators of economic conditions for a geographic area, include demographics, income, un/employment, and poverty level. Socioeconomic resources include consideration of housing and population growth and growth-induced impacts.

An evaluation of the growth-inducing impacts of the Proposed Action is required. A growth-inducing impact is defined as: "[T]he ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment. Included in this are projects which would remove obstacles to population growth. It must not be assumed that growth in any area is necessarily beneficial, detrimental, or of little significance to the environment."

Grazing expansion under Alternative 2 would increase the number of acres available to be leased for grazing. This would have a direct, permanent, beneficial effect on both the USAF, in the form of increased revenue, and the lessees, in the form of available land. Leases are awarded in a competitive bid process that is open to any interested parties. Grazing leases do not affect properties outside of the base. Other activities would have no impact on socioeconomic resources. The Proposed Action would not lead to unplanned population growth directly or indirectly and would not displace any people or housing; invasive species control is not related to human population growth. The Proposed Action would not contribute to changes in other socioeconomic resources, such as housing availability, employment, community resources or local population. Therefore, there would be no adverse impact to socioeconomic resources as a result of the Proposed Action.

3.1.1.4 Environmental Justice

The United States Environmental Protection Agency (EPA) defines Environmental Justice as the fair treatment and meaningful involvement of all people regardless of race, color, national origin, or income with respect to the development, implementation, and enforcement of environmental laws, regulations and policies (U.S. EPA 2018b). EO 12898, *Federal Actions to Address Environmental Justice in Minority Populations and Low-Income Populations*, requires federal agencies to identify and address disproportionately high and adverse health effects on minority and low-income populations, and to ensure that federal programs do not discriminate on the basis of race, color, or national origin. EO 13045, *Protection of Children from Environmental Health Risks and Safety Risks*, requires federal actions and policies to identify and assess disproportionately adverse risks to the health and safety of children. The *Air Force Guide for Environmental Justice Analysis with the Environmental Impact Analysis Process* (DOAF 1997) provides a general approach for conducting environmental justice analyses in accordance with NEPA, and has been employed in the preparation of this EA.

Schools, childcare centers, and youth centers on Beale AFB are all located in the cantonment or housing areas, which are the center for residential and commercial facilities on the base. The Lincoln High School Farm is located just north of the LRS. The nearest senior centers and convalescent homes are located in the City of Lincoln approximately three miles east of the LRS. Only very temporary, intermittent impacts would occur as a result of the Proposed Action. None of these facilities is located in an area that would experience disproportionately high and adverse impacts. Invasive plant treatments would not be conducted on the aforementioned sites. If treatments were conducted near these facilities, they would be done during weather conditions that minimize smoke or herbicide drift. There are no senior facilities located on the base. Treatments on the main base would occur solely on the base and would not affect off-base populations. Due to the type of fuels on Beale AFB and the LRS (annual grasses) smoke output form prescribed fires would be relatively low and would disperse quickly. Prescribed burns would only be permitted on days that the local air quality board determined that there would not be adverse impacts on human health. Herbicide would be applied during appropriate weather conditions to avoid off-base drift. The Proposed Action would not include any activities that would discriminate in any way on the basis of race, color, national origin, age, or income.

3.1.1.5 Aesthetics

NEPA establishes that the federal government use all practicable means to ensure all Americans safe, healthful, productive, and aesthetically and culturally pleasing surroundings (42 United States Code [USC] 4331[b][2]). It is the policy of the state to take all action necessary to provide the people of the state "with…enjoyment of *aesthetic*, natural, scenic and historic environmental qualities" (California Public Resources Code §21001[b]).

While vegetation removal would occur under the Proposed Action, those species removed would be invasive species that currently impede the visual character of the landscape. The project would not change rural and undeveloped landscapes to an urban appearance. Invasive species removal efforts would be expected to be seen as positive by the public given that invasive species, especially those most likely to form monocultures that destroy the scenic beauty of native landscapes, would be removed. Many projects would not be within public view. While the proposed project would include prescribed burns, which would not change the visual character of a vista from brown grasses to black soil, the change would not be considered adverse given that prescribed burns would help prevent more catastrophic wildfires, visual impacts would be temporary as grasses and forbs germinate in the early fall upon the first rains, and because of the resulting improvement of the visual character and quality of the view after fire. Fires provide one or more years of invasive species control primarily of invasive annual grasses which obscure native flowering forbs. The presence of flowering forbs after fire can dramatically improve scenic vistas.

The Proposed Action would not have adverse effects on scenic vistas, would not damage scenic resources including trees, rock outcroppings, or historic buildings and would not degrade the existing visual character or quality of public views. Finally, the project would not create a new source of substantial light or glare that would affect day or nighttime views in the area. Therefore, this resource area is not further analyzed under this EA.

3.1.1.6 Agricultural and Forest Resources

NEPA and the Farmland Protection Policy Act (FPPA, 7 United States Code [USC] 4201-4209; and its regulations, (7 CFR Part 658) require federal agencies to coordinate with the Natural

Resources Conservation Service (NRCS) if their activities may irreversibly convert farmland (directly or indirectly) to nonagricultural use. For purposes of the FPPA, farmland includes prime farmland, unique farmland, and land of statewide or local importance. Farmland subject to the act's requirements does not have to be currently used for cropland. It can be forest land, pastureland, cropland, or other land, but not water or urban built-up land (NRCS 2019).

A review is required of projects that would convert Williamson Act contract land to non-agricultural uses. The main purposes of the Williamson Act are to preserve agricultural land and to encourage open space preservation and efficient urban growth. The Williamson Act provides incentives to landowners through reduced property taxes to discourage the early conversion of agricultural and open space lands to other uses. Impacts to timberland are analyzed as required by the California Timberland Productivity Act of 1982 (CA Government Code §51100 et seq.), which was enacted to preserve forest resources. Similar to the Williamson Act, this program gives landowners tax incentives to keep their land in timber production.

As the objective of the Proposed Action would be to improve native landscapes, grazing lands and forested landscapes would be maintained. Grazing would provide numerous conservation benefits and the aim of the Proposed Action would be to expand grazing, not reduce it. The Proposed Action would, therefore, not convert farmland to another use, would not conflict with existing zoning for agricultural use, and would not conflict with existing zoning for or cause rezoning for forest lands or timberlands. While unplanned and uncontrolled wildfires could result in the conversion of oak woodlands to non-forested grasslands, prescribed burns proposed under the Proposed Action would help prevent such wildfires. Prescribed burns would be conducted in such a way that protects oaks if woodlands are targeted for burning, which they typically are not. Oak trimming (i.e., removing low branches) could be undertaken as a fuels reduction practice to help reduce the possibility that oak trees would burn during a wildfire. Oaks are a valuable part of the natural flora and their protection, not removal, would be planned under the Proposed Action. Therefore, this resource area is not further analyzed under this EA.

3.1.1.7 Recreation

Recreation resources at Beale AFB include a recreation facility (the Harris Fitness center), walking trails, designated hunting and fishing areas, and other open spaces. The Proposed Action would not involve construction or expansion of recreational areas or facilities. The Proposed Action could improve, but would not negatively impact existing recreation facilities. Invasive plant removal at restoration sites, hunting areas, and walking paths would improve recreation opportunities. Any impacts to access or use of outdoor recreation from prescribed burns would be temporary. Recreation at Beale AFB would not be negatively impacted by the Proposed Action and therefore is not analyzed in detail.

3.1.1.7 Wildfire

Per the latest CalFIRE Fire Hazard Severity Zone Maps for Yuba County (CalFire 2007), Beale AFB is identified as a Federal Responsibility Area and is thus not given a fire severity zone which are only designated on state responsibility areas. The base is, however, surrounded on three sides by moderate fire hazard severity zones as well as several sections of very high fire hazard severity zones.

While invasive species activities may increase vehicle or ATV-traffic on little used gravel and dirt roads or off-road travel, thereby increasing the risk of fire, all staff are briefed on fire prevention strategies. Overall, the Proposed Action would have a beneficial impact on wildfire severity as it would expand prescribed burning, grazing and mowing practices which would reduce fuel loads and fire risk. While the No Action Alternative would not have a smaller impact, it would still be expected to be beneficial. The Proposed Action would not impair emergency response or evacuation plans, would not exacerbate wildfire risk, would not include installation of equipment such as utility lines that exacerbate wildfire risks, and would not expose people or structures to downstream flooding or landslides as a result of runoff or post-fire slope instability. Therefore, this resource area is not further analyzed under this EA.

3.2 LAND USE

Land use refers to Real Property classifications – either natural conditions or the types of human activity occurring on a parcel. In many cases, land use descriptions are codified in local zoning laws. Two main objectives of land use planning are to ensure orderly growth and compatible uses among adjacent property parcels or areas.. There is no nationally recognized convention or uniform terminology for describing land use categories. As a result, the meanings of various land use descriptions, labels, and definitions vary among jurisdictions. There is a wide variety of land use categories resulting from human activity. Descriptive terms often used include residential, commercial, industrial, agricultural, institutional, and recreational.

3.2.1 Regulatory Setting

California Government Code §65300 requires every county and city in the state to adopt a comprehensive, long-term general plan. A general plan provides a vision for and guides future development of the jurisdiction and any land outside the jurisdiction's boundaries which, in the planning agency's judgement, bears relation to its planning. General plans must include seven mandated elements: land use, housing, circulation, noise, safety, open space, and conservation.

The California State Aeronautics Act (Public Utilities Code §21670 et seq.) requires the creation of airport land use commissions and preparation of airport land use compatibility plans. The act requires creating a compatibility plan for each public use and military airport. Airport land use commissions promote land use compatibility around airports "to protect public health, safety, and welfare by ensuring the orderly expansion of airports and the adoption of land use measures that minimize the public's exposure to excessive noise and safety hazards within areas around public airports to the extent that these areas are not already devoted to incompatible uses" (Mead & Hunt, Inc. 2011).

3.2.2 Affected Environment

Within Beale AFB, a variety of land uses can be found that are typical of military installations. The four largest land uses at Beale AFB are open space, airfield, industrial, and housing. Collectively, they comprise approximately 96% of the land use total for the installation (Figure 3.3; Table 3.1). The most current land use documents at Beale AFB are the Installation Development Plan (Beale AFB 2015) and the INRMP (Beale AFB 2019).

The Beale AFB Land Use Compatibility Plan and Joint Land Use Study address off-base land use compatibility between Beale AFB and the surrounding communities (Governor's Office of Planning and Research 2008, Mead & Hunt, Inc. 2011). The Yuba County 2030 General Plan, adopted in June 2011, incorporates the findings of the Beale AFB Joint Land Use Study and AICUZ. Existing land uses surrounding Beale AFB consist largely of resource production, crops, and grazing – all compatible land uses. The Installation Development Plan (Beale AFB 2015) addresses on-base land use compatibility and planning.

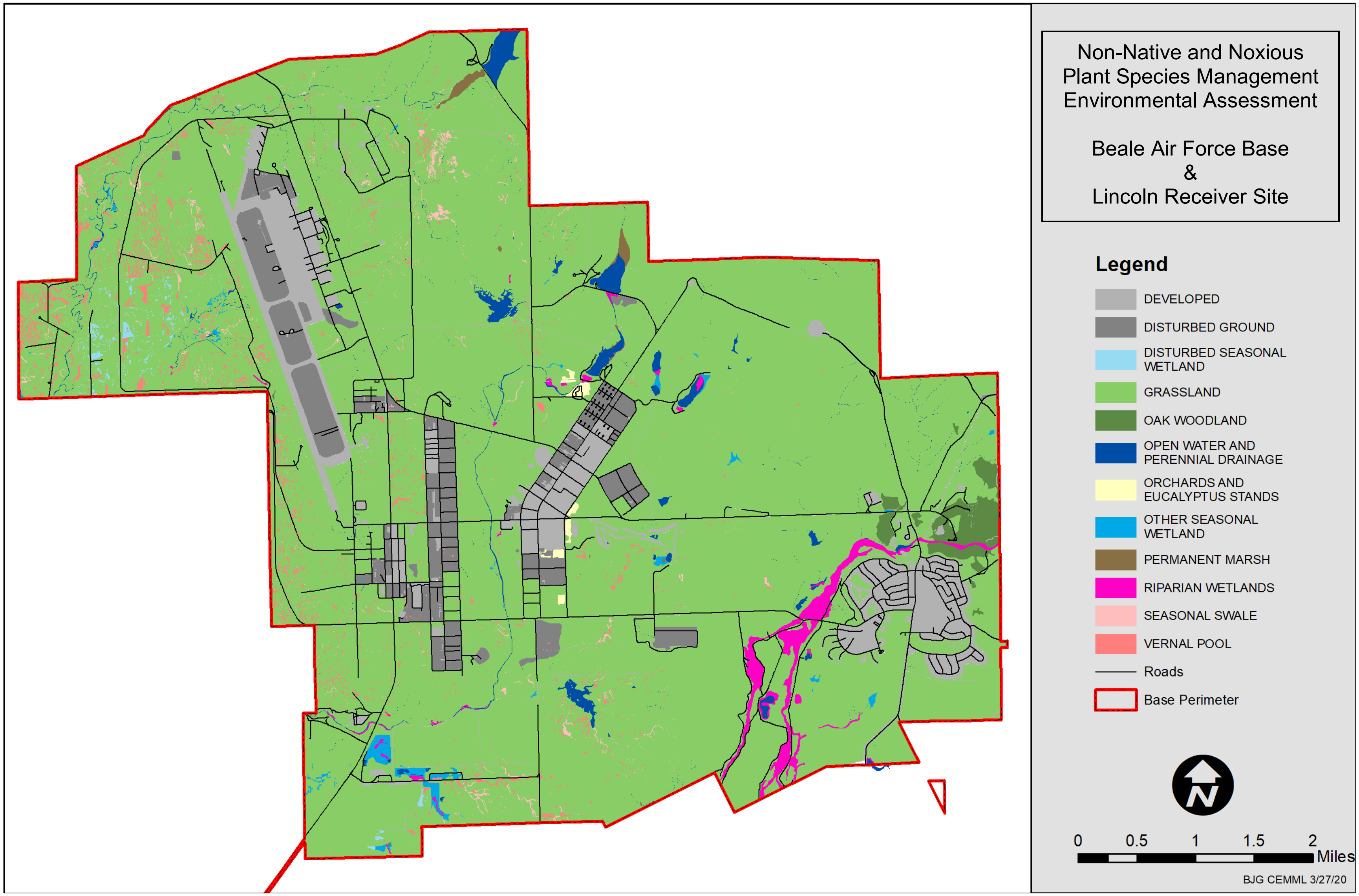

Figure 3.3. Beale AFB Land Use.

Table 3.1. Acreage and Typical Facilities/Features of Land Uses on Beale AFB.

Land Use Category	Typical Facilities/Features	Existing Area (acres)
Administration	Headquarters, Security Operations, Office	36
Airfield	Runway, Taxiway, Apron, Overrun	1,285
Communities Commercial and support)	Dining Facility, Club, Commissary, Base Exchange, Gym/Recreation Center, Theater, Religious Facility	223
Housing (Unaccompanied and family)	Dormitory and Visitor Housing – Visiting Quarters, Temporary Lodging Facility	613
Industrial	Munitions, Base Engineering, Maintenance Shop, Warehousing	713
Medical/Dental	Clinic, Pharmacy	21
Open Space	Conservation Area, Buffer Space, Quantity Distance Arc	19,562
Operations and maintenance	Hangar, Aircraft Maintenance Unit, Squad Operations, Control Tower, Fire Station, Training Functions (including Simulator, High Bay Technical Training, Classroom, Maneuver Area, Firing Range)	385
Outdoor Recreation	Outdoor Court, Athletic Field, Golf Course, Range	304
Uncategorized		50
Total		23,192
Source: Beale AFB 2015		

Beale AFB is a large installation with three geographically separated built-up areas: the flightline, main base, and privatized housing area. These three areas form compact development clusters which effectively group compatible, and separate conflicting land uses. Large areas of open space, as well as ranges and training areas, provide buffers between the more intensely developed flightline, main base, and privatized housing areas. Land on Beale AFB is classified as improved, semi-improved and unimproved land areas based on definitions in AFI 32-7064, *Integrated Natural Resources Management*.

Improved grounds include all areas at Beale AFB for which personnel annually plan and perform intensive maintenance activities. Approximately 2,089 acres at Beale AFB are included in the improved grounds category. Improved grounds are primarily clustered in three main developed areas, with smaller areas of improved ground located across the base.

Approximately 33 acres of the 235-acre LRS are improved grounds. The developments consist of antenna fields, Building 4131, a stabilization pond, an abandoned power substation, and the Moore irrigation canal, which carries water managed by the South Sutter Water District.

Semi-improved grounds include all areas of the base on which personnel perform periodic maintenance primarily for operational and aesthetic reasons. Most of this land is adjacent to runways, taxiways and aprons, or on rifle and pistol ranges, in training areas, and on golf course roughs. Exact acreage is not available for this land use category.

Unimproved grounds include all areas of the base not under the improved or semi-improved grounds categories and for which periodic maintenance is not a requirement. Approximately 20,022 acres at Beale AFB fall into this category. Unimproved grounds also include areas related to specific natural resource conservation and management activities. There are approximately 200 acres of unimproved grounds on the LRS.

Current Grazing Program

Beale AFB lands are managed to permit multiple uses of natural resources, including grazing domestic livestock. The grazing component of this multiple-use policy is based on the recognition that grazing is a way to maintain sound stewardship of public lands. Grazing livestock would be used to reduce fuel loads, control invasive plants, and improve wildlife habitat. Agricultural outleasing on the base is an economically self-sustaining program that enhances other aspects of natural resources management.

Beale AFB has nearly 20,000 acres classified as “open space.” Of this area, 12,792 acres are currently part of Beale’s grazing program with 12,634 acres grazed by cattle and 158 acres serving as horse pasture. Beale’s grazing areas are divided into six Management Areas, A-F, with each Management Area subdivided into pasture units (Table 3.2). Currently, there are 36 pasture units. For most of Beale’s grazing program Management Areas, the grazing season is 1 November – 31 May. Management Area E horse pasture units are used year-round. Three small Management Area C pasture units serve as temporary livestock holding areas and are used on a temporary basis as needed.

Table 3.2. Current Grazing Management Unit Acreage and Stocking Rates.

Management Area	Pasture Unit	Acreage	Livestock Type and Animal Unit Months
A	A-1	832	cattle (1,855)
	A-2	471	
	A-3	359	
	A-4	746	
	A-5	207	
	A-6	284	
	A-7	114	
	A-9	167	
	Total	**3,180**	
B	B-1	825	cattle (1,633)
	B-2	1,102	
	B-3	182	
	B-5	584	
	B-6	360	
	B-8	15	
	Total	**3,068**	
C	C-1	2,553	cattle (1,800)
	C-2	375	
	C-3	147	
	C-4	26	
	C-5	4	
	C-6	131	
	Total	**3,236**	
D	D-1	37	cattle (487)
	D-2	23	
	D-3	111	
	D-4	281	
	D-5	259	
	D-6	90	
	Total	**801**	
E	E-1	21	horse
	E-2	21	
	E-3	55	
	E-4	11	
	E-5	24	
	E-6	26	
	Total	**158**	
F	F-1	1,333	cattle (1,094)
	F-2	387	
	F-3	360	
	F-4	269	
	Total	**2,349**	
Beale AFB grazing program total area		**12,792**	**Cattle (6,869), horse (varies)**
Source: Beale AFB 2017b			

Grazing leases effectively last for five years; although more precisely, they are in effect for the first year, with four years of annual renewals thereafter. In compliance with AFI 32-7064, *Integrated Natural Resources Management,* Beale's grazing leases include land use rules. Lease terms limit the number of animals to prevent overgrazing. Grazing is allowed 1 November–31 May, unless otherwise specified to meet unusual conditions. Ranchers' annual fees for the leases depend on the acreage and the number of AUMs (Animal Units Monthly) supported on the parcel.

Current land use rules identify a target RDM of 800 lbs/acre and a minimum RDM of 600 lbs/acre. Stocking rates may not exceed those listed in Table 3.2. Ranchers are responsible for bringing their livestock onto their lease, ensuring the safety and security of their livestock, ensuring availability of water and dietary supplements, rotating livestock between pastures as needed to prevent overgrazing, responding if livestock escape from the pasture, and removing livestock at the end of the grazing season.

Beale AFB natural resources management personnel conduct rangeland management including: monitoring populations of desirable and undesirable forage species, consulting with grazing lessees on placement of mineral and supplemental feed, and monitoring the distribution of livestock to obtain uniform range use. They notify lessees of any observed problems and maintain cattle fences and water tanks as needed.

3.3 AIR QUALITY

Air quality is determined by the concentration of pollutants in the atmosphere and can be influenced by many factors including:

- the type and amount of pollutants emitted into the atmosphere;
- the size and topography of the air basin;
- transformation of pollutants into other chemical substances such as acid rain;
- and the prevailing meteorological conditions such as wind and precipitation patterns affecting the distribution, dilution, and removal of pollutant emissions.

According to §39655 of the California Health and Safety Code, a toxic air contaminant is "an air pollutant which may cause or contribute to an increase in mortality or an increase in serious illness, or which may pose a present or potential hazard to human health." Most air pollutants are anthropogenic in origin and include mobile sources (e.g., cars, trucks, buses) and stationary sources (e.g., factories, refineries, power plants). They can also include indoor sources (e.g., some building materials and cleaning solvents) and pollutants released from natural sources such as volcanic eruptions and forest fires.

GHG emissions are gaseous emissions that trap heat in the atmosphere. These emissions occur from natural processes and human activities but are primarily produced by the burning of fossil fuels and through industrial and biological processes. The most common GHGs emitted include carbon dioxide, methane, and nitrous oxide.

3.3.1 Regulatory Setting

The Clean Air Act (42 USC §7401) provides comprehensive federal legislation designed to establish nationwide air quality standards and control air pollution throughout the United States. Initially passed in 1963 and last amended in 1990, the Clean Air Act identifies two types of ambient air quality standards. Primary standards provide public health protection including sensitive populations such as asthmatics, children, and the elderly. Secondary standards provide public welfare protection such as decreased visibility and damage to animals, crops, vegetation, and buildings (U.S. EPA 2018a).

The EPA is responsible for enforcing the Clean Air Act and establishing standards. The EPA has set National Ambient Air Quality Standards (40 CFR Part 50) for six principal pollutants considered harmful to the public and environment including: ozone, particle pollution (respirable particulate matter and fine particulate matter), carbon monoxide, nitrogen dioxide, sulfur dioxide, and lead (U.S. EPA 2018a; Table 3.3). Areas historically in compliance with the National Ambient Air Quality Standards are designated as attainment areas, and areas that currently violate federal air quality standards are designated as nonattainment areas. Areas transitioning from nonattainment to compliance are designated as maintenance areas and are required to adhere to maintenance plans to ensure continued compliance.

On 22 Sep 2009, EPA issued a final rule for mandatory GHG reporting from large GHG emissions sources in the United States. The purpose of the rule is to collect comprehensive and accurate data on carbon dioxide and other GHG emissions that can be used to inform future policy decisions. In general, the threshold for reporting is 25,000 metric tons or more of carbon dioxide equivalent emissions per year but excludes mobile source emissions.

AFI 32-7040, *Air Quality Compliance and Resource Management*, implements AFPD 32-70, *Environmental Considerations in Air Force Programs and Activities*. The instruction provides details of the USAF Air Quality Compliance and Resource Management Program and explains how to assess, attain, and sustain compliance with the Clean Air Act; other federal, state, and local environmental regulations; Final Governing Standards or the Overseas Environmental Baseline Guidance Document; applicable international agreements; and related DoD and USAF directives.

Table 3.3. National Ambient Air Quality Standards and California Ambient Air Quality Standards

Pollutant	Averaging Time	Federal Primary Standards	Federal Secondary Standards
Carbon Monoxide	8 hours (1)	9 ppm	N/A
	1 hour (1)	35 ppm	N/A
Lead	3-month rolling (2)	0.15 $\mu g/m^3$	0.15 $\mu g/m^3$
	30-day average	None	None
Nitrogen Dioxide	1 hour (3)	100 ppb	None
	1 year (4)	53 ppb	1 year[4]
Ozone	8 hours (5)	0.07 ppm	0.07 ppm
PM2.5	24 hours (6)	35 $\mu g/m^3$	35 $\mu g/m^3$
	1 year (7)	12 $\mu g/m^3$	15 $\mu g/m^3$
PM10	24 hours (8)	150 $\mu g/m^3$	150 $\mu g/m^3$
Sulfur Dioxide	1 hour (9)	75 ppb	None
	3 hours (1)	N/A	0.5 ppm
	24 hours	140 ppb	None
Visibility Reducing Particles	8 hours	None	None
Sulfates	24 hours	None	None
Hydrogen Sulfide	1 hour	None	None
Vinyl Chloride	24 hours	None	None

[1] Not to be exceeded more than once per year; [2] Not to be exceeded; [3] 98th percentile of 1-hour daily maximum concentrations, averaged over 3 years; [4] Annual mean; [5] Annual 4th-highest daily maximum 8-hour concentration, averaged over 3 years; [6] 98th percentile, averaged over 3 years; [7] Annual mean, averaged over 3 years; [8] Not to be exceeded more than once per year on average over 3 years; [9] 99th percentile of 1-hour daily maximum concentrations, averaged over 3 years

Smoke management in California is governed by the California Air Resources Board, which implements the guidelines found in Title 17 CCR Subchapter 2. Guidelines provide direction for air pollution control and air quality management districts (air district) in the regulation and control of agricultural burning, and prescribed fire, in California. All prescribed fires require prior permission from the local air district. Permission is obtained by completing the following planning steps: (1) register the prescribed fire with the local air district, (2) obtain an air district and/or fire agency burn permit, (3) submit a Smoke Management Plan to the air district, and (4) obtain air district approval of the Smoke Management Plan. Each air district has developed specific requirements for Smoke Management Plans based upon 17 CCR §80160.

There are local air quality air district regulations also apply to activities conducted on Beale AFB. These include Feather River Air Quality Management District (FRAQMD) Regulation 2, *Open Burning*, and Placer County Air Pollution Control District (PCAPCD) Rule 303, *Prescribed Burning Smoke Management*. The purpose of these regulations is to ensure that open burning in the districts is conducted in a manner that minimizes emissions and smoke and is managed consistent with state and federal law. FRAQMD Regulation 3.16, *Fugitive Dust Emissions* and PCAPCD Rule 228, *Fugitive Dust*, are in place to reasonably regulate operations that periodically may cause fugitive dust emissions into the atmosphere. Agricultural operations are exempt from these regulations.

The General Conformity Rule requires that any federal action meet the requirements of a state or federal implementation plan. More specifically, Clean Air Act conformity is ensured when a federal action does not cause a new violation of, contribute to an increase in the frequency or severity of, or delay the timely attainment of interim progress milestones, or other milestones toward achieving compliance with the National Ambient Air Quality Standards.

The General Conformity Rule applies only to actions in nonattainment or maintenance areas and considers both direct and indirect emissions. The rule applies only to federal actions that are considered “regionally significant” or where the total emissions from the action meet or exceed the de minimis thresholds presented in 40 CFR §93.153. An action is regionally significant when the total nonattainment pollutant emissions exceed 10% of the Air Quality Control Region’s total emissions inventory for that nonattainment pollutant. If a federal action does not meet or exceed the de minimis thresholds and is not considered regionally significant, then a full Conformity Determination is not required.

3.3.2 Affected Environment

Beale AFB is located in the Northern Sacramento Valley Air Basin, which includes Shasta, Tehama, Glenn, Butte, Colusa, Yuba and Sutter counties. Beale AFB is under the jurisdiction of the Feather River Air Quality Management District, which is responsible for implementing and enforcing state and federal air quality regulations in the Yuba County and Sutter County portions of the Northern Sacramento Valley Air Basin. Beale AFB is in Yuba County Burn Management Zone 2. PCAPCD is the local authority for the LRS. All air permits for the Main Base are obtained through FRAQMD and updated/renewed annually.

The air quality in Yuba County is characterized by the EPA as maintenance for particulate matter (PM) 2.5, and as unclassified/attainment at the federal level for all other criteria pollutants (U.S. EPA 2019a; Table 3.4). Niether Beale AFB nor the LRS is within 10 kilometers of a Class I area, which includes federal lands such as national parks, national wilderness areas, and national monuments. These areas are granted special air quality protections under §162(a) of the federal Clean Air Act.

Table 3.4 Yuba and Placer Counties Air Quality Attainment Status, 2021.

Criteria Pollutant	Averaging Time	California Ambient Air Quality Standards			National Ambient Air Quality Sstandards		
		Standard	Yuba Attainment Status	Placer Attainment Status	Standard	Yuba Attainment Status	Placer Attainment Status
Ozone	1-hour	0.09 ppm	Attainment	Nonattainment	--	--	--
	8-hour	0.070 ppm			0.070 ppm	Attainment	Nonattainment
Carbon Monoxide	1-hour	20 ppm	Attainment	Attainment	35 ppm	Attainment	Maintenance
	8-hour	9 ppm			9 ppm		
Nitrogen Dioxide	1-hour	0.18 ppm	Attainment	Attainment	100 ppb	Attainment	Attainment
	Annual	0.030 ppm			0.053 ppm		
PM_{10}	24-hour	50 μg/m^3	Nonattainment	Nonattainment	150 μg/m^3	Unclassified	Unclassified
	Annual	20 μg/m^3			--	--	--
$PM_{2.5}$	24-hour	--	Attainment	Attainment	35 μg/m^3	Maintenance	Maintenance
	Annual	12 μg/m^3			12 μg/m^3		
Lead	30-day Average	1.5 μg/m^3	Attainment	Attainment	--	--	--
	Calendar Quarter	--	--	--	1.5 μg/m^3	Attainment	Attainment
	Rolling 3-month Average	--	--	--	0.15 μg/m^3	Unclassified	Unclassified
Hydrogen Sulfide	1-hour	0.03 ppm/42 μg/m^3	Unclassified	Unclassified	No National Standard		
Sulfate	24-hour	25 μg/m^3	Attainment	Attainment	No National Standard		
Sulfur Dioxide	1-hour	0.25 ppm	Attainment	Attainment	75 ppb	Attainment	Attainment
	24-hour	0.04 ppm	Attainment	Attainment	0.14 ppm,	Attainment	Attainment
	Annual	--	--	--	0.030 ppm	Attainment	Attainment
Vinyl Chloride	24-hour	0.01 ppm/26 μg/m^3	Unclassified	Unclassified	No National Standard		

[1] Source: CARB 2019a; [2] Source: FRAQMD 2020

Emission sources at Beale AFB include mobile sources (e.g., aircraft, automobiles, and grounds maintenance equipment), stationary sources (e.g., power generation, fire training exercises, fuel cell maintenance, painting operations, welding operations, and woodworking facilities), and prescribed burning for fuel hazard reduction and natural resources management.

GHG emissions attributed to cattle operations are generated primarily from vehicle traffic. The grazing management and addition of ranchers to the installation staff are analyzed as mobile sources utilizing the Air Conformity Applicability Model (ACAM; Table 3.5). Current conditions account for two civilian employees and nine ranchers (identified as contractor support personnel in ACAM). There are currently only 2 grazing lessees, but the analysis reflects the maximum number of ranchers, ranch hands, and associated personnel that could potentially be visiting the base under existing conditions. Detailed ACAM reports can be found in Appendix H.

Prescribed burns are routinely conducted on grasslands across the base, and the effects are analyzed individually through the USAF EIAP. Under existing conditions, RDM on pastures is approximately 800 lbs RDM/acre at the end of the grazing season. From 2001-2015 an average of 622 acres were burned annually. This number was used to estimate average total annual air pollutant emissions from prescribed burns under existing conditions (Table 3.6).

Table 3.5 Estimated Mobile Source (Rancher) Air Pollutant Emissions for Existing Conditions.

Pollutant	No Action Emissions[1]
PM10	0.007 tpy
PM2.5	0.003 tpy
Carbon Monoxide	0.276 tpy
Carbon Dioxide	48.70 tpy
Nitrogen Oxides	0.023 tpy
Sulfur Oxides	0.0005 tpy

[1] Emissions estimated using the Air Conformity Applicability Model for 9 ranchers and 2 base personnel.
tpy = tons per year

Table 3.6 Estimated Emissions from Prescribed Burns under the No Action Alternative.

Pollutant	Emission Factor [1]	Emissions per Acre (0.4 tons RDM/acre)	No Action Emissions (622 acres/year)
PM10	21.6 lbs/ton	8.64 lbs	2.687 tpy
PM2.5	6.4 lbs/ton	2.56 lbs	0.796 tpy
Carbon Monoxide	86 lbs/ton	34.4 lbs	10.7 tpy
Carbon Dioxide	3663.2 lbs/ton	1465.3 lbs	455.7 tpy
Methane	5.7 lbs/ton	2.28 lbs	0.709 tpy
Nitrous Oxide [2]	0.46 lbs/ton	0.184 lbs	0.057 tpy
Nitrogen Oxides [3]	4.9 lbs/ton	1.96 lbs	0.61 tpy
Sulfur Oxides [3]	0.74 lbs/ton	0.296 lbs	0.92 tpy

[1] Source: CONSUME model, based on National Wildfire Coordination Group data
[2] Source: AFCEC 2020. Air Emissions Guide for Air Force Transitory Sources Table 3-4
[3] AFCEC 2020 does not include NO_x or SO_2 entries, therefore NO_x was set to the specific crop values from Darley (1979), where available, or to the average field crop or orchard crop Darley values where specific crops were not listed. SO_2 values were set to the average of the Jenkins (1996) field crop values for the field crops, and the average of the Jenkins walnut and almond values for the orchard crops. Darley data were not used for SO_2 because of known overestimates due the method used.
Lbs/ton = pounds per ton
tpy = tons per year

3.4 WATER RESOURCES

This discussion of water resources includes groundwater, surface water, wetlands, and floodplains:

- Groundwater is the water present beneath the earth's surface, used for drinking, irrigation, and industrial purposes. Groundwater properties are often described in terms of depth from the surface, aquifer or well capacity, water quality, recharge rate, and surrounding geologic formations.
- Surface water resources generally consist of wetlands, lakes, rivers, and streams. Surface water is important for its contributions to the economic, ecological, recreational, and human health of a community or locale.
- Wetlands are jointly defined by the EPA (2019b) and the U.S. Army Corps of Engineers (USACE) as "those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions." Wetlands generally include swamps, marshes, bogs, sloughs, and vernal pools.
- Floodplains are areas of low-level ground present along rivers, stream channels, large wetlands, or coastal waters. Floodplain ecosystem functions include natural moderation of floods, flood storage and conveyance, groundwater recharge, and nutrient cycling. Floodplains also help to maintain water quality and are often home to a diverse array of plants and animals. In their natural vegetated state, floodplains slow the rate at which incoming overland flow reaches a main water body. Floodplain boundaries are most often delineated by estimating flood elevation during a 100-year and 500-year flood.

3.4.1 Regulatory Setting

The Clean Water Act (CWA) of 1977 (33 USC §1251 et, seq.) is an amendment to the Federal Water Pollution Control Act of 1972, administered by the EPA, sets the basic structure for regulating discharges of pollutants into WoUS. WoUS include interstate and intrastate lakes, rivers, streams, and wetlands that are used for commerce, recreation, industry, sources of fish, and other purposes. The objective of the CWA is to restore and maintain the chemical, physical, and biological integrity of the nation's waters. The CWA requires the EPA to establish water quality standards for specified contaminants in surface waters and forbids the discharge of pollutants from a point source into navigable waters without a NPDES permit. NPDES permits are issued by the EPA or the appropriate state if it has assumed responsibility. §404 of the CWA establishes a federal program to regulate the discharge of dredge and fill material into WoUS. §404 permits are issued by the USACE.

§303(d) of the CWA requires states and the EPA to identify waters not meeting state water-quality standards and to develop Total Maximum Daily Loads. A Total Maximum Daily Load is the maximum amount of a pollutant that a water body can receive and still be in compliance with state water-quality standards. After determining Total Maximum Daily Loads for impaired waters, states are required to identify all point and nonpoint sources of pollution in a watershed that are contributing to the impairment and to develop an implementation plan that would allocate reductions to each source to meet the state standards. The Total Maximum Daily Loads program is currently the nation's most comprehensive attempt to restore and improve water quality. While the program does not explicitly require the protection of riparian areas, Total Maximum Daily Load plans typically call for restoration of riparian areas a required management measures for achieving reductions in nonpoint source pollutant loadings.

The Safe Drinking Water Act (42 USC §7401) is the federal law protecting drinking water throughout the United States. Passed in 1974 and amended in 1986 and 1996, it focuses on all waters with the potential to be used as drinking water, including surface and groundwater sources. Under the Safe Drinking Water Act, the EPA is responsible for setting drinking water standards and overseeing states and any other water suppliers who implement those standards.

EO 11990, *Protection of Wetlands*, dated May 24, 1977, requires all federal agencies to provide leadership in wetland protection when acquiring, managing, and disposing of federal lands. The EO recommends avoiding adverse impacts associated with destruction and modification of wetlands, if possible, as well as avoiding new construction when there are alternatives. Under EO 11990, a FONPA must be prepared by the installation and signed by the Commander, before any action in wetlands would proceed. In support of EO 11990, DoDI 4715.3, *Environmental Conservation Program* (DoD 1996b), was issued, which sets a goal of no net loss of wetlands on DoD lands.

EO 11988, *Floodplain Management*, also dated May 24, 1977, provides guidance and direction regarding actions of federal agencies in floodplains. It requires federal agencies to avoid long and short-term adverse impacts associated with occupancy and modification of floodplains when possible, to avoid direct and indirect support of floodplain development when there are practicable alternatives, and to avoid risks to human health and safety. As with EO 11990, DoDI 4715.3 supports EO 11988 by recommending avoidance of adverse impacts on floodplains when possible.

In California, the California Porter-Cologne Water Quality Act (California Water Code § 13000 et seq.) provides a framework for protecting water quality and beneficial uses of water. Created in 1969, the Act applies to both surface and groundwater and uses the NPDES permit program, authorized by the CWA, and/or Waste Discharge Requirements to regulate discharges and protect water quality.

The California State Water Resources Control Board adopted the Statewide General NPDES Permit for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications, Water Quality Order 2013-0002-DWQ, for the reissuance of General NPDES Permit CAG990005 in June 2013. Order 2013-0002-DWQ became effective on December 1, 2013. This general permit covers the point source discharge to WoUS of residues resulting from pesticide applications using products containing 2,4-D, acrolein, copper, diquat, endothall, flumioxazin, fluridone, glyphosate, hydrogen peroxide, imazamox, imazapyr, penoxsulam, peroxyacetic acid, sodium carbonate peroxyhydrate, and triclopyr-based algaecides and aquatic herbicides, and additives containing ingredients represented by the surrogate nonylphenol. This General Permit covers only discharges of algaecides, and aquatic herbicides that are currently registered for use in California, or that become registered for use and contain the above-listed active ingredients and ingredients represented by the surrogate of nonylphenol (California State Water Resources Control Board 2019).

California enacted the Sustainable Groundwater Management Act in 2014 in order to halt overdraft and bring groundwater basins into balanced levels of pumping and recharge. The act requires local agencies to adopt sustainability plans for high- and medium-priority groundwater basins. Under the Sustainable Groundwater Management Act, basins must reach sustainability within 20 years of implementing their plans. The act requires the State Water Board to protect basins that are not managed sustainably through a process called State Intervention.

3.4.2 Affected Environment

3.4.2.1 Hydrology

Hydrology and water management on Beale AFB is complex due to both natural and man-made influences. Beale AFB is located on the eastern margin of the Sacramento Basin Hydrologic Area, within the Marysville Hydrologic Unit as designated by the California Department of Water Resources, just east of the confluence of the Feather and Yuba rivers. This is a region of elevation change between the Sierra Nevada foothills and the Central Valley, which influences the direction of both surface and groundwater flow (CH2M Hill 2017). Hydrology on the base has been significantly altered by the creation of impoundments, channel re-direction and groundwater pumping. Impoundments have been created historically for flood control, stock watering and recreation areas. The State and Regional Water Boards are responsible for overseeing and enforcing water laws. Beale AFB is within the jurisdiction of the Central Valley Regional Water Quality Board (California State Water Resources Control Board 2018).

3.4.2.2 Groundwater

Beale AFB is within the Yuba subbasin of the Sacramento groundwater basin. The groundwater table on Beale AFB is shallowest in the western portion of the base adjacent to the flightline (42-53 feet in 2016) and deepest in the eastern portion (260 feet or greater). Prior to the development of irrigated agriculture in the Sacramento Basin, groundwater moved westward through this margin from the Sierra Nevada foothills to discharge in the Feather and Sacramento rivers. Due to extensive groundwater extraction, primarily for agricultural irrigation, the main groundwater discharge is now through well withdrawals. The rivers no longer serve as the groundwater discharge points; now water from the river channels recharges the groundwater system. The base's groundwater recharge comes from the Yuba River to the north (CH2M HILL 2017). The LRS is within the North American River subbasin of the Sacramento groundwater basin.

There are currently more than 1,000 groundwater monitoring wells, extraction wells and piezometers on the base (CH2M Hill 2017). As the result of historical Army and USAF activities, groundwater in some places is contaminated with chemicals of concern, such as petrochemicals and solvents, at concentrations above maximum legal levels. Groundwater contaminant levels are monitored at 23 sites, including 15 groundwater plumes (Figure 3.4). There are several water bodies on the base that have chemical contamination, including Best Slough and Parks Lake. Drinking water wells are drawn from an aquifer underlying the western portion of the base (Beale AFB 2019) away from known or suspected contaminants.

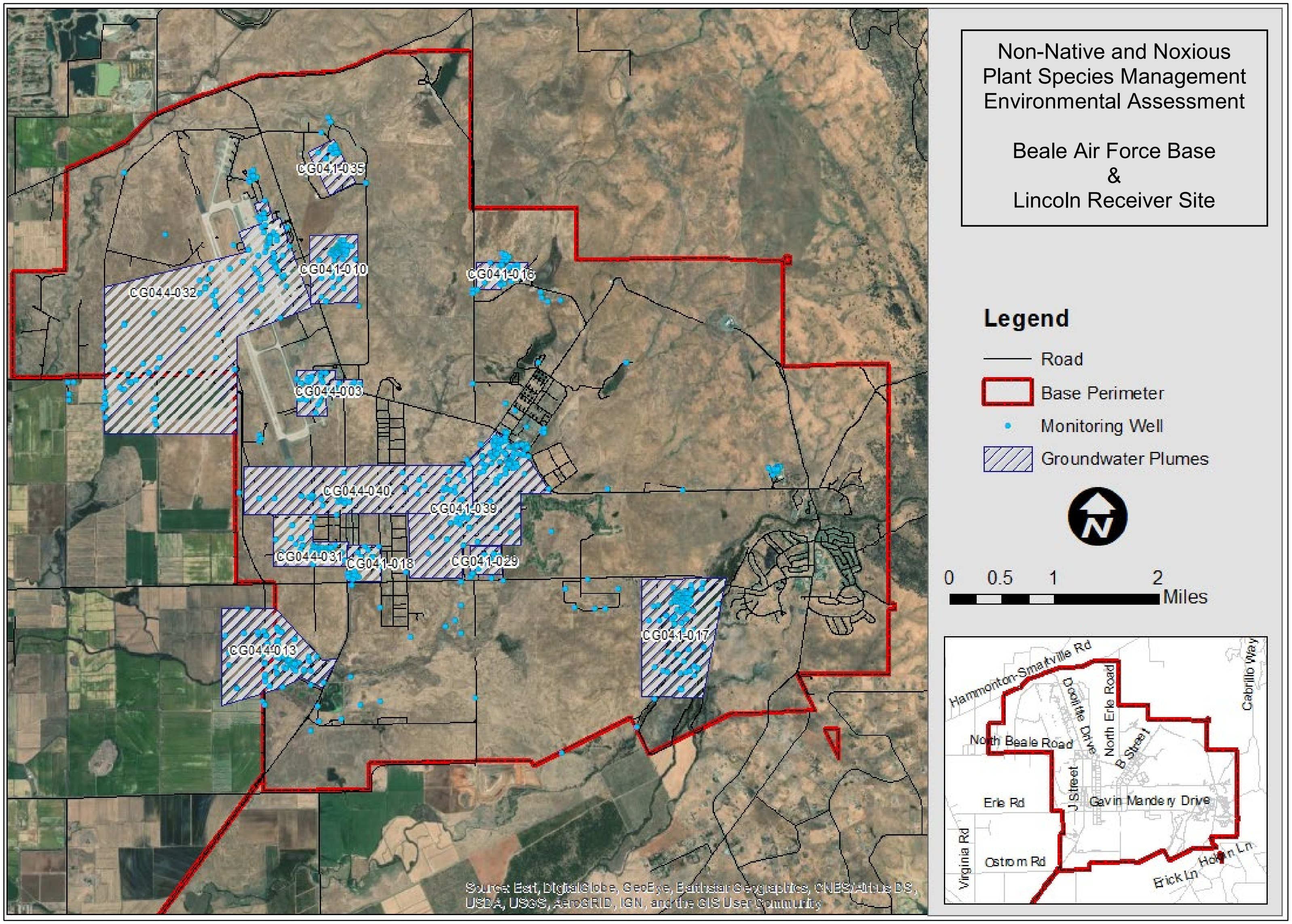

Figure 3.4. Groundwater Plumes and Monitoring Wells.

3.4.2.3 Surface Water

Beale AFB is flanked by major river systems to the north (Yuba River), west (Feather River), and south (Bear River). Three named creeks flow southwesterly across the area of Beale AFB (Figure 3.5):

- Dry Creek/Best Slough systems are naturally-occurring seasonal streams augmented by water from the Nevada Irrigation District. Dry Creek enters the eastern side of the base from the adjacent Spenceville Wildlife Area and is the main drainage for the eastern side of the base. Surface runoff from the family housing area drains into Dry Creek via small tributaries. Dry Creek is impounded at its northern end on the base, creating Beale Lake. Dry Creek diverges into the Dry Creek/Best Slough system before discharging into the Bear River.
- Hutchinson Creek originates from multiple small tributaries originating north of the base and is the main drainage for the central portion of the base including main base and parts of the flightline. Water from Upper and Lower Blackwelder, Goose, Frisky, Mad Dog, multiple other small lakes and ponds, and recycled wastewater from golf course irrigation all drain into Hutchinson Creek. Hutchinson Creek merges with Reeds Creek southwest of Beale AFB, eventually draining into Plumas Lake.
- Reeds Creek is fed by water released from Miller Lake, drainages around the flightline, and Brophy Canal. Reeds Creek enters the base at its northwestern boundary and flows southwest along its northern border before turning south. Brophy Canal joins Reeds Creek at the northern base boundary, fed by water from the Yuba River and groundwater pumping discharges used to rework old hydraulic mine tailings.

The creation of impoundments both before and after the establishment of Beale AFB dramatically changed the hydrology of the area. Many of the lakes were created more than 30 years ago by building dams and spillways. There are approximately 44 lakes and stock ponds on the base, most of them man-made (Figure 3.5; Table 3.7). The number and size of water bodies has changed since 2016, due to dam removals or failures at several lakes.

Impoundments on the base fluctuate in size throughout the year, depending on winter rainfall and summer temperatures. Water levels are highest during the winter and lower dramatically during the summer, when many of the smaller water bodies dry up completely.

Based on the geologic conditions and topographic characteristics of the base, there are five watersheds/storm water drainage basins at Beale AFB. Each drainage/basin represents a unique drainage pattern and area and is affected differently by industrial and non-industrial land uses. The drainages/basins at Beale AFB are used to identify and monitor for the management and prevention of pollutant discharges to surface waters.

Most surface water at the LRS is ephemeral. The topography of the LRS is essentially level, with some shallow depressions, one drainage swale trending from south-southwest to north-northeast within the southeast area of the property, and a drainage canal flowing through the top northeast corner. Surface drainage primarily flows toward the onsite swale (Beale AFB 2019).

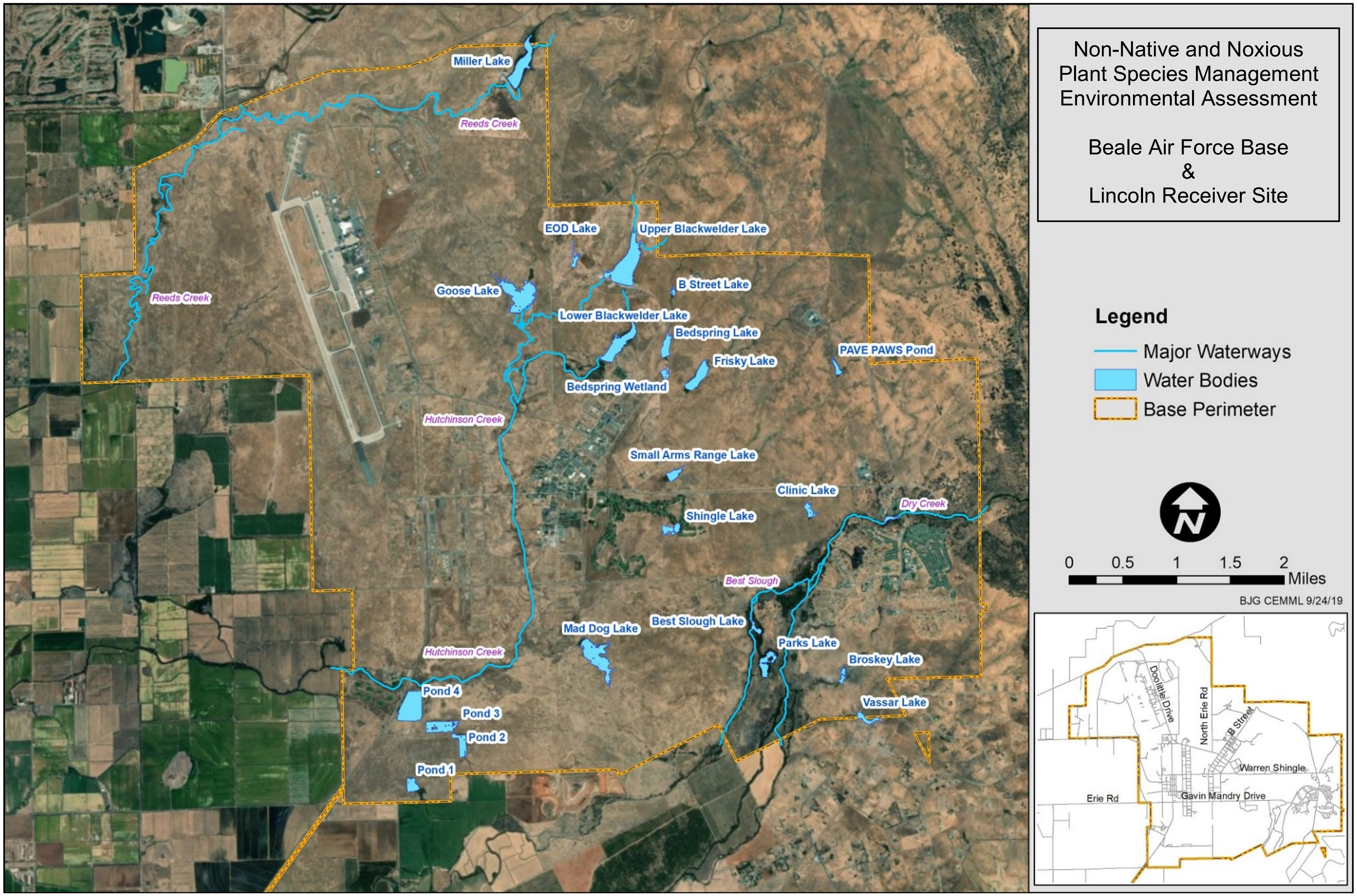

Figure 3.5. Water Courses and Bodies on Beale AFB. Not labeled: A Street Pond, Beale Lake, golf course ponds.

Table 3.7. Surface Water Bodies at Beale AFB.

Water Body	Area (Acres)[a]	Uses	Drainage
A Street Pond	1.3	Gray Water/Golf Course/Catch and Release Fishing	Hutchinson Creek
B Street Lake	1.6	Stock Pond/Hunting and Fishing	Hutchinson Creek
Beale Lake	2.4[c]	Dam removed summer/fall 2020	Dry Creek
Bedspring Lake	6.4[c]	Dam Breached/Closed	Hutchinson Creek
Bedsprings Wetland	2[c]	Overflow	Hutchinson Creek
Broskey Lake	1.8	Catch and Keep Fishing	Dry Creek
Best Slough Lake	3.1	Catch and Release Fishing	Dry Creek
EOD Lake	0.4	Not accessible	Hutchinson Creek
Frisky Lake	11[c]	Dam Breached/Closed	Hutchinson Creek
Goose Lake	29[c]	Dam Breached/Hunting	Hutchinson Creek
Golf Course Ponds	4	Golf Course	Hutchinson Creek
Clinic Lake	4.3	Hunting and Fishing	Dry Creek
Lower Blackwelder Lake	21.8	Flood Control/Recreation/Catch and Keep Fishing	Hutchinson Creek
Mad Dog Lake	24.2	Hunting and Fishing	Hutchinson Creek
Miller Lake	46[c]	Flood Control/Recreation	Reeds Creek
Parks Lake	7	ERP Site/Catch and Release	Dry Creek
PAVE PAWS Pond	2.5	Catch and Keep Fishing	Dry Creek
Pond #1	7.7	Stock Pond	Hutchinson Creek
Pond #2	8	Stock Pond/Catch and Keep Fishing	Hutchinson Creek
Pond #3	18.2	Wastewater	Hutchinson Creek
Pond #4	22.4	Wastewater/Closed	Hutchinson Creek
Shingle Lake	0.8	Gray Water/Golf Course	Hutchinson Creek
Small Arms Range Lake	3	Flood Control	Hutchinson Creek
Upper Blackwelder Lake	31[c]	Flood Control/Recreation	Hutchinson Creek
Vassar Lake [b]	1.2	Stock Pond/Catch and Keep Fishing	Dry Creek
Unnamed Ponds	8.4	Flood Control/Stock Ponds/Recreation	Various
Total	269.5		

[a] Acreage at capacity calculated using LiDAR or hand-drawn GIS, [b] Acreage within the base boundary
[c] Historic acreage, current acreage TBD
ERP: Environmental Restoration Program, GIS: Geographic Information Systems, LiDAR: Light Detection and Ranging; Source: Beale AFB 2019

3.4.2.4 Wetlands

A Preliminary Jurisdictional Determination from USACE concurred that there are approximately 3,089 acres of WoUS including wetlands and/or other water bodies present within the Beale AFB that are potential WoUS regulated under §404 of the CWA, as depicted in the 23 February 2010, Beale AFB Wetland Delineation drawings (Figure 3.6). This includes 2,328 acres of wetlands (including vernal pools) and 761 acres of non-wetland waters. There are some areas, such as "Vernal Pool Swale Complexes," that were too complicated to delineate based solely on remote sensing. In this case, it was estimated that 50% of these areas are wetlands. Wetland types at Beale AFB of particular importance to wildlife include vernal pools, riparian forests and freshwater marsh. There are approximately 36 acres of wetlands on the LRS; all are vernal pools (AECOM 2013; Figure 3.7).

Vernal Pools: Vernal pools are extensive in the western, central and southern portions of Beale AFB, covering 1,379 acres (Figure 3.6). Vernal pools have a claypan, hardpan or bedrock bottom that prevents or slows water percolation through the soil profile. Annual water levels in pools are entirely dependent upon rainfall, leading to inconsistent water levels and hydro-periods from year to year. In high water years, pools may remain inundated through the winter. These pools provide unique habitat for plants that germinate as aquatic or semiaquatic plants but must survive a terrestrial life and a drought environment as the pool dries. There are approximately 35 acres of man-made vernal pools at two sites on the base, one west of the flightline and one near the Wheatland Gate. There are approximately 36 acres of vernal pools on the LRS (AECOM 2013; Figure 3.7).

Riparian Forests: Riparian areas at Beale AFB are primarily associated with lakes and perennial streams. Riparian systems occur in transition zones between aquatic and upland ecosystems and, in their undisturbed condition, are characterized by dominant vegetation that is tolerant of and adapted to periodic flooding or soil saturation. Prime riparian habitat on the base is found along Dry Creek and Best Slough. Past management actions have resulted in most creeks and ephemeral streams on the base having downcut streambeds. This has impaired the adjacent vegetation and elevated sediment delivery within the watersheds.

Freshwater Marsh: Freshwater marshes are found in ponds and drainages that have a relatively permanent water supply. Freshwater marsh intermingles with riparian woodland vegetation along drainages, such as Hutchinson Creek and Dry Creek.

3.4.2.5 Floodplains

The Federal Emergency Management Agency develops floodplain maps to ensure compliance with regulatory statues and not necessarily from an ecosystem value standpoint. In addition, the Federal Emergency Management Agency categorizes Beale AFB as flood zone D, meaning it has not determined the flood hazard for the area (FEMA 2019). For this reason, the Beale AFB GIS layers were used to determine the location and extent of floodplains. Based on the GIS data, there are roughly 2,500 acres of floodplains across the installation (Beale AFB 2019). Large floodplains exist around the major drainages at Beale AFB and surround two unnamed drainages west of the flightline (Figure 3.8). These areas may flood during heavy rainfall in the region due to impervious soil conditions and lack of topographic relief. The LRS is outside the 100-year floodplain, which extends along the southern boundary of the site (Figure 3.9).

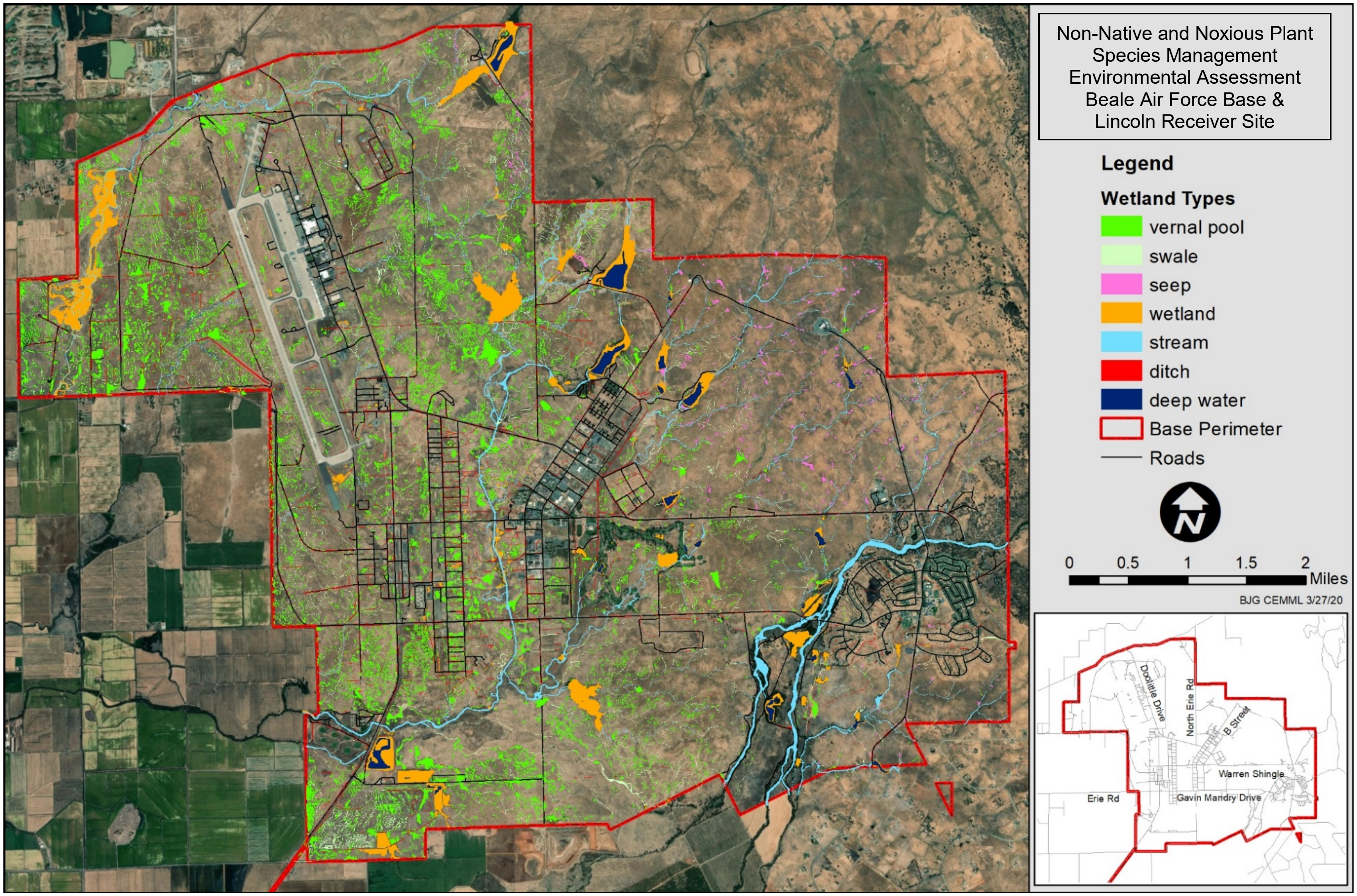

Figure 3.6. Beale AFB Wetlands.

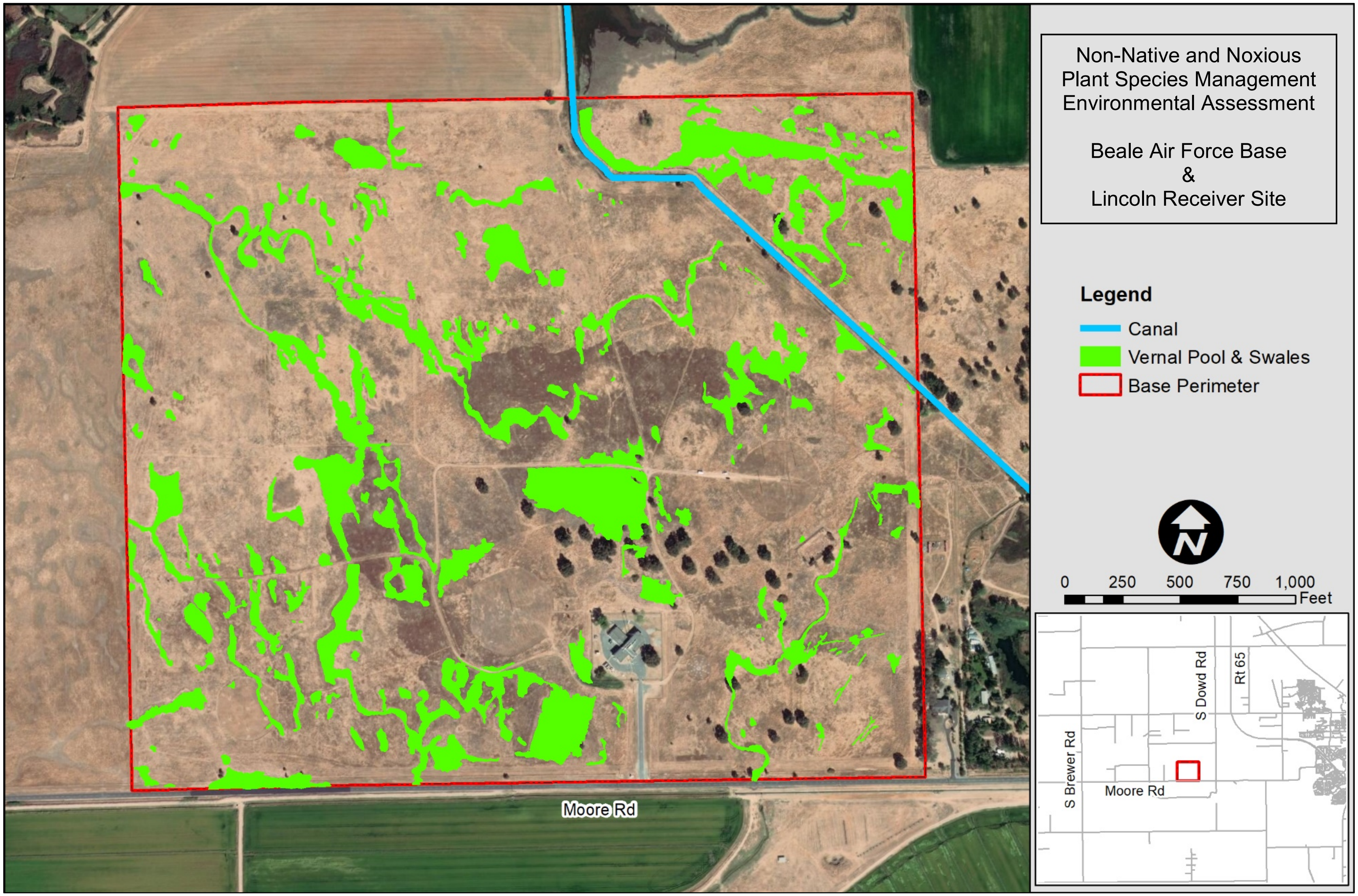

Figure 3.7. LRS Wetlands.

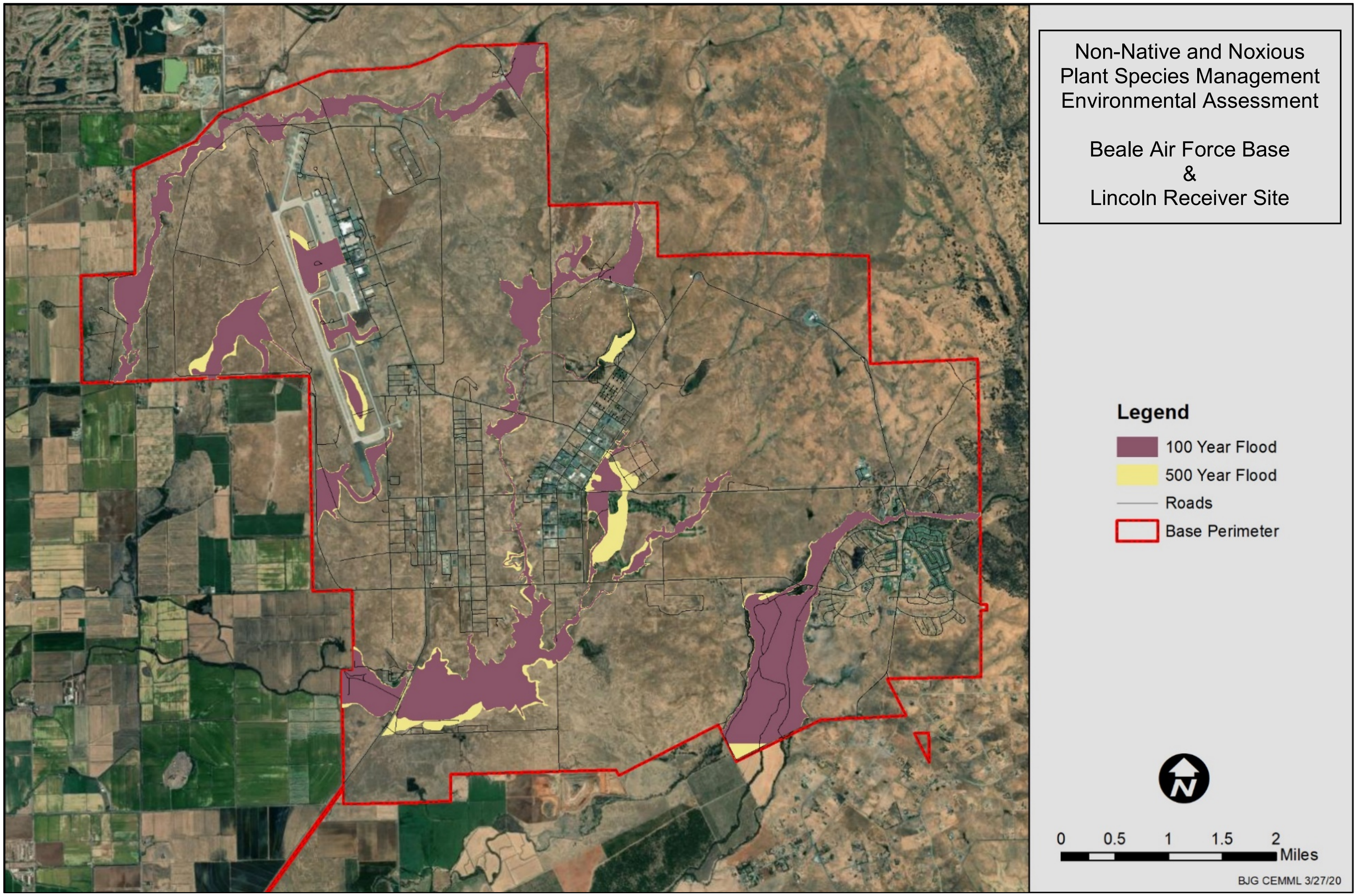

Figure 3.8. Beale AFB Floodplains.

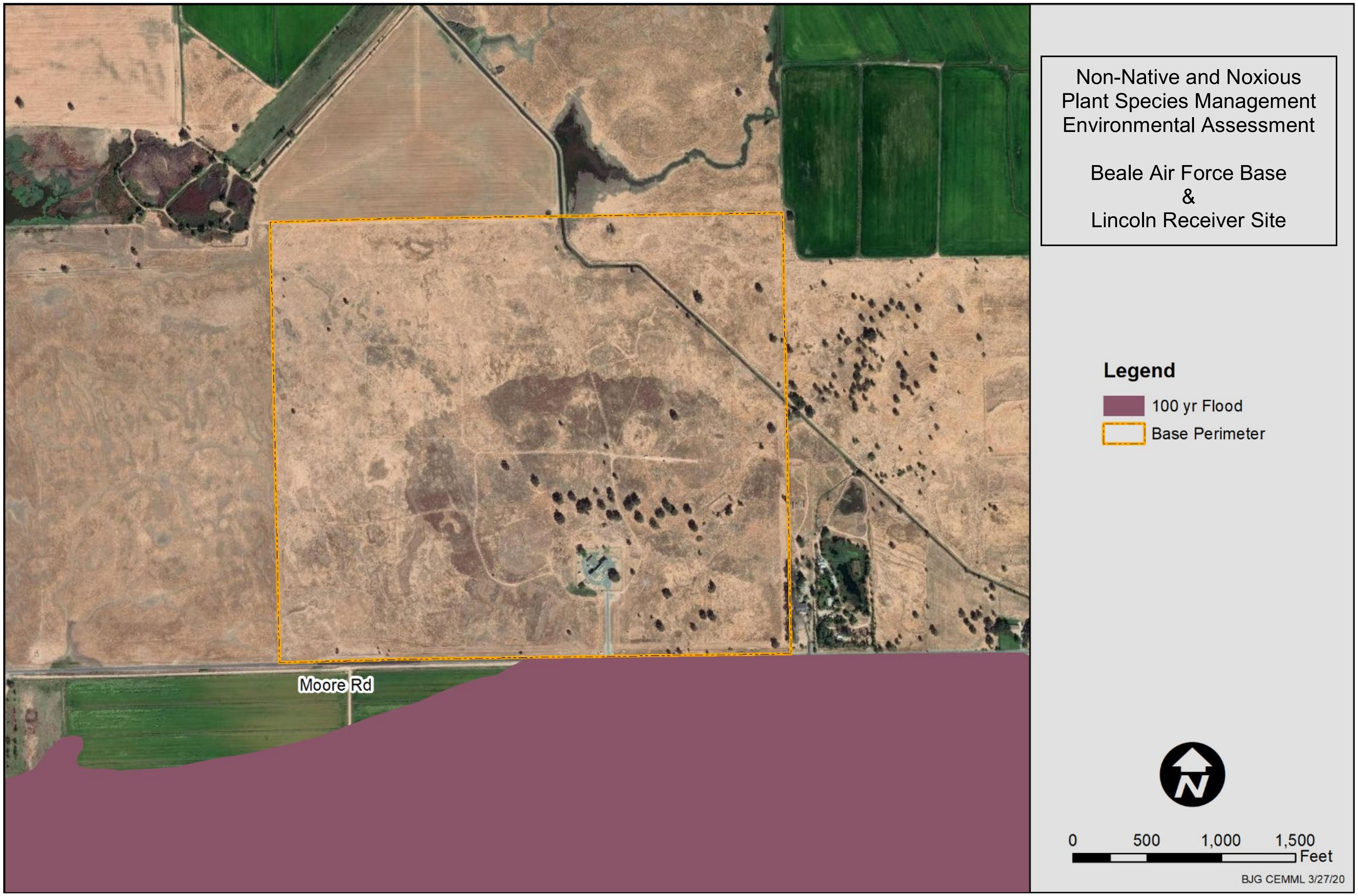

Figure 3.9. LRS Floodplain.

3.5 SAFETY AND OCCUPATIONAL HEALTH AND PUBLIC SERVICES

This discussion of safety and occupation health covers any activities, occurrences, or operations having the potential to affect the safety, well-being, or health of members of the public. A safe environment is one in which there is no, or optimally reduced, potential for death, serious bodily injury or illness, or property damage. The primary goal is to identify and prevent potential accidents or impacts to the general public. Additionally, a review of impacts to public services is included here.

3.5.1 Regulatory Setting

The Occupational Safety and Health Act of 1970 (PL 91-596) assures safe and healthy working conditions by setting and enforcing safe workplace standards. As a result, Congress created the Occupational Safety and Health Administration to enforce standards as well as to provide training, outreach, education, and assistance (OSHA 2018). OSHA safety guidance published in the Department of Labor 29 series CFR provides employees a safe and healthful workplace. OSHA dictates what must be accomplished in the workplace, but in some cases, not necessarily how it would be accomplished, or by whom. OSHA standard 29 CFR 1960, standards addressing Field Federal Safety and Health Council organization and operation; EO 12196, *Occupational safety and health programs for Federal employees*; and 29 USC § 668, *Programs of Federal agencies*; require the heads of federal agencies to establish programs to protect their personnel from work-related deaths, injuries and illnesses. Commanders are responsible for the safety of their facilities and personnel, including the correction of all hazards and deficiencies in their workplaces (USAF 2018).

AFMAN 91-203, *Air Force Occupational Safety, Fire, and Health Standards* (USAF 2018) compliments AFI 91-202, *The US Air Force Mishap Prevention Program* (USAF 2019), and assigns responsibilities to individuals or functions to help Commanders manage their safety and health program, ensuring they comply with OSHA and USAF guidance. AFMAN 91-203 provides uniform guidance, which safety staffs and commanders may supplement when additional or more stringent safety, fire prevention and health criteria are required. USAF activities must comply with OSHA requirements at all times, unless the military-unique exemption applies in accordance with DoDI 6055.01, *DoD Safety and Occupational Health Program* (DoD 2014), and AFI 91-202.

AFI 91-202, *The US Air Force Mishap Prevention Program* (USAF 2019a), implements AFPD 91-2, *Safety Programs* (USAF 2019b), relevant safety portions of DoD Directives, DoDIs, Memorandum of Agreement between the Department of the USAF and the Federal Aviation Administration, and North Atlantic Treaty Organization Standardization Agreements on flight, airspace, and space safety. The purpose of the USAF Mishap Prevention Program is to minimize the loss of USAF resources and protect USAF personnel from death, injuries or occupational illnesses by managing risks on and off-duty. This program is aligned with and framed using the USAF Safety Management System as the core structure and applies to all USAF organizations and personnel. The USAF Safety Management System is a systematic approach to managing safety and includes the necessary organizational structures, accountabilities, policies, and procedures. The overarching mishap prevention program is system compliant with the tenants of the American National Standards Institute Z-10 and the Federal Aviation Administration, Aviation Safety Management Program, which were used as the foundational sources of the USAF Mishap Prevention Program.

AFPD 91-2, *Safety Programs* (USAF 2019b) describes the necessary overarching structure, including policies, roles and responsibilities that enable the USAF to manage its safety programs efficiently and effectively to allow the identification and mitigation of hazards, investigation of reportable mishaps, prevention of mishaps, and provide necessary safety training. USAF leadership is committed to providing safe, healthful environments both for USAF personnel and for those affected by USAF operations.

Federal worker protection standards for pesticide use (40 CFR Part 170), are designed to reduce the risks of illness or injury resulting from workers' and handlers' occupational exposures to pesticides used in the production of agricultural plants on farms or in nurseries, greenhouses, and forests and also from the accidental exposure of workers and other persons to such pesticides. It requires workplace practices designed to reduce or eliminate exposure to pesticides and establishes procedures for responding to exposure-related emergencies.

The State of California administers its own occupational safety and health program to protect and improve the health and safety through setting and enforcing standards; providing outreach, education, and assistance; and issuing permits, licenses, certifications, registrations, and approvals (DOSH 2018). California regulations for *Pesticide Worker Safety for Pest Control Operations* (3 CCR § 6700) applies to workers who mix, load, apply, store, transport, or otherwise handle pesticides for any use, except for manufacturing, formulating or repackaging of pesticides; and for workers who are exposed to residues of pesticides after application to fields. The regulations are designed to reduce risk of exposure and to ensure availability of medical services for employees who handle pesticides, and to provide safe working conditions for field and other workers.

AFI 32-1053, *Integrated Pest Management Program* (USAF 2014b), provides guidance for pest management programs at USAF installations. It implements AFPD 32-10, *Installations and Facilities* (USAF 2010), and DoDI 4150.07, *DoD Pest Management Program* (DoD 2008b). It includes worker protection measures that must be followed when applying pesticides on USAF property. These are further specified in individual IPMPs.

3.5.2 Affected Environment

All contractors performing construction activities at Beale AFB or the LRS are responsible for following federal and California Occupational Safety and Health Act regulations as well as worker compensation programs. Occupational health and safety are the responsibility of contractors. As such, contractor responsibilities are:

- To review potentially hazardous workplace operations;
- To monitor exposure to workplace chemicals (e.g., asbestos, lead, hazardous material), physical hazards (e.g., noise propagation and falls), and biological agents (e.g., infectious waste, wildlife, poisonous plants);
- To recommend and evaluate controls (e.g., administrative, engineering, and Personal Protective Equipment (PPE) [e.g., ventilation and respirators]) to ensure personnel are properly protected or unexposed; and
- To ensure a medical surveillance program is in place to perform occupational health physicals for those workers engaged in hazardous waste work and subject to any accidental chemical exposures, the use of respiratory protection, or other work requiring medical monitoring (USAF ACC 2014).

The IPMP (Beale AFB 2018b) states that contractors applying herbicide on Beale AFB must comply with all applicable parts of 29 CFR Part 1910, *Occupational Safety and Health Standards*; 29 CFR Part 1925, *Safety and Health Standards for Federal Service Contracts*; 40 CFR Parts 150-189, *Pesticide Programs*; and 49 CFR Part 171, *Hazardous Materials Regulations*, while on a USAF installation, to ensure safe working conditions for contract personnel and a safe environment for the occupants of USAF facilities.

All prescribed fires would be done in accordance with the WFMP (Beale AFB 2018a; Appendix D) and a project-specific Prescribed Fire Plan which covers burning prescription, goals and objectives, safety procedures, mitigation measures, and active ignition operations. Specific safety requirements for prescribed burns on Beale AFB would be specified in individual Prescribed Fire Plans and would include the BMPs in Appendix G.

There are many public services at Beale AFB including a Fire Department, Police Department, schools, parks, and other recreational facilities such as pools and gyms.

3.6 HAZARDOUS MATERIALS / WASTE

Hazardous materials are defined by 49 CFR §171.8 as "hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Material Table (49 CFR §172.101), and materials that meet the defining criteria for hazard classes and divisions in 49 CFR Part 173." Transportation of hazardous materials is regulated by the U.S. Department of Transportation regulations within 49 CFR Parts 105–108.

Hazardous wastes are defined by the Resource Conservation and Recovery Act (RCRA) at 42 USC §6903(5), as amended by the Hazardous and Solid Waste Amendments, as "a solid waste, or combination of solid wastes, which because of its quantity, concentration, or physical, chemical, or infectious characteristics may (a) cause, or significantly contribute to an increase in mortality or an increase in serious irreversible, or incapacitating reversible, illness; or (b) pose a substantial present or potential hazard to human health or the environment when improperly treated, stored, transported, or disposed of, or otherwise managed." Certain types of hazardous wastes are subject to special management provisions intended to ease the management burden and facilitate the recycling of such materials. These materials are called universal wastes and their associated regulatory requirements are specified in 40 CFR Part 273. Four types of waste are currently covered under the universal waste regulations: hazardous waste batteries, hazardous waste pesticides that are either recalled or collected in waste pesticide collection programs, hazardous waste thermostats, and hazardous waste lamps such as fluorescent bulbs.

3.6.1 Regulatory Setting

Pollution Prevention Act of 1990 (42 USC §13101(b)) established a national policy that pollution should be prevented or reduced at the source whenever feasible; pollution that cannot be prevented should be recycled in an environmentally safe manner, whenever feasible; pollution that cannot be prevented or recycled should be treated in an environmentally safe manner whenever feasible; and disposal or other release into the environment should be employed only as a last resort and should be conducted in an environmentally safe manner.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (42 USC §9601 et seq.) authorizes the EPA to respond to spills and other releases of hazardous substances to the environment, and authorizes the National Oil and Hazardous Substances Pollution Contingency Plan. CERCLA also provides a federal "Superfund" to respond to emergencies immediately. Although the "Superfund" provides funds for clean-up of sites where potentially responsible parties cannot be identified, the EPA is authorized to recover funds through damages collected from responsible parties. This funding process places the economic burden for clean-up on polluters.

The RCRA of 1976 (42 USC §6901 et seq.) is an amendment to the Solid Waste Disposal Act. RCRA authorizes the EPA to provide for "cradle-to-grave" management of hazardous waste and sets a framework for the management of nonhazardous municipal solid waste. Under RCRA, hazardous waste is controlled from generation to disposal through tracking and permitting systems and restrictions and controls on the placement of waste on or into the land. Under RCRA, a waste is defined as hazardous if it is ignitable, corrosive, reactive, toxic, or listed by the EPA as being hazardous. The Hazardous and Solid Waste Amendments of 1984 strengthen control of both hazardous and nonhazardous waste and emphasize the prevention of pollution of groundwater.

The Toxic Substance Control Act of 1976 (40 CFR §700 et seq.) consists of four titles. Title I established requirements and authorities to identify and control toxic chemical hazards to human health and the environment. The Toxic Substance Control Act authorized the EPA to gather information on chemical risks, require companies to test chemicals for toxic effects, and regulate chemicals with unreasonable risk. Further, any federal agency having jurisdiction over a property or facility must comply with all federal, state, interstate, and local requirements concerning lead-based paint.

The DoD developed the Environmental Restoration Program (ERP) to facilitate thorough investigation and cleanup of contaminated sites on military installations (i.e., active installations, installations subject to Base Realignment and Closure, and formerly used defense sites). The Installation Restoration Program and the Military Munitions Response Program (MMRP) are components of the ERP. The Installation Restoration Program requires installations to identify, investigate, and clean up hazardous waste disposal or release sites. The MMRP addresses nonoperational rangelands that are suspected or known to contain UXO, discarded military munitions, or munitions constituent contamination (USAF ACC 2014).

Hazardous material storage sites that are still actively used are managed under Beale AFB's Hazardous Material Management Process, in accordance with AFI 32-7086, *Hazardous Materials Management* (USAF 2015b), and the Beale AFB Supplement to AFI 32-7086.

3.6.2 Affected Environment

Issues regarding hazardous materials include the ongoing use, storage and disposal of hazardous materials on Beale AFB. Active hazardous waste disposal sites are managed under Beale AFB's Hazardous Waste Management Plan (Beale AFB 2018d). Beale AFB does not have a RCRA Part B Permit; instead, Beale AFB has a Central Accumulation Point at Building 539 to accumulate and consolidate hazardous waste for up to 90 days from Initial Accumulation Point sites throughout the base.

Chemical contamination was released into the environment in various ways from historic base operations. In the past, unknown and undocumented quantities of chemicals were potentially released by discharge to the sanitary or storm sewer system. Other potential release pathways include runoff onto surface soils adjacent to maintenance facilities or discharged directly to the land. Some materials were disposed of at the base landfills. Waste oils, fuels, and solvents were contained in above and underground storage tanks. Explosives were released to the explosive ordinance areas. Currently, contamination is managed on Beale AFB in accordance with all California and federal regulations. Waste generated from groundwater sampling or remedial actions are either discharged to an onsite groundwater treatment system or transported by contractors to permitted waste disposal facilities (CH2M Hill 2017). Beale AFB has 56 sites administered by the ERP, 19 of them open (Figure 3.10), grouped into the following categories:

- 39 CERCLA sites: 30 closed (AFCEC/CZOW 2020).

- 5 leaking underground fuel tank (LUFT) sites: 2 closed (AFCEC/CZOW 2020)
- 12 RCRA sites: 5 closed (AFCEC/CZOW 2020)
- 94 munition response sites: 79 No Further Action, 7 closed small arms ranges, 7 remedial action required, 1 new site (URS 2012; USACE and URS Group Inc. 2016)

The entire LRS is an RCRA site. Closed sites have been cleaned up and are designated as unlimited use with unrestricted exposure.

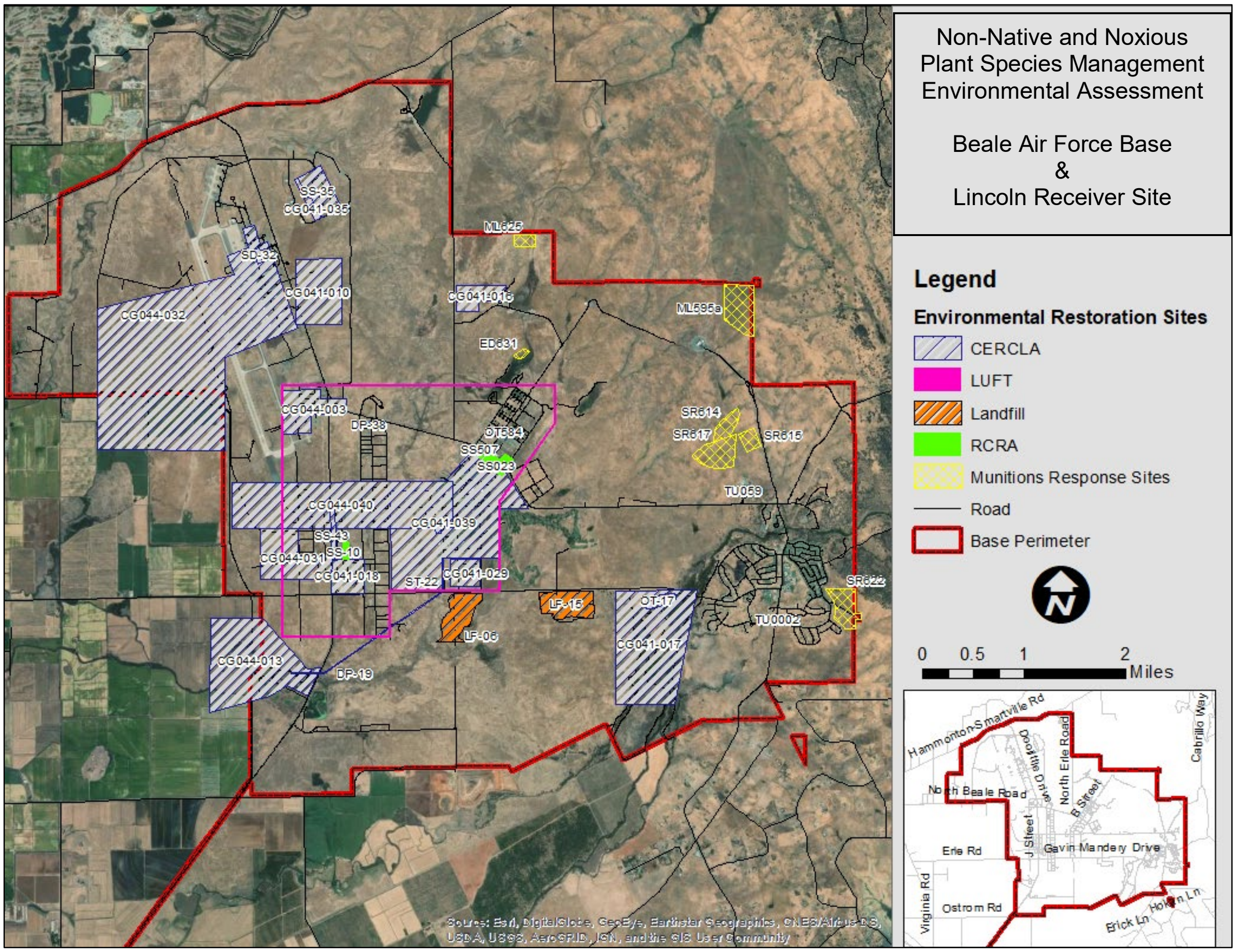

Figure 3.10. Open ERP sites (LRS not pictured).

3.7 BIOLOGICAL / NATURAL RESOURCES

Biological/natural resources include living, native or naturalized plant and animal species and the habitats within which they occur. Plant associations are generally referred to as vegetation, and animal species are generally referred to as wildlife. Habitat would be defined as the resources and conditions present in an area that support a plant or animal such as grasslands, forests, and wetlands.

Special status biological resources with federal legal protection include species listed as threatened or endangered under the ESA, and migratory birds protected under the Migratory Bird Treaty Act (MBTA) and Bald and Golden Eagle Protection Act. Other special status species that do not have federal legal protection, but that are monitored or managed on Beale AFB include species proposed, under review, or candidates for listing under the ESA; species listed, proposed, or candidates under the California ESA (CESA); California fully protected species; federal species of concern; California species of special concern; federal birds of conservation concern; DoD-Partners in Flight mission-sensitive priority bird species; California watch list species; Western Bat Working Group priority species; and plants considered rare by the California Native Plant Society or CDFW.

Federally endangered species are in danger of extinction throughout all or a significant portion of their range. Threatened species are those species likely to become endangered within the foreseeable future. All species of plants and animals, except pest insects, are eligible for listing as endangered or threatened. In addition to federally endangered and threatened species, state-listed species are those identified as threatened or endangered by CDFW.

3.7.1 Regulatory Setting

EO 13112, *Invasive Species*, states that federal agencies subject to the availability of appropriations, and within Administration budgetary limits, use relevant programs and authorities to: (i) prevent the introduction of invasive species; (ii) detect and respond rapidly to and control populations of such species in a cost-effective and environmentally sound manner; (iii) monitor invasive species populations accurately and reliably; (iv) provide for restoration of native species and habitat conditions in ecosystems that have been invaded; (v) conduct research on invasive species and develop technologies to prevent introduction and provide for environmentally sound control of invasive species; and (vi) promote public education on invasive species and the means to address them. Furthermore, the EO directs agencies not to authorize, fund, or carry out actions that it believes are likely to cause or promote the introduction or spread of invasive species in the United States or elsewhere unless, pursuant to guidelines that it has prescribed, the agency has determined and made public its determination that the benefits of such actions clearly outweigh the potential harm caused by invasive species; and that all feasible and prudent measures to minimize risk of harm would be taken in conjunction with the actions.

The ESA (16 USC §1531 et seq.) conserves, protects, and restores threatened and endangered plants by prohibiting the “take” of and animals and their habitats. “Take” under the ESA is defined as “to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct.” It is administered by the USFWS and the NMFS with the USFWS having primary responsibility for terrestrial and freshwater organisms and NMFS primarily responsible for marine fish and wildlife. Under the ESA, federal agencies are responsible for using their authority to conserve threatened and endangered species. All federal agencies must ensure any action they authorize, fund, or carry out is not likely to jeopardize the continued existence of a threatened and endangered species or result in the destruction of critical habitat for these species, unless granted an exemption. The Secretary of the Interior determines which species are officially endangered or threatened, and the USFWS maintains the endangered species list.

Critical habitat is designated if USFWS determines that the habitat is essential to the conservation of a threatened or endangered species. In consultation for those species with critical habitat, federal agencies must ensure that their activities do not adversely modify critical habitat to the point that it would no longer aid in the species' recovery. Areas that are currently unoccupied by the species, but which are needed for the species' recovery, are protected by the prohibition against adverse modification of critical habitat. However, there is no designated critical habitat on Beale AFB or the LRS.

The CDFW, under the California Natural Resources Agency, manages and protects the state's fish, wildlife, plant, and native habitats. The mission of the CDFW is to manage California's diverse fish, wildlife, and plant resources, and the habitats upon which they depend, for their ecological values and for their use and enjoyment by the public (CDFW 2018). The CESA (14 CCR §783 et seq.) functions similarly to the ESA for plant and animal species and subspecies within California. However, federal agencies are not legally required to protect or manage species listed under the CESA.

The MBTA of 1918 (16 USC §703-712), as amended, implements treaties and conventions between the United States, Canada, Japan, Mexico, and the former Soviet Union for the protection of migratory birds. Unless otherwise permitted by regulations, the MBTA makes it unlawful to pursue, hunt, take, capture, or kill; attempt to take, capture or kill; possess, offer to or sell, barter, purchase, deliver, or cause to be shipped, exported, imported, transported, carried, or received any migratory bird, part, nest, egg, or product, manufactured or not. The MBTA also makes it unlawful to ship, transport or carry from one state, territory, or district to another, or through a foreign country, any bird, part, nest, or egg that was captured, killed, taken, shipped, transported, or carried contrary to the laws from where it was obtained; and import from Canada any bird, part, nest, or egg obtained contrary to the laws of the province from which it was obtained. The U.S. Department of the Interior has authority to arrest, with or without a warrant, a person violating the MBTA.

The 2003 Bob Stump National Defense Authorization Act (PL 107-314) gave the Secretary of the Interior authority to prescribe regulations to exempt the Armed Forces from the incidental taking of migratory birds during authorized military readiness activities. The final rule authorizing the DoD to take migratory birds in such cases includes a requirement that the Armed Forces must confer with the USFWS to develop and implement appropriate conservation measures to minimize or mitigate adverse effects of the Proposed Action if the action would have a significant negative effect on the sustainability of a population of a migratory bird species.

A recent Department of the Interior Solicitor's Opinion (M-37050) was issued that states the MBTA prohibition on "taking" or "killing" of migratory birds applies only to deliberate acts intended to take migratory birds, their nests or their eggs. This replaces Department of the Interior Solicitor's Opinion M-3741, Incidental Take Prohibited under the MBTA, which concludes that "the MBTA's broad prohibition on taking and killing migratory birds by any means and in any manner includes incidental taking and killing." In response, the Deputy Assistant Secretary of Defense issued a Memorandum for the Record stating that until Department of the Interior Solicitor's Opinion M-37050 is reconciled with existing rules, acts, EOs, and memorandums of understanding (MOUs), and legal clarification is given, the Memorandum for the Record advises Military Departments to continue to follow existing DoD guidance on the incidental take of migratory birds.

Bald and golden eagles are protected under the Bald and Golden Eagle Protection Act (16 USC §668-668c). Enacted in 1940, the Bald and Golden Eagle Protection Act prohibits anyone, without a permit issued by the Secretary of the Interior, from taking bald eagles, including their parts, nests, or eggs. The act defines "take" as "pursue, shoot, shoot at, poison, wound, kill, capture, trap, collect, molest or disturb."

The Magnuson-Stevens Act (16 USC. Ch. 38 § 1801 et seq.) is the primary law governing marine fisheries management in U.S. federal waters. First passed in 1976, the Magnuson-Stevens Act fosters long-term biological and economic sustainability of our nation's marine fisheries. Key objectives of the Magnuson-Stevens Act are to: Prevent overfishing, rebuild overfished stocks, increase long-term economic and social benefits, and ensure a safe and sustainable supply of seafood. The Magnuson-Stevens Act, as amended by the Sustainable Fisheries Act of 1996 (PL 104-267), established procedures designed to identify, conserve, and enhance EFH for those species regulated under a Federal fisheries management plan. Federal agencies must consult with NMFS regarding any action authorized, funded, or undertaken, or proposed to be authorized, funded, or undertaken that may adversely affect EFH. Under the Magnuson-Stevens Act the term EFH means those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity. The geographic extent of salmon freshwater EFH is described as all water bodies currently or historically occupied by NMFS-managed salmon within the USGS 4th field hydrologic units. Salmon EFH includes the channels within the designated 4th field hydrological units with a lateral extent as defined by the ordinary high-water line (33 CFR 319.11). Salmon EFH excludes areas upstream of longstanding naturally impassable barriers (i.e., natural waterfalls in existence for several hundred years). Salmon EFH includes aquatic areas above all artificial barriers except the impassable barriers (dams) listed in the Pacific Coast Salmon Fishery Management Plan (Pacific Fisheries Management Council 2014).

EO 13186, *Conservation of Migratory Birds* (January 10, 2001), creates a more comprehensive strategy for the conservation of migratory birds by the federal government. EO 13186 provides a specific framework for the federal government's compliance with its treaty obligations to Canada, Mexico, Russia, and Japan. EO 13186 provides broad guidelines on conservation responsibilities and requires the development of more detailed guidance in a Memorandum of Understanding. EO 13186 will be coordinated and implemented by the USFWS. The Memorandum of Understanding will outline how federal agencies will promote conservation of migratory birds. EO 13186 requires the support of various conservation planning efforts already in progress; incorporation of bird conservation considerations into agency planning, including NEPA analyses; and reporting annually on the level of take of migratory birds.

EO 11514, *Protection and Enhancement of Environmental Quality* (March 5, 1970), states that the President, with assistance from the CEQ, will lead a national effort to provide leadership in protecting and enhancing the environment for the purpose of sustaining and enriching human life. Federal agencies are directed to meet national environmental goals through their policies, programs, and plans. Agencies should also continually monitor and evaluate their activities to protect and enhance the quality of the environment. Consistent with NEPA, agencies are directed to share information about existing or potential environmental problems with all interested parties, including the public, in order to obtain their views.

3.7.2 Affected Environment

3.7.2.1 Native Vegetation Communities

Beale AFB is located within the Sacramento Valley Region of the California Floristic Province. Major features of the region that influence the distribution of plants and animals, both historically and currently, include the Sierra Nevada foothills, trending to the Sierra Nevada in the east; the Sacramento Valley to the west; and major rivers including the Feather, Yuba, and Sacramento rivers.

There are four major vegetation communities that occur on Beale AFB: grassland, grassland associated vernal pool complexes, oak woodland, and riparian forest. Other vegetation communities that occupy smaller areas on the base include freshwater marsh, aquatic, ruderal, and scrubland. Figure 3.3 shows the current land cover on the base, including dominant vegetation types. Due to variations in elevation, topography and soils, a wide diversity of plants has been documented on Beale AFB; a complete list is included in Appendix I.

Vegetation at the LRS is a fairly uniform mixture of grassland and associated vernal pool complexes with scattered oak trees (Figure 3.11).

<u>Grasslands</u>: Grasslands cover approximately 18,835 acres of Beale AFB. The LRS contains 202 acres of annual grasslands and forbs. The majority of grassland species on Beale AFB are non-native naturalized or invasive species. Naturalized species include wild oats (*Avena* spp.), ripgut brome (*Bromus diandrus*), Italian ryegrass (*Festuca perennis*), soft chess (*Bromus hordeaceus*), and foxtail barley (*Hordeum marinum*). Medusahead grass (*Elymus caput-medusae*) and barbed goatgrass (*Aegilops triuncialis*) are two invasive grasses present on the base that can have severe negative ecological impacts (Cal-IPC 2019). Native grass species do persist in some areas occurring naturally, as part of restoration plantings, or from areas seeded with the base revegetation seed mix. These grasses are found in varying densities in pastures and roadsides throughout the base. Native grass species include perennial bunch grasses, such as purple needlegrass (*Stipa pulchra*), California melic (*Melica californica*), squirrel tail grass (*Elymus elymoides*), and annual grasses including oldfield three awn (*Aristida oligantha*), California brome grass (*Bromus carinatus*), and small fescue (*Festuca microstachys*).

A diverse assemblage of native and introduced forb species are intermixed with the grasses. Forb species include turkey mullein (*Croton setiger*), common sheep sorrel (*Rumex acetosella*), clover species (*Trifolium* spp.), fiddleneck (*Amsinckia menziesii*), yellow owl's-clover (*Castilleja campestris*), popcorn flowers (*Plagiobothrys* spp.), native poppies (*Eschscholzia* spp.), yellow mariposa lily (*Calochortus luteus*), lupine (*Lupinus* spp.), vetch (*Vica* spp.), blue-eyed grass (*Sisyrinchium bellum*), filaree (*Erodium* spp.), field mustard (*Brassica rapa*) and spikeweed (*Centromadia* spp.).

Grassland and forbs found at the LRS include soft chess, ripgut brome, wild oats, foxtail fescue (*Festuca bromoides*), red brome (*Bromus matridensis* ssp. *rubens*), filaree, mouse barley (*Hordeum murinun*), clover, lupine, vetch, field mustard, yellow starthistle and other thistles. In addition, large swathes of medusahead grass infest upland areas at the LRS.

<u>Vernal Pool Complexes</u>: Vernal pools are extensive in the western, central and southern portions of the base, covering approximately 1,380 acres. The associated vegetation is classified as Vernal Pool and California Annual and Perennial Grassland Matrix (Menke et al. 2011). With the exception of coyote thistle (*Eryngium* spp.) and toad rush (*Juncus bufonius*), vernal pool plants are annuals that complete their entire life cycles in a single wet season. Seeds from the prior growing season germinate once pools are inundated. Flowers bloom and set seed in late spring after pools have dried. Mature seeds become part of the seed bank and lie dormant until the next wet season.

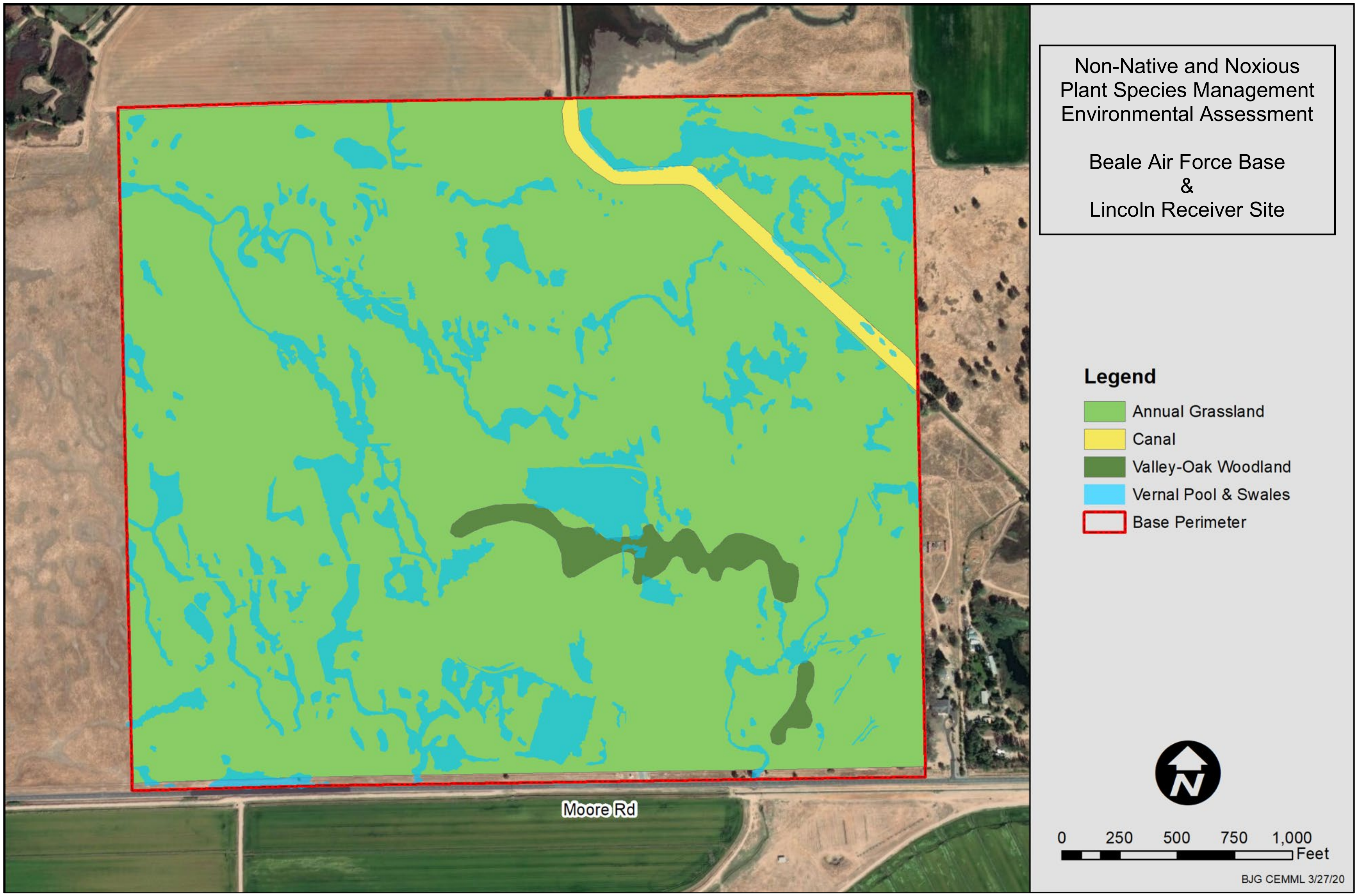

Figure 3.11. LRS Vegetation.

Dominant plants of vernal pools on the base include coyote thistle, California goldfields (*Lasthenia californica*), Fremont goldfields (*Lasthenia fremontii*), white headed navarretia (*Navarretia leucocephala*), bractless hedge-hyssop (*Gratiola ebracteate*), vernal pool buttercup (*Ranunculus bonariensis* var. *trisepalus*), annual hairgrass (*Deschampsia danthonioides*), yellow owl's-clover, Sacramento mesa mint (*Pogogyne zizyphoroides*) and woolly marbles (*Psilocarphus brevissimus*). At the LRS, 36 acres of vernal pools have been identified and mapped during surveys (AECOM 2013). The site is bisected by several shallow intermittent drainages and strings of seasonally ponded depressions that support vernal pool vegetation.

<u>Oak Woodlands</u>: Oak woodlands cover approximately 481 acres on Beale AFB. Oaks grow in small isolated groves scattered throughout the dominant grassland community. Oak woodlands occur in the foothills on the east side of the base and as a component of the Dry Creek/Best Slough riparian corridor. Oak woodlands on the base are classified as *Quercus douglasii* (blue oak) Alliance (Menke et al. 2011). Blue oaks are intermixed with other oaks including interior live oak (*Quercus wislizenii*) and valley oak (*Quercus lobata*), as well as hardwood and conifer species such as California buckeye (*Aesculus californica*) and gray pine (*Pinus sabiniana*). The woodlands on the base have an annual grass understory that also contains shrubs such as manzanita (*Arctostaphylos* spp.), poison oak (*Toxicodendron diversilobum*) and buck brush (*Ceanothus cuneatus*).

Oak trees occur at the LRS but not at a density considered a woodland.

<u>Riparian Areas</u>: Riparian vegetation includes vegetation along rivers, permanent and intermittent creeks, lakes, and ponds. Riparian systems are found in transition zones between aquatic and upland ecosystems. In their undisturbed condition, these areas are characterized by dominant vegetation adapted to periodic flooding or soil saturation. Riparian systems occur entirely within the 100-year floodplain of streams and rivers. However, most riparian plant species require flooding more frequently than once every 100 years.

The largest riparian area at Beale AFB is found along Dry Creek and Best Slough. This area consists of a continuous corridor of well-developed riparian forest. Along other drainages, riparian vegetation is patchy and sparse, such as along Hutchinson and Reeds creeks. Hutchinson Creek is deeply incised/downcut below its natural streambed and may contribute to low amounts of riparian vegetation. Portions of Dry Creek are also downcut, but periodic beaver dams aid in watering the adjacent floodplain riparian vegetation. Three specific types of riparian forest have been identified at Beale AFB: cottonwood-willow riparian forest, valley oak riparian forest, and mixed riparian forest (Jones & Stokes Associates 1995). The dominant cottonwood-willow riparian forest is composed of a multi-layered complex of Freemont cottonwoods (*Populus fremontii*) with occasional valley oaks, boxelder (*Acer negundo*), California sycamore (*Platanus racemose*), ash (*Fraxinus* spp.), white alder (*Alnus rhombifolia*) and willows (*Salix* spp.). Wild grape vines (*Vitis californica*) are typically found draping the overstory and mid-story trees of the riparian forest. Thickets of wild rose (*Rosa californica*), invasive Himalayan blackberry and other shrubs can also be found in the understory. Groundcover is usually dense and composed of grasses and herbs. Riparian scrub can also be found on the base along Hutchinson and Reeds creeks in addition to the Dry Creek/Best Slough riparian area. Riparian scrub on the base is generally composed of willows, often with cottonwood and sycamores. Multiple invasive species have been detected in riparian areas on Beale AFB including Himalayan blackberry, arundo, verbena, tree-of-heaven, black mustard, bull thistle, stinkwort and edible fig (CEMML 2017).

Other Vegetation Types: Other vegetation types include freshwater marsh, aquatic vegetation, ruderal vegetation, scrubland, and invasive species.

- Freshwater Marsh: This vegetation is found in ponds and drainages that have a relatively permanent water supply. Freshwater marsh vegetation also intermingles with riparian woodland vegetation along drainages, such as Hutchinson Creek and Dry Creek. Marshlands contain perennial plants such as cattails (*Typha* spp.) and tules (*Schoenoplectus acutus* var. *occidentalis*), rushes (*Juncus* spp.), and sedges (*Carex* spp.), as well as scattered trees and shrubs such as willows, cottonwoods and common buttonbush (*Cephalanthus occidentalis*).
- Aquatic Vegetation: Some drainages and impoundments on the base support aquatic vegetation. The vegetation includes free-floating and submerged rooted, obligate aquatic plants. These include pondweeds (*Potamogeton* sp.), smartweeds (*Persicaria* spp.), lesser duckweed (*Lemna aequinoctialis*), western waterweed (*Elodea nuttallii*), water milfoil (*Myriophyllum* spp.) and mosquito fern (*Azolla filiculoides*).
- Ruderal: Areas of annual grassland that undergo frequent or severe disturbance (e.g., corrals, staging areas and some roadsides) may be dominated by ruderal vegetation. Ruderal vegetation species are the first to colonize bare areas of soil, and thrive under conditions that are often too harsh for other plant species. Many invasive weeds are considered ruderal vegetation. This vegetation type typically grows within or adjacent to annual grassland and is characterized by a low absolute plant cover. Yellow starthistle, blessed milkthistle, field bindweed (*Convolvulus arvensis*), cheeseweed (*Malva parviflora*), and chicory (*Cichorium intybus*) are common.
- Scrubland*:* Although limited, some scrubland species are present on the base. They include ceanothus, manzanita, toyon (*Heteromeles arbutifolia*), sagebrush (*Artemisia* spp.), and coyote brush (*Baccharis pilularis*).

3.7.2.2 Terrestrial Wildlife

Over 244 wildlife species have been observed on Beale AFB, including 192 species of bird, 36 species of mammal, and 16 species of reptiles and amphibians (Appendix I). The diversity of wildlife is influenced by the variety of habitats on Beale AFB, which provide food, shelter and breeding habitat to specific suites of species.

Annual grasslands provide breeding habitat for a variety of grassland birds, as well as foraging habitat for bird species that breed in other habitats. The proximity of riparian areas, oak woodlands and wetlands enhances the habitat value of the annual grasslands on the base. Many species of birds have observed in the annual grassland during field surveys including resident and neotropical migrant species. During the winter, open annual grasslands are particularly important for raptors. Owls forage in the grasslands at night year-round. Annual grasslands provide important habitat for many mammals as well, particularly for small rodents and their larger predators. In addition, several species of snakes and lizards use the grassland and grassland edges.

During the dry season, vernal pools are similar in their wildlife species composition to annual grasslands. During the wet season, however, from late fall to early spring, this habitat supports a higher diversity of bird species. Concentrations of several hundred waterfowl have been observed using seasonal wetlands in the northwestern corner of Beale AFB. Other water birds and shorebird also use seasonal wetlands on the base. Amphibians also use vernal pools and other seasonal wetlands while they are inundated, and predators feed on these amphibians. Vernal pools provide habitat for a highly diverse assortment of copepods, amphipods, crustaceans and insects and their larvae. These species include the vernal pool shrimp species regulated under the federal ESA.

Oak woodlands provide important nesting, roosting and perching habitat for a variety of bird species. They also provide shade in the summer and cover in the winter for many bird and mammal species. Acorns produced in the oak woodlands are an important food resource for many species of mammals and birds. Oak foliage and bark support insect populations that provide food for insectivorous birds. Oaks also provide nest sites for cavity-nesting birds.

The riparian forest, especially mixed riparian forest, is the most structurally diverse habitat on Beale AFB and one of the most important habitats for wildlife on the base. The riparian forest provides a source of water and cover and can function as a travel or migration corridor for many species. The structural diversity provides many habitat niches in a small area (e.g., canopy, brushy understory, tree cavities, and leaf litter). Songbirds forage on insects in the trees and shrubs. This habitat provides nesting and rearing cover for a number of resident and migratory bird species. Many mammals, amphibians and reptiles also occupy mixed riparian forests.

Permanent wetlands are important habitats because of their high biological value and scarcity in the immediate region and the Sacramento Valley relative to their historical distribution. Freshwater marsh within Beale AFB provides important foraging habitat for fish-eating birds. These aquatic habitats also attract waterfowl and other water birds. Several species nest in cattails and other emergent vegetation. A number of mammals use or occupy freshwater marsh habitats at Beale AFB. Amphibians and snakes can also be found in and around permanent wetland habitats.

The LRS contains grasslands, some oak trees, vernal pools, and a canal. Wildlife observed at the LRS is similar to that found on Beale AFB. It is less likely to be used by larger animals or species requiring large areas of habitat.

3.7.2.3 Aquatic Wildlife

Freshwater marshes along Dry Creek and Best Slough function as one component of the overall aquatic system in these perennial drainages. The varying types of aquatic habitats along Dry Creek and Best Slough support wildlife species as well as both native and non-native fisheries. Although perennial drainages at Beale AFB provide habitat primarily for year-round resident fish species, anadromous salmonids have been known to use Dry Creek. Common native fish species that may occur in Dry Creek and Best Slough include speckled dace (*Rhinichthys osculus*), California roach (*Hesperoleucus symmetricus*), Sacramento pikeminnow (*Ptychocheilus grandis*), Sacramento sucker (*Catostomus occidentalis*) and tule perch (*Hysterocarpus traskii*). Common non-natives include mosquitofish (*Gambusia affinis*), largemouth bass (*Micropterus salmoides*), channel catfish (*Ictalurus punctatus*), green sunfish (*Lepomis cyanellus*), bluegill (*Lepomis macrochirus*) and redear sunfish (*Lepomis microlophus*).

Ponds, lakes, and reservoirs provide habitat for many of the same wetland and open water-associated wildlife species described above for the freshwater marsh. The open water provides suitable foraging and resting habitat for dabbling ducks and fish-eating water birds. Ponds, lakes, and reservoirs provide foraging habitat and drinking water sources for bats. Common amphibians including chorus frogs (*Pseudacris sierra*) and American bullfrogs (*Lithobates catesbeianus*) also occupy this habitat. Ponds, lakes and reservoirs at Beale AFB support a variety of warm-water fish species including green sunfish, largemouth bass, carp and channel catfish. Water temperatures in stock ponds and lakes at Beale AFB are too warm to sustain trout fisheries.

The canal that runs through the LRS is shallow and warm. It has not been officially inventoried, but similar fish and amphibian species to those that occur in warm-water habitats on Beale AFB may occur. It needs to be determined if special status western spadefoot toads (*Spea hammondii*) are using the canal for breeding.

3.7.2.4 Special Status Species

There are 61 special status plant, fish and wildlife species known, or with the potential to occur on Beale AFB, and nine special status wildlife species that have been observed at the LRS (Table 3.8). To date, Beale AFB properties contain suitable habitat for six federally-listed threatened or endangered species (Beale AFB 2019). Of these six federally-listed species, three (vernal pool fairy shrimp, vernal pool tadpole shrimp, and valley elderberry longhorn beetle) are known to occur on Beale AFB properties, one (Central Valley steelhead) is strongly suspected in high-flow years, and two have the potential to occur but have never been confirmed on Beale AFB properties (giant garter snake, and western yellow-billed cuckoo). Two species, California red-legged frog (*Rana draytonii*) and conservancy fairy shrimp (*Branchinecta conservatio*), were included in USFWS consultations in the past, but more recent surveys of habitat and distribution have confirmed these species are not likely to be present on Beale AFB. Detailed descriptions of federally threatened and endangered species occurrences within the action area can be found in the *Biological Assessment for Invasive Plant Species Management* (Appendix F).

Beale AFB also contains EFH for Chinook salmon designated under the Magnuson-Stevens Act (Figure 3.12). The southeastern portion of Beale AFB is within the Upper Bear -Below Camp Far West Dam hydrologic unit, and the northwest portion is within the Honcut Headwaters-Lower Feather – Below Dam hydrologic unit, both which contain EFH for Chinook salmon. Freshwater EFH for Chinook salmon consists of four major components, (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and holding habitat. Freshwater EFH depends on lateral (e.g., floodplain, riparian), vertical and longitudinal connectivity to create habitat conditions for spawning, rearing, and migration including: (1) water quality (e.g., dissolved oxygen, nutrients, temperature, etc.); (2) water quantity, depth, and velocity; (3) riparian-stream-marine energy exchanges; (4) channel gradient and stability; (5) prey availability; (6) cover and habitat complexity; (7) space; (8) habitat connectivity from headwaters to the ocean (e.g., dispersal corridors); (9) groundwater-stream interactions; and (10) substrate composition. No Habitat Areas of Particular Concern or EFH Areas Protected from Fishing occur on Beale AFB (Pacific Fisheries Management Council 2014).

Table 3.8. Special Status Species with the Potential to Occur on Beale AFB.

Name	Status	Habitat	Present on Beale	Present on LRS
Greene's legenere *Legenere limosa*	CNPS 1B.1/	Vernal pools	Yes, small populations	Not surveyed
Veiny monardella *Monardella venosa*	S2	Heavy clay, Cismontane woodland, and valley and foothill grasslands	Not detected in surveys	Not surveyed
Dwarf downingia *Downingia pusilla*	CNPS 1B.1/S1	Vernal pools	Yes, several locations	Not surveyed
Brazilian watermeal *Wolffia brasiliensis*	CNPS 2B.2/ S2	Marshes and swamps-assorted shallow freshwater	Not detected in surveys	Not surveyed
Stinkbells *Frittalaria agrestis*	CNPS 2B.3/	Clay, chaparral, cismontane woodland, pinyon juniper woodland, valley and foothill grassland	Yes, small population	Not surveyed
Brandegee's clarkia *Clarkia biloba ssp. brandegeeae*	CNPS 4.2	Roadcuts, Chaparral, cismontane woodland, lower montane coniferous forest	Not detected in surveys	Not surveyed
Dwarf dwarf cudweed/ Hogwallow starfish *Hesperevax caulescens*	CNPS 4.2/ S3	Valley and foothill grassland (mesic, clay), vernal pools	Detected in 2016	Not detected
Tehama navarretia Navarretia heterandra	CNPS 4.3	Mesic areas in valley and foothill grasslands, vernal pools	Detected in 2003	Not surveyed
Vernal pool fairy shrimp *Branchinecta lynchi*	FT	Vernal pools; also found in sandstone rock outcrop pools	Yes; numerous locations	Surveyed - not detected, though suitable habitat exists
Conservancy fairy shrimp *Branchinecta conservatio*	FE	Large, deep vernal pools in annual grasslands	Not detected during surveys. Not likely to occur–outside range.	Surveyed - not detected, not likely to occur-outside range.
Vernal pool tadpole shrimp *Lepidurus packardi*	FE	Vernal pools; ephemeral stock ponds	Yes; numerous locations	Yes
Valley elderberry longhorn beetle *Desmocerus californicus dimorphus*	FT	Riparian and oak savannas habitats with elderberry shrubs	Elderberry shrubs present. Beetle exit holes observed in shrubs along Best Slough and Dry Creek.	Surveyed–not detected. No suitable habitat
Monarch *Danaus plexippus plexippus*	FR	Open fields and grasslands with milkweed present	Butterflies and caterpillars observed at multiple locations adjacent drainages on Beale AFB.	Yes, incidental observation
Crotch bumblebee *Bombus crotchii*	SC	Open grassland and scrub habitats.	Not surveyed	Not surveyed
Western bumblebee *Bombus occidentalis*	FR/SC	Areas with blooming flowers from early February to late November	Likely, but not confirmed. No surveys conducted.	Not surveyed

Name	Status	Habitat	Present on Beale	Present on LRS
Steelhead – Central Valley Distinct Population Segment *Oncorhynchus mykiss irideus*	FT	Perennial and intermittent streams	Observed upstream of Beale AFB at Spenceville Wildlife Area; may use Dry Creek in higher flow years	Not surveyed. No suitable habitat
Chinook salmon– Central Valley fall/late fall-run Evolutionarily Significant Unit *Oncorhynchus tshawytscha*	SoC/ SSC	Perennial and intermittent streams	Small run reported in Dry Creek 2012, successful spawn in 2014/15 with 400 fry, also observed in 2015/16	Not surveyed. No suitable habitat
Chinook salmon – Central Valley spring-run Evolutionarily Significant Unit *Oncorhynchus tshawytscha*	FT/ST	Deep and large streams	Surveyed. Not detected, but has small potential to occur during high flow years	Not reported. Not likely to occur–unsuitable habitat
Delta smelt *Hypomesus transpacificus*	FT/SE	Brackish water below 25℃	Not surveyed. Not likely to occur	Not surveyed, no suitable habitat
Sacramento perch *Archoplites interruptus*	SSC-in native range only	Sluggish, heavily vegetated waters of sloughs and lakes	Potential to occur, but species-specific surveys have not been done	Not surveyed. Potential to occur
California tiger salamander–Central California Distinct Population Segment *Ambystoma tigrinum californiense*	FT/ ST	Open woodlands and annual grasslands for hibernation; ponds or pools (especially vernal pools) in streams for breeding	Not detected during surveys; base is north of the species' range (known from Travis AFB)–not likely to occur	Surveyed-not reported. Not likely to occur outside range, unsuitable habitat
Western spadefoot toad *Spea hammondii*	FR/SSC	Floodplains and vernal pools	Faint calls heard during 2018 surveys, possible calls heard/recorded during 2012, 2016, and 2017 surveys	Heard calling from within site in 2018, several visual and aural detections in canals and irrigated fields adjacent to site
Foothill yellow-legged frog *Rana boylii*	FR/SC/SSC	Shallow streams with riffles	Marginal habitat exists but it has not been detected during surveys and is likely not to occur due to predator abundance (bullfrog). The closest occurrence is 11.3 miles to the northeast	Not surveyed. No suitable habitat

Name	Status	Habitat	Present on Beale	Present on LRS
California red-legged frog *Rana draytonii*	FT/SSC	Slow-moving streams, perennial and ephemeral ponds with upland sheltering such as rocks, small mammal burrows, logs etc. Breeding is in deep, slow-moving water with varying amounts of emergent vegetation that stays cool in the summer	Surveys have produced no detections. Likely extirpated from area. Habitat is degraded by presence of predatory bullfrogs	Surveyed–not detected. Not likely to occur–unsuitable habitat
Western pond turtle *Actinemys marmorata*	FR/SSC	Ponds, marshes, and streams for foraging and cover; adjacent grasslands and savannas for nesting	Yes; many locations	Surveyed/Not Reported. Habitat is marginal.
Giant garter snake *Thamnophis gigas*	FT/ST	Marshes, water conveyance channels, and adjacent uplands	Possible sighting in Reeds Creek in 2004. not detected during protocol surveys 2005-2018	No detections reported. Marginal habitat present
American white pelican *Pelecanus erythrorhynchos*	SSC	Found in fresh or saltwater bodies of various depths	Observed at permanent lakes/ponds	Not surveyed
Western least bittern *Ixobyrchus exilis hesperis*	BCC/ SSC	Found in marshlands and along pond edges, where tules and rushes can provide cover; nests are built low in the tules over the water	Not surveyed	Not surveyed
Cooper's hawk *Accipiter cooperii*	WL	Oak woodlands, riparian woodlands, and second- growth coniferous forests for nesting; often nests near water; uses snags and dead branches for resting and perching; woodlands and edges of other habitats for foraging	Confirmed breeder in Dry Creek area. Detected year-round	Observed foraging over site
Sharp-shinned hawk *Accipiter striatus*	WL	Breeds primarily in lower elevation conifer forests and oak, pinyon-juniper, aspen, and riparian woodlands; nests in single-tiered dense pole and small tree stands; feeds in open stands; often nests near water	Winter visitor	Observed foraging over site
Ferruginous hawk *Buteo regalis*	BCC/ WL	Open grassland with perch sites	Winter resident	Not surveyed
Swainson's hawk *Buteo swainsoni*	BCC/ ST	Riparian habitats and isolated trees for nesting; grasslands and agricultural fields for foraging	Summer visitor; confirmed nesting at Beale AFB in 2004, 2016-2018	Observed foraging over site
Northern harrier *Circus cyaneus*	SSC	Nests in dense grasslands and wetlands; forages in wetlands, grasslands, and agricultural fields	Year-round resident	Observed foraging over site
White-tailed kite *Elanus caeruleus*	FP	Open savannas, grasslands, and wetlands for foraging; trees and large shrubs in riparian and oak woodland areas for nesting	Irregular visitor	Observed foraging over site
Bald eagle *Haliaeetus leucocephalus*	FD/SE, FP/ MSPBS	Large lakes or streams with large trees for nesting; lakes, reservoirs, and streams with perching trees for foraging	Regular winter visitor	Not surveyed

Name	Status	Habitat	Present on Beale	Present on LRS
Golden eagle *Aquila chrysaetos*	BCC/WL/FP/ MSPBS	Grasslands and savannas for foraging	Year-round visitor	Not surveyed
Osprey *Pandion haliaetus*	WL	Rivers, lakes, and reservoirs with perching trees for foraging; large trees within 1 mile of aquatic habitats (lakes and streams) for nesting	Regular visitor	Not surveyed
Prairie falcon *Falco mexicanus*	BCC/WL	Nests on cliff ledges and escarpments; forages in open country, including grasslands; feeds on insects, small mammals, and birds	Regular winter visitor	Observed foraging over site
Peregrine falcon *Falco peregrinus anatum*	BCC, FD/SD, FP	Protected ledges of high cliffs, usually adjacent to marshes, lakes, or rivers, for nesting; open habitats for foraging; in winter forages in grasslands and wetlands	Regular winter visitor	Not surveyed
California black rail *Laterallus jamaicensis coturniculus*	BCC/ ST, FP/ MSPBS	Tidal salt marshes associated with heavy growth of pickleweed; also occurs in brackish marshes or freshwater marshes emergent vegetation at low elevations	Observed in marsh below Miller Lake, at pond by Small Arms Range and at PAVE PAWS lake as recently as 2009. Subsequent surveys have not found any on the base.	Not surveyed–no suitable habitat
Greater sandhill crane *Antigone canadensis tabida*	ST, FP	Summers in open terrain near shallow lakes or freshwater marshes; winters in plains and valleys near bodies of fresh water and agricultural fields	Winter visitor (Observed in February during 2001 BASH surveys, observed 2015, 2016, 2017 and 2018-winter)	Not surveyed
Short-eared owl *Asio flammeus*	SSC	Use fresh and saltwater marshes, lowland meadows, and irrigated alfalfa fields; need dense tules or tall grass for nesting and daytime roosts	Winter resident	Not surveyed
Western yellow-billed cuckoo – Distinct Population Segment *Coccyzys americanus occidentalis*	FT /SE	Wooded forests with dense cover and water nearby	Not detected during surveys. Possible incidental detections in 2014 and 2017 not confirmed.	Not surveyed. No suitable habitat
Western burrowing owl *Athene cunicularia hypugea*	BCC/ SSC/ MSPBS	Breeds and forages in annual grasslands and agricultural fields; open, dry, and nearly level grassland or prairie habitat	Year-round resident–sporadic breeding confirmed	Not surveyed
Bank Swallow *Riparia riparia*	ST	Streamside habitats with steep banks and very little vegetation	Rare visitor to the base, observed by BASH employee near flightline	Not surveyed–no suitable habitat
Olive-sided flycatcher *Contopus cooperi*	BCC/SSC	Mid- to high-elevation conifer forests with open canopy cover	Migrant in spring and fall	Not surveyed
Willow flycatcher *Empidonax trailii*	BCC/SE	Bushes and willow thickets, brushy fields along woodland edges, often near marshes or other water bodies	Some detections in the Dry Creek area by sight and sound breeding has not been confirmed.	Not surveyed

Name	Status	Habitat	Present on Beale	Present on LRS
Loggerhead shrike *Lanius ludovicianus*	BCC/SSC/ MSPBS	Grasslands and agricultural areas. Prefers open habitats with scattered shrubs, trees, posts, fences, utility lines, or other perches.	Year-round resident	Observed using site for foraging
Oak titmouse *Baeolophus inornatus*	BCC/ WL	Oak woodland and dry slopes throughout California	Year-round resident	Not surveyed
Yellow-billed magpie *Pica nuttalli*	BCC	Stream groves, scattered oaks, ranches, farms and orchards	Occasional visitor	Not documented
Lewis' woodpecker *Melanerpes lewis*	BCC	Oak woodlands, cottonwood groves and scattered forests	Yes, winter resident	Not documented
Yellow warbler *Dendroica petechia brewsteri*	BCC/SSC	Riparian forests and scrub habitats for nesting and foraging; breeds in riparian woodlands, montane chaparral, conifer forests with substantial brush; and desert woodlands	Migrant in spring and fall, possible summer resident	Not surveyed
Yellow-breasted Chat *Icteria virens*	SSC	Nests in dense, multi-layered riparian forests with perennial or nearly perennial water	Summer resident	Not surveyed–no suitable habitat
Grasshopper sparrow *Ammodramus savannarum*	MSPBS	Open grasslands, especially where grasshoppers are plentiful.	Summer resident	Not surveyed
Tricolored blackbird *Agelaius tricolor*	BCC/ ST/ MSPBS	Breeds in freshwater marshes and blackberry thickets, cattail and tule marshes. Utilizes grasslands, agricultural fields, irrigated pastures, and wetlands for foraging; known to forage up to 3 miles from nesting colony.	Year-round resident, nesting at A Street Pond, Reeds Creek and Goose Lake	Not surveyed, should be verified in blackberries
Pallid bat *Antrozous pallidus*	SSC/ WBWG	Open, dry habitats with rocky areas for roosting; roosts in undisturbed areas, such as abandoned buildings and caves	Yes, several locations	Not surveyed.
Long-legged myotis *Myotis volans*	WBWG	Uses abandoned buildings, cracks in the ground, cliff crevices, exfoliating tree bark, and hollows within snags as summer day roosts; caves and mine tunnels as hibernacula	Yes, several locations	Not surveyed.
Western red bat *Lasiurus blossevillii*	SSC/ WBWG	Known to roost in cottonwoods or willows, but it is commonly detected in a variety of habitats	Yes–one found dead near the running path by the golf course	Not surveyed.
Townsend's big-eared bat *Corynorhinus townsendii*	SSC/ WBWG	Coniferous forests, mixed meso-phytic forests, deserts, native prairies, riparian communities, active agricultural land and coastal habitats	Yes, confirmed via acoustic survey. Also observed in the SWA	Not surveyed.
Marysville kangaroo rat *Dipodomys californicus Eximus*	SSC	Occurs in grassland and sparse chaparral habitats above the valley floor on slopes with well-drained soils	Not likely–possibly extirpated	Not surveyed

Name	Status	Habitat	Present on Beale	Present on LRS
Ringtail *Bassariscus astutus*	FP	Prefers riparian forests, chaparral, brushland, oak woodlands, and rocky hillsides	Scat observed in Dry Creek area in 2000 during trapping	Not surveyed

Status Codes	
Federal	
BCC	United States Fish and Wildlife Service (USFWS) Birds of Conservation Concern. (No ESA protections) (USFWS 2008)
FE	Federally listed as endangered under the federal ESA.
FT	Federally listed as threatened under the federal ESA.
FD	Federally delisted under the ESA.
FR	Species under federal review are those species that have either been petitioned for federal listing or for which the USFWS has concluded in their 90-day finding that there is substantial scientific or commercial information indicating that listing may be warranted. No ESA protections.
SoC	Species of concern are sensitive species that have not been listed, proposed for listing nor placed in candidate status. Species of concern is an informal term used by NMFS and some, but not all, U.S. Fish & Wildlife Service offices. – no ESA protections.
MSPBS	Department of Defense-Partners in Flight; Mission-Sensitive Priority Bird Species (No ESA protections)
State	
SE	Listed as endangered under the California Endangered Species Act (CESA).
ST	Listed as threatened under the CESA.
SD	Delisted under the CESA.
FP	Fully protected under the California Fish and Game Code.
SC	Candidate for listing as threatened or endangered. Full CESA protections.
SSC	Species of special concern – no CESA protections.
WL	Watch List-taxa to watch due to population declines – No CESA protections.
Western Bat Working Group	
WBWG	Listed as a high priority species by the Western Bat Working Group. No ESA or CESA protection.
California Native Plant Society (CNPS) Rare Plant Rank (No ESA or CESA protections)	
CNPS 1B.1	Rare or endangered in California and elsewhere (1: Seriously endangered in California).
CNPS 2B.2	Rare or endangered in California, common elsewhere (2: Fairly endangered in California).
CNPS 2B.3	Rare or endangered in California, common elsewhere (3: Not very endangered in California).
CNPS 4.2	Limited distribution in California (2: Fairly endangered in California).
CNPS 4.3	Limited distribution in California (3: Not very endangered in California)
Plant State Rank (No ESA or CESA protections)	
S1	Critically imperiled.
S2	Imperiled.
S3	Vulnerable.
Other Acronyms	
SWA	Spenceville Wildlife Area
Source: Beale AFB 2019	

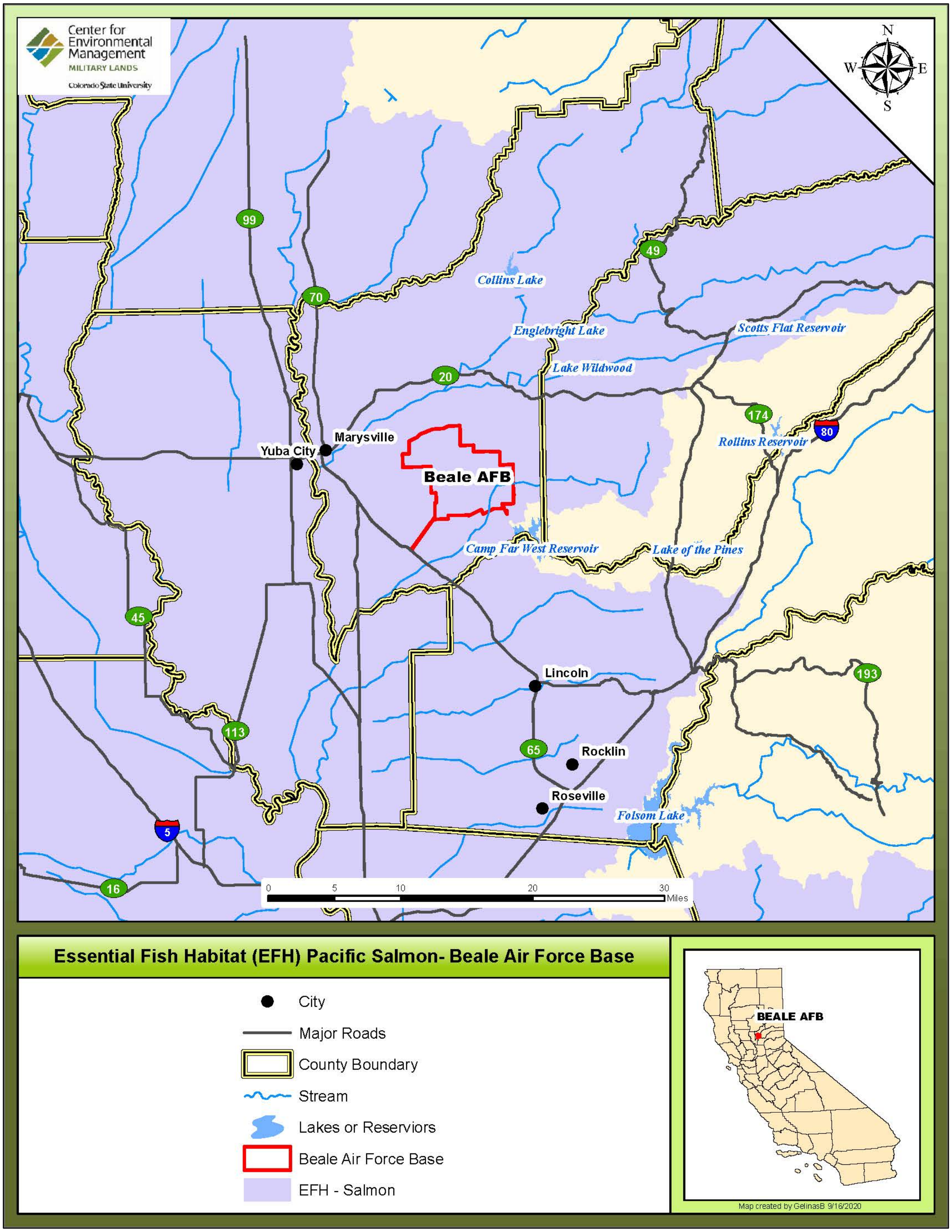

Figure 3.12. Essential Fish Habitat (EFH) near Beale AFB and the LRS.

3.8 CULTURAL AND TRIBAL CULTURAL RESOURCES

Cultural resources are heritage related resources including prehistoric and historic archaeological sites; historic buildings, structures, and districts; and any other physical evidence of human activity or natural features important to a culture, a subculture, or a community for scientific, traditional, religious, or other reasons.

Cultural resources are commonly divided into three major categories including archaeological resources, architectural resources, and traditional cultural properties:

- Archaeological resources are defined in the Archaeological Resources Protection Act as any material remains of past human activity. These resources are further categorized as prehistoric – occurring prior to written records, or historic – occurring after written record.
- Architectural resources include standing buildings, structures, landscapes, objects, and other built-environment resources, usually 50 years or older.
- Traditional cultural properties are places with traditional, religious or cultural significance to a living Native American tribe and are important to the cultural identity of the community.

3.8.1 Regulatory Setting

California Assembly Bill 52 establishes heritage-related resources termed 'Tribal Cultural Resources' to ensure consideration of tribal cultural values as part of project planning. This section discusses both 'Cultural Resources' under federal statutes and 'Tribal Cultural Resources' under California law.

The National Historic Preservation Act of 1966, as amended (54 USC §300101 et seq.) is the nation's largest most comprehensive legislation concerning cultural resources and historic preservation issues. §106 of the National Historic Preservation Act requires federal agencies to take into account the effects of their undertakings on historic properties. §110 of the act requires federal agencies to establish, in conjunction with the Secretary of the Interior, historic preservation programs for the identification, evaluation, and protection of historic properties. Cultural resources also may be covered by state, local, and territorial laws.

Cultural resources listed in or eligible for listing in the National Register of Historic Places are "historic properties" as defined by the National Historic Preservation Act. The National Register was established under §101 of the National Historic Preservation Act and is administered by the National Park Service on behalf of the Secretary of the Interior. The National Register of Historic Places includes properties on public and private land. Properties would be determined eligible for listing by the Secretary of the Interior or by a federal agency official with concurrence from the applicable State Historic Preservation Office. An eligible property has the same protections as a property listed in the register.

The Archaeological Resources Protection Act of 1979 (16 USC §470aa-47011) provides legal penalties for the unauthorized excavation, removal, damage, alteration, defacement, or the attempt of such acts, of any archaeological resource more than 100 years old on federal lands.

The American Indian Religious Freedom Act of 1978 and Amendments of 1994 recognize that freedom of religion for all people is an inherent right, and traditional American Indian religions are an indispensable and irreplaceable part of Indian life. It also recognized the lack of federal policy on this issue and made it the policy of the United States to protect and preserve the inherent right of religious freedom for Native Americans. Federal agencies are responsible for evaluating their actions and policies to determine if changes should be made to protect and preserve the religious and cultural rights and practices of Native Americans. These evaluations must be made in consultation with native traditional religious leaders.

The Native American Graves Protection and Repatriation Act of 1990 (25 USC §3001-3013) ensures the protection and rightful disposition of Native American cultural items located on federal or Native American lands and in the federal government's possession or control.

EO 13007, *Indian Sacred Sites* (May 24, 1996), provides direction to federal agencies concerning the management of sacred Native American sites. Within the constraints of the mission, federal agencies are required to accommodate Native American tribes' access to and ceremonial use of sacred sites on public lands and avoid damaging the physical integrity of such sites.

EO 11593, *Protection and Enhancement of the Cultural Environment* (May 13, 1971), directs the federal government to provide leadership in the preservation, restoration, and maintenance of the historic and cultural environment. Federal agencies are required to locate and evaluate all federal sites under their jurisdiction or control which might qualify for listing on the National Register of Historic Places.

EO 13175, *Consultation and Coordination with Indian Tribal Governments* (November 6, 2000), was issued to provide for regular and meaningful consultation and collaboration with Native American tribal officials in the development of federal policies that have tribal implications, and to strengthen the United States government-to-government relationships with Native American tribes.

DoDI 4715.16, *Cultural Resources Management* (DoD 2008a), establishes policy and assigns responsibilities to comply with Integrated Cultural Resource Management Plans (ICRMPs) on DoD managed lands.

AFMAN 32-7003, *Environmental Conservation* (USAF 2020), implements AFPD 32-70, *Environmental Quality*, and DoDI 4715.16 by outlining required actions and processes for managing and protecting cultural resources on property affected by operations on installations of the USAF including Active Duty USAF, USAF Reserve Command, Air National Guard, and government owned, contractor operated facilities on USAF controlled lands.

Discoveries of cultural items, including Traditional Cultural Properties, human remains and archaeological resources, may occur on USAF controlled lands. When discoveries are made, proper actions must be taken to minimize damage to resources and to ensure that applicable laws and requirements are identified and met as outlined in the base ICRMP.

California law requires the consideration of cultural resources that are historical resources and tribal cultural resources, as well as "unique" archaeological resources. California Public Resources Code §5024.1 established the California Register of Historical Resources (CRHR) and outlines the necessary criteria for a cultural resource to be considered eligible for listing in the register and, therefore, a historical resource. Historical resources are defined in Public Resource Code §5020.1(j).

Effective July 1, 2015, California Assembly Bill 52mandates consultation with California Native American tribes during project development to determine whether or not the proposed project may have a significant impact on a Tribal Cultural Resource, and that this consideration be made separately from cultural resources.

§21073 of the California Public Resources Code defines California Native American tribes as "a Native American tribe located in California that is on the contact list maintained by the California

Native American Heratige Commission for the purposes of Chapter 905 of the Statutes of 2004." This includes both federally and non- federally recognized tribes.

§21074(a) of the Public Resource Code (Added by Stats. 2014, Ch. 532, Sec. 4. (AB 52) Effective January 1, 2015.) defines "Tribal Cultural Resources" as:

"1) Sites, features, places, cultural landscapes (geographically defined in terms of the size and scope), sacred places, and objects with cultural value to a California Native American tribe that are either of the following:

A) Included or determined to be eligible for inclusion in the California Register of Historical Resources; and/or

B) Included in a local register of historical resources as defined in subdivision (k) of §5020.1; and/or

2) A resource determined by the lead agency, in its discretion and supported by substantial evidence, to be significant pursuant to criteria set forth in subdivision (c) of §5024.1. In applying the criteria set forth in subdivision (c) of §5024.1 for the purposes of this paragraph, the lead agency shall consider the significance of the resource to a California Native American tribe.

(b) A cultural landscape that meets the criteria of subdivision (a) is a tribal cultural resource to the extent that the landscape is geographically defined in terms of the size and scope of the landscape.

c) A historical resource described in Section 21084.1, a unique archaeological resource as defined in subdivision (g) of Section 21083.2, or a "nonunique archaeological resource" as defined in subdivision (h) of Section 21083.2 may also be a tribal cultural resource if it conforms with the criteria of subdivision (a)."

Because criteria a) and b) also meet the definition of a Historical Resource under California law, a Tribal Cultural Resource may also require additional consideration as a Historical Resource. Tribal Cultural Resources may or may not exhibit archaeological, cultural, or physical indicators.

Recognizing that California tribes are experts in their Tribal Cultural Resources and heritage, Assembly Bill 52 requires that lead agencies carry out consultation with tribes at the commencement of the project analysis process to identify Tribal Cultural Resources. Furthermore, because a significant effect on a Tribal Cultural Resource is considered a significant impact on the environment, consultation is required to develop appropriate avoidance, impact minimization, and mitigation measures. Consultation is concluded when either the lead agency and tribes agree to appropriate mitigation measures to mitigate or avoid a significant effect, if a significant effect exists, or when a party, acting in good faith and after reasonable effort, concludes that mutual agreement cannot be reached, whereby the lead agency uses its best judgement in requiring mitigation measures that avoid or minimize impact to the greatest extent feasible.

3.8.2 Affected Environment

A records search of the Beale AFB cultural resources database, which includes records obtained from the North Central Information Center of the California Historical Resources Information System, was conducted in October 2019 as part of the State Historic Preservation Office consultation. As a result, it was determined that the non-built areas of Beale AFB and the LRS have been previously surveyed for cultural resources. To date, 38 surveys have been performed, resulting in identification of 162 archaeological sites. With all areas of potential effect having been surveyed for cultural resources, Beale AFB has conducted a reasonable and good-faith effort to identify historic properties within the area pursuant to 36 CFR 800.4(a)-(d) and 36 CFR 800.5(a)-(d).

The Office of Historic Preservation has concurred with the USAF on the National Register of Historic Places listing eligibility of 82 sites, or site components, that are part of the undertaking. This includes one site eligible for listing, 80 found not eligible, and one site with a military component found not eligible, but prehistoric bedrock milling and rock art features were not evaluated. All unevaluated sites (or components) would be considered eligible for the National Register of Historic Places for the purposes of this undertaking unless formal evaluation and Office of Historic Preservation and Tribal consultation is warranted by the base for other projects during the duration of this undertaking.

Cultural resources reported at Beale AFB include archaeological sites related to the prehistoric occupation of the area by the Southern Maidu (Nisenan); historic archaeological sites representing Euro-American settlement and the development of a farming/ranching economy; transportation, and mining; the U.S. Army operation of Camp Beale during World War II; and the Cold War-era Precision Acquisition Vehicle Entry Phased Array Warning System (PAVE PAWS) facility (Beale AFB 2018e; USAF ACC 2014). A detailed history of the land now occupied by Beale AFB can be found in the base ICRMP (Beale AFB 2018e). No cultural resources have been identified to date at the LRS.

Pre-historic archaeological sites associated with the Southern Maidu and prehistoric ethnographic activities of Native American peoples on Beale AFB property include: complex archaeological deposits (e.g., remains of villages); sparse flaked lithic scatters (e.g., marking resource procurement or processing areas); milling stations and cupules; quarries for extraction of rocks used for manufacture of flaked stone tools; and rock art. Milling stations comprised of bedrock mortar features are the most visible and abundant prehistoric property type inventoried at Beale AFB. Eligible bedrock mortar and cupule sites are of critical importance for recordation and preservation and occur with high probability along creek and river drainages. An historic district of approximately forty pre-historic bedrock mortar and cupule sites has been proposed by the USAF, but is still in pre-planning stages. Four flaked lithic scatters have been recorded within Beale AFB.

Pre-military sites are associated with early historic settlements established along the first roads connecting Marysville and Sacramento with foothill gold mining areas. These include mining sites, historic trails and roads, and agricultural sites. More than 20 historic trails and roads passed within the base boundaries at one time or another (Raven et al. 1987). Disarticulated segments of historic roads have been noted or recorded as isolated features during previous archaeological surveys. Several concrete bridges and bridge remains have also been noted or recorded along secondary and unnamed roads apparently abandoned after the establishment of Camp Beale. The predominant pre-military historic property type at Beale AFB is the historic ranch/farm complex. Evidence of historic mining at Beale AFB consists primarily of tailings and the remains of small dams in creeks, ditches, and other water conveyance features. Historic maps indicate only a few mining ditches paralleling Dry Creek and smaller drainages in the eastern portion of the base, and one location in the far southeastern corner.

Scattered remains of WWII-era structures and materials may still be encountered around the base, but aside from a prisoner of war solitary confinement cell block, there are no cultural resources associated with the era that are of great significance. Significant Cold War assets were constructed, housed, and supported at Beale AFB and stand out as meaningful components of the base and local history. The Semi-Automatic Ground Environment building, also known as Building 2145, had the primary mission to provide early warning and response in case of a Soviet bomber attack. The SR-71, also known as the Blackbird, was a long-range, supersonic, high-altitude reconnaissance aircraft that entered into service at Beale AFB in 1966 and was retired from service in 1990. Cultural resources associated with the SR-71 include maintenance docks and engine stands, aprons and engine run-up areas, refueling and bulk storage, parking, a maintenance composite building, a headquarters composite facility (the renovated Semi-Automatic Ground Environment building), and a physiological training building. PAVE PAWS is one of four Cold War era early warning and radar systems developed to detect ballistic missile attacks against the United States. PAVE PAWS continues to support a variety of missile warning and space surveillance missions. PAVE PAWS has been evaluated and recommended eligible for listing on the National Register of Historic Places.

3.9 EARTH RESOURCES

Earth resources consist of the earth's surface and subsurface materials. Within a given physiographic province, these resources typically are described in terms of geology, topography and soils, and geologic hazards and paleontology, when applicable. Geology and topography are not affected by invasive plant control activities.

Soils are the unconsolidated materials overlying bedrock or other parent material. Soils are typically described in terms of their type, slope, and physical characteristics. Differences among soil types in terms of their structure, elasticity, strength, shrink-swell potential, and erosion potential affect their abilities to support certain applications or uses. Soil formation is a continual process that is ultimately determined by the parent geologic material and influence of factors such as climate, topography, and vegetation. The susceptibility of the soil to erosion depends on several factors including, but not limited to, soil texture, saturation point, and slope. Soil erodibility generally decreases with increasing clay and organic matter content, whereas uniform silts and sands tend to have high soil erodibility.

3.9.1 Regulatory Setting

For geologic and topographic features, the key federal law is the Historic Sites Act of 1935, which establishes a national registry of natural landmarks and protects "outstanding examples of major geological features." Topographic, geologic features, and mineral resources are also protected under California state law. The regulations do not specifically define mineral resources. Therefore, the definition of mineral resource from the Department of Conservation, State Mining and Geology Board, and the United States Bureau of Mines, and United States Geological Survey is "a concentration of naturally occurring solid, liquid, or gaseous material in or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible". As such, both non-fuel mineral resources as well as petroleum resources are considered.

3.9.2 Affected Environment

<u>Geology</u>: Beale AFB is located on the boundary between the Great Valley and Sierra Nevada Geologic provinces. The Great Valley Province was formed as a basin between the Coast Range Province on the west and the Sierra Nevada Province on the east. The basin has filled with alluvial deposits from the erosion of the Sierra Nevada and the Coast ranges. Because of its location on the boundary of the two provinces, Beale AFB contains characteristics of both the Great Valley and the Sierra Nevada Mountains. Geological formations at the LRS are similar to those at the main base. The hardpan at this site is near the surface.

Four geomorphic units, characteristic of the Great Valley Province, cover most of Beale AFB: river floodplains and channels of the Modesto Formation, low alluvial plains and fans of the Riverbank Formation, dissected uplands of the Mehrten Formation, and dissected uplands of the Laguna Formation. A fifth geomorphic unit, metavolcanic rock, occurs in the eastern portion of the base and is characteristic of the Sierra Nevada foothills (Beale AFB 2019).

Topography: The western and central portions of Beale AFB (which include the flightline and main base) consist of relatively flat grasslands, characteristic of the topography of the Central Valley. The eastern portion of the base (with the family housing area) contains low, rolling hills that gradually merge with the foothills of the Sierra Nevada Mountains. The elevation of Beale AFB ranges from 80-90 feet above mean sea level along the western and southern boundary to more than 600 feet in the northeastern part of the base.

The topography of the LRS is essentially level, with some shallow depressions, one drainage swale trending from south-southwest to north-northeast within the southeast area of the property, and a drainage canal flowing through the top northeast corner. Markham Ravine is located one mile to the north, and Auburn Ravine is located one-half mile to the south. The elevations of the site range between 84-95 feet above sea level. Surface drainage primarily flows toward the onsite swale (Beale AFB 2019a).

Soils and Minerals: There are 14 soil map units of soil series or soil complexes on Beale AFB (Figure 3.13; Table 3.9) that can be grouped into two main categories: Central Valley Terraces and Sierra Nevada Foothill. The main base and flightline are on the valley soils. Family housing is on foothill soils. The subsoil consists of primarily sandy clay and gravel. Since the soils at Beale AFB contain a high amount of clay and have an underlying hardpan, the construction period is limited to the dry season. The Limited Operations Period for earth-disturbing activities is from 1 November – 1 May to avoid problems arising from saturated soil in work areas. The soils become so soft during the wet season that even small ATVs can get stuck.

The high clay content and underlying hardpan result in soils with slow permeability and a shallow rooting depth, which favor annual grasses and forbs. There are three types of valley soils that could be considered prime farmland if irrigated. However, there are a number of cropping limitations including poor fertility, flooding, and mound micro relief. The condition of the soils creates building restrictions as well, which are characterized by flood potential, shrink and swell potential, and poor soil drainage associated with the soil's cemented hardpan.

The foothill soils are suitable for wildlife habitat and livestock grazing. They favor native oaks, shrubs, forbs and annual grasses. Restrictions are soil depth (highly variable), slope (3-75%), and water erosion. Building restrictions consist of difficult slope, shallow depth to bedrock, and shrink-swell potential.

Pits and dumps were mapped by the Natural Resources Conservation Service (2016). A miscellaneous soil unit for areas used for excavations and refuse deposits. The landfill sites at Beale AFB are designated as pits and dumps.

Soils at the LRS are predominantly sandy loams in the San Joaquin series (Figure 3.14). This series consists of well-drained, clay-pan soils underlain by indurated granitic alluvium. The Cometa series is also a well-drained, clay-pan soil underlain by compacted (but not indurated) alluvium (USDA 1980). The indurated layer of the San Joaquin soils creates the impermeable bottom of vernal pools. ID numbers and names of soils underlying the LRS:

- 142 Cometa-Ramona sandy loam, 1-5%
- 181 San Joaquin sandy loam, 1-5%
- 182 San Joaquin-Cometa sandy loam, 1-5%

Mineral resources do occur near Beale AFB, with 304 and 887 mining claims in Yuba and Nevada Counties, respectively. No mineral resources are known from Beale AFB or the LRS.

Table 3.9. Soil Map Units within the Beale AFB Pasture Units, with Acreage and Water Erosion Hazard Rating.

Soil Series/Map Unit, with Percent Slope Class	Map Symbol	Acreage	Water Erosion Hazard
Argonaut-Auburn complex, 3-8%	102	2,154.0	slight
Argonaut-Auburn complex, 15-30%	104	86.2	severe
Auburn loam, 15-30%	108	100.5	severe
Auburn-Sobrante complex, 3-8%	110	319.0	slight
Auburn-Sobrante-Rock outcrop complex, 15-30%	118	18.7	severe
Hollenbeck clay, 0-3%	133	37.4	slight
Conejo loam, 0-2%	141	294.8	slight
Pardee gravelly loam, 3-8%	201	804.3	slight
Pardee-Ranchoseco complex, 0-3%	202	536.3	slight
Perkins loam, 0-2%	203	1,526.2	slight
Redding-Corning complex, 0-3%	209	1,080.5	slight
Redding-Corning complex, 3-8%	210	2,127.1	moderate
San Joaquin loam, 0-1%	214	2,617.5	slight
San Joaquin loam, 1-3%	215	1,068.8	slight
Dumps, landfills	145	8.5	na
Water	254	10.0	na
Source: Beale AFB 2017b			

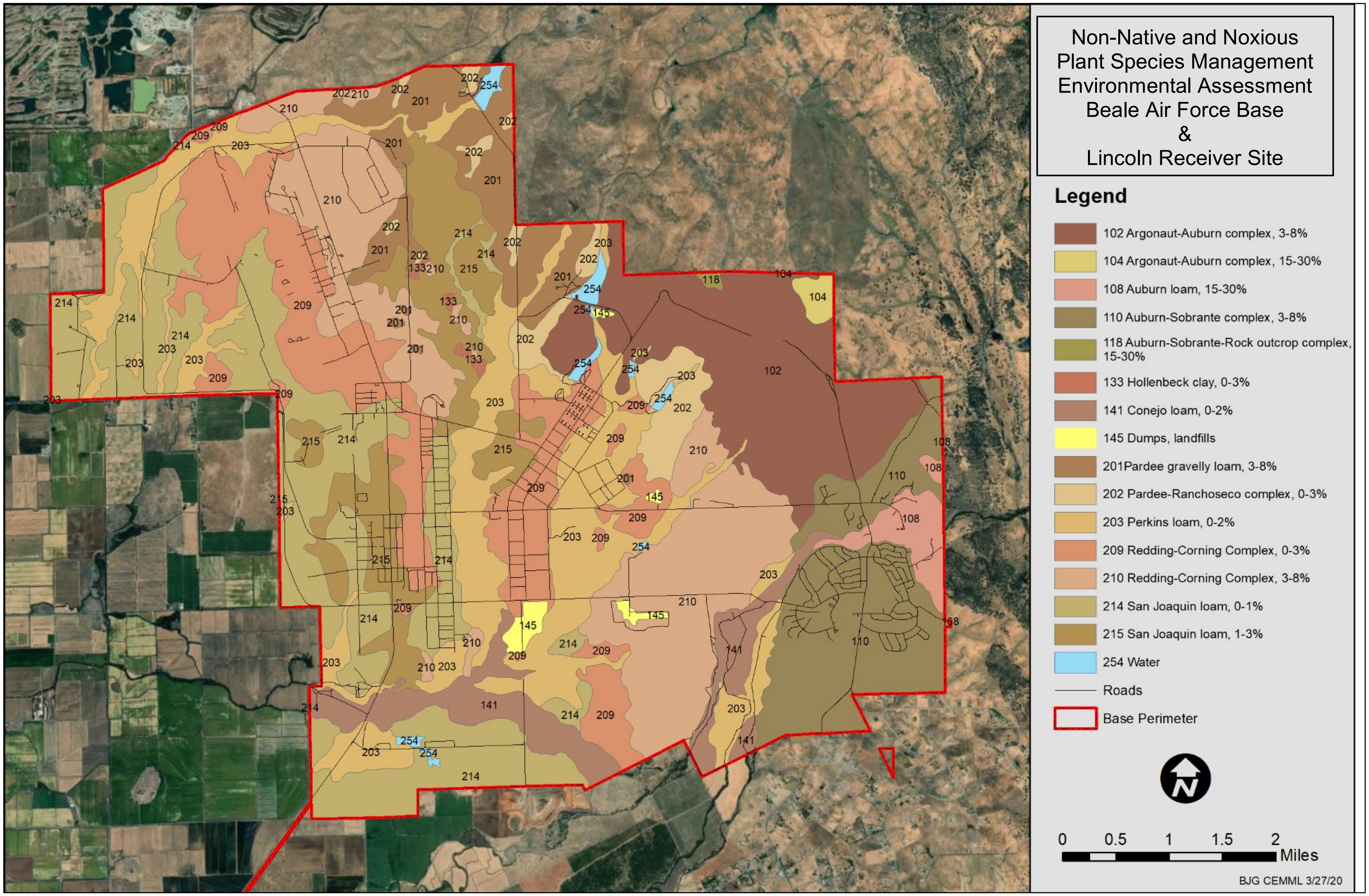

Figure 3.13. Beale AFB Soils.

Figure 3.14. LRS Soils.

3.10 UTILITIES AND INFRASTRUCTURE

3.10.1 Regulatory Setting

Infrastructure consists of the systems and physical structures that enable a population in a specified area to function, to include utility lines. Infrastructure is wholly human-made, with a high correlation between the type and extent of infrastructure, and the degree to which an area is characterized as "urban" or developed. The availability of infrastructure and its capacity to support growth are generally regarded as essential to the economic growth of an area. Utilities and infrastructure generally include water supply, storm drainage systems, sanitary sewer and wastewater systems, power supply, and solid waste management.

3.10.2 Affected Environment

The infrastructure and utility information presented in this section provides an overall general description of each infrastructure component at Beale AFB.

Water Supply**:** Water on Beale AFB is supplied from seven on-installation wells containing submersible pumps. Water is pumped to a treatment plant where iron and manganese are removed from the well water. The installation has a total water storage capacity of 5.2 million gallons and has an average demand of 1.28 million gallons per day (mgd) during the winter months and 3.5 mgd during the summer months. Beale AFB has funded more than $15 million in upgrading their water supply infrastructure including replacing steel piping, renovating wells, and grouting casings (Beale AFB 2014).

Sanitary Sewer and Wastewater System: The Beale AFB sanitary sewer system consists of a gravity and force main collection system and a wastewater treatment plant. The system includes approximately 47 miles of sewer main. Because the elevations at Beale AFB are 400 to 500 ft higher on the eastern portion of the base, much of the sanitary sewer system is gravity fed. The wastewater treatment plant treats, on average, 0.26 mgd, with a peak flow of 2.06 mgd in the winter. Effluent from the plant is pumped to the golf course pond or discharged to the 40-acre irrigation field (Beale AFB 2014).

Storm Drainage System: Dry Creek, Hutchinson Creek, and Reeds Creek are the three principle surface drainage systems for Beale AFB. Dry Creek flows perennially and Hutchinson and Reeds creeks' flows are intermittent. Stormwater runoff is discharged through a system of open ditches, storm sewers, culverts, and pipes. Stormwater flow is directed to drainage ditches and is discharged into the creeks (Beale AFB 2014).

Electrical System: Pacific Gas and Electric is the primary supplier of electrical power at Beale AFB. Power is delivered by three transmission lines and two metering points, which enter Beale AFB at the Grass Valley Substation. At peak demand the installation is at approximately 35 percent of the design capacity of its electrical system.

Natural Gas System: Pacific Gas and Electric also supplies non-interruptible natural gas to Beale AFB.

Communication Systems: The communication system at Beale AFB consists of aerial and underground copper and fiber optic cables. A government-owned buried copper cable plant services the installation, except for multi-family housing units, where the cable plant is owned by Pacific Bell. The Beale AFB fiber optic backbone cable system joins local area networks together across the installation and carries the heaviest information transfer traffic (Beale AFB 2014).

Solid Waste: Recology Yuba-Sutter, Inc. is contracted to provide storage, collection, handling, and disposal of solid waste at Beale AFB. They are responsible for collecting refuse, yard, and wood waste; handling office paper and cardboard recycling; and handling refuse disposal. Once collected, solid waste is transported to the Ostrom Road Landfill, an off-installation landfill located in Wheatland, California (Beale AFB 2014).

3.11 TRANSPORTATION AND TRAFFIC

3.11.1 Regulatory Setting

In July 1999, the U.S. Department of Transportation issued an Accessibility Policy Statement pledging a fully accessible multimodal transportation system. Accessibility in federally assisted programs is governed by the U.S. Department of Transportation regulations (49 CFR 27) implementing §504 of the Rehabilitation Act (29 USC 794). The FHWA has enacted regulations for the implementation of the 1990 Americans with Disabilities Act, including a commitment to build transportation facilities that provide equal access for all persons. These regulations require application of the Americans with Disabilities Act requirements to federal-aid projects.

Transportation is defined as the system of roadways, highways, and all other transportation networks that are in the vicinity of the proposed project area and could reasonably be expected to be affected by the Proposed Action. Traffic relates to changes in the number of vehicles on roadways and highways as a result of a Proposed Action.

3.11.2 Affected Environment

Regional access to Beale AFB is provided by State Route (SR) 65, SR 70, and SR 20. Five roads provide access to the installation through five gates. North Beale Road extends from SR 70 in Linda to the Main Gate. This is the primary road that connects the installation and SR 70, Marysville, and Yuba City. Hammonton-Smartville Road provides access to the installation at the Doolittle Gate. Smartville Road provides access to the installation at the Grass Valley Gate and is south of SR 20. South Beale Road provides access from SR 65 northwest of Wheatland to the Wheatland Gate. Spenceville Road connects SR 65 at the City of Wheatland to the Vassar Lake Gate (Beale AFB 2014).

The road network at Beale AFB consists of arterials, collectors, and local streets. The majority of traffic at the base is on Gavin Mandery Drive (Main Gate to Camp Beale Highway), Doolittle Drive (Doolittle Gate to Warren Shingle Road), Grass Valley Road/Warren Shingle Road (Grass Valley Gate to J Street), Camp Beale Highway (Vassar lake Gate to Warren Shingle Road), and J Street (Wheatland Gate to Doolittle Drive).

3.12 ENERGY RESOURCES

3.12.1 Regulatory Setting

NEPA requires the identification of all potentially significant impacts to the environment, including energy impacts. Energy Conservation requires an analysis of a project's energy use to determine if the project may result in significant environmental effects due to wasteful, inefficient, or unnecessary use of energy, or wasteful use of energy resources. The goal of conserving energy implies efficient use of energy by decreasing overall energy consumption, decreasing reliance on natural gas and oil, and increasing reliance of renewable energy resources.

3.12.2 Affected Environment

Currently there are large amounts of energy usage in the project area given that the Proposed Action would take place base-wide and at the LRS. As of 2016, the total employee population at Beale AFB was approximately 4,224 active duty military personnel, 15 Air Force Reserve/Air National Guard (ANG), 687 non-extended duty ANG, and 1,339 civilians. As of September 2016, housing facilities supported 76 officers, 424 enlisted families, and 503 enlisted and transient personnel. The LRS has a number of regular personnel that work on the base though no living quarters are currently in use. Given the status of the Project Area as an active Air Force Installation, energy use is understandably high.

3.13 CLIMATE CHANGE

Climate change refers to long-term changes in temperature, precipitation, wind patterns, and other elements of the earth's climate system. An ever-increasing body of scientific research attributes these climatological changes to GHG emissions, particularly those generated from the production and use of fossil fuels. The U.S. EPA has not issued explicit guidance or methods on how to conduct project-level GHG analysis.

3.13.1 Regulatory Setting

While climate change has been a concern for several decades, the establishment of the Intergovernmental Panel on Climate Change by the United Nations and World Meteorological Organization in 1988 led to increased efforts devoted to GHG emissions reduction and climate change research and policy. These efforts are primarily concerned with the emissions of GHGs generated by human activity, including carbon dioxide, methane, nitrous oxide, tetrafluoromethane, hexafluoroethane, sulfur hexafluoride, and various hydrofluorocarbons. Carbon dioxide is the most abundant GHG; while it is a naturally occurring component of Earth's atmosphere, fossil-fuel combustion is the main source of additional, human-generated carbon dioxide.

A GHG emissions inventory estimates the amount of GHGs discharged into the atmosphere by specific sources over a period of time, such as a calendar year. Tracking annual GHG emissions allows countries, states, and smaller jurisdictions to understand how emissions are changing and what actions may be needed to attain emission reduction goals. U.S. EPA is responsible for documenting GHG emissions nationwide, and the California Air Resources Board does so for the state.

National GHG Inventory

The U.S. EPA prepares a national GHG inventory every year and submits it to the United Nations in accordance with the Framework Convention on Climate Change. The inventory provides a comprehensive accounting of all human-produced sources of GHGs in the United States, reporting emissions of carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and nitrogen trifluoride. It also accounts for emissions of carbon dioxide that are removed from the atmosphere by "sinks" such as forests, vegetation, and soils that uptake and store carbon dioxide (carbon sequestration). The 1990–2016 inventory found that of 6,511 million metric tons of carbon dioxide equivalent GHG emissions in 2016, 81% consist of carbon dioxide, 10% are methane, and 6% are nitrous oxide; the balance consists of fluorinated gases (USEPA 2018). In 2016, GHG emissions from the agricultural sector accounted for 9% of U.S. GHG emissions and the commercial and residential economic sector accounted for 11%.

To date, no national standards have been established for nationwide mobile-source GHG reduction targets, nor have any regulations or legislation been enacted specifically to address climate change and GHG emissions reduction at the project level.

State GHG Inventory

The Air Resources Board collects GHG emissions data for transportation, electricity, commercial/residential, industrial, agricultural, and waste management sectors each year. It then summarizes and highlights major annual changes and trends to demonstrate the state's progress in meeting its GHG reduction goals. The 2019 edition of the GHG emissions inventory found total California emissions of 424.1 million metric tons of carbon dioxide equivalent for 2017, with the agricultural sector responsible for 8%, residential 7%, and commercial 5% of total GHGs (CARB 2019c). It also found that overall statewide GHG emissions declined from 2000 to 2017 despite growth in population and state economic output (CARB 2019d).

Assembly Bill 32 required the Air Resources Board to develop a Scoping Plan that describes the approach California will take to achieve the goal of reducing GHG emissions to 1990 levels by 2020, and to update it every five years. The Air Resources Board adopted its second updated plan, *California's 2017 Climate Change Scoping Plan*, which reflects the 2030 target established in EO B-30-15 and SB 32. The Assembly Bill 32 Scoping Plan and the subsequent updates contain the main strategies California will use to reduce GHG emissions.

The GHG emissions are analyzed as a cumulative impact due to the global nature of climate change. In assessing cumulative impacts, it must be determined if a project's incremental effect is "cumulatively considerable". To make this determination, the incremental impacts of the project must be compared with the effects of past, current, and probable future projects. Although climate change is ultimately a cumulative impact, not every individual project that emits GHGs must necessarily be found to contribute to a significant cumulative impact on the environment.

To provide GHG emission guidance to entities within its jurisdiction FRAQMD developed GHG significance thresholds in 2010 to help determine whether a project may have a significant impact on air quality (FRAQMD 2010). In developing thresholds of significance for air pollutants, FRAQMD considered the emission levels for which a project's individual emissions would be cumulatively considerable. While this guidance exists, thresholds for PM2.5 and GHGs are labeled "not yet determined" (FRQAMD 2010). Neighboring Bay Area Air Quality Management District (BAAQMD) identified significance thresholds of 1,100 metric tons of carbon dioxide equivalent emissions per year for operational non-stationary emissions or compliance with qualified GHG reduction strategy, a significance threshold of 10,000 metric tons of carbon dioxide equivalent emissions per year from operational stationary GHG sources and no thresholds for construction-related activities (BAAQMD 2017). A qualified GHG reduction strategy is a general plan or climate action plan that requires adoption via a public review process following environmental review (BAAQMD 2017).

3.13.2 Affected Environment

The proposed project is located in rural areas of Yuba and Placer Counties with a well-developed road and street network, accessed by several major roads. The project area is mainly undeveloped grasslands surrounding residential, industrial and commercial buildings. Traffic congestion during peak hours is uncommon except around base gates. The current air emissions of the Base including GHGs are reviewed in Section 3.3.2 and discussed in Section 4.13.1

4.0 ENVIRONMENTAL CONSEQUENCES

4.1 INTRODUCTION

This EA provides a detailed analysis of the potential direct, indirect, and cumulative impacts that would result from implementation of the Proposed Actions. As discussed in Sections 2.4 and 3.1, of this EA and consistent with 32 CFR §989.8(c), alternatives not fully achieving established selection standards (Alternative 3, Limited Control) were not retained for detailed analysis. Direct impacts would be those effects that are caused by the action and occur at the same time and place (40 CFR §1508.8[a]). Indirect impacts are those effects that would be caused by the Proposed Action and would occur later in time or further removed in distance, but would still be reasonably foreseeable (40 CFR §1508.8[b]). Cumulative impacts would be those that would result from the incremental impacts of the Proposed Action when added to other past, present, and reasonably foreseeable future actions. As appropriate, potential impacts are further discussed as being temporary, short-term, or long-term. For purposes of this EA, temporary effects are defined as those that would last for the duration of implementation of a given treatment or control method. Short-term impacts would last from the completion of a given treatment, or from the first treatment if repeated annually to three years. Long-term impacts are defined as those impacts that would occur from three to 10 years after a given treatment, or from the first treatment if repeated annually. Permanent impacts indicate an irretrievable loss or alteration.

In an EA, the magnitude of the impact is considered regardless of whether the impact is adverse or beneficial. Environmental consequences are weighed by their significance. Under NEPA, significance is based on context and intensity (40 CFR. § 1508.27); under in the state process, significance is contextualized as a significant effect on the environment resulting from the entire action. Context considers the geographic extent of the potential impact (local, regional, or greater extent) while intensity considers the severity of the impact.

The following terms are used to describe the magnitude of impacts in this EA:

- No Effect: The action would not cause a detectable change.
- Negligible: The impact would be at the lowest level of detection; the impact would not be significant.
- Minor: The impact would be slight but detectable; the impact would not be significant.
- Moderate: The impact would be readily apparent; the impact would not be significant.
- Major: The impact would be clearly adverse or beneficial; the impact has the potential to be significant. The significance of adverse and beneficial impacts is subject to interpretation and should be determined based on the final proposal. In cases of adverse impacts, the impact may be reduced to less than significant by mitigation, design features, and/or other measures that may be taken

4.2 LAND USE

4.2.1 Alternative 1 (No Action Alternative)

Under the No Action Alternative, there would be no change to existing conditions as described in Section 3 and there would be no new effects on land use.

4.2.2 Alternative 2 (Comprehensive Control)

Implementation of all proposed activities under Alternative 2 would result in overall negligible, beneficial, long-term, effects and minor, temporary, adverse effects on land use. The actions would occur entirely on Beale AFB property, and the projects associated with Alternative 2 would be sited in a manner compatible with Beale AFB's land uses as well as surrounding off-installation land uses. The proposed projects would comply with existing land use plans and policies as identified in the *Beale AFB Installation Development Plan* (Beale AFB 2015) and *Beale Air Force Base Land Use Compatibility Plan* (Mead & Hunt 2011). Alternative 2 would not increase the use of existing parks or other recreational facilities.

Grazing

Expansion of the grazing program under Alternative 2 could have negligible, long-term, beneficial effects on land use. Under Alternative 2, stocking rates on existing pastures would be adjusted based on precipitation in accordance with rates recommended in the GMG (Table 4.1; Beale AFB 2017b; Appendix C). In addition, the program would be expanded to include grazing on undeveloped land that is currently un-grazed.

Expansion of the grazing program would follow the strategy outlined in H.T. Harvey & Associates (2015) to expand grazing into new areas of Beale AFB and the LRS, in order to meet management goals, including maintaining firebreaks, controlling invasive plants, and protecting and enhancing resources. The strategy identifies approximately 3,332 acres on Beale AFB and 210 acres on the LRS of land that could potentially be utilized for grazing (Figures 2.1 and 2.2). Estimates of grazing capacity for each management unit was calculated for three management scenarios: invasive plant control, firebreak management, and basic resource protection and enhancement. A target RDM value was established at 200 lbs/acre of RDM for both the invasive plant control and firebreak management scenarios; an RDM target of 800 lbs/acre was established for the basic resource protection and enhancement scenario. The expanded grazing area could support an additional 1,061 to 8,783 AUM, depending on precipitation and desired management outcome (Table 4.2).

Approximately 66,000 feet of linear fencing would be needed to enclose proposed grazing areas. This would involve modifying existing fencing and installing new, permanent barbed wire fencing and temporary electric fencing. No new access roads would be installed within the proposed grazing units, but existing access roads would be maintained. During informal consultation with USFWS, Beale AFB discussed and received verbal concurrence on project assumptions for power pole replacements, which required larger excavations than those proposed for fence installation, within and adjacent to vernal pool habitats (USFWS personal communication 2014). The same assumptions for impacts were used for fencing actions that would create disturbance similar to power pole replacements (H-brace and gate brace installation; Appendix G).

A Cattle Distribution Plan (ManTech SRS Technologies 2017) was prepared that identified potential locations for new water troughs and wells in existing and proposed pastures. The plan identified four locations for wells/troughs in existing pastures, 39 trough locations in proposed grazing expansion pastures on Beale AFB and two trough locations at the LRS.

Table 4.1. Estimated Grazing Capacity in Animal Unit Months (AUM) for Favorable, Average, and Unfavorable Rainfall Years in Existing Beale AFB Pasture Units and Management Areas.

Management Area	Pasture unit	Acreage	AUM*			
			Favorable	Average	Unfavorable	No Action
A	A-1	832	1,711	1,119	327	
	A-2	471	918	615	170	
	A-3	359	603	392	107	
	A-4	746	1,418	935	263	
	A-5	207	492	327	98	
	A-6	284	551	360	103	
	A-7	114	187	122	33	
	A-9	167	288	194	51	
	Total	**3,180**	**6,168**	**4,064**	**1,152**	**1,855**
B	B-1	825	1,572	978	242	
	B-2	1,102	2,124	1,333	338	
	B-3	182	355	237	66	
	B-5	584	1,252	764	189	
	B-6	360	610	410	108	
	B-8	15	25	17	4	
	Total	**3,068**	**5,938**	**3,739**	**947**	**1,633**
C	C-1	2,553	5,377	3,041	650	
	C-2	375	850	465	107	
	C-3	147	337	184	40	
	C-4	26	59	33	8	
	C-5	4	8	4	1	
	C-6	131	286	164	35	
	Total	**3,236**	**6,917**	**3,891**	**841**	**1,800**
D	D-1	37	101	67	21	
	D-2	23	60	40	12	
	D-3	111	270	179	54	
	D-4	281	466	317	79	
	D-5	259	432	294	74	
	D-6	90	193	113	28	
	Total	**801**	**1,522**	**1,010**	**268**	**487**
E	E-1	21	43	21	1	
	E-2	21	42	20	0	
	E-3	55	127	71	17	
	E-4	11	21	10	1	
	E-5	24	50	23	0	
	E-6	26	59	32	7	
	Total	**158**	**343**	**177**	**27**	**-**
F	F-1	1,333	2,763	1,913	652	
	F-2	387	722	486	162	
	F-3	360	697	454	130	
	F-4	269	551	362	106	
	Total	**2,349**	**4,733**	**3,215**	**1,050**	**1,094**
Grazing Program Totals		**12,792**	**25,620**	**16,096**	**4,284**	**6,869**

*Animal Unit Conservation Factors: 1 AUM = 1 cow, 0.75 AUM = 1 yearling heifer/steer, 0.10 AUM = 1 goat, 0.15 AUM = 1 sheep, 1.8 AUM = 1 horse.
Source: Beale AFB 2017b

Table 4.2. Recommended AUM for New Pastures under Different Resource Management Scenarios.

Management Scenario	Location	Acreage	AUM Rates by Forage Condition		
			Favorable	Average	Unfavorable
Firebreak Creation and Invasive Management, March 1 through June 30 or as authorized, 200 lbs RDM/acre	Beale AFB	3,332	8,276	5,733	2,760
	LRS	210	507	369	184
	Total	3,542	8,783	6,102	2,944
Basic Resource Protection and Enhancement, November 1 through May 31, or as authorized, 800 lbs RDM/acre	Beale AFB	3,332	6,401	3,924	1,051
	LRS	210	369	230	46
	Total	3,542	6,770	4,154	1,061
Source: H.T. Harvey & Associates 2015b					

Grazing currently ungrazed areas would not change the “undeveloped” land use classification. The Installation Development Plan (Beale AFB 2015) does not include any plans for developing areas proposed for inclusion in the cattle grazing program in the short to medium term. In addition, grazing infrastructure could easily be removed if future mission requirements necessitate development of these areas. Grazing lessees shall adhere to all provisions set forth in the Beale AFB Grazing Operating Agreement, provided to lessees at the time of lease award. The NRM and grazing lessees would also implement the grazing BMPs in the IPSMG (Section 5.2.2 of Appendix B). Therefore, the actions carried out under Alternative 2 would not result in significant effects to land use.

Prescribed Burns

Prescribed burns would have temporary to short-term, minor adverse effects to land use. Cattle grazing and recreation would be limited for several months following a burn. Grazing lessees would be advised of planned burn locations that may impact their cattle operations. These effects would be temporary, and a prescribed burn would likely have a neutral to beneficial long-term effect on cattle forage. Therefore, no significant effects to land use would occur as a result of prescribed burns under Alternative 2.

Chemical Treatments

Chemical treatments would have temporary to short-term, minor, adverse effects to land use. Cattle grazing may be limited for a period of several hours to several weeks after herbicide application, depending on the chemical used. Large-scale herbicide application would result in some loss of forage. Grazing lessees would be advised of planned herbicide applications that may impact their cattle operations. These effects would be temporary, and invasive plant control would likely have a beneficial long-term effect on cattle forage. Therefore, no significant effects to land use would occur as a result of chemical treatments under Alternative 2.

Manual/Mechanical Treatments

Manual/mechanical treatments would have temporary, negligible, adverse effects on land use. Large-scale mechanical treatments could reduce available forage within grazed areas. However, these methods would target invasive plants generally less palatable to cattle. Even large-scale mechanical treatments would not significantly reduce forage on a grazing management unit or base-wide scale. These effects would be temporary, and invasive plant control would likely have a beneficial long-term effect on cattle forage. Therefore, no significant effects to land use would occur as a result of manual/mechanical treatments under Alternative 2.

Restoration Treatments

Restoration treatments may have temporary to short-term, negligible, adverse effects to land use, but would have a long-term beneficial impact on forage quality. Cattle may be temporarily excluded from grazing in restored treatment areas for one year or longer after seeding. Restored areas would be relatively small and would not significantly reduce forage availability on a base-wide scale. Revegetation decisions would be compatible with future uses and management actions, and would consider suitability and cost of available options as well as the suitability of the restoration site itself. Therefore, no significant effects to land use would occur as a result of restoration treatments under Alternative 2.

4.3 AIR QUALITY

4.3.1 Alternative 1 (No Action Alternative)

Under the No Action Alternative there would be temporary, moderate, adverse effects to air quality as a result of prescribed burns. The potential effects would continue to be determined individually for each burn during the EIAP. There would be no new effects to air quality as a result of continued grazing, chemical, manual/mechanical, or restoration treatments under the No Action Alternative.

Grazing

Under the No Action Alternative, there would be no change to the grazing program as described in Section 3 and there would be no new effects to air quality as a result of continuing existing grazing practices under the No Action Alternative.

Prescribed Burns

Under the No Action Alternative, there would be no change to existing conditions as described in Section 3. Prescribed burns conducted under the No Action Alternative have the potential for direct, temporary, moderate, adverse effects to air quality (See Table 3.6 in Section 3.3.2). The effects of prescribed burns would continue to be analyzed individually using the USAF EIAP.

Chemical, Manual/Mechanical, and Restoration Treatments

Under the No Action Alternative, there would be no change to existing conditions as described in Section 3. On-going activities would not involve the use of equipment greater than 50 horse power or chemicals that produce VOCs regulated by the EPA or California Air Resources Board. If new invasive plant treatments wee proposed the effects would be analyzed on a project-by-project basis using the USAF EIAP. Therefore, there would be no impacts to air quality as a result of the No Action Alternative.

4.3.2 Alternative 2 (Comprehensive Control)

Alternative 2 would lead to temporary, minor to moderate, adverse effects to air quality. All adverse impacts to air quality would be temporary and would not affect regional air quality attainment status or exceed significance thresholds. The effects to air quality from prescribed burns would be temporary, localized, and mitigated by a Smoke Management Plan, and therefore, would not be significant. None of the active herbicide ingredients proposed for use are subject to the California Department of Pesticide Regulation’s nonfumigant volatile organic compounds regulations. Herbicides would not be applied under conditions when volatilization or drift are likely to occur.

Grazing

Grazing infrastructure construction could have temporary, minor, adverse impacts to air quality. These activities may generate particulate emissions as fugitive dust from ground-disturbing activities (e.g., grading, soil piles) and from combustion of fuels in construction equipment. Fugitive dust emissions would be greatest during the initial site preparation activities and would vary from day to day depending on the construction phase, level of activity, and prevailing weather conditions. The quantity of uncontrolled fugitive dust emissions from a construction site is proportional to the area of land being worked and the level of construction activity. Trough and well installation would require the greatest amount of ground disturbance and equipment. However, the area of disturbance would be relatively small, and with adherence to dust control BMPs and applicable regulations the effects to air quality from fugitive dust and fuel combustion would be negligible.

The FRAQMD has established mitigation measures for fugitive dust, construction, and agricultural engines. Grazing lessees and construction projects shall be required to comply with FRAQMD “Standard Mitigation Measures for All Projects” and “Fugitive Dust Control Mitigation Measures” to minimize air quality impacts. These measures include maintaining a speed limit of 15 mph or less on unpaved roads. Additional measures including road watering, covering soil piles, and other dust mitigation BMPs would be implemented as needed during construction.

GHGs are often emitted or produced by ranching operations. GHGs, including carbon dioxide and methane, have been linked to climate change. The EPA regulates manure-related GHGs from livestock operations under 40 CFR Part 98, Subpart JJ. However, Subpart JJ does not apply to “pasture/range/paddock systems” (Subpart JJ, §98.360(c)), such as those on Beale AFB.

Under Alternative 2, GHGs would be generated primarily from vehicles used to manage cattle operations. The increase in cattle grazing would increase the maximum number of ranchers, ranch hands, and vehicles used for fence installation (identified as support contractor personnel) on the base from nine to 24. The additional personnel were analyzed as mobile sources utilizing the ACAM (Table 4.3; Appendix H). The increased personelle numbers would include transportation and maintenance of goat or sheep to the LRS for vegetation management.

The General Conformity Rule applies to actions in air quality nonattainment or maintenance areas and considers both direct and indirect emissions. The rule applies only to federal actions that are considered “regionally significant” or where the total emissions from the action meet or exceed the de minimis thresholds presented in 40 CFR §93.153. Beale AFB is within a maintenance area for PM2.5. The LRS is in Placer County which is in moderate non-attainment for 8 hour ozone and PM2.5, and in Maintenance for carbon monoxide. The additional vehicle emissions would not result in an impact to the National Ambient Air Quality Standards or exceedance of General Conformity thresholds. Therefore, no significant effects to air quality would occur as a result of grazing expansion under Alternative 2.

Table 4.3. Estimated Air Pollutant Emissions for Proposed Personnel Increase (Mobile Source).

Pollutant	No Action Emissions[1]	Alternative 2 Emissions[2]	Increase
PM10	0.007 tpy	0.012 tpy	0.005 tpy
PM2.5	0.003 tpy	0.005 tpy	0.002 tpy
Carbon Monoxide	0.276 tpy	0.496 tpy	0.220 tpy
Carbon Dioxide	48.70 tpy	87.70 tpy	39.0 tpy
Nitrogen Oxides	0.023 tpy	0.042 tpy	0.019 tpy
Sulfur Oxides	0.0005 tpy	0.0009 tpy	0.0004 tpy

[1] Emissions estimated using the Air Conformity Applicability Model for 9 ranchers and 2 base personnel.
[2] Emissions estimated using the Air Conformity Applicability Model for 24 ranchers.
tpy = tons per year

Prescribed Burns

Prescribed burns conducted under Alternative 2 would have localized, moderate, temporary, adverse impacts to air quality. Smoke from prescribed fires and emissions from vehicles and equipment used for fire management would reduce visibility and overall air quality in the vicinity of these activities. Moderate adverse effects would be very localized at the sites of prescribed fires and short-term, on the order of less than 24 hours.

Wildland fires can emit large amounts of trace gases and particles. The wide variety of pollutants released by wildland fire include GHGs (carbon dioxide, methane, nitrous oxide), photochemically reactive compounds (e.g., carbon monoxide, nonmethane volatile organic carbon, nitrogen oxides), and fine and coarse PM. Wildland fires influence climate both directly, through the emission of GHGs and aerosols, and indirectly, via secondary effects on atmospheric chemistry (e.g., ozone formation) and aerosol and cloud microphysical properties and processes. Air quality impacts occur through the emission of primary pollutants (e.g., PM, carbon monoxide, nitrous oxide) and the production of secondary pollutants (e.g., ozone, secondary organic aerosols) when nonmethane volatile organic carbon and nitrous oxide released by fires undergo photochemical processing. Air quality can be degraded through local, regional, and continental scale transport and transformation of fire emissions (Urbanski et al. 2009).

Total emissions for various air pollutants from the proposed prescribed burns were calculated for Alternative 2 (Table 4.4). Fuel loads used to estimate emissions are based on desired RDM values of 300-1000 lbs/RDM/acre. The acreage used to estimate emissions (4,500 acres) reflects the maximum numbers of acres that would be burned annually under Alternative 2.

In accordance with the WFMP (Beale AFB 2018a; Appendix D), individual Prescribed Fire Plans would specify conditions required for burning that would minimize impacts to air quality from prescribed fire, including compliance with the requirements of state and local air quality regulatory agencies. Smoke management on Beale AFB and the LRS would follow recommendations of the latest edition of the National Wildfire Coordinating Group publication: *Smoke Management Guide for Prescribed Fire* (NWCG 2018) and smoke management guidelines in Section 3.6.3.2.4, *Smoke Management* of the WFMP. Each individual fire would also be required to have a Smoke Management Plan describing how impacts to human health and safety, including visibility impacts, would be avoided.

Table 4.4 Estimated Air Pollutant Emissions for Proposed Prescribed Burns at Beale AFB

Pollutant	Emission Factor [1]		Emissions per Acre				Alternative 2 Emissions (4,500 acres)			
			0.15 tons RDM/acre		0.5 tons RDM/acre					
PM10	21.6	lbs/ton	3.24	lbs	10.8	lbs	7.29	-	24.3	tpy
PM2.5	6.4	lbs/ton	0.96	lbs	3.2	lbs	2.16	-	7.2	tpy
Carbon Monoxide (CO)	86	lbs/ton	12.9	lbs	43	lbs	29.025	-	96.75	tpy
Carbon Dioxide (CO_2)	3663.2	lbs/ton	549.48	lbs	1831.6	lbs	1236.3	-	4121	tpy
Methane (CH_4)	5.7	lbs/ton	0.855	lbs	2.85	lbs	1.9238	-	6.413	tpy
Nitrous Oxide (N_2O) [2]	0.46	lbs/ton	0.069	lbs	0.23	lbs	0.1553	-	0.518	tpy
Nitrogen Oxides (NO_x) [3]	4.9	lbs/ton	0.735	lbs	2.45	lbs	1.6538	-	5.513	tpy
Sulfur Dioxide (SO_2) [3]	0.74	lbs/ton	0.111	lbs	0.37	lbs	0.2498	-	0.833	tpy

[1] Source: CONSUME model, based on National Wildfire Coordination Group data
[2] Source: AFCEC 2020. Air Emissions Guide for Air Force Transitory Sources Table 3-4
[3] AFCEC 2020 does not include NO_x or SO_2 entries, therefore NO_x was set to the specific crop values from Darley (1979), where available, or to the average field crop or orchard crop Darley values where specific crops were not listed. SO_2 values were set to the average of the Jenkins (1996) field crop values for the field crops, and the average of the Jenkins walnut and almond values for the orchard crops. Darley data were not used for SO_2 because of known over estimates due the method used.; Lbs/ton = pounds per ton; tpy = tons per year

In addition, all prescribed fires require burn day authorization from the local air district (FRAQMD or PCAPCD) and must be coordinated with the local air district, through the Beale AFB Air Quality Manager. Coordination with the air district would occur at least five days prior to the prescribed fire for weather considerations, the day prior to the prescribed fire for weather updates, and the morning of the prescribed fire to determine state allocated acreage for the area and the acreage that would be allocated by the air district. Open burning in Yuba and Sutter Counties must be done in accordance with FRAQMD Regulation II - Open Burning. Prescribed burns at the LRS must adhere to PCAPCD Regulation 303, *Prescribed Burning Smoke Management*.

Adverse effects to air quality from prescribed fires primarily affect visibility and human health. Effects would be minor to moderate because burns are permitted only when the applicable air quality management district believes that adverse effects of smoke on human health would be minimized. Burning would only be permitted when the smoke would go directly upward, and not towards neighboring properties. This is a greater concern at the LRS where there are several neighboring properties that have residences. Reduced visibility from smoke that drifts across roads would be mitigated by traffic controls during prescribed fires. Significant impacts to flying operations from reduced visibility would be avoided by coordinating the timing of prescribed burns with the Beale AFB Flight Safety Office. The primary concerns with smoke are generally at night when inversions can trap the smoke and elevate particulate levels, or when a fire is very intense or large. To mitigate these concerns, prescribed burns would be conducted during daytime hours and burn size would be limited to the numbers of acres approved for burning by the FRAQMD or PCAPCD. All impacts to air quality would be temporary and would not affect regional air quality attainment status. Emissions from fire response equipment is considered exempt. Therefore, no significant effects to air quality would occur from prescribed burns conducted as part of Alternative 2.

Chemical Treatments

Chemical treatments performed as part of Alternative 2 would result in negligible, temporary, adverse effects to air quality. Herbicide application could result in the fugitive release of VOCs and organic hazardous air pollutants from both active and inactive ingredients. Air pollutants may be emitted during pesticide application and up to 30 days after application. Although particulates may be emitted due to the use of granular or dust/powder herbicides, particulate matter emissions are considered negligible (AFCEC 2018). VOC emissions were estimated for the maximum number of acres that would potentially be treated under Alternative 2 and can be found in Table 4.5. Actual emissions would be lower if the maximum acreage is not treated within a given year. Although some of the herbicides proposed for use have the potential to emit VOCs, none of the active ingredients are subject to the California Department of Pesticide Regulation's nonfumigant VOC regulations (CA DPR 2019a).

Another concern with herbicide application is herbicide drift causing negative affects to nearby receptors (i.e., non-target plants, wildlife, or humans). Drift is most likely with aerial application. Spray drift is dependent primarily on droplet particle size, release height, and wind speed. Aerial application would not be used on Beale AFB, and spray-boom heights would generally be lower than those used in standard agricultural application methods.

By applying herbicides in accordance with product label requirements and the BMPs listed in Appendix G, including weather-related use restrictions, droplet size, and boom height restrictions, the risk of drift or volatilization would be minimized. Therefore, no significant effects to air quality would be anticipated as a result of chemical treatments under Alternative 2.

Table 4.5. Estimated Volatile Organic Compound (VOC) Emissions from Herbicide Applications.

Active Ingredient	Application Rate	Application Rate Unit	Acres Treated	Total VOC Emissions (lbs)	VOC Emission Rate (lbs/acre/application)
Aminopyralid, Triisopropanolamine salt	0.05	gallons/acre	1050	28.48	0.03
Chlorsulfuron	0.16	lbs/acre	205	0.33	0
Glyphosate, Isopropylamine salt	2.65	gallons/acre	170	0	0
Glyphosate, Isopropylamine salt	2	gallons/acre	144	0	0
Imazamox, ammonium salt	1	gallons/acre	2.5	8.56	3.43
Imazapyr, Isopropylamine salt	0.75	gallons/acre	137	52.22	0.38
Sulformeturon-Methyl	0.375	lbs/acre	322	1.23	0
Triclopyr, Butoxyethyl ester (BEE)	2	gallons/acre	157.5	213.62	1.36
Triclopyr, Triethylamine salt (TEA) – in formulation with aminopyralid	2.25	gallons/acre	27.5	30.03	1.09
Triclopyr, Triethylamine salt (TEA) – single chemical formulation	2.67	gallons/acre	18.25	53.79	2.95
Source: CA DPR 2019b.					

4.4 WATER RESOURCES

4.4.1 Alternative 1 (No Action Alternative)

No direct effects to groundwater would occur as a result of the No Action Alternative, but long-term, adverse, indirect effects could occur. Significant, long-term, adverse effects on surface water flow would be expected because invasive aquatic plants would not be controlled. Significant, long-term, adverse effects to wetlands would also be anticipated as a result of the No Action Alternative due to the potential for decreased water availability and altered wetland hydrology if invasive plant infestations go untreated. No direct impacts to floodplains would occur as a result of the No Action Alternative, but indirect adverse effects such as property or infrastructure damage from flooding could occur if invasive plants crowding water ways are not controlled.

4.4.1.1 Groundwater

No direct effects to groundwater would occur as a result of the No Action Alternative, but long-term, adverse, indirect effects could occur. On-going actions that have been analyzed individually in other documents would continue. Any new actions would be analyzed on a project-by-project basis using the USAF EIAP. Under the No Action Alternative, invasive plant biomass would be allowed to accumulate in the absence of adaptive grazing and limited prescribed burns. This would increase the risk of wildfire, and potentially result in larger and higher intensity burns. This may have the indirect effect of increased runoff, which could result in reduced groundwater levels through loss of recharge and lower stream base flow.

4.4.1.2 Surface Water

The No Action Alternative would have significant, long-term, indirect adverse effects on surface water. A number of aquatic invasive plants are present on Beale AFB. Giant reed is present at multiple locations along Dry Creek. If infestations continue to go untreated, they would eventually block the creek channel and alter the flow of the creek, preventing upstream fish passage. Large infestations of other aquatic invasive plants occur in still or slow-moving water. These infestations can block lake outflows and drainage channels, impede recreation, and reduce habitat quality for native species.

Under the No Action Alternative, terrestrial invasive plant biomass would be allowed to accumulate in the absence of adaptive grazing and limited prescribed burns. This would increase the risk of wildfire and potentially result in larger and higher intensity burns. Increased site runoff could result in a more rapid stream rise and an increased potential for flash floods. These burns could also have indirect impacts to water quality as a result of increased erosion and sediment and nutrient transport from storm water runoff.

4.4.1.3 Wetlands

Significant, long-term, adverse effects to wetlands would occur as a result of the No Action Alternative. Invasive plants often use more water than native plants. Large infestations of plants like giant reed, use so much water that they can alter the water availability and hydrology within a wetland. Under the No Action Alternative, giant reed infestations would continue to spread and use increasing amounts of water. Invasive plants such as medusahead and yellow starthistle have been shown to shorten the hydroperiod in vernal pools. Where infestations occur in wetlands, there is the potential for decreased water availability and altered wetland hydrology if infestations continue to go untreated.

4.4.1.4 Floodplains

No direct impacts to floodplains would occur as a result of the No Action Alternative. There is the potential for increased property or infrastructure damage from flooding if invasive plants crowding water ways are not controlled. If the plants crowd waterways it could increase the height or frequency of flooding by blocking flow within the channel.

4.4.2 Alternative 2 (Comprehensive Control)

Under Alternative 2 no significant effects to water resources would occur. Livestock would either be excluded from aquatic resources, or would be closely managed in areas where they could access aquatic resources. Vegetated buffers would be used to protect aquatic resources from erosion resulting from prescribed burns. Herbicide-specific application buffers would be implemented around aquatic resources to prevent contamination. Any herbicide application in or adjacent to aquatic resources would be done using aquatic-approved herbicides and would follow the Aquatic Pesticide Application Plan best management practices and monitoring requirements. Erosion control measures would be implemented for large areas of exposed ground to reduce the potential for erosion and water contamination. Work conducted in wetlands and 100-year floodplains is anticipated to have overall beneficial impacts by improving water flow and wetland hydrology. Ground disturbance within wetlands and floodplains would be minimized to the greatest extent possible, including limiting firebreak creation to non-soil disturbing methods. A Notice of Intent to prepare an EA for Proposed Actions that would occur in floodplains and may affect wetlands was published in the Marysville Appeal-Democrat newspaper, soliciting public comments on 2 and 6 October 2019. The notice invited the public to provide comments on the proposal and any practicable alternatives that may reduce impacts by 31 October 2019. No comments were received.

4.4.2.1 Groundwater

Grazing

Grazing under Alternative 2 would result in negligible, long-term, adverse impacts to groundwater. Long-term, negative impacts to groundwater are possible if an area is overgrazed, but this would be avoided with proper management. Overgrazing in both upland and riparian areas can adversely impact the water table. Direct effects of grazing are decreased infiltration due to loss of vegetation, compaction of soil, and increased runoff. Bare soil is more exposed, leading to greater evaporation and subsequent loss of soil moisture. Changes to channel morphology may alter the direction and rate of groundwater flow and the depth to groundwater. Stream bank changes, such as down-cutting lower the streambed and groundwater table (U.S. EPA 1994). By carefully monitoring and managing grazing in accordance with the GMG (Beale AFB 2017b; Appendix C), impacts to groundwater would be negligible.

Troughs would be installed in new pastures created for the grazing expansion. Where possible, troughs would be tied into existing waterlines, but some would require the installation of solar-powered wells. Using groundwater for agricultural purposes is considered a “beneficial use” by the State Water Resources Control Board. Wells would be permitted by the Yuba County Department of Environmental Health. When reviewing the permit application, the Department of Environmental Health verifies that the proposed well location(s) and construction details meet Department of Water Resources’ requirements (Yuba County Water Agency 2010). Therefore, significant impacts to groundwater would not occur as a result of expanding the grazing program under Alternative 2. Groundwater monitoring wells are part of the Environmental Restoration Program, and are discussed in Section 4.6, Hazardous Material/Waste.

Prescribed Burns

Minor, temporary, adverse impacts to groundwater could result from prescribed burns due to loss of vegetation and associated increased runoff following precipitation events. Increased site runoff could result in a more rapid stream rise and greater potential for flash floods. Increased runoff could also result in reduced groundwater levels through loss of recharge and lower stream base flow. As part of the planning process, prescribed burns would be physically spaced and timed to prevent the concentration of impacts in a small area. This would allow the ecosystem to assimilate the effects of burning without substantial change and would help minimize potential indirect impacts to groundwater. Therefore, no impacts to groundwater would be anticipated as a result of prescribed burns under Alternative 2.

Chemical Treatments

Chemical treatments would have negligible, short-term, adverse effects to groundwater. There is the potential for pesticides to leach into groundwater if improperly applied. Major factors influencing herbicide movement into groundwater include the herbicide’s solubility in water, its photo- or biodegradation characteristics, its ability to bind with soil and organic matter, and its ability to persist until it reaches a water source. In addition to chemical mobility, other factors can influence herbicide activity underground and result in groundwater contamination. For example, if microorganisms in the soil that decompose herbicides are absent, as found in some water-saturated soils, herbicides may persist longer than they would in unsaturated soils (Eglin AFB 2008). See Table 4.6 for mobility, groundwater contamination potential, and half-life (the time it takes for 50% of a chemical to degrade or break down) in water of each herbicide’s active ingredient. The risk of groundwater contamination would be minimized by selecting pesticides with low soil mobility in sensitive areas and shallow soils, and adhering to herbicide applications BMPs in Appendix G.

Table 4.6. Mobility, Ground and Surfacewater Contamination Potential and Half-lives of Herbicide Active Ingredients in Water.

Herbicide	Mobility	Water Contamination Potential	Half-life in Water
Aminopyralid [1]	Mobile to highly mobile	Potential to reach groundwater in soils with low organic carbon content or shallow groundwater	0.6 days
Chlorsulfuron [2]	Mobile to highly mobile	Moderate potential to contaminate groundwater. High potential for surface runoff	Low pH: 22-23 days High pH: does not degrade
Glyphosate [3]	Slightly mobile to hardly mobile	Very low potential to contaminate groundwater	7 to 14 days
Imazamox [4]	Very mobile	Potential to contaminate groundwater	6.8 hours
Imazapyr [5]	Mobile	High potential to leach to groundwater, High surface water runoff potential	2.3 to 3 days
Sulfometuron Methyl [6]	Moderately mobile	Potential to leach to groundwater in permeable soils with shallow groundwater, High potential for surface runoff.	6 days to 7 months; slower at high pH.
Triclopyr [7]	Highly mobile	Potential to contaminate groundwater	0.6 to 9.3 days.

[1] U.S. EPA 2014a [3] U.S. EPA 2009 [5] U.S. EPA 2014c [7] U.S. EPA 2014d
[2] U.S. EPA 2012a [4] U.S. EPA 2014b [6] U.S. EPA 2008

Manual/Mechanical, and Restoration Treatments

Manual/mechanical, and restoration treatments would have no effect on groundwater. Manual/mechanical treatment may result in some loss of vegetative cover, but manually treated areas would be too small to significantly increase runoff, and most mechanical treatments leave behind vegetation stubble and root structures that slow water movement. Areas where giant reed would be removed using heavy equipment are not on sloped surfaces, and would be revegetated. Restoration treatments are designed to increase vegetation cover, not reduce it. Therefore, effects to groundwater would not occur as a result of these treatments under Alternative 2.

4.4.2.2 Surface Water

Grazing

There would be the potential for minor, permanent, adverse effects to surface water as a result of expanding the grazing program under Alternative 2, but these impacts would be avoided through careful grazing management. Cattle grazing is currently excluded from the Dry Creek riparian area and many of the ponds and lakes on Beale AFB. Alternative 2 would allow for targeted grazing of these areas to achieve invasive species control and biomass reduction goals.

Cattle and horses, as heavier animals, can have an impact on soil stability and creek banks, as can large numbers of smaller livestock. Cattle, in particular, are attracted to riparian zones. Livestock grazing may create conditions that decrease soil infiltration, increase runoff, and increase sedimentation and erosion from rangelands. These direct impacts can affect the hydrologic regime and water quality of receiving streams.

Decreased soil infiltration often associated with increased grazing intensities can result in increased overland flow. This increase in runoff often results in increased erosion and sediment production. Also, the loss of vegetation resulting from livestock grazing leaves more bare ground, further exacerbating the sedimentation problems associated with grazing. This input of additional runoff water into streams can result in fairly significant channel modification and a host of related effects (e.g., reduction in the cover and area suitable for fish habitat). Overgrazing can also affect channel morphology and water quality through impacts to stream banks. Increased runoff, greater sediment load, stream bank erosion, loss of ground cover, and loss of root biomass all contribute to the instability of the stream system, causing increased incision (down-cutting and head or back-cutting) and widening of the stream channel (U.S. EPA 1994). Livestock grazing can also cause an increase the level of bacterial pollutants (i.e., fecal coliform) in water, as well as nutrient enrichment. The level of severity is related to the intensity of grazing activities and the proximity of animals to the water.

The Beale AFB storm water monitoring program has never identified any adverse impacts to surface water quality from the cattle grazing program. Under Alternative 2, cattle use of water features would be carefully monitored. Stocking rates would be kept at a level that would not result in adverse impacts to surface water. Livestock would be distributed so as to maintain density and diversity of vegetation and to minimize erosion, sedimentation, and adverse impacts to surface water. By carefully monitoring and managing grazing in accordance with the GMG (Beale AFB 2017b; Appendix C), impacts to hydrology would be minimized. Therefore, no significant impacts to surface water would occur as a result of grazing expansion as part of Alternative 2.

Prescribed Burns

Temporary, moderate, adverse effects to surface water quality could occur as a result of nutrient transport in runoff following burns or disturbed soils on firebreaks. Transport could occur downslope, into immediately adjacent waters, or downstream from a headwater wetland that is within a burn area. Impacts to waters may result from:

- Sediment – soil material suspended in water resulting from erosion. Sediment from runoff causes cloudy water and covers the bottom of streams and lakes. These conditions limit the ability of aquatic organisms to breathe, feed, and reproduce.
- Nutrients – chemical elements required by plants and animals to live and grow. Ash remaining after a burn contains readily available nutrients that could be transported into waters. Excess nutrients can be toxic to aquatic life, cause undesirable aquatic plant growth, and change water color.
- Elevated Water Temperature – caused by direct sunlight resulting from tree canopy removal adjacent to waterways. Elevated water temperature limits the ability of aquatic organisms to breathe, feed, and reproduce (TDA Division of Forestry 2003).

No prescribed burns are planned for the Dry Creek Riparian corridor, so water quality in Dry Creek would not be affected. The topography around Hutchinson and Reeds creeks is generally flat, so the run-off potential is fairly limited. If prescribed burns are conducted adjacent to a creek or other water body, a vegetated buffer would be maintained between it and the burn area to trap sediment and ash before it could enter the water course/body.

As part of the planning process, prescribed burns would be physically spaced and timed to prevent concentration of potential impacts in a small area. This would allow the ecosystem to assimilate the effects of burning without substantial change and would help minimize potential hydrologic impacts. Prescribed burns would be timed appropriately when soil moisture is moderate to allow for a cooler burn and to reduce the resident heat time. This would aid in keeping the root structure intact and thus reducing the chances of erosion. Following a prescribed burn, there could be a minor increase in runoff resulting from loss of ground cover. Ground vegetation would re-establish following burns, thus minimizing runoff potential. Therefore, no significant impacts to surface water would occur as a result of prescribed burns as part of Alternative 2.

Chemical Treatments

There would be the potential for surface water contamination due to pesticide application. Contamination could result from storm water runoff, accidental drift, direct spraying, or an accidental spill a water body or wetland with an herbicide not labeled for aquatic use. Major factors influencing herbicide movement from an upland site to surface water include the herbicide's solubility in water, its photo- or biodegradation characteristics, its ability to bind with soil and organic matter, and its ability to persist until it reaches a water source. Wet, marshy areas generally contain higher levels of herbicides for longer periods of time than do upland areas. If applied to seasonally dry stream channels, herbicides or their decomposition products may move into surface waters when rainfall occurs. See Table 4.6 for mobility, groundwater contamination potential, and degradation processes/rates in water of the active ingredients of herbicides proposed for use.

Water contamination rates were estimated for the herbicides proposed for use as part of the Human Health Hazard Assessment (Appendix J) prepared for this EA. For the hazard assessment, two types of estimates were made for the concentration of selected herbicides in ambient water: acute exposure from an accidental spill and longer-term exposure theoretically associated with the typical application of this compound to a 100-acre treatment area.

The estimates of short- and long-term concentrations of the herbicides in receiving waters are summarized in Table 4.7. It is important to note that water monitoring conducted by the U.S. Forest Service from 1991-2001, involving glyphosate and triclopyr, did not show levels of water contamination as high as these for normal (i.e., not accidental) applications (USDA 2001). This indicates that, at least for these two herbicides, the assumptions in this risk assessment are a conservative (i.e., protective) assessment of risk.

Because there is the potential for surface water contamination, an Aquatic Pesticide Application Plan was prepared to satisfy a general requirement for obtaining coverage under the Statewide General NPDES Permit for Residual Aquatic Pesticide Discharges to WoUS from Algae and Aquatic Weed Control Applications. The plan includes BMPs to reduce water quality impacts (see Appendix G), and how those impacts would be monitored in accordance with Water Quality Order No. 2013-0002-DWQ. Adherence to these and other herbicide application BMPs, including aquatic resource buffers (see Table 1 in Appendix G) would minimize the risk of surface water contamination. In a meta-analysis of buffer studies, Zhang et al. (2009) reported that buffers of 65 feet had a 92% efficacy at removing herbicide from runoff. Therefore, no significant impacts to surface water would occur as a result of chemical treatments under Alternative 2.

Manual/Mechanical Treatments

There would be the potential for indirect, temporary adverse effects to surface water quality from soil erosion following manual or mechanical treatments. Most adverse effects would be avoided by implementing erosion control measures and revegetating treated areas. Ground disturbance from manual treatments would occur from drawing up a plant by its roots or digging sufficient to leverage the roots out. Disturbance from manual and mechanical treatments would be short term and not lead to chronic erosion from the relatively small disturbance footprint and retained groundcover.

There would be a short-term risk of erosion from disturbed ground if a highly infested area had contiguous bare ground sufficient to initiate surface erosion, or was on a feature such as a roadside slope that was subject to surface runoff. The risk would largely be due to slope of the ground and erosiveness of the slope, whether it was a natural surface or not. Any disturbance within 100 feet of a water body, sufficient in size to cause surface erosion, could potentially deliver sediment to the water body (USDA 2013).

Table 4.7. Water Contamination Rates of Herbicides and the Metabolite 3,5,6-trichloro-2-pyridinol (TCP).

Herbicide	Short-Term Rate (mg/L) [1]			Long-Term Rate (mg/L) [1]			NPDES Permit Limit [1]	EPA Limit [1]
	Typical	Low	High	Typical	Low	High		
Aminopyralid	0.1	0.002	0.6	0.04	0.001	0.26	na	3.0 [2]
Chlorsulfuron	0.1	0.01	0.2	0.0006	0.0001	0.0009	na	0.3 [2]
Glyphosate	0.011	0.0013	0.083	0.00019	0.000088	0.0058	0.7	0.7 [3]
Imazamox	0.5	0.5	0.5	0.36	0.36	0.36	9.4 [4,5]	na
Imazapyr	0.02	0.000009	0.26	0.007	0.000003	0.12	11.2 [3]	16.0 [3]
Sulfometuron Methyl	0.001	0.00006	0.02	0.00004	0.00001	0.00007	na	1.76 [3]
Triclopyr (TEA)	0.003	0.000001	0.24	0.001	0.0000000002	0.06	13.0 [3]	0.3 [3]
TCP [4]	0.0009	0.00000001	0.028	0.00005	0.000000000003	0.002	na	na

[1] milligrams/Liter (part per million [ppm]) per lb. active ingredient or acid equivalent applied, values in Table must be multiplied by the rate of application to estimate actual contamination rate.
[2] EPA Human Health Benchmarks for Pesticides (U.S. EPA 2017b)
[3] EPA Maximum Contaminant Levels (Toccalino and Morman 2018)
[4] Ambient Water Quality Criteria are unavailable for imazamox and imazamox salt, the value shown is one-tenth of the lowest LC50 to protect the most sensitive freshwater aquatic life for imazamox is greater than 9.4 mg/l.
[5] Due to its safe use in the environment or absence of water quality criteria and low toxicity to aquatic life as indicated in U.S. EPA's Ecotoxicity Database, the NPDES Permit does not have a receiving water limitation for this chemical. The monitoring trigger is based on one-tenth of the lowest LC50 from U.S. EPA's Ecotoxicity Database and requires receiving water monitoring to collect data, which provide information on whether the chemicals have water quality impacts.
[4] Because TCP is a biproduct of triclopyr it is not regulated individually.

Mechanical removal of giant reed using excavators would also cause temporary soil disturbance. The roots of giant reed are very shallow, so soil disturbance would be limited to the top two feet of soil. Areas of exposed soil would be protected from erosion by re-seeding with a wetland plant seed mix or other riparian vegetation. Other treatments such as cutting, clipping, mowing and mulching do not cause ground disturbance. Therefore, no significant impacts to surface water would occur as a result of manual or mechanical treatments under Alternative 2.

Restoration Treatments

Disking treatments associated with restoration projects may have indirect, temporary adverse effects on surface water quality. There is potential for soil run-off if a site receives precipitation prior to seeding and installation of erosion control measures, or if very heavy precipitation occurs shortly after seeding. Disking would not be used immediately adjacent to drainages without leaving a vegetated buffer. The restoration areas would be fairly small, and the ultimate goal of restoration treatments is to increase vegetative cover of native plants, so any negative effects would be minor and temporary. Therefore, no significant impacts to surface water quality would occur as a result of restoration treatments under Alternative 2.

4.4.2.3 Wetlands

Grazing

Alternative 2 could result in both positive and negative impacts to wetlands. Available scientific data indicate limited grazing is an essential component of vernal pool management (Marty 2015). The USFWS (2012) issued an opinion to Beale AFB that grazing would benefit vernal pool crustaceans by removing thatch, controlling invasive grasses, and improving the hydrology of the vernal pools and swales. Expanding the grazing program is anticipated to have a positive impact on vernal pool wetlands in currently ungrazed areas.

Alternative 2 could result in minor positive impacts to other wetland vegetation and minor negative impacts on erosion and pollution in those wetlands open to grazing. Limiting the number of cattle with access to these areas, monitoring, and ensuring proper distribution of the animals would help control invasive plants and enable more functional vegetation to reestablish in these sensitive areas, without increasing erosion or polluting the watershed. If overgrazing occurs, negative impacts could include increased erosion, sedimentation, and fecal pollution (U.S. EPA 1994). Under Alternative 2, livestock would be closely monitored in wetland habitats and removed before overgrazing occurred to provide positive impacts while minimizing adverse impacts. Adverse effects would be avoided by maintaining 800 lbs RDM/acre in sensitive resource areas and in pastures with soils or slopes susceptible to erosion. If lower RDM targets are desired for resource management purposes, additional monitoring would occur as needed to prevent overgrazing.

Ground-disturbing activities associated with grazing infrastructure installation (post-driving, trenching, filling, scraping) adjacent to WoUS could have temporary, minimal impacts. All new grazing infrastructure would be designed to avoid effects to sensitive habitats. To minimize adverse effects to species and habitat, all field-verified wetlands, drainages, and vernal pools within 50 feet of proposed infrastructure locations would be protected by implementation of the AMMs in Appendix G. It would be anticipated that any effects to wetlands from infrastructure installation would be temporary and self-mitigating. Based on past monitoring of the managed grazing program and implementation of AMMs, Alternative 2 would not have a significant impact on wetland habitat.

Prescribed Burns

Alternative 2 may result in direct, temporary adverse effects to wetlands. The creation of firebreaks (mown, handlines, scraped firebreaks, etc.) have the potential to negatively affect wetlands. Handlines and scraped firebreaks could cause soil and vegetation disturbance, and in extreme cases could alter wetland hydrology. Mown and wet lines would be used to the greatest extent possible when conducting prescribed burns to avoid soil disturbance. Blacklining would be the alternative to mowing, when feasible. Mineral firebreaks would not be used in wetlands. Fireline construction would avoid all sensitive habitats and active wildlife dens and nests. Torching would not require firelines and would be extremely localized. Therefore, no significant impacts to wetlands would occur as a result of prescribed burns as part of Alternative 2.

Chemical Treatments

Long-term beneficial impacts to wetlands would occur as a result of chemical treatments under Alternative 2. Many invasive plants use a greater amount of water than native plants, potentially altering wetland hydrology. Removal of these plants would help maintain natural hydrological regimes. Chemical treatments would have the potential for direct and indirect, temporary negative impacts to wetlands through soil and water contamination or through direct mortality of non-target plants. The risks of contamination and environmental persistence of herbicides proposed for use are described in Sections 4.4.2.1, *Groundwater*, 4.4.2.2, *Surface Water*, and 4.9.2.2, *Soils*. Implementation of the BMPs in Appendix G would minimize the risk of soil and water contamination within wetlands. Herbicide would be applied in such a way as to minimize drift and other accidental exposure to non-target vegetation. Wetland-specific protection measures include: only applying herbicide in and around wetlands during the dry season, restricting application prior to rain events, using herbicides and additives approved for aquatic use in and around wetlands, and adhering to aquatic resource protection buffers (Table 1 in Appendix G). Therefore, no significant impacts to wetlands would occur as a result of chemical treatments as part of Alternative 2.

Manual/Mechanical Treatments

There would be the potential for direct, short and long-term negative effects and long-term beneficial effects to wetlands as a result of invasive plant removal using heavy equipment. There would be the potential for negative impacts to soils and biota from crushing or disturbance from excavation. In wetlands, the use of heavy equipment and ride-on mowers would be limited to the dry season when the soil is no longer saturated. By restricting the use of flail mowers or masticators for Himalayan blackberry removal to the dry season, no effects to wetlands would occur.

Giant reed control using excavators may be implemented in wetlands. This treatment is covered under the USACE Nationwide Permit 27, *Aquatic Habitat Restoration, Enhancement, and Establishment Activities*. A pre-construction notification would be sent to USACE prior to project initiation. Treatments would be done during the dry season. The roots of giant reed are very shallow, so soil disturbance would be limited to the top two feet of soil. Areas of exposed soil would be protected from erosion by re-seeding with a wetland seed mix or riparian vegetation and/or by installing physical erosion prevention structures. No excavation using heavy machinery would be used in or near vernal pools. These treatments would occur to have long-term beneficial effects to wetlands by increasing water availability within the system. By following the BMPs in Appendix G, the effect of mechanical treatments using heavy equipment would be minimized. No impacts would occur as a result of using hand-held tools and equipment. Therefore, no significant impacts to wetlands would occur as a result of manual/mechanical treatments as part of Alternative 2.

Restoration Treatments

Restoration treatments would have long-term direct and indirect beneficial effects on wetlands. Disking would not be used for restoration plantings within wetlands. Wetland areas would be revegetated using wetland-specific seed mixes and/or container plants. No impacts would occur as a result of using hand-held tools and equipment to maintain restoration plantings. It is anticipated that adherence to the BMPs in Appendix G would result in “no net loss” of riparian vegetation or shaded riverine aquatic habitat as a result of the Alternative 2.

4.4.2.4 Floodplains

EO 11988, *Floodplain Management*, requires federal agencies to avoid adverse impacts such as property and infrastructure damage and impacts to human safety, health and welfare that are associated with the occupancy and modification of floodplains. It also requires federal agencies to avoid floodplain development where there is a practicable alternative, and to restore and preserve the natural and beneficial values served by floodplains. The EO applies to major federal actions significantly affecting the quality of the human environment that would occur in a floodplain. None of the treatments included in Alternative 2 would have an impact on human safety, health or welfare in the event of a flood. Alternative 2 would have beneficial long-term effects by restoring and preserving the natural and beneficial values served by floodplains.

All invasive plant control actions conducted under Alternative 2 would occur to have direct and indirect beneficial impacts to floodplains. The invasive plant treatments would reduce the hazard and risk of flood loss by improving water flow and floodplain functionality by controlling invasive vegetation growing in waterways and floodplains. Successful invasive plant control and revegetation of floodplains with native plant species would help to reduce the impact of floods on human safety, health, and welfare. Therefore, no significant impacts to floodplains would occur as a result of Alternative 2.

If this work is not conducted in floodplains, invasive plants currently degrading floodplains and water ways would not be controlled, which would lead to increased risk of flood damage and reduced floodplain functionality and biodiversity. Therefore, a FONPA would be warranted if the Alternative 2 is selected.

4.5 SAFETY AND OCCUPATIONAL HEALTH

4.5.1 Alternative 1 (No Action Alternative)

No new effects to safety and occupational health including public services would occur as a result of the No Action Alternative. The effects of prescribed burns and chemical treatments conducted under the No Action Alternative have been analyzed in other EIAP/NEPA documents.

Grazing

No new effects to health or occupational safety would occur as a result of continuation of the existing grazing program under the No Action Alternative.

Prescribed Burns

Potential air quality impacts, including anticipated levels of particulate matter are addressed in Section 4.3, *Air Quality*. Under the No Action Alternative, safety and occupational health would be assessed for each burn individually during the USAF EIAP.

Chemical Treatments

Under the No Action Alternative, no new herbicide use would occur. Past and ongoing herbicide applications on Beale AFB include the use of glyphosate. There would be the potential for herbicide exposure from projects on Beale AFB currently being conducted that would continue under the No Action Alternative. Ongoing treatments include yellow starthistle control on the airfield, Himalayan blackberry control along Reeds Creek, and incidental invasive plant control conducted by Beale AFB Pest Management and grounds maintenance contractors. It is assumed that there would not be any extensive changes in these use patterns into the near future, as those projects have been analyzed in other EIAP/NEPA documents.

Manual/Mechanical and Restoration Treatments

No new effects to health or occupational safety would occur as a result of implementing manual or mechanical treatments under the No Action Alternative. Under this alternative, safety and occupational health would be assessed for each project individually during the USAF EIAP.

4.5.2 Alternative 2 (Comprehensive Control)

Alternative 2 would have an overall significant, long-term, positive impact on safety and occupational health due to the reduction of the fire hazard caused by excess plant biomass. With the implementation of safety requirements and procedures in the WFMP (Beale AFB 2018a; Appendix D) and individual Prescribed Fire Plans, prescribed burns would have negligible, adverse, temporary effects on safety and occupational health. Herbicide application could result in minor, temporary and short-term, adverse effects to safety and occupational health. The risk of herbicide exposure would be reduced through adherence to label directions and applicable AMMs. There would be a slight risk of minor, temporary, adverse effects to workers from accidental injury from tools or heat exposure, and the potential significant, long-term, adverse effect of hearing damage from using equipment without appropriate PPE. Alternative 2 invasive species control activities would not result in adverse physical impacts to government facilities, would not require new or altered government facilities in order to maintain service ratios, and would not reduce or affect response times of any public service offered on Beale AFB.

Grazing

Alternative 2 would lead to minor, long-term, beneficial effects to safety and occupational health. California Farm Bureau Federation policy recognizes that grazing is the most practical and environmentally acceptable way to prevent the buildup of excessive, dry vegetation that can lead to catastrophic wildfires. Alternative 2 would have a positive impact on safety due to the reduction of fire hazards.

Prescribed Burns

Alternative 2 would have negligible, adverse, temporary effects and minor, long-term beneficial effects to health and human safety. Prescribed burns would be conducted in accordance with safety requirements and procedures in the WFMP and individual Prescribed Fire Plans. With the implementation of plans there would be negligible to minor, temporary, adverse effects to safety and occupational health. The safety of installation and cooperator firefighters is of the utmost concern in all wildland fire operations. Controlled burn standards for prescribed burns would be implemented to protect workers. A Prescribed Fire Plan, which would include a Job Hazard Analysis, would be prepared for each prescribed burn. Safety would be promoted through training, removal of hazards, adhering to the Job Hazard Analysis, and through provisions for PPE and devices. The procedure, equipment, and number of trained personnel would be adequate to accomplish the intended purposes. Oversight and implementation of prescribed burns would be conducted by personnel from the Beale AFB Wildland Fire Module. The Beale AFB Fire Department is responsible for obtaining all permits related to occupational health and safety. Regular implementation of prescribed burns would have a minor, long-term, beneficial effect on human safety by reducing fuel loads and lessening the potential for a high-intensity wildfire, and provide live fire training opportunities. While the Fire Department is directly involved in managing and executing prescribed burns, it may have reduced availability or response times to the public. However, its participation in prescribed burns would have long-term benefits as it would reduce the prevalence of more catastrophic wildfires, ultimately increasing public service. There would be the possibility of fires escaping from control lines, and even burning off the base or LRS. The risk to human safety would be greater at the LRS because of the proximity of residences. Escaped fires on the LRS would be prevented to the greatest extent possible by conducting burns early in the season when vegetation moisture is higher and fires would be easier to control, and by having Cal Fire and a dozer on-site during prescribed burns. Most of the land directly adjacent to Beale AFB is agricultural, so escaped fires would pose less of an immediate risk to human safety. The base heavy equipment operators would be on stand-by during any prescribed burns in the event that one escaped control lines. Therefore, under Alternative 2, impacts to health and safety would be minor to beneficial.

Chemical Treatments

Alternative 2 could result in minor, temporary and short-term, adverse effects to safety and occupational health. Long-term adverse effects to safety and occupational health could result from improper herbicide handling or application. Adherence to label directions and the AMMs in Appendix G would reduce the risk of herbicide exposure for both workers and the general public. A Human Health Risk Assessment associated with the proposed use of herbicide was prepared for this project and is included in Appendix J. The analysis of the potential human health effects associated with the use of chemical herbicides uses the risk assessment method generally accepted by the scientific community (NRC 1983; U.S. EPA 1986). In essence, this herbicide risk assessment compares possible herbicide doses for various exposure scenarios experienced by workers and the public with the EPA's established reference doses (RfDs). RfDs are based on doses shown to cause no observed ill effects in test animals in either short-term (acute) or long-term (sub-chronic or chronic) studies. Much of the information used in the risk assessment completed for this project was gathered from herbicide-specific risk assessments completed by Syracuse Environmental Research Associates, Inc. (SERA), and the Human Health Risk Assessment prepared for the EA of Eradication and Control of Invasive Plants on the El Dorado National Forest (Carroll 2012; USDA 2013). The site-specific risk assessment also examines the potential for these treatments to cause synergistic effects, cumulative effects, and effects on sensitive individuals, including women and children. For each type of dose assumed for workers and the public, a hazard quotient (HQ) was computed by dividing the potential dose of herbicide by the RfD. If an HQ is ≤ 1, the risk of effects is considered negligible and below a level of concern.

The Human Health Risk Assessment completed for this project analyzed the potential for adverse health effects in workers and members of the public from the use of the proposed herbicides. Workers include applicators, supervisors, and other personnel directly involved in the application of the herbicides. The public includes base personnel who are not directly involved in the herbicide application, and other base occupants and visitors who could be exposed through the drift of herbicide spray droplets, through contact with vegetation, by eating or placing in the mouth food items or other plant materials such as berries or shoots growing in or near treated areas, by eating game or fish containing herbicide residues, or by drinking water that contains residues. The risk assessment examines the potential health effects on all groups of people who might be exposed to any of the herbicides proposed for use.

The uncertainty factors used in the development of the RfD takes into account much of the variation in human response. The uncertainty factor of 10 for sensitive subgroups is sufficient to ensure that most people would experience no toxic effects. "Sensitive" individuals are those that might respond to a lower dose than average, which includes women and children. As stated by the National Academy of Sciences (1993), the quantitative differences in toxicity between children and adults are usually less than a factor of approximately ten-fold. An uncertainty factor of 10 for sensitive subgroups may not cover all individuals that may be sensitive to herbicides because human susceptibility to toxic substances can vary by two to three orders of magnitude. Factors affecting individual susceptibility include diet, age, heredity, preexisting diseases, and life style. Individual susceptibility to the herbicides proposed in this project cannot be specifically predicted. Unusually sensitive individuals may experience effects even when the HQ is less than or equal to one.

Aminopyralid

Workers: The HQs for acute exposure are based on an acute oral RfD of 1.0 mg/kg/day and the HQs for chronic exposures are based on a chronic RfD of 0.5 mg/kg/day. For workers, no exposure scenarios, acute or chronic, exceeds the RfD at the upper bound of the estimated dose associated with the highest anticipated application rate of 0.11 lbs acid equivalent/acre (ae/ac), or the maximum label application rate of 0.22 lbs ae/ac. The HQs for directed ground spray are below the level of concern by a factor of at least 50 over the range of application rates considered in this risk assessment.

Given the very low HQs for both general occupational exposures and accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios approach a level of concern.

General Public: The same RfDs for aminopyralid of 1.0 mg/kg/day for acute and 0.5 mg/kg/day for chronic used for workers were also used for the public. For the public, no exposure scenarios, acute or chronic, exceeds the RfD or approaches a level of concern at the upper bound of the estimated dose associated with the highest anticipated application rate of 0.11 lbs ae/ac.

Exposure resulting from the consumption of contaminated vegetation is of greatest concern. This exposure scenario has a HQ of 0.15, at the upper level, which is well below the level of concern. Exposure as the result of consuming water contaminated from a spill is 0.22 for a child; however, this is a very unlikely scenario and still below the level of concern. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day. If any of these conservative assumptions were modified, the HQs would drop substantially.

Although there are several uncertainties in the longer-term exposure assessments for the general public, the upper limits for HQs are sufficiently far below a level of concern that the risk characterization is relatively unambiguous: based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that the general public would be at any substantial risk from longer-term exposure to aminopyralid.

The risk characterization given in this risk assessment is qualitatively similar to that given by the EPA: no risks to workers or members of the general public would occur. The current risk assessment derives somewhat higher HQs than those in the EPA human health risk assessment because the current risk assessment uses a number of extreme exposure scenarios that are not used by the EPA.

Sensitive Individuals: There is no information to suggest that specific groups or individuals may be especially sensitive to the systemic effects of aminopyralid. Due to the lack of data in humans, the effects of aminopyralid in humans, if any, cannot be identified. It is not clear that aminopyralid has any remarkable systemic toxic effects. The most common effects in experimental mammals are on the gastrointestinal tract. These effects are variable among different mammalian species and appear to be associated with exposure levels substantially higher than any likely human exposures. Thus, it would seem highly speculative to suggest that individuals with gastrointestinal diseases might be more susceptible than other individuals to aminopyralid (SERA 2007).

Chlorsulfuron

Workers: The toxicity data on chlorsulfuron allows for separate dose-response assessments for acute and chronic exposures. For acute exposures, the HQs are based on EPA recommended acute RfD of 0.25 mg/kg/day. For chronic exposures, the HQs are based on the proposed chronic RfD from the EPA of 0.02 mg/kg/day. Given the very low HQs for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios approach a level of concern.

Given that the highest HQ for any of the accidental exposures is a factor of about 2,000 below the level of concern, more severe and less plausible scenarios would be required to suggest a potential for systemic toxic effects. The HQs for general occupational exposure scenarios are somewhat higher than those for the accidental exposure scenarios. The upper limit of the HQs (0.9) approaches the level of concern. However, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified, the HQs would drop substantially. The simple verbal interpretation of this quantitative characterization of risk is that, even under the most conservative set of exposure assumptions, workers would not be exposed to levels of chlorsulfuron that are regarded as unacceptable. Under typical application conditions, levels of exposure would be far below levels of concern.

Mild irritation to the skin and eyes can result from exposure to relatively high levels of chlorsulfuron, i.e., placement of chlorsulfuron directly onto the eye or skin. From a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling chlorsulfuron. These effects would be minimized or avoided by prudent industrial hygiene practices during the handling of the compound.

General Public: As with workers, the HQs for acute exposure are based on an acute oral RfD of 0.25 mg/kg/day and a chronic RfD of 0.02 mg/kg/day. None of the acute scenarios exceed a level of concern. The consumption of contaminated vegetation has an HQ of 0.7, at the upper level. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified, the HQs would drop substantially.

The longer-term consumption of contaminated vegetation after application of the highest dose yields an HQ that is greater than unity (HQ= 3.5) at the highest dose. At typical and lower levels of exposure, this scenario yields HQs below a level of concern. This is a common pattern with herbicides or any pesticide applied directly to plants. The scenario for the longer-term consumption of contaminated vegetation is also an extremely conservative assumption, in that most plants treated with herbicide at the highest application rate would show some signs of damage and humans would not be likely to consume the plant over a prolonged period of time.

Chlorsulfuron is listed by the state of California on its Groundwater Protection List and is a reproductive toxicant under Proposition 65 (the Safe Drinking Water and Toxic Enforcement Act of 1986).

Sensitive Individuals: There is no information to suggest that specific groups or individuals may be especially sensitive to the systemic effects of chlorsulfuron. Due to the lack of data in humans, the likely critical effect of chlorsulfuron in humans cannot be identified clearly. In animals, the most sensitive effect of chlorsulfuron appears to be weight loss. There is also some evidence that chlorsulfuron may produce alterations in hematological parameters. However, it is unclear if individuals with pre-existing diseases of the hematological system or metabolic disorders would be particularly sensitive to chlorsulfuron exposure. Individuals with any severe disease condition could be considered more sensitive to many toxic agents (SERA 2004a).

The 1996 Food Quality Protection Act requires that the EPA evaluate an additional 10-times safety factor, based on data uncertainty or risks to certain age/sex groupings. The EPA has evaluated chlorsulfuron against this standard and has recommended a 3-times additional safety factor be used for the protection of infants and children. This additional 3-times safety factor was factored into the acute and chronic RfDs of the risk assessment as it applies to chlorsulfuron.

Glyphosate

Workers: For both acute and chronic scenarios, HQs are based on an RfD of 2 mg/kg/bw (U.S. EPA 2000b). Given the low HQs for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios exceed a level of concern. The accidental exposure scenarios represent reasonable accidental exposures, not the worst-case scenario. Given that the highest HQ for any of the accidental exposure scenarios is almost a factor of 100 below the level of concern, more severe and less plausible scenarios would be required to suggest a potential for systemic toxic effects.

The HQs for general occupational exposure scenarios are somewhat higher than those for the accidental exposure scenarios. Nonetheless, the upper limit HQs are below the level of concern. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified to reflect more realistic scenarios, the HQs would decrease substantially. The simple verbal interpretation of this quantitative characterization of risk is that even under the most conservative set of exposure assumptions, workers would not be exposed to levels of glyphosate that are regarded as unacceptable.

Glyphosate and glyphosate formulations are skin and eye irritants. Quantitative risk assessments for irritation are not normally derived, and, for glyphosate specifically, there is no indication that such a derivation is warranted. Glyphosate with a polyethoxylated tallowamine (POEA) surfactant, is about as irritating as standard dishwashing detergents, all-purpose cleaners, and baby shampoos (SERA 2003).

General Public: For both acute and chronic scenarios HQs are based on an RfD of 2 mg/kg/bw. None of the longer-term exposure scenarios approach a level of concern. Although there are several uncertainties in the longer-term exposure assessments for the general public, the upper limits for HQs are sufficiently far below a level of concern that the risk characterization is relatively unambiguous: based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that the general public would be at any substantial risk from longer-term exposure to glyphosate.

For the acute scenarios, the consumption of contaminated vegetation after application of the highest dose yields a HQ greater than unity (HQ = 2) at the highest dose. At typical and lower levels of exposure, this scenario yields HQs below a level of concern. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified, the HQs would drop substantially. In addition, signs at likely access points informing the public that an area has been sprayed would reduce the potential that freshly sprayed material would be consumed.

The other highest HQ for acute exposure scenarios is 5.1, from the consumption of contaminated water by a child after an accidental spill of 200 gallons of a field solution of glyphosate. It is important to realize that the exposure scenarios involving contaminated water are arbitrary scenarios: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting HQ. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of glyphosate, all of the HQs would decrease by a factor of 10. A further conservative aspect to the water contamination scenario is that it represents standing water, with no dilution by water flow or decomposition of the herbicide, both aspects that contribute to the conservatism of this assessment. This scenario would require a child to drink 1.5 liters of contaminated water from a non-potable standing water source, which is unlikely. To further prevent such unlikely scenarios, herbicides would not be mixed within 150 feet of open water in accordance with the BMPs in Appendix G. Nonetheless, this and other acute scenarios help to identify the types of scenarios that are of greatest concern and may warrant the greatest steps to mitigate. For glyphosate, such scenarios involve oral (contaminated water and vegetation) rather than dermal (spills or accidental spray) exposure.

Sensitive Individuals: No reports were encountered in the glyphosate literature leading to the identification of sensitive subgroups. There is no indication that glyphosate causes sensitization or allergic responses, which does not eliminate the possibility that some individuals might be sensitive to glyphosate as well as many other chemicals (SERA 2011b).

Carcinogenic Risk: Recent legal cases have highlighted concerns about the carcinogenic risk posed by glyphosate. Since its registration in 1974, numerous human and environmental health analyses have been completed for glyphosate, which consider all anticipated exposure pathways. The human carcinogenic potential of glyphosate has been evaluated by the EPA several times. Glyphosate is currently undergoing Registration Review. As part of this process, the hazard and exposure of glyphosate are reevaluated to determine its potential risk to human and environmental health using current practices and policies. As part of the current evaluation for Registration Review, the EPA has performed a comprehensive analysis of available data from submitted guideline studies and the open literature (U.S. EPA 2017a). This includes epidemiological, animal carcinogenicity, and genotoxicity studies.

According to the EPA (2017a) an extensive database exists for evaluating the carcinogenic potential of glyphosate, including 63 epidemiological studies, 14 animal carcinogenicity studies, and nearly 90 genotoxicity studies for the active ingredient glyphosate. These studies were evaluated for quality and results were analyzed across studies within each line of evidence. The modified Bradford Hill criteria were then used to evaluate multiple lines of evidence using concepts such as strength, consistency, dose response, temporal concordance and biological plausibility. The available data at this time do no support a carcinogenic process for glyphosate. Overall, animal carcinogenicity and genotoxicity studies were remarkably consistent and did not demonstrate a clear association between glyphosate exposure and outcomes of interest related to carcinogenic potential. In epidemiological studies, there was no evidence of an association between glyphosate exposure and numerous cancer outcomes; however, due to conflicting results and various limitations identified in studies investigating non-Hodgkin's lymphoma, a conclusion regarding the association between glyphosate exposure and risk of non-Hodgkin's lymphoma cannot be determined based on the available data. Increases in tumor incidence were not considered treatment-related in any of the animal carcinogenicity studies. In six of these studies, no tumors were identified for evaluation. In the remaining studies, the tumors were not considered treatment-related due to lack of pairwise statistical significance, lack of a monotonic dose response, absence of pre-neoplastic or related non-neoplastic lesions, no evidence of tumor progression, and/or historical control information (when available). Additionally, tumor findings seen in individual rat and mouse studies were not reproduced in other studies, including those conducted in the same animal species and strain at similar or higher doses. Furthermore, data from epidemiological and animal carcinogenicity studies do not reliably demonstrate expected dose-response relationships. In genotoxicity studies, there was no convincing evidence that glyphosate is genotoxic in vivo via the oral route.

For cancer descriptors, the available data and weight-of-evidence clearly do not support the descriptors “carcinogenic to humans”, “likely to be carcinogenic to humans”, or “inadequate information to assess carcinogenic potential”. For the “suggestive evidence of carcinogenic potential” descriptor, considerations could be looked at in isolation. However, following a thorough integrative weight-of-evidence evaluation of the available data, the database would not support this cancer descriptor. The strongest support is for “not likely to be carcinogenic to humans” (U.S. EPA 2017a).

Although the International Agency for Research on Cancer (2015) concluded, that glyphosate is probably carcinogenic, the carcinogenic designation was based on animal testing results and mechanistic data. The International Agency for Research on Cancer conclusion has also been contradicted by findings from the European Union and a joint World Health Organization/Food and Agriculture Organization evaluation using additional evidence (Tarazona et al. 2017).

Imazamox

Workers: The risk characterization for workers is simple and unambiguous: there is no basis for asserting that workers are likely to be at risk in applications of imazamox. The dose-response assessment for imazamox is highly atypical because endpoints of concern for imazamox cannot be identified. In other words, imazamox does not appear to be toxic to mammals, and potential hazards to humans cannot be identified. The risk assessment used the RfD of 3 mg/kg/bw proposed in EPA (1997) to generate HQs.

The highest HQ for general exposure is 0.004. If the RfD of 3 mg/kg/bw is taken as the level of concern, this HQ is below the level of concern by a factor of over 250. The highest accidental HQ is 0.3, the upper bound of the HQ for a worker involved in aquatic applications wearing contaminated gloves for 1 hour.

General Public: The risk characterization for members of the general public is essentially identical to the risk characterization for workers: there is no basis for asserting that members of the general public are likely to be at risk due to applications of imazamox. Based on the RfD of 3 mg/kg/bw, the highest HQs are those associated with an accidental spill of imazamox into a small pond and the subsequent consumption of contaminated water by a small child. For this exposure scenario, the HQ is 0.2 (0.05 to 0.8) for aquatic applications.

For most pesticides, HQs in the range of 0.3 to 0.8 might be characterized as approaching a level of concern. This is not the case for imazamox. As discussed for workers, the dose of imazamox that might actually pose a risk to humans has not been determined. The RfD of 3 mg/kg/bw may be regarded as a dose that will not lead to adverse effects in humans; however, the same may be said for higher doses of imazamox. The RfD of 3 mg/kg/bw is used as a convenience to quantitatively illustrate that the use of imazamox is not likely to pose any identifiable risk to humans.

Sensitive Individuals: No hazards to members of the general population associated with exposure to imazamox have been identified. Because no mechanism of toxicity for imazamox in humans can be identified, subgroups within the human population that might be sensitive to imazamox cannot be identified (SERA 2010).

Imazapyr

Workers: The chronic RfD of 2.5 mg/kg/day was used to characterize the risks of both acute and longer-term exposures to imazapyr, consistent with the approach taken in the EPA (2005a) human health risk assessment. The risk characterization for workers is simple and unambiguous: there is no basis for asserting that workers are likely to be at risk in applications of imazapyr. The highest HQ for general exposures is 0.06, the upper bound of the HQ for workers involved in ground broadcast applications of imazapyr. If the RfD of 2.5 mg/kg/bw (HQ=1) is taken as the level of concern, this HQ is associated with a dose which is below the level of concern by a factor of about 17. The highest accidental HQ is 0.01, the upper bound of the HQ for a worker wearing contaminated gloves for one hour.

Risks are explicitly characterized only for workers involved in ground or aerial broadcast applications or direct applications to water. Other application methods, including various forms of cut surface and basal bark treatments, may be used for control of some species. Exposure assessments for workers involved in these types of treatments have not been developed because adequate worker exposure studies are not available. The highest documented worker exposure rates are associated with directed foliar applications. On Beale AFB, considering cut surface and basal bark treatments, it may be reasonable to use worker exposure rates for directed foliar applications with the amount of imazapyr that would be handled to approximate worker exposures.

Some cut surface applications may involve handling highly concentrated solutions of imazapyr (i.e., up to about 480 mg ae/L), which are more concentrated than imazapyr solutions used in foliar applications (24 mg ae/L) by a factor of about 20. As noted above, the highest HQ for workers involved in foliar or aquatic applications is 0.01 associated with wearing contaminated gloves for one hour. If a worker involved in hack and squirt applications were to apply a 480 mg ae/L solution of imazapyr and wear contaminated gloves for one hour, the corresponding HQ would be about 0.2, below the level of concern by a factor of five. Because the exposure period is directly proportional to the HQ, the HQ for gloves contaminated by a 480 mg ae/L solution of imazapyr would reach a level of concern (HQ=1) at five hours. However extreme this exposure scenario may seem; it would be prudent to caution workers who use highly concentrated solutions of imazapyr to exercise particular caution to prevent prolonged skin contact with the concentrated solutions.

Some formulations of imazapyr may cause eye irritation. From a practical perspective, mild to moderate eye irritation is likely to be the only overt effect as a consequence of mishandling imazapyr. This effect would be minimized or avoided by prudent industrial hygiene practices, including exercising care to reduce splashing and wearing goggles, while handling concentrated solutions of imazapyr. As with skin contact, the risks of eye irritation would probably be greatest for workers handling very concentrated solutions of imazapyr during cut surface applications.

General Public: As with the quantitative risk characterization for workers, the quantitative risk characterization for the general public used the chronic RfD of 2.5 mg/kg/day for both acute and longer-term exposures. The risk characterization for members of the general public is essentially identical to the risk characterization for workers: there is no basis for asserting that members of the general public are likely to be at risk due to applications of imazapyr.

Based on the RfD of 2.5 mg/kg/bw, the highest HQs are those associated with an accidental spill of imazapyr into a small pond and the subsequent consumption of contaminated water by a small child. For this exposure scenario, the highest HQ is 0.8 for both terrestrial and aquatic applications. For imazapyr as well as most other chemicals, a large spill into a small body of water should lead to steps to prevent the consumption of the contaminated water. Nonetheless, the current risk assessment suggests that only very severe accidental spills would approach a level of concern. The dose of imazapyr that might actually pose a risk to humans has not been determined (SERA 2011c). The RfD of 2.5 mg/kg/bw may be regarded as a dose that would not lead to adverse effects in humans; however, the same may be said for higher doses of imazapyr. The RfD of 2.5 mg/kg/bw is used as a convenience to quantitatively illustrate that the use of imazapyr is not likely to pose any identifiable risk to humans.

The highest HQ for members of the general public associated with expected (i.e., non-accidental) exposure scenarios is 0.5, the upper bound of the acute HQ for the consumption of contaminated vegetation. For any pesticide applied directly to vegetation, this is an extraordinarily conservative exposure scenario which typically leads to HQs that exceed the level of concern. For imazapyr, no risks can be identified.

Sensitive Individuals: Because there is no known mechanism of toxicity for imazapyr in humans, subgroups within the human population that might be sensitive to imazapyr cannot be identified. Notwithstanding, imazapyr is a weak acid. Imazapyr would influence and be influenced by other weak acids excreted by the kidney. However, this effect would occur only at high doses at which the ability of the kidney to excrete weak acids might be saturated or nearly so. Given the very low HQs for imazapyr, there appears to be no basis for asserting that this or other adverse effects in a specific subgroup are plausible. The EPA (2005a) judged that infants and children are not likely to be more sensitive than adults to imazapyr. Given the number of studies available on reproductive and developmental effects and the unremarkable findings from these studies, this judgement appears appropriate (SERA 2011c).

Sulfometuron Methyl

Workers: The EPA (2008) has established an RfD of 0.275 mg/kg/day for both acute and chronic sulfometuron methyl exposure scenarios. No exposure scenarios, acute or chronic, exceed the RfD at the upper bound of the estimated dose associated with the highest anticipated application rate of 0.199 lbs active ingredient/acre (ai/ac). At this application rate, the highest HQ (0.11) is associated with general exposure at the upper limits of broadcast spraying, well below the threshold of concern. The highest HQ for the upper ranges for general exposure associated with the maximum application rate of 0.281 lbs ai/ac, is still only 0.2. These upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions are modified (e.g., the compound is applied at the typical rather than the maximum application rate), the HQs would be less. Given the conservative nature of the RfD itself, it is unlikely that there would be any signs of toxicity in workers applying sulfometuron methyl.

While the accidental exposure scenarios are not the most severe one might imagine (e.g., complete immersion of the worker or contamination of the entire body surface for a prolonged period of time), they are representative of reasonable accidental exposures. None of the HQs approach a level of concern at the upper ranges, even when considering the level of concern associated with an application rate of 0.281 lbs ai/ac. The simple verbal interpretation of this quantitative characterization of risk is that under the most protective set of exposure assumptions, workers would not be exposed to levels of sulfometuron methyl that are regarded as unacceptable so long as reasonable and prudent handling practices are followed.

Irritation and damage to the skin and eyes can result from exposure to relatively high levels of sulfometuron methyl. From a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling sulfometuron methyl. These effects would be minimized or avoided by prudent industrial hygiene practices during the handling of sulfometuron methyl.

General Public: An RfD of 0.275 mg/kg/day for both acute and chronic sulfometuron methyl exposure scenarios was used for the public. Two public exposure scenarios resulted in a HQ greater than one at the upper bounds at the application rates of 0.199 lbs ai/ac and 0.281 lbs ai/ac: the consumption by a child of contaminated water from a small pond immediately after an accidental spill (HQ = 1.5 and 2), and consumption of contaminated vegetation by an adult female (HQ = 1 and 1.4).

As discussed previously, these are extremely conservative estimates and often unlikely scenarios. The contaminated water scenario would require a child to drink 1.5 liters of contaminated water from a non-potable standing water source. Sulfometuron methyl would not be applied to any desirable forage plants, so vegetation consumption is unlikely. The vegetation consumption scenario does not consider the effects of washing contaminated vegetation in reducing doses. In addition, signs at likely access points informing the public that an area has been sprayed would reduce the potential that freshly sprayed material would be consumed.

For chronic exposure, all HQs are below the level of concern for the maximum application rate of 0.281 lbs ai/ac. This means that, under most conditions, sulfometuron methyl would not pose a significant risk to the public, and risks would be further reduced by following best management practices.

Sensitive Individuals: There is no information to suggest that specific groups or individuals may be especially sensitive to the systemic effects of sulfometuron methyl. Due to the lack of data in humans, the likely critical effect of sulfometuron methyl in humans cannot be identified clearly. The most sensitive effect reported in animals for chronic sulfometuron methyl exposure appears to involve changes in blood that are consistent with hemolytic anemia. Thus, individuals with pre-existing anemia could potentially be at an increased risk. It appears that sulfometuron methyl has the potential to alter thyroid gland function. Individuals with pre-existing thyroid dysfunction may, therefore, be at increased risk. However, there are no data on humans to directly support these speculations (SERA 2004b).

Triclopyr

Workers: The EPA (2002a) has established a chronic RfD for triclopyr at 0.05 mg/kg/day. The EPA has concluded that the triethylamine acid (TEA) and butoxyethyl ester (BEE) of triclopyr are toxicologically equivalent; thus, this RfD applies to both forms of triclopyr. In the same study, the EPA (2002a) has recommended an explicit acute RfD of 1 mg/kg/day for the general population and 0.05 mg/kg/day for women of childbearing age.

None of the general occupational exposure scenarios, acute or chronic, exceed the RfD at the upper bound of the estimated dose associated with the highest application rate. The highest HQ at the upper exposure level approaches, but does not exceed, the level of concern (HQ = 0.9). As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified, the HQs would drop substantially. So, even under the most conservative set of exposure assumptions, workers would not be exposed to levels of triclopyr that are regarded as unacceptable. Under typical application conditions, levels of exposure would be well below levels of concern.

None of the accidental scenarios for workers involving triclopyr exceed a level of concern based on the acute RfD of 1 mg/kg/day for the general public and 0.05 mg/kg/day for women of childbearing age.

Ocular exposure to the triclopyr TEA formulations is characterized in Material Safety Data Sheets variously as Irreversible/C, Corrosive/Irreversible, or simply Corrosive. The Garlon 3A label carries a Danger signal word for eye and other effects. While eye irritation is not treated quantitatively in the current risk assessment, it is a clear concern for occupational exposures. The risk would be mitigated by following proper industrial hygiene practices when applying triclopyr TEA.

General Public: As for workers, the HQs for acute exposure are based on acute RfD of 1 mg/kg/day and the HQs for chronic exposures are based on the chronic RfD from EPA of 0.05 mg/kg/day. For women of childbearing age, the acute RfD is 0.05 mg/kg/day.

Several acute/accidental scenarios lead to HQs that are above the level of concern. The consumption of contaminated fruit exceeds the level of concern at the upper level of exposure

(HQ = 6), while the consumption of contaminated vegetation exceeds the level of concern at the central (HQ = 5) and upper estimate of exposure (HQ = 41). None of the other acute/accidental scenarios led to HQs that are above the level of concern. These findings suggest that in the event of human consumption of vegetation sprayed with triclopyr, adult females could be at risk. At the typical level of exposure, the consumption of contaminated vegetation could lead to acute exposures where the nature and severity of effects are uncertain. At the upper level of exposure, the consumption of contaminated vegetation could lead to a one-time dose of 2.0 mg/kg, which could result in overt signs or symptoms of toxicity. The plausibility of this scenario is limited by several important factors. First, most areas proposed for treatment with triclopyr are well removed from private residences and, hence, vegetable gardens. Secondly, unless the triclopyr contamination were to occur immediately before picking, it is plausible that the accidental contamination would kill the plants or diminish their capacity to yield consumable vegetation. Thirdly, this scenario is extremely conservative in that it does not consider the effects of washing contaminated vegetation in reducing doses. Finally, signs at likely access points informing the public that an area has been sprayed would reduce the potential that freshly sprayed material would be consumed.

Similarly, adult females who consume contaminated fruit could be exposed to triclopyr residues. At the upper level of exposure, the consumption of contaminated fruit could lead to acute exposures where the nature and severity of effects are uncertain (a one-time dose of 0.28 mg/kg). At the typical and lower levels of exposure, this scenario yields HQs below a level of concern. This scenario is conservative in that it does not consider the effects of washing contaminated fruit in reducing doses and, unless the triclopyr contamination were to occur immediately before harvest and consumption, it is plausible that the accidental contamination would kill the plants or diminish their capacity to yield consumable vegetation. In addition, signs at likely access points informing the public that an area has been sprayed would reduce the potential that freshly sprayed material would be consumed.

The same longer-term exposure scenarios (long-term consumption of contaminated fruit and vegetation) exceed a level of concern (HQ = 4 and 10, respectively) at the upper levels of exposure. None of the other longer-term scenarios led to HQs that are above the level of concern. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified, the HQs would drop substantially. This is a standard scenario used in risk assessments and is extremely conservative, i.e., it assumes that vegetation or fruit that has been directly sprayed is harvested and consumed for a prolonged period of time. In addition, this scenario does not consider the effects of washing contaminated vegetation or the likelihood that such treated vegetation would be expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long term.

<u>Sensitive Individuals</u>: Because triclopyr may impair glomerular filtration, individuals with pre-existing kidney diseases are likely to be at increased risk (SERA 1996). Because the chronic RfD for triclopyr is based on reproductive effects, women of child-bearing age are an obvious group at increased risk (SERA 2011a). This group is given explicit consideration and is central to the risk characterization.

Negative impacts to worker and public safety would be avoided by applying herbicides in accordance with the IPSMG (Beale AFB 2017a; Appendix B); the IPMP (Beale AFB 2018b); the INRMP (Beale AFB 2019a); the USAF Pest Management Program; a General NPDES Permit for Residual Aquatic Pesticide Discharges (Appendix F); all applicable federal, DoD, USAF, State of

California, and local directives and regulations; label instructions; and AMMs in Appendix G. Workers would wear appropriate PPE (as specified on the product label) whenever applying herbicides. Therefore, no significant impacts to safety and occupational health would occur as a result of chemical treatments under Alternative 2.

TCP (3,5,6-trichloro-2-pyridinol)

Scenarios of concern involving exposures to 3,5,6-trichloro-2-pyridinol (TCP; a byproduct of triclopyr) are limited to the consumption of contaminated vegetation, so exposure scenarios are not analyzed separately for workers and the general public. Potential exposures to TCP exceed the level of concern at the upper bound of the HQs for both the acute and longer-term consumption of contaminated vegetation and fruit. For TCP, the upper bound of HQs for acute exposures is less than the upper bound of the HQs for longer-term exposures. For the central estimates and the lower bounds, the opposite pattern is apparent. While this may seem incongruous, the calculations reflect the interplay of the lower chronic RfD and the different half-lives used to estimate the longer-term time-weighted average doses (SERA 2011a). The qualitative interpretation of the HQs for TCP is similar to that of the HQs for triclopyr. In the event members of the general public consume contaminated fruit or vegetation, these people could be at risk.

The plausibility of the acute scenario is limited by several important factors. First, most areas proposed for treatment with triclopyr are well removed from private residences and, hence, vegetable gardens. Secondly, unless the triclopyr contamination were to occur immediately before harvest and consumption, it is plausible that the accidental contamination would kill the plants or diminish their capacity to yield consumable vegetation. Third, this scenario is extremely conservative in that it does not consider the effects of washing contaminated vegetation in reducing doses. Finally, signs at likely access points informing the public that an area has been sprayed would reduce the potential that freshly sprayed material would be consumed.

For the longer-term scenario, as previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified, the HQs would drop substantially. This scenario assumes that vegetation or fruit that has been directly sprayed is harvested and consumed for a prolonged period of time. In addition, this scenario does not consider the effects of washing contaminated vegetation or the likelihood that such treated vegetation is expected to be dead, dying, chlorotic, brittle or deformed and thus undesirable to consume in the long term.

Inert Ingredients

Most pesticide products contain substances in addition to the active ingredient(s) that are referred to as inert ingredients or sometimes as “other ingredients.” An inert ingredient generally is any substance (or group of similar substances) other than an active ingredient that is intentionally included in a pesticide product. Examples of inert ingredients include emulsifiers, solvents, carriers, aerosol propellants, fragrances and dyes.

Comparison of acute toxicity data between the formulated products (including inert ingredients) and their active ingredients alone shows that the formulated products are generally less toxic than their active ingredients (USDA 1984, 1989). While these formulated products have not undergone chronic toxicity testing like their active ingredients, the acute toxicity comparisons, the EPA review, and examination of toxicity information on the inert ingredients in each product leads to the conclusion that the inert ingredients in these formulations do not significantly increase the risk to human health and safety over the risks identified for the active ingredients.

Adjuvants

Adjuvants are spray solution additives that are mixed with an herbicide solution to improve performance of the spray mixture. Adjuvants can either enhance activity of an herbicide's active ingredient (activator adjuvant) or offset any problems associated with spray application, such as adverse water quality or wind (special purpose or utility modifiers). Activator adjuvants include surfactants, wetting agents, sticker-spreaders and penetrants.

The adjuvants proposed for use do not contain ingredients found on the EPA's inerts list 1 or 2. This is either based on the identified ingredients or, if these ingredients are not sufficiently identified, by information given by the manufacturers. The assessment of hazards for these adjuvants is limited by the proprietary nature of the formulations. Unless the EPA classifies a compound in the formulation as hazardous, the manufacturer is not required to disclose its identity. At the current time, the disclosure of whether a material is hazardous is based primarily on acute toxicity (Bakke 2007).

The more common risk factors for the use of these adjuvants are through skin or eye exposure. These adjuvants all have various levels of irritancy associated with skin or eye exposure. This highlights the need for good industrial hygiene practices while utilizing these products, especially when handling the concentrate, such as during mixing. The use of chemical resistant gloves and goggles, especially while mixing, would reduce the risk to workers (Bakke 2007).

Synergistic Effects

Synergistic effects are those effects resulting from exposure to a combination of two or more chemicals that are greater than the sum of the effects of each chemical alone (additive). Reviews of the scientific literature on toxicological effects and toxicological interactions of agricultural chemicals indicate that exposure to a mixture of pesticides is more likely to lead to additive rather than synergistic effects (U.S. EPA 2000a; ATSDR 2004).

The herbicide mixtures proposed for this project have not shown synergistic effects in humans who have used them in agricultural applications. However, synergistic toxic effects of herbicide combinations, combinations of the herbicides with other pesticides such as insecticides or fertilizers, or combinations with naturally occurring chemicals in the environment are not normally studied. Based on the limited data available on pesticide combinations involving these herbicides, it is possible, but unlikely, that synergistic effects could occur as a result of exposure to the herbicides considered in this analysis.

Manual/Mechanical Treatments

There would be a slight risk of minor, temporary, adverse effects to workers from accidental injury from tools or heat exposure, and the potential significant, long-term, adverse effect of hearing damage from using equipment without appropriate PPE. All equipment used in performing work would be of the proper type, appropriate size, operated at appropriate speed and be in such mechanical condition as to enable workers to safely perform the work. All workers would be trained in the safe and proper use of any and all equipment used in manual/mechanical treatments. Workers would wear all applicable PPE for a specific tool, which may include gloves, ear plugs, eye protection, steel-toed boots, and/or chaps. Work would be done in accordance with applicable safety regulations and guidance in AFPD 91-2, *Safety Programs*. During mechanical fuels treatments, the project manager would make sure that work is done in compliance with the guidelines set forth by the NRM. The project manager would document if project work goals are met or setbacks are documented, in order to improve future project safety and efficiency. Therefore, no significant effects to occupational health and safety would occur as a result of Alternative 2.

Restoration Treatments

When doing restoration treatments, workers would follow all applicable safety regulations and guidance in AFPD 91-2, *Safety Programs*. Therefore, no significant effects to occupational health and safety would occur as a result of restoration treatments under Alternative 2.

4.6 HAZARDOUS MATERIALS / WASTE

4.6.1 Alternative 1 (No Action Alternative)

Grazing, and manual/mechanical treatments under the No Action Alternative would have no effect on hazardous materials or waste, as these activities would not use hazardous materials or generate hazardous waste. There would be the potential for minor, temporary, beneficial effects to hazardous waste if UXO are exposed during prescribed burns, but significant, adverse effects could occur in extreme cases if a prescribed burn caused a UXO to explode. This would be avoided through coordination with the MMRP. Ongoing herbicide treatments could have minor, temporary to short-term, adverse effects on hazardous materials and waste. Adverse effects would be minimized through proper handling and disposal procedures.

Grazing

No hazardous waste or materials would be generated from grazing under the No Action Alternative. There are ERP sites on and near existing grazing areas, but no effects would occur. Contaminated soils have been treated or removed from these ERP sites, leaving groundwater contamination in or near grazing parcels A, B, D, and F (Figure 4.1). Groundwater monitoring wells are present in the grazing areas and are monitored under an ongoing base-wide groundwater monitoring program. Under the No Action Alternative, neither the livestock nor the grazing lessees would have access to contaminated groundwater from the ERP sites. There are munition response sites on all of the grazing areas. Potential hazards of munition response sites include lead contamination in soil, metallic debris, and unexploded ordnance. Comprehensive Site Evaluations conducted under the MMRP have determined the majority of the munition response sites pose no significant risk to human health or ecological receptors, and they have been closed with regulatory concurrence that no further investigation or remedial action is needed. Therefore, no new effects would occur as a result of the No Action Alternative.

Prescribed Burns

There would be the potential for minor, temporary, beneficial effects if UXO are exposed during prescribed burns. In extreme cases significant, adverse effects could occur if a prescribed burn caused a UXO to explode. Under the No Action Alternative, the locations proposed for prescribed burns would be approved by the ERP on a project-by-project basis in order to avoid burning areas that could pose a potential environmental or safety hazard. Chemical retardants would not be used during prescribed burns so there would be no generation of hazardous waste. If UXO were encountered, they would be reported to the proper authorities.

Chemical Treatments

Ongoing herbicide treatments would continue under the No Action Alternative. These treatments could have minor, temporary to short-term, adverse effects on hazardous materials and waste. Herbicides would continue to be used and applied in accordance with label instructions. Herbicide containers would be disposed of in accordance with label instruction and California state regulations.

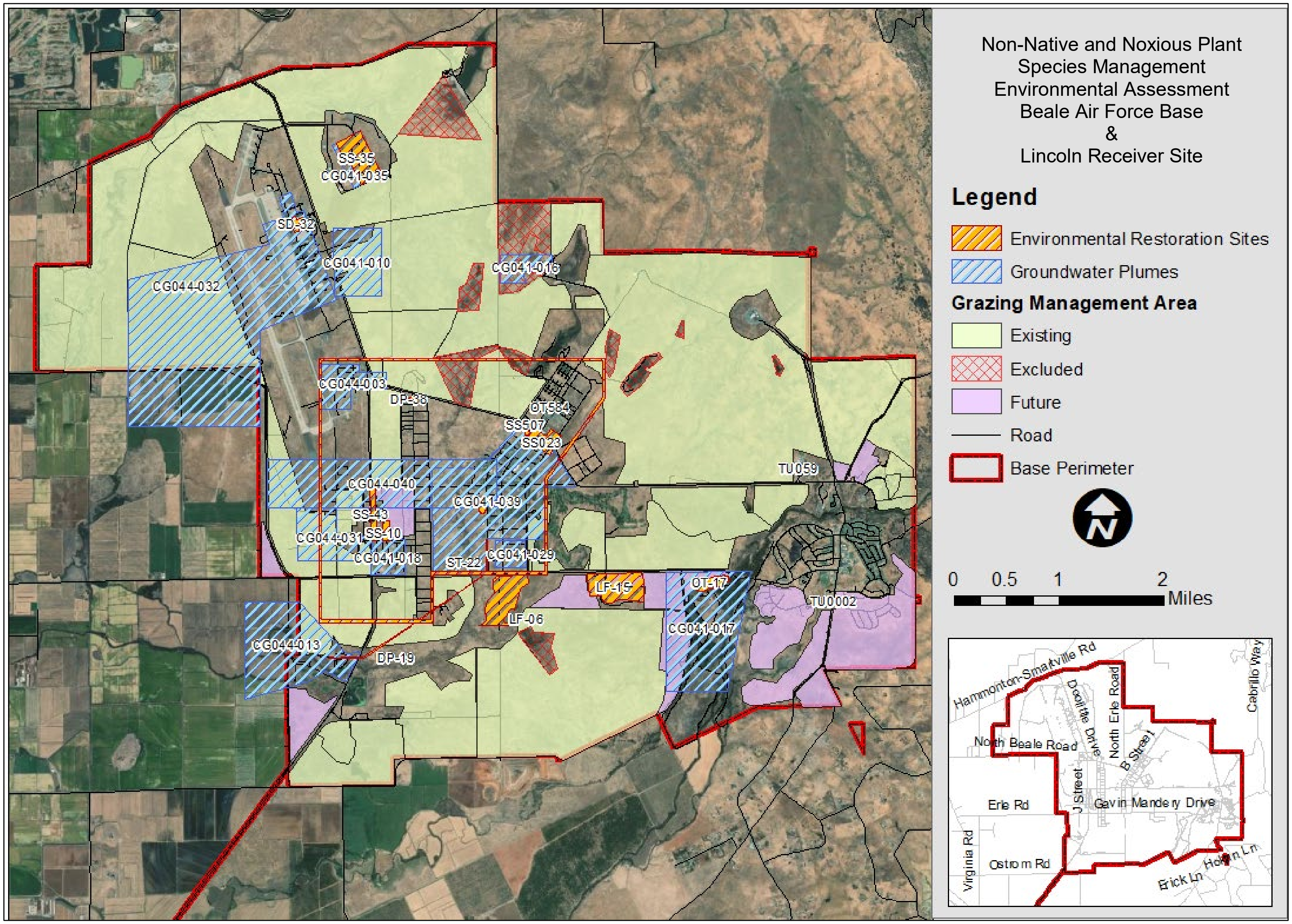

Figure 4.1. Grazing Parcels and ERP Sites.

A Comprehensive Spill Program has been established that addresses procedures to minimize spill impacts. In the event of a spill, the applicator would notify the 9 CES spill response team and NRM. Any new herbicide use would be analyzed on a project-by-project basis using the USAF EIAP.

Manual/Mechanical and Restoration Treatments

Small-scale manual and mechanical treatments under the No Action Alternative would have no effect on hazardous materials or waste, as these activities would not generate hazardous materials or waste. There is a slight potential for workers to encounter UXO. If UXO are encountered the proper authorities would be notified.

4.6.2 Alternative 2 (Comprehensive Control)

Alternative 2 could have negligible to significant, temporary to long-term, adverse effects on hazardous materials and waste, but would primarily have minor, temporary, beneficial effects. The slight potential for significant, long-term adverse effects would be mitigated through planning and safety measures. Grazing expansion under Alternative 2 would have minor, temporary, beneficial effects on hazardous materials and waste. Livestock reduce vegetation, which makes it easier to locate ERP monitoring wells and reduces the fire hazard from vehicles that enter the area for ERP and MMRP activities. There would be the potential for minor, temporary, beneficial effects to hazardous waste if UXO are exposed during prescribed burns, but significant, adverse effects could occur in extreme cases if a prescribed burn caused a UXO to explode. This risk would be mitigated through coordination with the MMRP and safety procedures. Herbicide treatments under Alternative 2 could result in minor, temporary, adverse effects to hazardous materials and waste. Herbicides are considered hazardous materials, and would be handled, applied, and disposed of in accordance with label instructions and Beale AFB waste disposal procedures and other applicable regulations and AMMs. Manual/mechanical and restoration treatments would have negligible, temporary, adverse effects on hazardous materials and waste. Adverse effects from hazardous materials associated with mechanical equipment would be minimized through proper handling and disposal procedures.

Grazing

Grazing expansion under Alternative 2 would have minor, temporary, beneficial effects on hazardous materials and waste. Grazing Management Areas A, B, D, and F would continue to be used (as described under the No Action Alternative). There are munition response sites within all of the existing Grazing Management Areas. Under the expanded grazing program, additional munition response sites may be grazed, but as stated under the No Action Alternative, they would be unlikely to pose a significant risk to human health or ecological receptors.

Environmental baseline surveys were conducted for two of the proposed grazing expansion areas (Parcels G and H; Beale AFB 2018f, g). An environmental baseline survey would be conducted for each new proposed parcel before it is developed and used for grazing. During this process, any hazardous waste or MRSs would be identified. If remediation is required, it would be determined if cattle grazing would interfere with the remediation effort, or if the contamination precludes grazing of the area until after remediation has been completed. Remedial investigation and soil removal activities would take place during the dry season, after the grazing season is over and cattle have been removed. Open ERP sites on Beale AFB that may conflict with grazing and grazing infrastructure are identified in Table 4.8. All new solar well locations would be reviewed by the ERP before installation through the USAF 103 process to avoid contaminated groundwater sites.

Table 4.8 Open Environmental Restoration Program (ERP) Sites as of 2018.

Site Number	Type	Description	Chemical(s) of Concern	Potential Conflicts
LF002	Landfill	Landfill No. 2		Sheep and goat grazing, prescribed burns
LF003	Landfill	Landfill No. 3		Sheep and goat grazing, prescribed burns
LF013	CERCLA	Landfill No. 1	VOC, metals, TCE, lead, arsenic, cyanide	Sheep and goat grazing, prescribed burns
OT017	CERCLA	Best Slough	TCE	Restoration planting, grazing infrastructure and wells
ST018	CERCLA	Bulk Fuel Storage Facility	TPH, VOC	
SD032	CERCLA	Building 1086	TCE	None
SS035	CERCLA	Buildings 1322 and 1319, Weapons Storage Area	VOC	Cattle grazing infrastructure and wells
DP038	CERCLA	Skeet Range		Cattle grazing infrastructure and wells
CG041	CERCLA	Base-wide Groundwater	TCE, Benzene, PCE	Restoration sites, cattle grazing infrastructure and wells, giant reed removal, sheep or goat grazing
SS043	CERCLA	Building 469 Loading Dock and Railroad Track Offloading Area	VOC	Cattle grazing infrastructure and wells
CG044	CERCLA	Western Plumes	PCB, PAH, TPH, VOC, TCE, BTEX	Cattle grazing infrastructure and wells
ST022	LUFT	Underground Storage Tanks (USTs) Base-wide	TPH, VOC	Restoration sites, cattle grazing infrastructure and wells, giant reed removal, sheep or goat grazing
TU002	LUFT	Capehart Service Station	methyl tert butyl ether	Cattle grazing infrastructure and wells
TU509	LUFT	Beale AFB Clinic Underground Storage Tanks	TPH-D, PCE	None
SS023	RCRA	Solid Waste Management Unit (SWMU) 23	TCE	None
PL582	RCRA	Lincoln Receiver Site	TCE	Cattle grazing infrastructure and wells
OT584	RCRA	Civil Engineering Heavy Equipment Parking Lot Sumps	PCE	None
SS010	RCRA	Area of Concern 10B	Carbon tetrachloride, PCE, TCE	Cattle grazing infrastructure and wells
SS507	RCRA	Child Development Center	1,1- dichloroethane	None
ED631	MRS	OB/OD Disposal Area	Munitions Debris, Soil Contamination	Sheep or goat grazing
ML595	MRS	57mm Rifle/60mm Mortar/.50 Cal. Machine Gun Range	Munitions Debris	
SR614	MRS	Range 6	Munitions Debris	
SR615	MRS	Range 10	Munitions Debris	
SR617	MRS	Range 9	Munitions Debris	
SR622	MRS	Range 6	Subsurface Anomalies	Cattle grazing infrastructure
ML625	MRS	Primary Toss Bomb	Munitions Debris	

CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act; LUFT = Leaking Underground Fuel Tank; MRS = Munitions Response Site; PCE = tetrachloroethene; RCRA = Resource Conservation and Recovery Act; TCE = trichloroethene; TPH = total petroleum hydrocarbons (-D) as diesel; VOC = Volatile Organic Compounds. Sources: AFCEC/CZOW 2019; CH2M Hill 2017; USACE and URS Group Inc. 2016

There could be temporary, beneficial effects if UXO are exposed during prescribed burns. In extreme cases significant, adverse effects could occur if a prescribed burn caused a UXO to explode. Because of the installation's history, the potential for encountering UXO would be a remote possibility. Fires could cause UXO to explode, as could tractors and plows used in suppression activities, posing a serious risk to firefighter safety. Therefore, extreme caution would be exercised by personnel leading heavy equipment. Engines would stay on existing roads and firebreaks. Personnel would refrain from disturbing UXO if found and report it to Explosive Ordinance Disposal and the MMRP. Burns could benefit the MMRP by revealing UXO and other debris that has been covered by vegetation.

The effect of livestock grazing on the ERP and MMRP sites would be beneficial. Grazing livestock remove vegetation, which makes it easier to locate ERP monitoring wells and also reduces the fire hazard for vehicles that enter the area for the ERP and MMRP activities. Any grazing infrastructure would be placed so as to avoid potential remediation sites. Therefore, expansion of the grazing program under Alternative 2 would not have a significant effect on hazardous materials or waste.

Prescribed Burns

Prescribed burns conducted under Alternative 2 could result in minor, temporary, beneficial and adverse effects to hazardous materials and waste. There would be the potential for minor, temporary, negative impacts.

Several days before the prescribed fire the ERP Manager would be notified with sufficient time to shut down nearby restoration infrastructure systems and ensure that monitoring and extraction wells are properly protected from the fire. Mowed firebreaks or other protective measures would be created around any ground water monitoring and extraction wells in any prescribed fire unit to ensure that they were properly protected from the fire. Therefore, prescribed burns conducted under Alternative 2 would not significantly affect hazardous materials or waste.

Chemical

Herbicide treatments under Alternative 2 could result in minor, temporary, adverse effects to hazardous materials and waste. Herbicides are considered hazardous materials, and would be handled, applied, and disposed of in accordance with label instructions, Beale AFB waste disposal procedures, and other applicable regulations and AMMs. Herbicide containers would be disposed of in accordance with label instructions and USAF hazardous waste disposal guidelines if disposed of on-base. Per DoDI 4150.07, *DoD Pest Management Program*, excess herbicides would be returned to the Defense Logistics Agency Materials Return Program or transferred to the servicing Defense Reutilization and Marketing Office. Pesticides stored on Beale AFB would be stored in accordance with the requirements in DoDI 4150.07 and Armed Force Pest Management Board *Military Handbook - Design of Pest Management Facilities* (AFPMB 2009). These guidelines specify that it is essential for pesticide storage areas to be secured to prevent unauthorized entry. Additional facility design features and use of PPE as described in guidance documents would protect workers from harmful levels of herbicide exposure as discussed in Section 4.5, *Safety and Occupational Health*. All containers would be rinsed before disposal in accordance with the BMPs in Appendix G. Herbicide containers would be disposed of in accordance with California state regulations if disposed of off-base. The California Code of Regulations (3 CCR 6670) states that "Pesticides, emptied containers or parts thereof, or equipment that holds or has held a pesticide, shall not be stored, handled, emptied, disposed of, or left unattended in such a manner or at any place where they may present a hazard to persons, animals (including bees), food, feed, crops or property." There are several state requirements related to pesticide container security, posting, labeling, and rinse and drain procedures that would be followed to prevent herbicides and their containers from presenting a hazard to the aforementioned groups. Containers of spray adjuvants and petroleum oils are exempt from these requirements (3 CCR 6402) but would be included here to ensure safe practices.

Rinsing containers in accordance with the BMPs in Appendix G before disposal would minimize the risk of waste management personnel being exposed to herbicides. Any herbicide residue remaining after rinsing would be sufficiently dilute that it would not present a health risk from dermal contact. Proper storage and disposal of containers would prevent unauthorized personnel from contact with herbicides or herbicide containers. A Comprehensive Spill Program has been established that addresses procedures to minimize spill impacts. In the event of a spill, the applicator would notify the 9 CES spill response team and NRM. Chemical treatments would not affect ERP sites. Herbicides proposed for used under Alternative 2 do not contain Chemicals of Concern that are sampled and monitored at ERP sites. Therefore, no significant effects to hazardous materials/waste would occur as a result of Alternative 2.

Manual/Mechanical and Restoration Treatments

Manual/mechanical and restoration treatments would have negligible, temporary, adverse effects on hazardous materials and waste. Materials such as lubricants and fuels would be used with mechanical invasive plant control. Fuel and lubricants would be stored in accordance with USAF guidance. Any hazardous waste generated due to the implementation of Alternative 2 would be disposed of in accordance with applicable state and federal regulations. A Comprehensive Spill Program has been established that addresses procedures to minimize spill impacts. In the event of a spill, the applicator would notify the 9 CES spill response team and NRM. There would be a slight potential for workers to encounter UXO. If UXO are encountered the proper authorities would be notified. Therefore, treatments under Alternative 2 would not have a significant effect on hazardous materials/waste.

4.7 BIOLOGICAL / NATURAL RESOURCES

4.7.1 Alternative 1 (No Action Alternative)

The No Action Alternative would have significant, long-term, adverse effects on biological/natural resources. Although the No Action Alternative would allow for some treatment of areas infested with invasive plants and addressed in prior project decisions, the majority of land infested by invasive plants identified for control would not be treated. Over time, the projected growth of these infestations would result in increasing negative impacts to vegetation, fish, wildlife, and native habitats. Under the No Action Alternative concurrence on effects to species listed under the ESA would require individual USFWS consultations on a project-by-project basis.

4.7.1.1 Vegetation

The No Action Alternative would have significant, long-term, adverse effects on native vegetation. Most invasive plants of concern on Beale AFB are early successional species, meaning they colonize areas that have been recently disturbed. Since invasive plants have the ability to deplete available resources to lower levels than native vegetation can tolerate, they can quickly dominate disturbed sites, displacing native vegetation. When invasive plants dominate native plant communities, native plant species diversity is decreased. Invasive plants can out-compete native species because they produce abundant seed, have fast growth rates, are more effective at extracting available resources, and lack natural enemies. For example, yellow starthistle is able to compete effectively with desirable native species by producing abundant seeds and growing a deep taproot system that extracts more deep soil moisture during the dry season (DiTomaso et al. 2006). Some invasive plants also produce secondary compounds, which can be toxic to native plant species or animals. Invasive plants can also physically interfere with the germination of native vegetation. For example, dense thatch from medusa head infestations has been shown to inhibit the germination of desirable native vegetation (Young 1992). Invasive plant infestation can therefore lead to a decrease in native plant species, potentially impacting a larger ecological process such as wildlife behavior (Trammell and Butler 1995), fire ecology (Pellant 1996), and hydrology (Renz et al. 2012).

Fire (along with insects and pathogens) is responsible for the decomposition of dead organic matter and the recycling of nutrients. Without fire, plant debris would accumulate and nutrients become tied up in dead vegetation. Plant debris accumulation can suppress living vegetation, increase likelihood of plant mortality from insects and disease, and lead to higher intensity fires.

4.7.1.2 Terrestrial Wildlife

The No Action Alternative would result in significant, long-term, adverse effects to terrestrial wildlife and habitat. Indirect effects would result from the continued expansion of invasive plant infestations on the base. Although the No Action Alternative would allow for treatment of 18 – 913 acres infested with invasive plants and addressed in prior project decisions, 19,854 acres of invasive plants identified for eradication or control would not be treated. Over time, the projected growth of these infestations would result in increasing impacts to habitats and wildlife populations. Any species of wildlife that depends on native understory vegetation for food, shelter, or breeding may be adversely affected by invasive plants.

The assortment of wildlife species supported by native habitats can be altered where invasive plants become established and displace native plants. Where invasive plants become abundant, they can cause highly detrimental effects on native wildlife species. These effects include altering vegetation type and structure, reducing natural food and cover species, and changing the natural fire regime. Invasive plants are known or suspected of causing the following impacts to animals and to wildlife populations: direct injury to individuals from embedded seeds in animal body parts or scratches leading to infection; alteration of habitat structure leading to habitat loss or increased chance of predation; reduction in availability of native forage species, leading to lack of proper forage quantity or forage nutritional value at critical life periods; and poisoning due to direct or indirect ingestion of toxic compounds found on or in invasive plants (USDA 2013).

Habitats that become dominated by invasive plants are often not used, or used much less, by native and rare wildlife species. Invasive plants, such as yellow starthistle, can impact upland game bird habitat. In rare situations, wildlife species may actually benefit from the presence of invasive plants. For example, lesser and American goldfinches (*Carduelis psaltria* and *C. tristis*, respectively) may benefit from feeding on yellow starthistle seeds, and tricolored blackbirds often nest in Himalayan blackberry brambles. While some invasive plants may be beneficial to certain animals, the alteration of native plant communities overall has deleterious effects to wildlife populations and wildlife diversity. The expansion of invasive plant species would continue to impact wildlife habitats and populations.

4.7.1.3 Aquatic Wildlife

The No Action Alternative would have significant, long-term, adverse effects on aquatic wildlife. Invasive plants would continue to grow within riparian areas, thus reducing the biodiversity and abundance of native plants growing there. Eventually, over time, changes in vegetation composition could affect the natural food web in the riparian areas and thereby indirectly impact aquatic species from changes in cover and food availability. Giant reed infestations within Dry Creek would continue to expand. Eventually these infestations could block upstream fish passage entirely. Other aquatic invasive plants would continue to degrade habitat for native wildlife and sport fish.

4.7.1.4 Threatened and Endangered Species and other Special Status Species

The No Action Alternative would have significant, long-term, adverse effects on threatened and endangered and other special status species. Under the No Action Alternative concurrence on effects to species listed under the ESA would require individual USFWS consultations on a project-by-project basis.

Vernal Pool Fairy Shrimp (Threatened) and Vernal Pool Tadpole Shrimp (Endangered)

Under the No Action Alternative, significant, long-term, adverse effects could result, as no new invasive plant control would be implemented in or around vernal pools that are suitable habitat for vernal pool shrimp. In general, invasive plant species within and surrounding vernal pools draw down the available water, resulting in a reduced inundation period that may be too short for native invertebrate growth cycles. Furthermore, invasive grasses increase levels of thatch (dead plant biomass) in vernal pool habitats. Non-native plant thatch build-up increases soil organic matter and consequently soil water-holding capacity; as a result, the surrounding soil holds more water, and less is retained in the vernal pool itself, reducing inundation period (Marty 2015). Abundant thatch can also create anoxic conditions as it decays, which negatively affects gill-breathing organisms such as large branchiopods (Rogers 1998; USFWS 2007; Marty 2015).

Valley Elderberry Longhorn Beetle (Threatened)

The No Action Alternative would have moderate, long-term, adverse effects on valley elderberry longhorn beetles. Under the No Action Alternative, no new invasive plant control would be implemented in or around elderberry shrubs, the valley elderberry longhorn beetle's host plant. The USFWS has acknowledged that invasive plants in riparian zones may threaten valley elderberry longhorn beetle habitat by inhibiting reproduction and growth of elderberry shrubs, thereby limiting host plants for the beetle. The USFWS names several riparian invasive plants found at Beale that may degrade valley elderberry longhorn beetle habitat and displace valley elderberry longhorn beetle host plants, including black locust, tree-of-heaven, and Himalayan blackberry (USFWS 2014).

Giant Garter snake (Threatened)

The No Action Alternative could have moderate, long-term, adverse effects on potentially suitable giant garter snake habitat. If left untreated, invasive aquatic plants can slow water flow or block waterways entirely, potentially reducing downstream flow and making movement through the waterways more difficult for giant garter snake. Untreated riparian and upland invasive plant infestations can make overland movement more difficult for giant garter snake.

Western Yellow-Billed Cuckoo (Threatened)

The No Action Alternative would have moderate, long-term, adverse effects on suitable western yellow-billed cuckoo habitat. Under the No Action Alternative, most invasive plants in riparian areas would continue to go untreated. Throughout its range, replacement of native riparian habitat by invasive plants has reduced available breeding habitat for western yellow-billed cuckoo; tamarisk (*Tamarix* spp.) is noted as a particular problem (USFWS 2017a), giant reed, and edible fig, both present on the base, also displace native riparian vegetation and are believed to offer limited nesting and foraging value to cuckoos (Laymon 1998).

Monarch Butterfly (Candidate Species)

The No Action Alternative would have significant, long-term, adverse effects on suitable monarch butterfly habitat. Milkweed is crucial to the lifecycle of monarch butterflies. If invasive plant infestations are left unchecked, these plants would continue to overrun milkweed habitat, leading to localized extirpations or significant population declines.

Steelhead - Central Valley Distinct Population Segment (Threatened)

The No Action Alternative would have significant, long-term, adverse effects on Central Valley Steelhead. Under the No Action Alternative, invasive plants along Dry Creek, including giant reed and water primrose, would go untreated. These infestations are located within the waterway. If left untreated, this may lead to changes in flow, migration barriers, water quality declines, and degradation of spawning gravel sites (DiTomaso et al. 2013; Cal-IPC 2015a).

4.7.2 Alternative 2 (Comprehensive Control)

Alternative 2 would primarily have significant, long-term, beneficial effects on biological/natural resources, but some minor, temporary to short-term, negative effects could occur. Native vegetation would benefit from the reduction in spread and establishment of invasive species that would result from control efforts. Partial or complete plant mortality or habitat degradation could occur if BMPs are not followed. Reducing the presence of invasive plants would benefit habitat for the vast majority of terrestrial wildlife species, which are adapted to and depend upon healthy native plant communities. The removal of invasive plants could, in the short term, decrease the amount of vegetative cover available to wildlife or remove a food source.

4.7.2.1 Native Vegetation

Alternative 2 would have significant, long-term, beneficial effects on native vegetation. The continued spread and establishment of invasive species can reduce native plant diversity by changing ecological processes and outcompeting native vegetation for limited resources (space, water, light, and nutrients). Controlling and eradicating invasive plants would reduce the potential impacts to native vegetation from existing and new invasive species on Beale AFB. In addition, Alternative 2 includes the use of restoration as a component of integrated pest management. This would improve native vegetation cover in areas currently occupied by invasive species. To the degree that proposed treatments are effective, benefits to native plant communities would occur.

Prescribed Burns

Prescribed burns under Alternative 2 would have moderate, short-term, adverse effects on vegetation, and significant, long-term, positive effects. An obvious, immediate effect of fire on vegetation is plant mortality. Plant species exhibit a variety of traits and mechanisms by which they are able to survive and recover from fire. These traits and mechanisms are common to species found in nearly all terrestrial North American ecosystems. Fire would promote plant species that are well adapted to fire and suppress plant species that are poorly adapted to fire. As a result, fire could cause dramatic and immediate changes in species composition and diversity. Under Alternative 2, prescribed burns would be used to shift vegetation communities toward a more natural composition or toward naturalized grasses that provide quality livestock forage. In general, prescribed burns would target annual grasses and forbs and avoid long-lived native vegetation such as oak trees and chaparral species. Under Alternative 2, overall impacts to plant communities would be insignificant to beneficial.

Grazing

Grazing under Alternative 2 could have moderate, temporary to long-term, adverse and beneficial effects on native vegetation. The type of animal used to graze an area would determine the potential impacts to native vegetation. Cattle prefer to eat grass rather than forbs or shrubs; sheep eat both grass and forbs and can eat shrubs; goats eat shrubs, forbs, grass, and have a wide tolerance for plants that are toxic or too thorny/spiny for other ungulates; horses primarily eat grass and can crop vegetation very close to the ground (Larson et al. 2015).

Livestock overgrazing can reduce the health and vitality of vegetation in several ways: trampling causes soil compaction, thus decreasing water infiltration, causing increased runoff, and decreased water availability to plants; herbage is removed, which allows soil temperatures to rise and increase evaporation to the soil surface; and physical damage to the vegetation occurs by rubbing, trampling, and browsing. An additional factor is that as foliage is removed, plants put a greater portion of energy into regrowth of leaves and less toward root growth, which has the effect of reducing root biomass, which in turn reduces soil stability and leads to increased erosion. Altered vegetation patterns can result in greater susceptibility to drought, fire, insects and invasive plants (U.S. EPA 1994).

Grazing has the potential to affect different vegetation communities differently:

- Grasslands: Purple needlegrass, the state's most intensively studied native grass, has shown varied responses to grazing: increasing in some instances, decreasing in others, or exhibiting no change (D'Antonio et al. 2002). Research conducted at Beale AFB showed cattle grazing reduced the height and reproductive stem production of purple needlegrass but did not appear to affect seedling numbers the following year (Marty et al. 2005). Furthermore, grazing from January to May appeared to increase purple needlegrass seedling survival. Research investigating grazing effects on native grasses other than purple needlegrass is very limited but, in general, suggests that California native grass species react differently to grazing (Dennis 1989). If native forbs are known to be abundant on any of the proposed units, sheep preference for forbs may present a problem that would need to be evaluated by the NRM (Beale AFB 2017b).
- Vernal Pools: Cattle grazing has been shown to protect native plant and animal biodiversity in vernal pool ecosystems in part by reducing invasive plants' competitive impacts and evapotranspiration (Marty 2015). See vernal pool tadpole shrimp and vernal pool fairy shrimp under *Threatened and Endangered Species* below for more detail.
- Oak woodlands: Research has shown that vertebrate grazing by wildlife and livestock reduces growth and survival of blue oaks; protection of seedlings as they move into the sapling stage may be necessary for successful maintenance of blue oak stands (Allen-Diaz et al. 2007). Especially when rangeland is grazed during the summer, livestock may browse on seedlings (McCreary and George 2005; McCreary 2001). Cattle grazing, however, may indirectly help blue oak seedlings by reducing competition with annual grasses and forbs (Tyler et al. 2006). Protection of blue oak seedlings from grazing would increase the probability of recruitment of seedlings into the sapling stage. Beale AFB would weigh impacts to oak regeneration in decision making for areas to include in the grazing expansion and pasture shape and design.
- Riparian: Livestock prefer to graze in riparian areas because they provide easily accessible water, favorable terrain, good cover, soft soil, a more favorable microclimate, and an abundant supply of lush palatable forage. Even though riparian areas represent a very small proportion of total rangeland, they provide much of the vegetation consumed

by livestock because it is such a preferred grazing area (U.S. EPA 1994). Overgrazing of riparian vegetation can lead to decreased stream quality. However, managed grazing would benefit riparian habitats when used to control invasive plants in riparian areas without the application of herbicide. Limiting the number of cattle with access to riparian areas, monitoring, and ensuring proper distribution of the animals would help control invasive plants and enable more functional vegetation to reestablish in these sensitive areas, without increasing erosion or polluting the watershed. If overgrazing occurs, negative impacts could include increased erosion, sedimentation and fecal pollution within the watershed. In general, in riparian areas, the RDM would be maintained at 800 lbs/acre. Under Alternative 2, livestock would be closely monitored in riparian areas and removed from the area before overgrazing occurred.

Carefully managed grazing in accordance with the GMG (Beale AFB 2017b; Appendix C) would provide positive benefits while minimizing adverse impacts. Beale AFB has full-time staff whose primary responsibility is to manage the grazing program and monitor pasture use. Based on past monitoring, expanding the grazing program under Alternative 2 would not significantly adversely affect, and may have a beneficial effect on native vegetation communities.

Chemical Treatments

Significant, long-term, positive effects to native vegetation would occur from chemical control of invasive plants that compete with native vegetation for resources. Potential minor, temporary, adverse effects to non-target vegetation from invasive plant treatment could also occur. Adverse effects involving herbicide fall into four broad categories: direct exposure (direct spraying or over spraying), off-target drift, movement of chemicals on soil, and accidental spills. Each exposure scenario is described further below:

- Direct exposure: Effects from direct exposure are dependent on a combination of factors including the non-target native plant species, the timing and method of application, and the herbicide being applied. The risk of direct exposure would also be dependent on the applicator's knowledge of non-target vegetation to be avoided and the selectivity of the application method. For all herbicide applications, potential for direct exposure would be limited to those plants in the immediate vicinity (within five feet) of targeted vegetation. Alternative 2 has been designed to reduce effects to non-target vegetation by always favoring the most selective/targeted treatment available whenever effective and feasible.

- Off-target drift: When using targeted spray applications, there is some potential for impacts from drift down-wind of application area. These impacts can range from reduced plant vigor, abnormal growth, or necrosis, to death depending on both the exposure (dose) and sensitivity of the affected plant. Herbicide drift is influenced by a number of factors including site topography and surrounding vegetation, spray droplet size, wind speed and direction, and height of spray nozzle. AMMs would be followed to reduce the potential of off-target drift including (1) using the largest appropriate droplet size thereby limiting the presence of driftable droplets, (2) using the lowest possible boom or spray nozzle height above the ground, and (3) restriction on wind speed and direction when applying herbicides.

- Other off-target movement (wind erosion, runoff, leaching): Off-target effects from herbicides are primarily a concern for chemicals that remain active in the soil (i.e., herbicide with pre-emergent properties), such as aminopyralid, and chlorsulfuron. Off-target effects could occur from wind erosion moving contaminated soil, water moving across a treated area into an untreated area, or herbicides moving in the soil. Potential for off-target movement is greatest for broadcast or spot applications where the herbicide is applied directly to the soil. Herbicides with residual pre-emergent properties would not be applied in areas with soils and topography conducive to erosions or run-off.

- Accidental spills: There is always a remote risk of accidental spills or exposure scenarios other than those described above. To limit the potential for herbicide spills in sensitive plant occurrences and other sensitive plant communities, mixing and loading of herbicides would occur at least 150 feet from any sensitive natural resources. Another possible exposure scenario for impacts to non-target vegetation is accidental equipment malfunction when treating invasive plant infestations. All herbicide application equipment would be regularly inspected to ensure it is in good working order. In addition, a spill kit would be kept on-site or in a vehicle.

Manual/Mechanical Treatments

Significant, long-term, positive effects to native vegetation would occur from the removal of invasive plants that compete with native vegetation for resources. Hand-pulling and other mechanical methods for removing invasive species would be effective and highly selective, but there is a slight risk for minor, temporary, adverse impacts if work crews inadvertently trample, uproot, or otherwise disturb non-target vegetation. Invasive plant material could be left on-site and re-sprout or suppress native vegetation. When using a string trimmer or mower, there is some risk of impacting non-target vegetation intermixed with the target invasive species or transporting invasive species propagules to new locations. Tarping and mulching invasive species may cause localized effects to surrounding non-target native vegetation. Hand-pulling and other mechanical treatments in close proximity of sensitive plants could result in adverse impacts if crews trample, uproot or disturb non-target vegetation. If work would be done within 100 feet of sensitive plant locations, the plant(s) would be flagged. Equipment would be cleaned between sites to reduce transport of propagules. Therefore, there would be no significant effects to native vegetation from manual/mechanical treatments under Alternative 2.

Restoration Treatments

Restoration treatments are designed to restore native and desirable vegetation and would have significant, long-term, beneficial effects on native vegetation communities. Habitat restoration and enhancement treatments, such as replanting or reseeding, would promote desirable species and habitat conditions in conjunction with invasive plant control treatments.

4.7.2.2 Terrestrial Wildlife

Invasive plant treatment methods described in Alternative 2 would result in significant, long-term, positive effects, and minor, short-term, negative effects to terrestrial wildlife habitat. Where invasive plants occur in large, dense patches, treatments would temporarily create bare ground by reducing plant cover. The removal of invasive plants would, in the short term, decrease in the amount of vegetative cover available to wildlife. For the most part, invasive plant treatments restore, rather than reduce, habitat available to wildlife and the successful control of invasive plant infestations provides long-term benefits by restoring and preventing further loss of native habitat. Removal of invasive plants generally increases the diversity of native herbaceous and shrub species within treated areas. Large infestations and monocultures of invasive plants (such as some areas of Beale AFB infested with yellow starthistle) do not support healthy wildlife populations, and the benefits associated with restoring native plant communities far outweigh the impacts of removing invasive vegetation cover. Invasive plants can actually act as a population sink by attracting a species and then exposing them to increased mortality or failed reproduction (Chew 1981).

Birds nest in and feed on several of these invasive plants found on Beale AFB (e.g., Himalayan blackberry and thistle species). Although certain species benefit to some degree from the presence of invasive plants, use of these plants as a nesting or feeding source near Beale AFB airfield creates a BASH concern, which is detrimental to both humans and wildlife. There is ample food and nesting habitat available for birds off-base and outside of the airfield wildlife exclusion zone, so removal of invasive plants is unlikely to reduce food availability or habitat quality for any native wildlife species to a meaningful degree. Reducing the presence of invasive plants would benefit habitat for the vast majority of species which are adapted to and depend upon healthy native plant communities.

Grazing

Expansion of the grazing program under Alternative 2 would have the potential to have minor, short and long-term, negative effects and moderate, short to long-term, beneficial effects on terrestrial wildlife. Annual grasslands at Beale AFB provide important foraging habitat and cover for a number of wildlife species. Direct impacts would include competition for palatable species, while stress producing modifications to the ecosystem induced by livestock (e.g., reduction in protective vegetation cover) are more indirect. A consistent, direct impact of livestock overgrazing on rangeland is loss of vegetative diversity. Selective grazing by livestock tends to reduce the presence of palatable species while allowing a few, typically unpalatable and undesirable species to increase. Over time the resulting change in plant composition lowers species diversity, changes species function, and reduces both the numbers and the variety of wildlife species the area can support. To sustain a given wildlife population, the pre-grazing plant composition, structure and function within an ecosystem must remain in balance, following the introduction of livestock (U.S. EPA 1994).

Conversely, properly managed grazing would have positive effects on wildlife and would be a beneficial natural resource management tool. Benefits to wildlife include: creation of patchy habitat with high structural diversity for feeding, nesting and hiding; opening up areas of dense vegetation to improve foraging areas for a variety of wildlife; removing rank, coarse grass encourages regrowth and improving abundance of high-quality forage for wildlife; and improving nutritional quality of grassland by stimulating plant regrowth. Greater flexibility in stocking rates and grazing timing under Alternative 2 would enhance the ability of the NRM to prescribe wildlife habitat-improvement treatments.

Prescribed Burns

Overall effects on wildlife from Alternative 2 would generally be beneficial, or if adverse temporary and negligible to minor. However, prescribed burns could have moderately adverse, short-term, effects on populations of small, less mobile animals that live in the center of prescribed fire subunits. Beneficial effects would be expected. Implementation of Alternative 2 would result in improved habitat conditions for native grassland birds and animal species (Smith 2000). Large mammals, some small mammals and birds would move to areas not burned. Some small mammals such as mice and voles would stay underground as the fire passed. It is possible that a small number of them may die from the effects of the fire (Smith 2000). The negative impact to those individuals would be mitigated by the overall improvement of the habitat for the species as a whole.

The long-term effect on most wildlife would be an indirect benefit of reduced invasive plant cover and reduced risk of high-intensity wildfire. Deer would benefit from the increase in growth of browse species that would be available on burned areas. Other wildlife including raptors and small mammalian predators would be able to locate prey more easily in burned areas. These benefits to some species of wildlife would be temporary, localized, and short-term but would recur following prescribed fires. Prescribed fires are conducted on a rotating basis to avoid burning extensive areas at one time, which is intended to allow wildlife to repopulate burn units from unburned areas.

Fire management is expected to have little negative impacts on wildlife. Primary concerns surround the potential for operations to have deleterious effects on vernal pool, riparian woodland, and oak woodland habitats. Fireline construction (handlines, scraped firebreaks, etc.) would avoid all sensitive habitats and active wildlife dens. Any prescribed fire units that contain nesting wildlife species would be surveyed prior to burning to ensure the nests are not active. Nesting bird surveys would be done prior to controlled burns in all areas from 15 February through 15 September. If active nests are found, the NRM would be notified and would determine the appropriate mitigation action. Therefore, with the implementation of AMMs, any adverse effects of prescribed burns on terrestrial wildlife would be minor and temporary, and would not be significant.

Chemical Treatments

Chemical treatments under alternative 2 would have an overall significant, long-term, beneficial effect on terrestrial wildlife habitat conditions by reducing the prevalence of invasive plants. However, moderate, short-term, adverse effects could occur to some groups of terrestrial wildlife. The likelihood that an animal would experience adverse effects from an herbicide depends on: (1) toxicity of the chemical, (2) the amount of chemical to which an animal is exposed, (3) the amount of chemical actually received by the animal (dose), and (4) the inherent sensitivity of the animal to the chemical. Assessments of the risks posed to wildlife from herbicides, surfactants, and application methods proposed for use are based upon Human Health and Ecological Risk Assessment reports and Microsoft Excel workbooks prepared for the U.S. Forest Service (SERA 1996; 2003; 2004a, b; 2007; 2010; 2011a, b, c). There is insufficient data on species-specific responses to herbicides for free-ranging wildlife, so wildlife species were placed into groups based on taxa type (e.g., bird, mammal), with similar body size and diet. Reptiles were not considered in these assessments, so small birds should be considered a surrogate. Ecological risk assessments use the same methodology described for Human Health Risk Assessments in Section 4.5, *Safety and Occupation Health*. A complete copy of the Ecological Risk Assessment is in Appendix K.

Terrestrial animals could be exposed to any applied herbicide from direct spray, the ingestion of contaminated media (vegetation, prey species, or water), grooming activities, or indirect contact with contaminated vegetation. All of these sources of exposure were considered in the Ecological Risk Assessment. Risk assessments show that the highest exposures for terrestrial vertebrates would occur after the consumption of contaminated vegetation or contaminated prey. Direct spray with herbicides could have adverse effects to terrestrial insects from herbicide toxicity or surfactant-induced drowning. Other routes of exposure, including dermal contact with contaminated vegetation, ingestion of contaminated water, or the consumption of contaminated fish, would lead to levels of exposure below the level of concern (HQ less than 1) for all species groups and all herbicides being considered in this project. If a group is not discussed for an herbicide below that means there are no exposure scenarios that generated HQs greater than 1.

Aminopyralid

<u>Birds</u>: Aminopyralid is considered “practically non-toxic” to birds (U.S. EPA 2005b), but two exposure scenarios generated HQs greater than 1: the consumption of a contaminated insect by a small bird (HQ = 1.8), and the consumption of contaminated vegetation by a large bird (HQ = 1.2). The Ecological Risk Assessment used the maximum label concentration (highest rate that

can be applied legally) of 0.22 lbs ae/ac, which is permitted for spot treatment on up to 50% of an acre only. At more typical application rates HQs do not exceed a level of concern. Applicators would be fairly precise when spot spraying, and would avoid directly spraying insects to the greatest extent possible. Plants would be treated prior to setting seed, and so there would be no risk of birds consuming contaminated seeds or berries. It is possible that waterfowl could consume contaminated grasses, but any application for treatment of invasive grasses in a contiguous area would be at a lower rate (e.g., 0.11 lbs ae/ac).

Chlorsulfuron

Mammals: Based on the Ecological Risk Assessment, long-term consumption of contaminated vegetation by a large mammal at an application rate of 0.24 lbs ae/ac reaches a level of concern (HQ = 1). The maximum label concentration was used for the Ecological Risk Assessment. However, this application rate would only be used for spot treatment on up to 50% of an acre. The maximum rate for an entire acre is 0.122 lbs ae/ac for general use, and 0.062 lbs ae/ac on pastures. Neither of these rates pose a risk to large mammals. In addition, spot-treatment would be targeting invasive plants, not desirable browse or forage, so it is unlikely an animal would eat a significant amount of treated vegetation.

Invertebrates: Chlorsulfuron is considered “practically non-toxic” to terrestrial invertebrates (Oregon State University and Intertox 2006). However, based on the ecological risk assessment, direct spray of 50% of a honey bee’s body with 100% absorption at 0.24 lbs ae/ac slightly exceeds a level of concern (HQ = 1.5). It is possible that other terrestrial invertebrates could also be adversely affected by direct spray. This application rate can legally only be used for spot treatment on up to 50% of an acre. Applicators would be fairly precise when spot spraying, and would avoid directly spraying insects to the greatest extent possible. At more typical application rates (0.62-0.122 lbs ae/ac) chlorsulfuron exposure would not pose a threat to terrestrial invertebrates.

Glyphosate

There are a number of commercially available glyphosate formulations which, for the purpose of the Ecological Risk Assessment, were characterized as more or less toxic. While some formulations cannot be easily classified as more or less toxic, the general approach is: formulations that contains a POEA surfactant should be regarded as more toxic, unless there is compelling evidence to the contrary. Studies have found that the toxicity of the original Roundup and similar formulations containing POEA surfactants is far greater than the toxicity of technical grade glyphosate, Rodeo, or other formulations that do not contain surfactants (SERA 2011b). A number of exposure scenarios for higher toxicity formulations yielded HQs greater than 1 for terrestrial wildlife:

Birds: Consumption of a contaminated insect by a small bird resulted in a HQ = 1.7, and both acute (HQ = 1.2) and chronic (HQ = 2) consumption of vegetation by a large bird exceeded an HQ of 1 at the highest estimated residue rate. These HQs are for the maximum label concentration of 8 lbs ae/ac. The label recommended rate for most target invasive plant species on Beale AFB is 3 lbs ae/ac or less. At this rate there are no avian exposure scenarios that exceed an HQ of 1.

Mammals: Several exposure scenarios resulted in HQs greater than 1 for mammals at the highest estimated residue rate: Direct spray of a small mammal (HQ = 1.1), consumption of contaminated grass by a small mammal (HQ = 1.8), consumption of contaminated grass by a large mammal (HQ = 2), and consumption of a contaminated insect by a small mammal at central and upper residue rates (HQ = 1.1, 3). These HQs are for the maximum label concentration of 8 lbs ae/ac. The label recommended rate for most target invasive plant species on Beale AFB is 3 lbs ae/ac or less. At this rate the only HQ greater than 1 is the consumption of a contaminated insect by a small mammal.

Invertebrates: The scenario of direct spray of 50% of a honey bee's body from 0 feet away also resulted in HQs greater than 1. The scenarios assumed different percentages of "foliar interception". No foliar interception resulted in a HQ = 2.1, 50% interception HQ = 1.1, 90% interception HQ = 0.2. The HQ also decreases as the distance between the insect and the sprayer increases. At 25 feet downwind no HQs were greater than 1. Broadcast application methods would not be used in areas with a high potential for indirect impacts to native vegetation from drift. This would also indirectly protect native pollinators and other insects visiting and using native vegetation.

Only two exposure scenarios for the application of less toxic glyphosate formulations resulted in HQs greater than 1:

Birds: Even when in less toxic formulations, the chemical glyphosate is considered "practically non-toxic" to "slightly toxic" to birds (U.S. EPA 2015). Long-term consumption of contaminated vegetation resulted in an HQ = 1.8. This scenario is for the maximum label application rate of 8 lbs ae/ac. The label recommended rate for most target invasive plant species on Beale AFB is 3 lbs ae/ac or less. The higher application rate would only be used for spot treatments, which would not be targeting desirable forage.

Mammals: The chemical glyphosate is considered "practically non-toxic" to "slightly toxic" mammals (U.S. EPA 2015). Consumption of a contaminated insect by a small mammal resulted in an HQ = 1.1. The application rate used for this exposure scenario was 8 lbs ae/ac, which would be primarily used for spot treatments. Applicators would be precise when spot spraying, and would avoid directly spraying insects to the greatest extent possible.

Imazamox

None of the exposure scenarios for imazamox resulted in HQs greater than 1. Imazamox would only be used for aquatic applications on Beale AFB, therefore the scenarios are limited to exposure risks from contact with, or consumption of, contaminated water.

Imazapyr

Although considered "practically non-toxic" (SERA 2011c) or "no risk of concern" (U.S. EPA 2006) for all types of wildlife, three exposure scenarios resulted in HQs greater than 1 for an application rate of 1.5 lbs ae/ac:

Birds: Consumption of contaminated grass at the highest residue rate by a small bird exceeded the level of concern in both acute (HQ = 1.0) and long-term (HQ = 2) scenarios. Imazapyr would not be used to treat invasive grass species, so this specific exposure scenario is unlikely to occur. In addition, plants would be treated prior to setting seed, so there would be no risk of birds consuming contaminated seeds or berries. These HQs are for the maximum label concentration, at lower application rates the risk would be less.

Mammals: Consumption of contaminated grass by a small mammal in an acute scenario exceeded the level of concern (HQ = 1.4). Imazapyr would not be used to treat invasive grass species, so this specific exposure scenario is unlikely to occur. In addition, plants would be treated prior to setting seed, and so there would be no risk of animals consuming contaminated seeds or berries. These HQs are for the maximum label application rate, at lower application rates the risk would be less.

Invertebrates: The imazapyr risk assessment worksheets did not include honey bees, but in both the oral and contact toxicity studies, the acute toxicity for imazapyr is comparable to the values reported in experimental mammals and birds. This similarity suggests that the toxicity of imazapyr to terrestrial invertebrates may be similar to the toxicity of this compound to terrestrial vertebrates (SERA 2011c), that is practically non-toxic.

Sulfometuron Methyl

Sulfometuron methyl is classified as "practically non-toxic" (U.S. EPA 2008) to all wildlife groups, but two exposure scenarios for terrestrial animals generated HQs greater than 1 at the label maximum application rate of 0.281 lbs ae/ac:

Birds: Chronic exposure through consumption of contaminated vegetation by a large bird (HQ = 1.7) exceeded the level of concern. This scenario could feasibly occur if a large animal consumed a significant amount of treated grasses. However, for treatment of grasses the recommended application rate is 0.04 to 0.09 lbs ae/ac, which would not lead to scenarios where HQs exceed the level of concern.

Mammals: Chronic exposure through consumption of contaminated vegetation by a large mammal (HQ = 1.1), just exceeded the level of concern. This scenario could feasibly occur if a large animal consumed a significant amount of treated grasses or forbs. However, for treatment of grasses the recommended application rate is 0.04 to 0.09 lbs ae/ac, which would not lead to scenarios where HQs exceed the level of concern. Invasive forbs that would be targeted for treatment are not generally desirable browse or forage. Plants would be treated before seed set, so there would be no risk of wildlife consuming contaminated seeds or fruit.

Triclopyr

The risk characterization for nontarget organisms is concerned with triclopyr acid, triclopyr TEA, and triclopyr BEE, in addition to TCP a metabolite of triclopyr. In terrestrial animals, triclopyr TEA and triclopyr BEE appear to be bioequivalent to triclopyr. TCP is a concern because it is more toxic than triclopyr (including triclopyr BEE, triclopyr TEA, and triclopyr acid) to most groups of nontarget organisms. The same toxicity values were used for triclopyr BEE and TEA for risk characterization for terrestrial animals. However, the maximum application rate for triclopyr TEA is 9 lbs ae/ac compared to 8 lbs ae/ac of triclopyr BEE. For this reason, the risk characterization for triclopyr TEA generated higher HQs than for triclopyr BEE. The HQs for Triclopyr TEA applied at 9 lbs ae/ac are included here:

Birds: Scenarios that exceeded the level of concern were chronic consumption of contaminated vegetation by a large bird at the central (HQ = 1.3) and highest estimated residue rate (HQ = 29), and the consumption of a contaminated insect at the highest estimated residue rate by a small bird (HQ = 8.1). Toxicity studies did not find TCP to be significantly more toxic to birds that triclopyr itself (SERA 2011a). The maximum label application rate would be used for spot treatments only, which would not be targeting desirable forage. Spot application would also minimize accidental spraying of insects.

Mammals: Chronic consumption of contaminated vegetation by a large mammal was greater than 1 for both the central (HQ = 12.6) and greatest estimated residue rate (HQ = 281), and the consumption of a contaminated insect at the highest estimated residue rate by a small mammal (HQ = 1.1). Neither the data in the EPA review nor the data found in the open literature permits an assessment of species sensitivity to TCP for mammals. Consequently, the No Observable Adverse Effects Levels of 25 mg/kg bw for acute exposures and 12 mg/kg bw for longer-term term exposures are used to characterize risks to all mammalian receptors associated with exposures to TCP (SERA 2011a). These HQs were generated for the maximum label application rate, the maximum allowable application rate on pastures or other grazed areas is 2 lbs ae/ac. The maximum label application rate would be used for spot treatments only, which would not be targeting desirable browse or forage.

Invertebrates: The direct spray of a honey bee, with no foliar interception generated an HQ = 1. The application rate used for this exposure scenario would be primarily used for spot treatments. Applicators would be fairly precise when spot spraying, and would avoid directly spraying insects to the greatest extent possible. A dose-response assessment of the toxicity of TCP to terrestrial invertebrates cannot be proposed due to the lack of pertinent data (SERA 2011a).

Reptiles and Amphibians: The toxicity of triclopyr or TCP to reptiles or terrestrial phase amphibians is not addressed in the available literature (SERA 2011a), and therefore not included in risk assessment worksheets. The available studies of triclopyr toxicity on reptiles and amphibians used on frogs or tadpoles in aquatic environments (Berrill et al. 1994; Edington et al. 2003; Yahnke et al. 2017). For our purposes terrestrial phase amphibians are presumed to respond similarly to aquatic phase amphibians and reptiles are presumed to respond similarly to birds. Triclopyr BEE has been found to be moderately to highly toxic to multiple species of frog (Berrill et al. 1994; Edington et al. 2003). Yahnke et al. (2017) performed toxicity tests with triclopyr as TEA. No mortality or behavioral changes were observed in connection with triclopyr exposure, but there was some lethargy, and slight delay in metamorphosis. Based on the risk assessment for birds, reptiles may be susceptible to toxicity from consumption of contaminated insects. In areas where western spadefoot toads occur triclopyr TEA would be used. The maximum label concentration would be used for spot treatments only. Spot application would minimize accidental spraying of insects.

Surfactants

Mammals: There is little information in the scientific literature on effects of seed oils and silicone-based surfactants on mammals beyond some basic acute testing results. There is more information on alkylphenol ethoxylates, such as nonylphenol ethoxylates. The interest in the alkylphenol ethoxylates surfactants is largely driven by findings of estrogenic effects. From Bakke 2003, based on various studies, it can be said that the threshold for estrogenic effects is generally above the threshold for other effects; hence protective levels of nonylphenol ethoxylates exposure would encompass any concerns for estrogenic effects (Bakke 2007).

Invertebrates: Based on a review of the current research by Bakke (2007), it would appear that surfactants have the potential to affect terrestrial insects. However, as is true with many toxicity issues, it would appear that any effect is dose related. The research does indicate that the silicone-based surfactants, because of their very effective spreading ability, may represent a risk of lethality through the physical effect of drowning, rather than through any toxicological effects. Silicone surfactants are typically used at relatively low rates and are not applied at high spray volumes because they are very effective surfactants. Hence it is unlikely that insects would be exposed to rates of application that could cause the effects noted in these studies. Other surfactants, which are less effective at reducing surface tension, can also cause the drowning effect. But as with the silicones, exposures have to be high, to the point of being unrealistically high, for such effects.

When considering the need for relatively high doses for a lethal effect, combined with the fact that individuals, not colonies or nests of invertebrates, may be affected, there is little chance that the surfactants could cause widespread effects to terrestrial invertebrates under normal operating conditions. Spills or accidents could result in concentrations sufficiently high to cause effects, depending upon the surfactant.

Manual/Mechanical Treatments

Manual and mechanical treatments under Alternative 2 would have an overall beneficial effect on terrestrial wildlife habitat. However, all treatment methods would result in minor, temporary, adverse effects from disturbance from human presence and noise. Because manual and mechanical techniques take longer than herbicide methods, the duration of disturbance caused by the presence of people, could be comparatively longer. Treatments could take from one to two days to several weeks depending on the method and target plant species. Weed whackers, mowers, and ATVs all have the potential to generate noise sufficient to flush birds from a nest or interfere with feeding of nestlings if conducted in proximity to nests. Nesting bird surveys would be done prior to any projects starting 15 Feb – 15 Sep. A buffer would be established around any nests found where no work is permitted to occur.

Restoration Treatments

Restoration treatments are designed to restore native and desirable vegetation and would have a significant, permanent, beneficial effect on terrestrial wildlife by improving habitat conditions. Revegetation with desirable native species would be used to enhance ecosystem function, provide habitat to wildlife, suppress invasive plant regrowth, and reduce the number of follow-up treatments required (Cal-IPC 2015b).

4.7.2.3 Aquatic Wildlife

Invasive plant treatment methods described in Alternative 2 would result in significant, long-term, positive effects, and negligible to moderate, short to long-term, negative effects aquatic wildlife. Any grazing permitted in riparian and marsh habitats, or around lakes and ponds would be closely monitored, and livestock would be removed if there are signs of streambank erosion, bare soil areas, or increased sediment runoff. Prescribed burns could lead to decreased water quality in aquatic habitats from sedimentation and turbidity. This effect would be minimized by using vegetation buffers between fires and waterways/bodies. The risks from chemical treatments would be minimized by the implementation of aquatic resource buffers and adherence to herbicide application and mixing BMPs. Manual and mechanical invasive plant treatments would all benefit aquatic wildlife by removing invasive plants blocking water channels and clogging water bodies. Restoration treatments would benefit aquatic habitats by reducing bare soil and slowing the speed of overland water flow, resulting in reduced and slower storm runoff, reduced erosion, and reduced water sedimentation. Invasive plant control in riparian areas is intended to improve native plant diversity and riparian ecosystem health. Therefore, beneficial effects to potential Central Valley steelhead habitat and EFH for Chinook salmon would occur as a result of Alternative 2.

Grazing

Under Alternative 2 grazing could have moderate, short to long-term, adverse effects on aquatic wildlife habitat. Effects of poor livestock and wildlife grazing management on stream hydromodification and water quality can have serious ramifications on aquatic ecosystems. Potential impacts such as bacterial contamination, increased sedimentation, and temperature changing can reduce the quality of the stream's ambient environment so as to affect the composition and health of aquatic organisms. Likewise, reduction of vegetation and increased runoff and flow may damage the stream's usefulness as aquatic habitat (U.S. EPA 1994).

Under Alternative 2 grazing may be permitted in riparian and marsh habitats, and around lakes and ponds. Any grazing within riparian corridors, marshes, or other habitat adjacent to water course or bodies of water would be closely monitored, and livestock would be removed if there are signs of streambank erosion, bare soil areas, or increased sediment runoff. Livestock would continue to be excluded from most riparian areas and lakes on the base when not being used for targeted vegetation management. Therefore, grazing expansion under Alternative 2 would not result in negative impacts to aquatic wildlife or their habitat.

Prescribed Burns

Aquatic habitat could have moderate, temporary, negative effects from prescribed burns due to increases in turbidity caused by runoff and erosion from nearby burned uplands. Water temperatures could also be affected if vegetation that provided pre-fire shade is removed. Chemical fire retardants and mineral firebreaks can indirectly affect wildlife through water contamination.

No prescribed burns are planned for the Dry Creek Riparian corridor, so water quality in Dry Creek would not be affected. Prescribed fire would not typically be used to control woody biomass near waterbodies, so there is little risk of elevated water temperatures from a lack of shade as a result of prescribed burns. The topography around Hutchinson and Reeds creeks is generally flat, so the run-off potential would be fairly limited. If prescribed burns were conducted adjacent to a creek or other water body a vegetated buffer would be maintained between it and the burn area to trap sediment and ash before it could enter the water course/body. Mowed, wet line, and/or blackline would be the primary types of controlled fireline perimeters where any riparian or wetland habitat is present. Chemical fire retardants and mineral firebreaks would not be used during prescribed burns. Therefore, no significant impacts to aquatic wildlife would occur as a result of prescribed burns under Alternative 2.

Chemical Treatments

There would be the potential for moderate, short-term, adverse effects to aquatic wildlife from chemical treatments under Alternative 2. These risks would be minimized by the implementation of aquatic resource buffers and adherence to herbicide application and mixing BMPs in Appendix G. Aquatic wildlife may be exposed to herbicides from accidental spills, direct application, overspray, or runoff into the body of water that they are inhabiting. A review of risk assessments for aquatic species shows that most of the concern for aquatic species is associated with exposures scenarios of an accidental spill. Aquatic wildlife was also analyzed in the Ecological Risk Assessment (Appendix K); potential adverse effects from specific herbicides are discussed below.

Glyphosate: There are a number of commercially available glyphosate formulations which, for the purpose of the Ecological Risk Assessment, were characterized as more or less toxic. While some formulations cannot be easily classified as more or less toxic, the general approach is: formulations that contain a POEA surfactant should be regarded as more toxic, unless there is compelling evidence to the contrary. Studies have found that the toxicity of the original Roundup and similar formulations containing POEA surfactants is far greater than the toxicity of technical grade glyphosate, Rodeo, or other formulations that do not contain surfactants (SERA 2011b). Aquatic animals, including amphibians (Battaglin et al. 2009; Reylea and Jones 2009), water flea (*Daphnia* spp.; Cuhra et al. 2013) and fairy shrimp (Brausch and Smith 2007), appear to be the most sensitive to the effects of POEA-containing formulations.

For more toxic glyphosate formulations, the accidental acute exposure scenarios (spills) in the Ecological Risk Assessment generated HQs greater than 1 for all aquatic animals, as did a number of the non-accidental acute exposure scenarios. The highest HQs generated were for sensitive species exposed through a spill of a high-concentration tank mix: fish HQ = 2,996; amphibians HQs = 3,596; invertebrates HQs = 1,918. HQs for species with less sensitivity, or lower-concentration solutions, still all exceeded 1 under a spill scenario. Non-accidental exposure (overspray, run-off) also poses a risk to aquatic species if herbicide mixes with moderate to high concentrations are applied: sensitive fish HQ = 1.8, 14; tolerant fish high concentration HQ = 1.3; sensitive amphibian HQ = 2, 17; sensitive invertebrate HQ = 1.2, 9. Long-term exposure to high concentration solutions also poses some risk: sensitive fish HQ = 1.0; sensitive amphibians HQ = 1.2.

Even less-toxic formulations of glyphosate can pose a risk to aquatic organisms. Accidental spill scenarios generated HQs greater than 1 for several groups: sensitive fish HQs = 3 to 484; tolerant fish upper HQ = 12; sensitive invertebrate mid and upper HQ = 5, 90; tolerant invertebrate upper HQ = 1.2. One non-accidental acute exposure scenario resulted in a HQ greater than 1 – the direct exposure of a sensitive fish species to spray from a highly concentrated field solution (HQ = 1.3).

Glyphosate would not be applied directly to water for any projects on Beale AFB, but there is the potential for run-off, overspray, or drift when it is applied to riparian or wetland vegetation. If a glyphosate-based herbicide would be used in riparian areas or around vernal pools a lower toxicity, aquatic-safe formulation would be used. Rodeo (i.e., essentially an aqueous solution of the IPA salt of glyphosate) and other equivalent formulations are among the least toxic formulations, with acute toxicity values ranging from about 200 to over 4,000 mg ae/L. Rodeo is much less toxic to aquatic invertebrates than traditional Roundup formulations and other formulations of glyphosate that contain surfactants. However, Rodeo and similar formulations still require the use of surfactants (SERA 2011b). The surfactants used with Rodeo and similar formulations are less toxic than POEA surfactants, but even these less-toxic surfactants would enhance the toxicity of glyphosate. If a surfactant is needed a non-ionic surfactant approved for aquatic use would be added to the tank mix prior to application.

<u>Imazamox</u>: Imazamox is an herbicide used for control of invasive aquatic plants, and as such must be applied directly to water in order to have an effect. Imazamox is considered “practically non-toxic” to fish and aquatic invertebrates (U.S. EPA 1997a). No scenarios from the ecological risk assessment, which assumed direct application to water, generated HQs greater than 1 for aquatic wildlife. Imazamox would not be used in Dry Creek or Best Slough or in waterbodies that feed into them, and would never be applied directly to flowing water.

<u>Imazapyr</u>: Although it is classified as “practically non-toxic” (U.S. EPA 2005a), or “no risk of concern” (U.S. EPA 2006), one exposure scenario for aquatic wildlife did result in an HQ greater than 1 – the exposure of a sensitive fish species from an herbicide spill of the most concentrated field tank mixture (HQ = 3). Herbicides would be mixed at least 150 feet away from water or other sensitive resources, which would minimize the risk of exposure via a spill.

<u>Sulfometuron Methyl</u>: Although it is classified as “practically non-toxic” (U.S. EPA 2008) to reptiles and amphibians, all accidental spill scenarios resulted in HQs greater than 1 for amphibians in aquatic environments at the maximum label rate of 0.281 lbs ae/ac (HQs = 1.7 to 13). Sulfometuron methyl is moderately mobile, but degrades rapidly in the environment. Implementation of aquatic resource buffers and adherence to herbicide application and mixing BMPs in Appendix G, would minimize the risk of exposure to amphibians.

<u>Triclopyr</u>: For most groups of aquatic organisms, triclopyr BEE is much more toxic than triclopyr TEA or triclopyr acid. TCP is a concern because it is more toxic than triclopyr (including triclopyr BEE, triclopyr TEA, and triclopyr acid) to most groups of nontarget organisms. Because triclopyr BEE is more toxic to aquatic organisms than triclopyr TEA the two were analyzed separately in the Ecological Risk Assessment.

Two triclopyr BEE exposure scenarios resulted in HQs greater than 1 for aquatic animals – exposure to “first flush” runoff after herbicide application at the highest tank mix concentration at an application rate of 8 lbs ae/ac for both fish (HQ = 2.6) and aquatic invertebrates (HQ = 5.3). Triclopyr BEE is highly mobile and has a high potential for surface water contamination. No scenarios of herbicide application using triclopyr TEA generated HQs greater than 1. Because of the highly mobile nature of triclopyr, triclopyr TEA would be used whenever possible, especially in the vicinity of aquatic resources. Implementation of aquatic resource buffers and adherence to herbicide application and mixing BMPs in Appendix G, would minimize the risk of exposure to aquatic wildlife.

Surfactants: In general, aquatic organisms are more negatively impacted by surfactants than terrestrial organisms due to surfactant sorption to biological membranes (skin, gills), which disrupts biological functions (Bakke 2007). Three surfactants would be classified as Practically Nontoxic to fish (i.e., Agri-Dex, LI 700, and Hasten-EA.

Most adverse effects to aquatic wildlife would be avoided by implementing aquatic resource buffers during herbicide application to prevent water contamination and protect aquatic wildlife from exposure (Table 1 in Appendix G). There would be several exceptions to the aquatic resource buffers: direct aquatic application of imazamox for control of aquatic plants, foliar or cut stump application to giant reed growing within Dry Creek and Best Slough, Himalayan blackberry control along Reeds Creek, and incidental invasive riparian or aquatic plant control. The purpose of these treatments is to improve fish habitat and improve water flow, so they would have long-term beneficial effects on fish, EFH for Chinook salmon, and other aquatic wildlife. There is however the potential for short-term, adverse impacts to aquatic wildlife from herbicide toxicity in the case of improper application or a spill.

Currently only aquatic-approved formulations of glyphosate, and aquatic-approved formulations of imazapyr can be used to treat invasive plants growing below the ordinary high-water mark of WoUS on base. This includes giant reed growing in Dry Creek. One or both of the approved herbicides would be mixed with a non-ionic surfactant approved for use in aquatic habitats. Therefore, chemical treatments under Alternative 2 would not result in negative impacts to aquatic wildlife, EFH, or other aquatic wildlife habitat.

Manual/Mechanical Treatments

Manual and mechanical invasive plant treatments would primarily have moderate, beneficial, long-term impacts to aquatic wildlife by removing invasive plants blocking water channels and clogging water bodies. There is the potential for indirect adverse impacts if invasive plant fragments capable of re-sprouting escape into the water course/body. Many invasive aquatic plants have the potential to re-sprout from very small stem fragments. Manual or mechanical treatment would only be done for small infestations where all plant particles would be contained and removed from the site. Therefore, manual/mechanical treatments under Alternative 2 would not result in negative impacts to aquatic wildlife or their habitat.

Restoration Treatments

Restoration treatments would have long-term, beneficial effects on aquatic habitats. Revegetation would reduce bare soil and slow the speed of overland water flow. This would result in reduced slower storm runoff, reduced erosion, and reduced water sedimentation. It would be anticipated that adherence to the BMPs in Appendix G would result in “no net loss” of riparian vegetation or shaded riverine aquatic habitat as a result of the Alternative 2.

4.7.2.4 Special Status Wildlife Species

Overall, Alternative 2 would have significant, long-term, beneficial effects on special status wildlife by maintaining and improving habitat quality. However, activities associated with implementation of invasive plant control activities would have the potential to result in moderate, temporary to short-term, adverse effects to special status wildlife species. The activities that could directly or indirectly adversely affect these species include off-road site access, movement of workers and vehicles, herbicide exposure, contamination of waterways and soil from vehicular leaks or improper maintenance, injury or death from prescribed fires, and increased disturbance.

Non-native plant species management activities would avoid effects to listed species through the use of AMMs. These AMMs, defined during consultation with the USFWS under §7 of the ESA, ensure that to the extent possible, activities would be designed to have no effect on or are not likely to adversely affect listed or sensitive resources through temporal or spatial avoidance. These measures are generally simple, low-cost practices that are easily incorporated into a work day, and are observed by workers and supervisors.

The USAF prepared a Biological Assessment for consultation with the USFWS on potential effects of invasive plant control activities conducted by Beale AFB on species that are regulated by the USFWS under the ESA, including activities incorporated in Alternative 2 (see Section 1.7, *Key Documents*). The Biological Assessment and relevant individual project concurrences are included in Appendix F.

All AMMs identified during consultation (Appendix G) would be implemented. The measures are intended to avoid and minimize any potential adverse effects to listed species during implementation of the project activities. General AMMs would be fully implemented as part of the project activities, and species-specific AMMs would be implemented based on the potential for the presence of federally threatened or endangered species. The toxicity of individual herbicides and additives to specific groups of organisms and species protected under the ESA are listed in Tables 4.9 and 4.10.

Restoration Treatments

Restoration activities are designed to result in significant, long-term, positive effects to vernal pool fairy shrimp, vernal pool tadpole shrimp, valley elderberry longhorn beetle, giant garter snake, western yellow-billed cuckoo, and monarch. Positive effects would be achieved through the reduction of competitive pressures from invasive plants to monarch breeding habitat (milkweed species), improved ponding duration and water quality in vernal pool fairy shrimp habitat, and improved productivity of western yellow-billed cuckoo, giant garter snake, and valley elderberry longhorn beetle habitat.

Table 4.9 Toxicity of Active Ingredients in Proposed Herbicides to Various Taxonomic Groups (Species listed in parentheses indicate applicable potentially affected candidate or listed species under the ESA at Beale AFB).

Herbicide		Amphibians & Reptiles (giant garter snake)	Birds (western yellow-billed cuckoo)	Fish (Steelhead)	Aquatic Invertebrates (vernal pool shrimp)	Terrestrial Invertebrates (valley elderberry longhorn beetle, monarch, bumble bees)
Active Ingredient	**Trade Names**					
Aminopyralid	Milestone, Capstone[a]	practically non-toxic to aquatic-phase amphibians[1]	practically non-toxic[2]	practically non-toxic[2]	practically non-toxic[2]	practically non-toxic[2]
Chlorsulfuron	Telar XP	no data available[3, d]	practically non-toxic[4]	practically non-toxic[4]	practically non-toxic[4]	practically non-toxic[4]
Glyphosate	Roundup Pro	practically non-toxic[5], aquatic: practically non-toxic - moderately toxic[17,e], terrestrial: see birds[17]	slightly toxic[6,17]	practically non-toxic[6], slightly toxic - highly toxic[17]	may be slightly toxic[6,7], practically non-toxic - moderately toxic[17,e]	non-toxic[6]
Glyphosate	Rodeo[b], Roundup Custom[b]	na, but see above	na, but see above	practically non-toxic - slightly toxic[17]	na, but see above	na, but see above
Imazamox	Clearcast[b]	no data available[8]	practically non-toxic[9]	practically non-toxic[9]	practically non-toxic[9]	practically non-toxic[9]
Imazapyr	Arsenal[b], Habitat[b]	practically non-toxic[10]	practically non-toxic[11], no risk of concern[19]	practically non-toxic[11], no risk of concern[19]	practically non-toxic[11], no risk of concern[19]	practically non-toxic[11], no risk of concern[19]
Sulfometuron Methyl[c]	Oust XP	practically non-toxic[12,d]	practically non-toxic[12]	practically non-toxic[12]	practically non-toxic[12]	practically non-toxic[12]
Triclopyr butoxyethyl ester (BEE)	Garlon 4 Ultra	moderately to highly toxic[13]	slightly toxic[18]	moderately - highly toxic[18]	slightly - moderately toxic[18]	na
Triclopyr triethylamine salt (TEA)	Garlon 3A[b]	likely practically non-toxic[13]	practically non-toxic[14,18]	practically non-toxic[18]	practically non-toxic - moderately toxic[14,15,18]	practically non-toxic[14,18]

[a] Aminopyralid + Triclopyr, a.k.a. Milestone VM Plus; [b] aquatic approved formulations; [c] toxicity 'levels' are based primarily on acute testing methods, chronic effects are extrapolated; [d] aquatic phase-amphibian toxicity is based on fish assessments, terrestrial phase are based on bird assessments; supplemental data exist for chlorsulfuron; [e] toxicity varies with specific formulation and species, etc.

1. SERA 2007; 2. U.S. EPA 2005b; 3. SERA 2016; 4. Oregon State University and Intertox 2006; 5. Vincent and Davidson 2015; 6. University of California at Davis 1996b; 7. No toxicity is expected from labeled use of glyphosate, toxicity is from the surfactant (Monsanto 2002); 8. SERA 2010; 9. U.S. EPA 1997a; 10. Trumbo and Waligora 2009; 11. SERA 2011c; 12. U.S. EPA 2008; 13. Berrill et al. 1994, Edington et al. 2003, Yahnke et al. 2017; 14. National Pesticide Information Center 2005; 15. Toxicity varies by formulation of finished product and species tested; 16. Garlon 4 formulation is highly toxic to salmonids (Wan et al. 1987); 17. U.S. EPA 2015; 18. U.S. EPA 1998; 19. U.S. EPA 2006

Table 4.10 Toxicity of Herbicide Additives (Adjuvants) Proposed for use to Various Taxonomic Groups (species listed in parentheses indicate potentially affected candidate or listed species under the ESA at Beale AFB).

Adjuvant Name	Approved for Aquatic Use in CA	Surfactant Type	Action	Amphibians & Reptiles (giant garter snake)	Birds (western yellow-billed cuckoo)	Fish (Steelhead)	Aquatic Invertebrates (vernal pool shrimp)	Terrestrial Invertebrates (valley elderberry longhorn beetle, monarch, bumble bees)
Agri-Dex	Yes	Crop oil concentrate	increase pesticide penetration	practically non-toxic in formulation with glyphosate IPA[1]	na	practically non-toxic[2], practically non-toxic in formulation with Arsenal[3]	practically non-toxic[2]	no toxicity observed[4]
Competitor	Yes	Modified vegetable oil	increase pesticide penetration	practically non-toxic in formulation with glyphosate IPA[1]	na	slightly toxic[2]	practically non-toxic[2]	na
Hasten-EA	Yes	Modified vegetable oil concentrate	increase pesticide penetration	na	na	practically non-toxic[3] (Hasten) in formulation with Arsenal - slightly toxic[5]	na	na
Dyne-Amic	Yes	Modified vegetable oil surfactant blend	increase pesticide penetration	no significant increase in mortality at environmentally-relevant concentrations and in formulation with glyphosate[6]	na	slightly toxic[2,7]	slightly toxic[2]	learning impairment following oral ingestion of 20µg[4]
Induce	Yes	Nonionic low foam wetter/spreader	increase pesticide penetration	na	na	moderately toxic[7]	na	no toxicity observed[4]
Grounded W	No	Deposition aid (sticker)	promotes even, uniform spray deposition	na	na	na	na	na
1. Vincent and Davidson 2015; 2. Washington State Department of Agriculture 2012; 3. Fisher et al. 2003; 4. Ciarlo et al. 2012; 5. Smith et al. 2004; 6. Johnson 2017; 7. Haller and Stocker 2003								

Vernal Pool Tadpole Shrimp (Endangered) and Vernal Pool Fairy Shrimp (Threatened)

Grazing

Vernal pool tadpole shrimp and vernal pool fairy shrimp may experience moderate, long-term, adverse, impacts due to grazing in the form of crushing or damage to cysts due to herbivore trampling (Hathaway et al. 1996). However, this effect would be offset by the significant, long-term, beneficial effects of grazing on vernal pool ecosystems. In vernal pool systems in the Central Valley of California, continuous grazing was associated with 5-20% more native plant cover, and 273% longer pooling durations (Marty 2015).

In addition, grazing would be expected to improve water quality issues by reducing RDM levels. RDM values in grazed pools were typically at least 50% lower than those in ungrazed pools (Marty 2015; Swiecki and Bernhardt 2008). If RDM levels are high, the breakdown of this material following inundation creates anoxic conditions incompatible with vernal pool fairy shrimp occupancy (SRS Technologies 2006). RDM build-up is also thought to create a positive feedback loop in which high RDM values decrease the inundation period, allowing increased grass encroachment, which further increases RDM build-up, which further reduces the hydroperiod. Left unchecked, the end result is vernal pools functionally incapable of supporting many species (Marty 2015).

Although branchiopod cysts are more vulnerable to breakage during the wet season (Hathaway et al. 1996), maximum positive impacts of grazing are achieved when grazing is allowed to occur during the wet season. During wet season grazing, animals avoid flooded pools and swales focusing on upland vegetation before moving into the basins after water has receded and upland vegetation has dried. Allowing grazing to occur as water levels draw down in pools has effectively suppressed invasive grasses in pool basins in Central Valley sites while significantly increasing native cover and diversity (Swiecki and Bernhardt 2008).

In grazing conducted in the Central Valley of California for vernal pool management, both cattle and sheep are typically employed (Marty 2015; Swiecki and Bernhardt 2008). Livestock type may play a key role in habitat management due to different feeding preferences and grazing behaviors (Borgias 2004). Sheep may have less impact due to their small size and behavior (sheep avoid vernal pools until they dry down, thereby reducing the impact of damage to cysts) and therefore may be more appropriate in areas with high densities of vernal pools (N. McCarten personal communication 2018). Studying the efficacy of different grazing animals on vernal pool fairy shrimp habitat would allow the selection of the most effective grazers for long-term habitat management on Beale AFB.

Ground-disturbing activities (post-driving, trenching, filling, scraping) adjacent to WoUS could have temporary, negligible, indirect impacts on federally-listed vernal pool fairy shrimp and vernal pool tadpole shrimp habitat but is not likely to adversely impact any protected species. New infrastructure would be designed to avoid effects to sensitive habitats, including known and potential vernal pool shrimp habitat. All new fence poles would be placed at a distance of 12.5 feet or greater to federally-listed vernal pool shrimp habitat, so no direct effects would occur. To minimize adverse direct and indirect effects to species and habitat, all field-verified wetlands, drainages, and vernal pools within 50 feet of new infrastructure would be protected during construction by implementation of the AMMs in Appendix G. The USFWS concurred that grazing under Alternative 2 may affect, but is not likely to adversely affect vernal pool tadpole shrimp and vernal pool fairy shrimp or their habitat.

Prescribed Burns

Prescribed burns would have significant, short to long-term, beneficial effects on vernal pool shrimp. Studies of wildland fire on vernal pool crustaceans have shown that fire does not pose a significant threat to cysts. In one study, cysts of the closely related *Branchinecta sandiegoensis* successfully hatched the first rainy season following a fire event (Wells et al. 1997). Controlled burns would improve vernal pool fairy shrimp habitat by removing thatch from vernal pools and surrounding uplands, thereby improving the ecological function of the pools.

Firefighting actions such as maintaining annual firebreaks and wildfire response actions like firelines often have negative effects on the vernal pool ecosystems when they plow through pool basins disrupting hydrology and injuring federally listed species that may be present. Controlled burns would avoid damaging vernal pool tadpole shrimp and vernal pool fairy shrimp habitat by using wet lines within 250 feet of vernal pool tadpole shrimp and vernal pool fairy shrimp habitat, and by using wet lines and hand lines in areas. To avoid crushing cysts, no fire suppression equipment would be allowed to access vernal pool tadpole shrimp or vernal pool fairy shrimp habitat during controlled burns. The USFWS concurred that prescribed burns under Alternative 2 may affect, but are not likely to adversely affect vernal pool tadpole shrimp and vernal pool fairy shrimp or their habitat.

Chemical Treatments

Little is known about the effects of pesticides on vernal pool branchiopods. Because of this, AMMs proposed to protect these species are very conservative. With the implementation of AMMs there would be negligible, temporary, adverse impacts on vernal pool tadpole shrimp and vernal pool fairy shrimp. One study conducted on *B. sandiegoensis* found that glyphosate, the active ingredient in Roundup, could be lethal to this species depending on the concentration of this chemical in the pool water (Ripley et al. 2002/2003). No studies have measured glyphosate concentrations in Central Valley vernal pools, but a study in the northeastern United States found glyphosate levels in some vernal pools well above the range of the lethal dose levels indicated in the Ripley et al. study (Battaglin et al. 2009). These concentrations were found in a pool where the adjacent habitat had been sprayed for invasive species seven days before the sample collection.

Studies have found that the surfactants found in some formulations of commercial preparations of glyphosate can be toxic to aquatic life including amphibians (Battaglin et al. 2009; Reylea and Jones 2009), water flea (Cuhra et al. 2013) and fairy shrimp (Brausch and Smith 2007). In general, aquatic organisms are more negatively impacted by surfactants than terrestrial organisms due to surfactant sorption to biological membranes (skin, gills), which disrupts biological functions. A study on the branchiopod *Thamnocephalus platyurus* assessed the acute toxicity of POEA and found it to be extremely toxic at low concentrations (Brausch and Smith 2007). Because inert ingredients are not required to be specified on product labels by the manufacturer, it can be difficult to discern which or even whether an additive is present in the formulation as well as whether or not it is harmful to wildlife (Cuhra et al. 2013). Herbicide application near vernal pools would follow the AMMs in Appendix G. The USFWS concurred that chemical treatments under Alternative 2 may affect, but are not likely to adversely affect vernal pool tadpole shrimp and vernal pool fairy shrimp or their habitat.

Manual/Mechanical Treatments

Manual and mechanical treatments would have significant, long-term, beneficial effects, and moderate, long-term adverse effects on vernal pool shrimp. Manual and mechanical removal of invasive plants in vernal pool tadpole shrimp or vernal pool fairy shrimp habitat could result in direct, adverse impacts by damaging or destroying cysts due to soil disturbance. Overall treatment is expected to significantly, permanently improve habitat conditions for aquatic shrimp life stages. Species targeted for removal include waxy mannagrass, an invasive species known to invade vernal pools and wetlands (DiTomaso et al 2013). To control waxy mannagrass, manual removal would be used to eliminate the plant from vernal pools during its terrestrial life stage. Manual removal is preferred for vernal pools because it would both kill the target species and remove plant biomass that could impact vernal pool fairy shrimp habitat as it decomposes. While hand tools (shovels) may be used, hand pulling would be the primary mode of removal, as hand pulling would cause the least amount of soil disturbance. All manual removal efforts would take care to avoid excessive disturbance to the soil. Weed whacking may also be used to reduce plant biomass. As a result, manual invasive plant removal may affect, and is likely to adversely affect vernal pool fairy shrimp, but is also expected to have a long-term beneficial effect on the species.

Mowing in and around vernal pool fairy shrimp habitat would only occur when the soil is no longer saturated to prevent damage to vernal pools and cysts. Mowing during the dry season may help improve vernal pool function by reducing thatch within vernal pools. The USFWS concurred that manual/mechanical treatments under Alternative 2 may affect, but are not likely to adversely affect vernal pool tadpole shrimp and vernal pool fairy shrimp or their habitat.

Valley Elderberry Longhorn Beetle (Threatened)

Grazing

Grazing under Alternative 2 would have negligible, temporary, adverse effects to valley elderberry longhorn beetle. Cattle can consume new growth of host plant, reducing habitat availability but probably not crushing beetle young, so grazing is not considered a widespread threat (Beale AFB 2017b). Grazing would be limited within areas containing high densities of elderberry shrubs (i.e. the Dry Creek riparian corridor). In locations where new grazing would occur near elderberry shrubs, exclosures would be erected around plants within new pastures, or fencing would be designed so as to exclude shrubs near the outer fence lines of pastures. A natural resources monitor would periodically check protected shrubs to maintain fences and ensure that grazing of elderberry shrubs has not occurred. If sheep or goat grazing would occur near elderberry shrubs, temporary fencing would be erected to protect them. Grazing infrastructure installation near elderberry shrubs would primarily be post pounding of steel t-posts and stringing wire, neither of which is anticipated to negatively impact valley elderberry longhorn beetle. All equipment would be kept on the far side of the fence line from the shrubs and access routes would be designed to avoid elderberry shrubs. The AMMs in Appendix G would be implemented during any construction near elderberry shrubs. Therefore, grazing expansion under Alternative 2 would not result in negative impacts to valley elderberry longhorn beetle. The USFWS concurred that grazing under Alternative 2 may affect, but is not likely to adversely affect valley elderberry longhorn beetles or their habitat.

Prescribed Burns

Prescribed burns would have long-term, significant, beneficial effects, but could also have short-term, moderate, adverse effects on valley elderberry longhorn beetles. The beetles utilize elderberry plants for all stages of their life cycle. Elderberry grows in riparian forests and, while they often re-sprout prolifically after fire, individual plants are immediately negatively affected by fire which results in a disruption of the life cycle of any valley elderberry longhorn beetle using them. In addition, several of the longer-lived overstory trees in riparian forests are negatively affected by fire in the short term.

In cases where prescribed burns must be conducted in an area with elderberry shrubs, a 100-foot minimum buffer would be maintained around each shrub. If burns are conducted during the active period of the adult valley elderberry longhorn beetle (March-July), a minimum 100-foot buffer would be maintained around each shrub. If a location is proposed to be burned that includes elderberry shrubs, the shrubs would be wetted to prevent ignition. Monitoring would be conducted into the subsequent growing season to ensure shrub survival. If any shrubs were determined to be damaged or killed by controlled burns, then Beale AFB would initiate consultation on mitigation of elderberry shrubs through riparian habitat restoration planting and long-term maintenance and monitoring in accordance with the USFWS (2017b) Framework for Assessing Impacts to the Valley Elderberry Longhorn Beetle. The USFWS concurred that prescribed burns under Alternative 2 may affect, but are not likely to adversely affect valley elderberry longhorn beetles or their habitat.

Chemical Treatments

Overall, the invasive plan control provided by chemical treatments under Alternative 2 would have long-term, significant, beneficial impacts on riparian habitats and plants used by valley elderberry longhorn beetle on Beale AFB. However, there could be moderate, temporary, adverse effects on valley elderberry longhorn beetle and their habitat as a result of chemical treatments. There are no known studies of the potential effects of herbicide use on valley elderberry longhorn beetle. However, studies using honey bees found that some herbicides and surfactants can be toxic to terrestrial invertebrates (Table 4.10 and 4.11). Most herbicides are toxic to elderberry shrubs, the valley elderberry longhorn beetle host plant. To reduce the chance of non-target drift harming elderberry shrubs, herbicide would not be applied within 20 feet of any shrubs. Persistent and pre-emergent herbicides would not be used within 150 feet of valley elderberry longhorn beetle habitat. Herbicides applied within 250 feet of an elderberry shrub would be sprayed with a backpack sprayer or other direct method. If herbicide is applied near elderberry shrubs it would be in low wind conditions in accordance with applicable AMMs in Appendix G.

The implementation of these AMMs would minimize adverse effects to valley elderberry longhorn beetle. In the unlikely event that shrubs are damaged or killed by chemical treatments, Beale AFB would implement the following compensation ratios: invasive species control that damages or kills elderberry shrubs with stem diameters greater than one inch would be replaced at a 3:1 (i.e., for every shrub impacted, 3 one-gallon shrubs plus supporting riparian component species would be planted) ratio, even if the shrub is not killed by the activity. The USFWS would be notified immediately if any shrub was found to be directly impacted from control activities. These ratios are in accordance with USFWS (2017) Framework for Assessing Impacts to the Valley Elderberry Longhorn Beetle. Chemical treatments under Alternative 2 may affect, but are not likely to adversely affect valley elderberry longhorn beetles or their habitat.

Manual/Mechanical Treatments

Manual and mechanical treatments would have a moderate, long-term, beneficial, impacts on valley elderberry beetle and their host plant. Elderberry plants would not be the target of, nor affected by, manual or mechanical treatments described in Alternative 2. Removal of invasive plant species by hand pulling or cutting with a string trimmer would not directly affect this species or its elderberry habitat. Indirect benefits could result if elderberry and other native vegetation is promoted through the removal of invasive plants within riparian zones. Removal of invasive plants is likely to improve habitat conditions for valley elderberry longhorn beetle by reducing competition with elderberry shrubs. All control within the dripline of a shrub would be conducted by hand to avoid damaging shrubs or injuring valley elderberry longhorn beetles.

Prior to any mowing activity, all elderberry plants would be flagged for avoidance. Any mowing treatment that must occur within the dripline of an elderberry plant would be conducted outside of the valley elderberry longhorn beetle active season (i.e., August-February). All elderberry shrubs would be flagged for avoidance by a USFWS-approved biologist. Manual or mechanical removal actions within the dripline of elderberry plants would occur outside of the valley elderberry longhorn beetle active season (i.e., would occur August-February). In extreme cases where manual or mechanical removal activities must occur during the valley elderberry longhorn beetle active season, it would only be performed with hand tools. Therefore, no adverse impacts would occur to valley elderberry longhorn beetle or their habitat as a result of manual or mechanical treatments. The USFWS concurred that manual/mechanical treatments under Alternative 2 may affect, but are not likely to adversely affect valley elderberry longhorn beetles or their habitat.

Giant Garter snake (Threatened)

Portions of Reeds Creek on the west side of the base contain suitable habitat for giant garter snake, and is part of the American Basin Recovery Unit as described in the Recovery Plan for the Giant Garter Snake (USFWS 2017c). However, there have been no confirmed occurrences recorded of the giant garter snake at Beale AFB despite multiple surveys (Hansen 2005, 2014, 2015, 2016). The nearest CNDDB recorded occurrence is approximately eight miles to the north of Beale AFB and was recorded in 2010 (CNDDB 2018). Given the lack of giant garter snake sightings on Beale AFB and the surrounding areas, and the negative results of eDNA surveys conducted along Reeds creek, it is highly unlikely that giant garter snake occur on or near Beale AFB. With the implementation of AMMs no impacts to giant garter snakes would occur.

Grazing

Grazing would have overall moderate, long-term, beneficial impacts, but could result in minor, temporary, adverse effects on giant garter snakes. The primary goal of livestock grazing is to reduce abundance of invasive plant biomass. As such, this would indirectly benefit giant garter snake by improving the overall habitat. The presence of livestock (e.g., cattle, sheep, goats) may cause temporary behavioral disruption to giant garter snake. There is also the chance that livestock may step on individual giant garter snake and cause harm or death. The likelihood of this happening, however, is very slim and grazing, as a whole, would not significantly affect giant garter snake. The USFWS concurred that grazing under Alternative 2 may affect, but is not likely to adversely affect giant garter snakes.

Prescribed Burns

Prescribed burns would have minor, temporary to long-term, beneficial impacts on giant garter snakes. Prescribed burns within giant garter snake habitat would occur during the active season (1 May- 1 Oct), when giant garter snakes would be in aquatic environments, and therefore not within proposed burn locations. Additionally, only wet-lines are proposed to be used near potential giant garter snake habitat and therefore no ground disturbance would occur. Any disruptions caused by controlled burns would be short-term behavioral disruptions. The USFWS concurred that prescribed burns under Alternative 2 there would be no effect on giant garter snakes.

Chemical Treatments

Some of the herbicides proposed for use are potentially toxic to reptiles (Table 4.10), so herbicide application has the potential to moderately, temporarily, adversely affect giant garter snakes if improperly applied. However, Beale AFB would only apply aquatic-approved herbicides and surfactants, with low toxicity, near potential giant garter snake habitat. Herbicides would be applied in accordance with the AMMs in Appendix G. With the implementation of these measures no significant effects to giant garter snakes would occur. The USFWS concurred that chemical treatments under Alternative 2 may affect, but are not likely to adversely affect giant garter snakes.

Manual/Mechanical Treatments

Manual and mechanical treatments have the potential to directly adversely affect giant garter snakes by disrupting behavior and injuring snakes. However, disturbance would be temporary and potential impacts to giant garter snakes would be minimized through the use of the established AMMs. Mowing is proposed for upland areas during the active season of the giant garter snake (1 May - 1 October), when snakes are typically within aquatic habitats instead of upland refugia. The USFWS concurred that manual/mechanical treatments under Alternative 2 may affect, but are not likely to adversely affect giant garter snakes.

Western Yellow-Billed Cuckoo (Threatened)

While there is the potential for western yellow-billed cuckoo to occur on Beale AFB, the available suitable habitat is limited to only three locations and is considered poor habitat.

Grazing

Grazing would have moderate, long-term, beneficial effects on yellow-billed cuckoos. Sheep or goat grazing could be used to control invasive plants in riparian areas considered suitable western yellow-billed cuckoo habitat. The goal of targeted grazing in riparian areas is to reduce the prevalence of invasive plants and improve native plant diversity and overall riparian ecosystem health which would indirectly benefit western yellow-billed cuckoos. Grazing would occur outside of the time period when western yellow-billed cuckoos could be present. Temporary electric fencing would be used to keep livestock within treatment areas and animals would be moved immediately if detrimental effects to native vegetation were observed. The USFWS concurred that manual/mechanical treatments under Alternative 2 may affect, but are not likely to adversely affect western yellow-billed cuckoos.

Prescribed Burns

Prescribed burns could have long-term, moderate, adverse effects on western yellow-billed cuckoos by destroying breeding/foraging habitat and nests and temporarily by altering behavior due to smoke. However, prescribed burns are not proposed within locations identified as suitable nesting habitat for western yellow-billed cuckoo. If burns are proposed to occur in a location near (within 1000 feet of) occupied habitat, then the western yellow-billed cuckoo-specific AMMs in Appendix G would be adhered to. The USFWS concurred that prescribed burns under Alternative 2 may affect, but are not likely to adversely affect western yellow-billed cuckoos.

Chemical Treatments

Herbicide application could temporarily, moderately, adversely impact western yellow-billed cuckoos through behavioral disruption via noise, environmental toxicity, or by reducing vegetative cover used for breeding and foraging. In areas where western yellow-billed cuckoos are confirmed, herbicide use would follow the species-specific AMMs in Appendix G to avoid any adverse effects on the species. Therefore, herbicide application would not have a significant effect on western yellow-billed cuckoos. The USFWS concurred that chemical treatments under Alternative 2 may affect, but are not likely to adversely affect western yellow-billed cuckoos.

Manual/Mechanical Treatments

Manual and mechanical removal may occur in suitable western yellow-billed cuckoo habitat and could temporarily, minorly, adversely affect yellow-billed cuckoos. This activity has the potential to directly affect the species due to alterations of the ambient noise levels. Changes in ambient noise levels resulting from the implementation of projects within western yellow-billed cuckoo habitat and the surrounding area could result in direct or indirect effects if they cause a nesting bird to abandon its nest. If western yellow-billed cuckoos are known to be present in or near a manual or mechanical removal project, then the associated species-specific AMMs would be adhered to. The USFWS concurred that manual/mechanical treatments under Alternative 2 may affect, but are not likely to adversely affect western yellow-billed cuckoos.

Monarch Butterfly (Candidate Species)

Grazing

Overall grazing would have negligible, temporary, adverse effects on monarchs, but there could be moderate, short-term, adverse impacts in the form of crushing of host milkweed plants, eggs, and larvae, and damage to upland nectar sources. Livestock avoid foraging on milkweed itself due to its toxicity (Pfister et al 2002). Milkweed and monarch butterflies have been documented within the current and proposed grazing pastures. Using BMPs, grazing is assumed to be beneficial to pollinator species by reducing RDM and controlling invasive species (Pelton et al 2018) and improving diversity of flowering forbs (Beale AFB 2017b). Currently, grazing on the base is conducted primarily during the dormant season (fall and winter) of local milkweed species and therefore impacts to both the host plant and the species itself would be negligible. Furthermore, grazing would be excluded from breeding locations that provide roosting sites and water (i.e., ephemeral drainages and riparian corridors) where monarchs have been observed occupying habitat. The USFWS concurred that, if listed, grazing under Alternative 2 may affect, but is not likely to adversely affect monarchs.

Prescribed Burns

Beale AFB has determined that controlled burns under Alternative 2 would have a moderate, temporary, negative impact and a moderate, long-term, beneficial effect on the monarch. There is limited information available as to the potential effects of prescribed fire on monarch butterflies and what information there is comes from the eastern population of monarchs in prairie habitat. However, in these habitats, monarchs have been shown to respond positively to prescribed fire, with more monarchs using areas that had previously burned areas. Milkweeds are a rhizomatous species, and both seeds and rhizomes are thought to sprout readily following fire. Furthermore, prescribed fire likely benefits milkweeds by reducing thatch and competition from invasive grasses and forbs, allowing plants to more readily establish, as native milkweeds typically germinate much later than other species and have trouble establishing in areas with high invasive plant pressures (Xerces 2018). Controlled burns could adversely affect monarchs by destroying milkweed plants, killing monarchs (all life stages) and eliminating roosting sites and nectar resources. Smoke may also affect monarchs, but no studies have been conducted to ascertain the effects of smoke on monarchs (Xerces 2018). However, it is likely that the removal of thatch via burning may promote the germination of milkweed seeds and allow newly emerged milkweeds to be more readily accessed by monarchs (Stephanie McKnight personal communication 2019).

Therefore, controlled burns in known monarch habitat would be conducted only when monarchs are not actively breeding on Beale AFB (15 Mar-31 Oct) to avoid take of monarchs and to stimulate flower production of spring-blooming nectar resources. All roosting trees would be avoided during prescribed burns. In prescribed fire areas where monarchs are known to occur where reseeding is required, Beale AFB would include seeds of plants known to be beneficial to monarchs. This would include native milkweed seed either collected from plats on the base, or purchased from a local nursery. Following the established AMMs and buffers, prescribed fire is not expected to have any adverse effects on the species. However, controlled burns are proposed for use with the specific goal of habitat enhancement within areas known to support milkweed. The USFWS concurred that, if listed, prescribed burns under Alternative 2 may affect, are likely to adversely affect monarchs or their habitat.

Chemical Treatments

Beale AFB has determined that herbicide application could have moderate, temporary to long-term, adverse impacts to monarchs, based on the Ecological Risk Assessment (Appendix K) and the toxicity determinations from Table 4.10. Herbicides could indirectly impact monarchs by reducing or eliminating plant resources needed by monarchs and other pollinators for foraging and egg laying (Forrester et al. 2005; Russell et al. 2005; Dover et al. 2010). The rise of herbicide-resistant row crops in particular has been linked to large-scale declines in milkweeds in the eastern U.S., with negative impacts on eastern monarch populations (Pleasants and Oberhauser 2013; Flockhart et al. 2014; Stenoien et al. 2016; Saunders et al. 2017; Thogmartin et al. 2017; Zaya et al. 2017). Herbicide use could also contribute to declines in nectar plants that would negatively affect monarchs (Bohnenblust et al. 2016). Some herbicides, including graminicides, also show direct toxicity to lepidopteran species (Schultz et al. 2016). However, carefully timed herbicide application, with surveys to flag and buffer milkweed occurrences, would likely benefit monarch breeding habitat by reducing invasive plant infestations that directly compete with milkweeds and native nectar plants.

Beale AFB would prevent risks posed by drift or accidental overspray of broad-spectrum herbicides to milkweed and monarchs by avoiding use of these herbicides within 100 feet of occupied monarch habitat during the breeding season to the maximum degree feasible. If use of such herbicides is necessary, Beale AFB would employ special precautions as outlined in the herbicide and monarch specific AMMs (Appendix G). Special precautions include placing temporary physical barriers around plants, using low pressure application techniques, and only applying herbicide during low wind conditions. Pre-emergent herbicides could prevent germination and development of milkweed seedlings if applied where seed occurred. However, pre-emergent herbicides would not be used within 150 feet of milkweed localities. All individuals operating within monarch habitat during the growing season would be trained on and be required to demonstrate proficiency in milkweed identification before working in monarch habitat. Based on these measures we believe the chance of drift or overspray damaging or killing milkweed is discountable.

If invasive plant infestations are left unchecked, these plants would continue to overrun milkweed habitat, leading to localized extirpations or significant population declines. Controlling invasive plant species with herbicides in occupied and suitable monarch habitat is expected to restore and enhance milkweed and increase the viability of known milkweed stands. Additionally, Beale AFB is actively conducting habitat enhancement for monarchs by conducting and monitoring plantings of native milkweeds and nectaring plants in areas near existing breeding sites. As a result, targeted herbicide application would have a long-term beneficial impact on this species. The USFWS concurred that, if listed, herbicide application under Alternative 2 may affect, and are likely to adversely affect monarchs or their habitat.

Manual/Mechanical Treatments

Manual and mechanical treatments have the potential to cause moderate, short or long-term, adverse effects to monarchs by damaging or destroying milkweed and injuring the eggs or larvae of the monarch. However, damage to milkweed plants would be minimized by adherence to the AMMs in Appendix G. Furthermore, removal of invasive plant species is likely to improve habitat for the monarch over time by removing competition and allowing for the establishment of additional milkweed plants. All disturbed areas near monarch habitat would be reseeded with the base-approved seed mix that includes milkweed seeds.

Mowing may occur in areas where milkweed is found. Mowing could have detrimental effects to monarchs during the breeding season by destroying larval food sources and killing caterpillars and eggs. Excessive mowing could also reduce native plant diversity and suppress milkweed abundance. However carefully timed mowing could benefit milkweeds by reducing competition for resources with invasive plants and promoting growth (Xerces Society 2018). If mowing is conducted during the summer, a USFWS-approved biologist would survey the project area and flag milkweeds for avoidance. All mowers would receive training to identify milkweeds and important nectar plants in order to avoid plants during mowing. Early spring mowing in areas where milkweed has been recorded would set mower height to a minimum of 10-12 inches to avoid damage to newly emerging milkweeds whenever possible. Use of mowing to control non-native plants using the established AMMs is likely to temporarily adversely affect the species by killing eggs and larvae on newly emerged milkweeds, however mowing is expected to have a long-term benefit to the species by improving habitat for both adults and larvae. The USFWS concurred that, if listed, manual/mechanical treatments under Alternative 2 may affect, but are not likely to adversely affect monarchs.

Steelhead - Central Valley Distinct Population Segment (Threatened) and EFH for Chinook salmon

The Central Valley steelhead DPS is listed as threatened under the ESA and falls under the jurisdiction of NMFS. Historically, steelhead spawned and reared in the most upstream portions of the upper Sacramento and San Joaquin Rivers and most, if not all, of their perennial tributaries (Beale AFB 2019a). Critical habitat has been designated for this species (USFWS 2005a), but it does not include the hydrologic units that occur on the base. A consultation has been initiated with NMFS that, with the implementation of applicable AMMs, invasive plant control under Alternative 2 may affect, but is not likely to adversely affect Central Valley steelhead or EFH for Chinook salmon. The consultation is discussed in detail in Section 1.5.1 and included in Appendix F.

Grazing

Grazing would not be conducted in the Dry Creek and Best Slough riparian corridor, therefore, grazing expansion under Alternative 2 would have no effect on CCV steelhead. Potential grazing impacts are changed streambank and channel morphology, increases in water temperatures, and impaired water quality. Any grazing within riparian corridors, marshes, or other habitat adjacent to a water course or body of water would be monitored, and livestock removed if there are signs of streambank erosion, bare soil areas, or increased sediment runoff. Livestock would be excluded from most riparian areas and lakes on the base when not being used for targeted vegetation management. For this reason, there would be no adverse effects to Chinook salmon EFH from grazing.

Prescribed Burns

Prescribed burns are not planned for the Dry Creek riparian corridor, and so would not impact Central Valley steelhead or their habitat. Other streams on the base which may be temporarily, moderately, negatively affected by fire due to increases in turbidity caused by runoff and erosion from nearby burned uplands, do not provide potential habitat for the Central Valley steelhead. If prescribed fires escape, they could have negative effects on riparian forests and stream reaches providing potential habitat for Central Valley steelhead. Water temperatures may also be affected if vegetation that provided pre-fire shade is removed.

Prescribed fire would not typically be used to control woody biomass near waterbodies, so there is little risk of elevated water temperatures from a lack of shade as a result of prescribed burns. Flat topography around Hutchinson and Reeds creeks and keeping vegetated buffers between burns and water bodies would prevent adverse effects to EFH for Chinook salmon.

Chemical Treatments

Overall, chemical treatments would have significant, long-term, beneficial impacts, but there is the potential for moderate, short-term, adverse effects to steelhead from herbicide toxicity if applied at the wrong time of year. The intent of invasive plant control within riparian areas, where it has the potential to impact Central Valley steelhead, is to improve native plant diversity and riparian ecosystem health. The toxicity of individual herbicides and surfactants to fish varies (Tables 4.10 and 4.11), as does the potential for an herbicide to contaminate surface or groundwater (Tables 4.6, 4.7 and 4.8). Studies have found that the surfactants found in some formulations of commercial preparations of glyphosate can be highly toxic to salmonids (U.S. EPA 2009). In general, aquatic organisms are more negatively impacted by surfactants than terrestrial organisms (Bakke 2007).

Two herbicide formulations proposed for use (Roundup Pro and Garlon 4 Ultra) are slightly to highly toxic to fish (Table 4.10). There are aquatic-safe formulations that contain the same active ingredients (Rodeo/Roundup Custom and Garlon 3) that are considered “practically non-toxic” to “slightly toxic” to fish (Table 4.10). These formulations would be used if herbicide is applied in or around aquatic resources. Direct aquatic application of imazamox (Clearcast) may be used for control of aquatic plants, but imazamox would not be used in potential listed species habitat (Dry Creek and Best Slough) or in waterbodies that feed into it.

Giant reed requires control at multiple locations within the Dry Creek stream channel using herbicide application. This treatment would improve water flow and upstream access for anadromous salmonids. To avoid direct and indirect impacts to steelhead from site access and chemical toxicity, giant reed would be controlled during summer when flows in Dry Creek are low, and steelhead are unlikely to be present. An aquatic-approved formulation of Glyphosate such as Rodeo or Roundup Custom, combined with an aquatic-approved formulation of Imazapyr such as Habitat would be used. The herbicides would be mixed with a non-ionic surfactant approved for use in aquatic habitats. No additional additives would be used. Aquatic resource buffers and other herbicide application AMMs would be implemented during non-aquatic herbicide application to prevent water contamination and protect steelhead and other aquatic species from exposure (Table 1 in Appendix G). Herbicides would always be applied in accordance with the IPSMG; the Beale AFB IPMP; the USAF Pest Management Program; the Statewide NPDES Permit and Beale AFB APAP; all applicable federal, DoD, USAF, State of California, and local directives and regulations; and label instructions. Therefore, chemical treatments are not likely to adversely affect, and are likely to benefit, listed species and EFH.

Manual/Mechanical Treatments

There would be a potential for significant, long-term, beneficial effects and negligible, short-term adverse effects to Central Valley steelhead as a result of manual and mechanical treatments. These treatments could leave small areas of bare ground in the Dry Creek/Best Slough riparian area which could be susceptible to erosion. Whenever possible a vegetated buffer to trap sediment would be left between the treatment area and flowing water. If treatment is required directly adjacent Dry Creek or Best Slough erosion control BMPs would be implemented. Invasive plant control in riparian areas is intended to improve native plant diversity and riparian ecosystem health. Therefore, beneficial effects to Central Valley steelhead and EFH for Chinook salmon would occur as a result of Alternative 2.

4.7.2.5 Special Status Plants

Five special-status native plant species, all herbaceous forbs, are known to occur at Beale: dwarf downingia (*Downingia pusilla*), hogwallow starfish (*Hesperevax caulescens*), Greene's legenere (*Legenere limosa*), Tehama navarretia (*Navarretia heterandra*), and stinkbells (*Fritillaria agrestis*). Significant, long-term benefits to special status plant species would occur from the proposed invasive plant control if occurrences currently invaded by invasive species are treated. By carefully designing invasive plant treatments within these special status plant occurrences Alternative 2 would improve existing habitat quality and prevent further impacts to existing special status plants.

In addition to removing invasive plants from known occurrences, Alternative 2 would also limit the threat of future invasion into threatened and sensitive plant occurrences from adjacent infested areas. While it is expected that reducing invasive plants across the base would benefit special status plants, it is difficult to quantify both the current threat to special status plants or to what degree treating invasive plants would reduce this threat since successful invasion involves a number of site specific conditions and variables (such as available vectors, presence of intact native vegetation, or soil disturbance).

Prescribed Burns

Prescribed burns could have negligible, short-term, adverse effects on special status plants. Fire is generally considered beneficial to natural resources on Beale AFB and the LRS. This is especially true in the annual grassland/vernal pool areas, provided that firefighting actions do not result in physical impacts (Beale AFB 2018a). Both native annuals and perennials have long-lived soil-stored seed and native perennials are protected by dormancy during fire season and below-ground perennating buds (Bliss and Zedler 1998) that buffer fire effects. Studies of vernal pools post-fire have observed neutral to positive effects on vernal pool vegetation (Black et al. 2016). Therefore, beneficial impacts to special status vernal pool plant species would occur. Stinkbells grow from a bulb, so low intensity fires should not pose a threat to this species. If higher intensity fires, intended to kill invasive plant seeds, are planned a 100-foot no-burn buffer would be implemented around individual plants. Therefore, no significant impacts to special status plants would occur as a result of Alternative 2.

Grazing

Grazing may have moderate, short-term, adverse effects, and long-term, beneficial effects on special status plants. Special status plant species may be vulnerable to livestock grazing and trampling, but there is very little information describing livestock effects for these species. Some general studies have found greater native California grassland forb diversity in grazed areas than in ungrazed areas. These five forbs are small-statured, potentially creating intense competition for light with taller invasive grasses. Grazing may ameliorate this competition by reducing vegetation height. In general, cattle prefer to eat grass rather than forbs (Larson et al. 2015) and so are likely to reduce invasive grasses, with limited impact on forbs.

The first four special status forbs are found primarily in vernal pools. Although grazing or overgrazing is listed as a potential threat for three of the four, research indicates that carefully managed livestock grazing in vernal pools tends to benefit native plant species. The USFWS in their vernal pool recovery plan observed that while more than one-third of Greene's legenere populations were in areas grazed by livestock, few of those populations were declining and cited a study that indicated that light grazing during winter and early spring did not appear to harm the species (USFWS 2005b).

Chemical Treatments

With the implementation of AMMs only minor, temporary, adverse effects and moderate, long-term, benefits to special status plants would occur. Special status plants may be subject to the same exposure and effects of chemical treatments as other types of native vegetation. Invasive plant treatments may occur near special status plant species if the NRM has determined that the treatment is consistent with management direction for a given species and other control methods are likely to be ineffective. In the event that future control efforts include herbicides near sensitive plants, a qualified biologist would work closely with applicators to avoid affects from off-target (drift, runoff, leaching) and direct exposure. Possible methods to limit affects from drift could include the use of alternative application methods that do not produce driftable fines associated with spray application such as wicking, wiping, drizzle; timing selective application methods so threatened and sensitive plants are not likely to be affected by drift; using a spray cone; covering sensitive plants during herbicide applications; scheduling spray applications when prevailing winds (less than 10 miles/hour) are blowing away from sensitive plant habitat; or flagging and avoiding occurrences. With the implementation of AMMs no adverse effects to special status plants would occur.

Manual/Mechanical Treatments

Manual/Mechanical treatment may have moderate, short-term, adverse effects on special status plants, and long-term, beneficial effects. Four of the species occur in vernal pools, manual/mechanical treatment of invasive plants in vernal pools may result in accidental pulling or trimming of special status plants. The Beale AFB NRM would determine on a case-by-case if the benefit of invasive plant control within vernal pools in a given location outweighs the risk to special status plant species. Any invasive plant control done when native vernal pool vegetation is growing would be done by hand. Mechanical treatments may only be used after the native vegetation has gone dormant for the year. With the implementation of AMMs effects to special status plants would be negligible to beneficial.

Other Special Status Species

Treatments conducted under Alternative 2 would have overall significant, long-term, positive effects on special status species and their habitats. Other special status species not specifically addressed above would be expected to have the same general responses to treatments as those described for terrestrial and aquatic wildlife species in Sections 4.7.2.2 and 4.7.2.3.

4.8 CULTURAL AND TRIBAL CULTURAL RESOURCES

4.8.1 Alternative 1 (No Action Alternative)

Under the No Action Alternative there would be no change to existing conditions for cultural resources under NEPA or tribal cultural resources as described in Section 3. If new invasive plant treatments are proposed, the effects would be analyzed on a project-by-project basis using the USAF EIAP and the Cultural Resources Manager would identify any necessary AMMs.

4.8.2 Alternative 2 (Comprehensive Control)

Invasive plant treatments under Alternative 2 could have minor, short and long-term, adverse effects on cultural and tribal cultural resources. Cultural resources have existed with grazing animals on Beale AFB for generations, but they could still be adversely affected by unregulated livestock; particularly where cattle congregate and trample the soil surface. The archaeological sites on the base have been exposed to fire over a long timeline without loss of integrity, but excessive fuel built up on cultural sites could lead to impacts from extreme heat if such an area burns. Sites could also be damaged if unknowing personnel use surface disturbing machinery upon a site. Chemical treatments would not be expected to have effects on cultural resources, but would avoid sensitive cultural resource features. Any invasive plant treatment located near sensitive cultural resources would be done by hand or using machinery that would not cause soil disturbance. Restoration treatments would have no effect on cultural resources.

Grazing

Grazing could have minor, long-term, adverse effects on cultural and tribal cultural resources. The cultural resources sites at Beale AFB and the LRS have been exposed to grazing animals over a long timeline. Tule elk (*Cervus canadensis nannodes*) and pronghorn (*Antilocapra americana*) natively grazed the area, and the elk used hard surfaces to rub free antler velvet. As American society disrupted this pattern, European livestock replaced the native grazers. Although Beale cultural resources have existed with grazing animals for generations, they may be adversely affected by unregulated livestock; particularly where cattle congregate and trample the soil surface. If livestock are likely to congregate in a location (for example, because water or shade are available), fencing the site to exclude livestock is a reliable method of protecting cultural resources from livestock impacts. If a cultural resource site is not located in an area of concentrated livestock activity, livestock use of the area would be managed so as to prevent damage to the cultural resource. BMPs that would be implemented including locating livestock-holding areas (e.g., corrals), livestock water sources, and mineral supplements outside of cultural resource site boundaries.

Cultural resources surveys have been conducted and archeological sites are located within the boundaries of invasive plant treatment areas proposed under Alternative 2. The base ICRMP includes the grazing program as a “mission conflict” that may negatively impact Cultural Resources. These negative impacts would be mitigated by following established environmental and cultural resources management procedures (i.e., completing USAF Form 103) and implementing the GMG (Beale AFB 2017b; Appendix C). The GMG require lessees to coordinate with the Cultural Resources Manager for activities including: construction or removal of livestock fences, ponds, troughs, or livestock water pipelines running cross country; placement of salt licks for livestock; and off-road vehicle travel. Livestock grazing would help reduce the adverse impacts of wildfire on cultural resources by lowering vegetative fuel loads to minimize wildfire risk. Invasive plants and the dense thatch they often produce may also negatively impact cultural resource values, and livestock grazing would significantly reduce invasive plants and associated thatch. By following established management procedures and the BMPs and procedures in the GMG, no significant impacts to cultural resources would occur from grazing expansion under Alternative 2.

Prescribed Burns

Prescribed burns could have minor, short to long-term, adverse effects on cultural and tribal cultural resources. The ecology of Beale AFB and the LRS have evolved with fire: fires caused by lightning, by the Nisenan for management of their foraging grounds, and by ranchers. As such, the archaeological sites here have been exposed to fire over a long timeline without loss of integrity. Modern fire suppression activities may have allowed excessive fuel to build up on cultural sites that could lead to impacts from extreme heat if such an area burns, or sites may be in danger if unknowing personnel use surface disturbing machinery upon a site. Therefore, the ICRMP includes the fire management as a “mission conflict” that may negatively impact Cultural

Resources. However, the negative impacts would be mitigated by creating sensitive area maps for emergency personnel, coordinating with fire personnel and following the WFMP (Beale AFB 2018a; Appendix D). Where necessary, excessive fuel would be removed by hand prior to a prescribed burn in order to prevent extreme heat affects to cultural resources.

The base Cultural Resources Manager reviews and approves all prescribed burn proposals through cultural resources management procedures (i.e., completing USAF Form 103) and implementing the WFMP. The WFMP requires coordination with the Cultural Resources Manager for activities including creating fire breaks, identifying where machinery would be employed, and areas that burns may target. By following established management procedures and the BMPs and procedures in the WFMP, no significant impacts to cultural resources would occur from prescribed burns under Alternative 2.

Chemical Treatments

Chemical treatments would not have direct effects on cultural or tribal cultural resources, but chemical treatments would avoid sensitive cultural resource features (e.g., bedrock mortar features, rock art features). The base Cultural Resources Manager reviews and approves all chemical treatments through cultural resources management procedures (i.e., completing USAF Form 103) and implementing the IPSMG (Beale AFB 2017a; Appendix B). Beale AFB is considering establishment of gathering areas for traditional stewardship of sensitive cultural sites and native plants for use by associated tribes. Herbicide use within such sites may not be allowed once established, per traditional management practices. By following established management procedures and the BMPs and procedures in the IPSMG, no significant impacts to cultural resources would occur from chemical treatments under Alternative 2.

Manual/Mechanical Treatments

Manual and mechanical treatments could have minor, long-term, adverse effects on cultural and tribal cultural resources. Before any soil-disturbing invasive plant treatments are conducted the location must be approved by the Cultural Resources Manager. Any invasive plant treatment located near sensitive cultural resources would be done by hand or machinery that would not cause soil disturbance (e.g., mowers, weed whackers, etc.). Therefore, restoration treatments would not have a significant effect on cultural resources.

Restoration Treatments

Restoration treatments would have no effect on cultural or tribal cultural resources. Restoration treatments in areas with sensitive cultural resources would be limited to re-seeding or planting of seedlings (i.e., no planting of large specimens that require soil disturbance). The base Cultural Resources Manager reviews and approves all restoration treatment proposals through cultural resources management procedures (i.e., completing USAF Forms and 103). Therefore, no significant impacts to cultural resources would occur from restoration treatments under Alternative 2.

4.9 EARTH RESOURCES

4.9.1 Alternative 1 (No Action Alternative)

The No Action Alternative would moderately, permanently, adversely affect soils by not treating the areas mapped with invasive plants. No effects to geology or topography would occur as a result of the No Action Alternative.

4.9.1.1 Geology and Topography

No effects to geology or topography would occur as a result of the No Action Alternative.

4.9.1.2 Soils and Minerals

The No Action Alternative would moderately, permanently, adversely affect soils by not treating the areas mapped with invasive plants. The spread of invasive plants is largely controlled by disturbance of ground by management activity, usually in close proximity to already infested ground. Invasive plants often maintain infested sites with a higher proportion of bare ground than native species, which increases risk of erosion. Disturbed areas that are slow to revegetate may be replaced with less diverse life forms if invasive forb species or annual grasses take over. An indirect result of the dominance of either single stemmed forb or annual grass is bare soil interspace that can erode via ravel or rainfall. These plants typically invade open areas that lack a tree or shrub overstory that intercepts and disperses rainfall. Most natural forest or native rangeland resists erosion in this climate regime; whereas continued high levels of bare soil could perpetuate a disturbed state. Given that soil communities can be tightly coupled to plants (Wardle et al. 2004), the danger in dominance of any single plant or change from a diverse plant community assemblage to a single stemmed forb such as the spotted knapweed is an accompanied shift in soil properties whereby a return to the prior desired vegetation becomes difficult (Seastedt et al. 2008). There would be no impact to mineral resources as none are known to be on Beale AFB or the LRS.

4.9.2 Alternative 2 (Comprehensive Control)

Invasive plant treatments under Alternative 2 do not have the potential to alter or otherwise affect geology or topography. The results of the Proposed Action on soils would be largely beneficial. Invasive plants can increase the risk of soil erosion and alter soil chemical composition, so controlling these plants would indirectly benefit soils. Restoration treatments would benefit soils by restoring native vegetation, increasing vegetative cover and soil moisture retention, and reducing soil erosion. Cattle and other livestock could have moderate, short to long-term, adverse effects on soils. However, with routine rangeland monitoring and carefully managed grazing effects to soil would be negligible to minor. Prescribed burns would be conducted in ways that limit fire intensity and would not result in a severe fire that could negatively impact the physical and chemical properties of the soils. Adverse effects to soils and soil biomes from herbicide would be avoided by adherence to herbicide application BMPs.

4.9.2.1 Geology and Topography

Actions conducted under Alternative 2 would not alter or otherwise affect geology or topography.

4.9.2.2 Soils and Minerals

There would be no impact to mineral resources as none are known to be on Beale AFB or the LRS.

Grazing

Cattle and other livestock could have moderate, short to long-term, adverse effects on soils. However, with routine rangeland monitoring and carefully managed grazing effects to soil would be negligible to minor. Ungulates can physically alter soil structure because their rather substantial mass is carried by relatively small hooves. The usual effect would be compaction, which could lead to reduced infiltration rates, which in turn would increase surface runoff and erosion. Trampling effects would not be uniform because livestock would preferentially use areas near shade and water sources. Two independent studies found that light to moderate livestock grazing in and around riparian areas of oak savanna did not significantly alter the morphology of streambanks. However, it has been frequently observed that heavy grazing can reduce vegetation cover and decrease the slope of streambanks, resulting in bank erosion and degraded aquatic habitat (Jackson and Bartolome 2007). Under Alternative 2, livestock would be closely monitored in riparian areas and removed from an area if evidence of bank erosion or destabilization was observed.

Grazing could also alter nutrient distribution because herbivores mineralize organic matter and return it to the environment in solid, liquid, and gaseous forms. Grazing in grasslands can accelerate carbon and nutrient cycling by effectively bypassing the microbial decomposition pathway. This acceleration would not be uniform because livestock use some areas preferentially, and a greater amount of feces (and nutrients) are deposited in high-use areas (Jackson and Bartolome 2007). Under Alternative 2, cattle would be moved regularly to avoid excessive nutrient redistribution.

The Beale AFB livestock pasture units contain 14 soil map units (soil series or soil complexes). Water erosion hazard for soils in more than 80% of the base's grazing area is rated as slight. Three soil series on 15-30% slopes and with very slow to moderate permeability and rapid runoff are rated as having severe water erosion hazard (Lytle 1998). There are only 205 acres of these soil map units, however, less than 1% of the current and proposed grazing areas. In addition, the Redding-Corning complex on 3-8% slopes, of which there are over 2,000 acres, has very slow permeability and medium runoff and is rated as a moderate water erosion hazard (Lytle 1998). Maintaining recommended levels of RDM by routinely monitoring grazed areas would minimize rainfall-induced soil erosion.

All 14 soil series/complexes are described as "used mainly for" or "suitable for" rangeland/livestock grazing with few limitations (Lytle 1998). In several pasture units, Auburn-Sobrante complex, 3-8%, has the limitation that livestock grazing should be delayed until soils are firm enough to prevent compaction and until forage species are rooted sufficiently to avoid being pulled up when trampled by livestock. The suitability for livestock grazing of Auburn-Sobrante-Rock outcrop complex, 15-30%, is limited by its tendency to produce woody vegetation that requires management. Regular RDM monitoring and appropriate stocking rates and grazing timing would limit the potential for erosion and soil compaction. Therefore, no significant impact to soils would be expected as a result of expanding the grazing program under Alternative 2.

Prescribed Burns

Fire could have temporary, minor, adverse effects on soil characteristics, erosion rates, patterns of vegetation, and nutrient availability. Extreme fire temperatures, as experienced during some severe wildfire situations, could cause volatilization of essential nutrients like nitrogen and impact soil productivity by creating bare soil and/or hydrophobic conditions. However, nutrients are also made available by fire, primarily by converting old plant growth into more easily decomposed materials. Prescribed burns would be conducted in ways that limit fire intensity and would not be expected to result in a severe fire that could negatively impact the physical and chemical properties of the soils. The resulting moderately burned organics with partially consumed, shallow ash layers should stimulate vigorous regrowth of vegetation during succeeding summers. Livestock grazing would be excluded from burned areas until vegetation has had a chance to re-establish. Under Alternative 2, only minor amounts of soil erosion would result, and overall, no significant effects would be anticipated.

Chemical Treatments

Chemical treatments could have moderate, short-term, adverse impacts to soils. The majority of the proposed use of herbicides would be to spray the foliage of target plants, but some herbicides (aminopyralid, chlorsulfuron, imazapyr, and Sulfometuron methyl) could be applied directly to soils as a pre-emergent. Herbicide residue that falls on or is applied directly to the soil surface could work its way through the soil solution into plant roots. The proposed herbicides are weak acids that dissociate into the parent acid, which is the active ingredient to penetrate plant tissue. After application, herbicides would be decomposed in the soil along with treated plant materials. The main degradation pathways for herbicides are by soil microbial decomposition, light (photolysis) and water (hydrolysis). Offsite transport of herbicides could occur through rainfall generated runoff, wind erosion, and percolation into groundwater or lateral movement through permeable soils. These fates are a function of both the herbicide's specific properties and a soil's physical and biological properties.

A half-life is the time it takes for 50% of the chemical to degrade into harmless or essentially inert compounds. Herbicide half-life ranges reflect the high variability in decomposition rates due to environmental factors: presence of soil microbes, exposure to sunlight, temperature and soil moisture content. Soils with high organic matter content, and thereby high cation exchange capacity, can increase decomposition rates by binding herbicide molecules while providing usable carbon that facilitates microbial processing (Bollag and Liu 1990).

Persistence of chemicals in a soil depends on levels of soil biological activity. Moderate temperatures and moist conditions are generally more favorable to biological activity. Less favorable conditions exist on dry rocky slopes, canyon rims, sunny aspects, as well as sites with soils that have inherently rapid drainage. Microbial activity ramps up at the start of the growing season, when mean soil temperatures rise over 44 degrees (Davidson et al. 1998). Water limits microbial activity during the dry hot summer when soil moistures drops below 10%. Similarly, disturbed soils that have less water availability, and scarce soil microbes have less potential for metabolizing herbicides. Soils along roadsides and old compacted surfaces from equipment use and excavation may have less water-holding capacity and organic matter to support decomposition.

Beyond the biological potential, herbicide half-life is correlated to properties of soil adsorption and water solubility using laboratory studies. There is an inverse relationship between adsorption rate and half-life. Soil properties influence adsorption rates depending on soil texture and level of organic matter. Fine textured soils and/or soils with high organic matter have more electrically positive charged sites for adsorption.

Assays of herbicide decay do not always find results that correlate directly with soil texture, pH, cation exchange capacity and percent organic matter (Wauchope et al. 2002). Clay and hydrated metal oxides, derivatives more closely associated with the soil parent rock material, are thought to have strong influence on herbicide degradation in the soil solution (Fast et al. 2010). Individual herbicide properties are discussed below:

<u>Aminopyralid</u>: Is classified as mobile to highly mobile in soils. It has the potential to reach groundwater, especially in vulnerable soils with low organic carbon content and/or the presence of shallow groundwater. Aminopyralid is degraded by aerobic metabolism in soils. In field studies, the half-life ranged from 6 to 74 days (U.S. EPA 2014a).

<u>Chlorsulfuron</u>: The range of half-lives for chlorsulfuron in soil and water indicates that it is persistent to very persistent. Hydrolysis is the primary mechanism of degradation at low pH, where the half-life is 22-23 days at 25 °C. However, in neutral and alkaline environments, biodegradation

is expected to dominate as pH increases and chlorsulfuron becomes less susceptible to hydrolysis. It is stable to aqueous photolysis and degrades slowly via soil photolysis (half-lives ranged from 138-183 days in one clay loam soil). Chlorsulfuron does not break down well in water, a property that is associated with long-term persistence if the chemical reaches groundwater (U.S. EPA 2012a).

Glyphosate: The potential for volatilization of glyphosate from soil and water is expected to be low, due to the low vapor pressure and low Henry's Law constant. The major route of transformation of glyphosate identified in laboratory studies is microbial degradation. In soils incubated under aerobic conditions, the half-life of glyphosate ranges from 1.8 to 109 days and in aerobic water-sediment systems is 14-518 days. However, anaerobic conditions limit the metabolism of glyphosate (half-life 199-208 days in anaerobic water-sediment systems) (U.S. EPA 2015). In laboratory studies, glyphosate was not observed to break down by abiotic processes, such as hydrolysis, direct photolysis in soil, or photolysis in water. Glyphosate dissipation appeared to correlate with climate, being more persistent in cold than in warm climates. The available field and laboratory data indicate that both glyphosate and its major metabolite aminomethylphosphonic acid adsorb strongly to soil. Glyphosate is classified as slightly mobile to hardly mobile according to the Food and Agriculture Organization of the United Nations classification scheme and would not be expected to leach to groundwater or to move to surface water at high levels through dissolved runoff. However, glyphosate does have the potential to contaminate surface water from spray drift or transport of residues adsorbed to soil particles suspended in runoff (U.S. EPA 2009).

Imazamox: This is a moderately persistent and mobile herbicide, but it does not readily volatize. Microbially mediated metabolism is the primary degradation mechanism in soils, where the aerobic metabolism calculated half-life is about 28 days in a sandy loam soil. Imazamox photolytically degrades more slowly in soils with a calculated half-life of 65 days. (U.S. EPA 2014b).

Because imazamox would only be used in aquatic environments, it would have no impact on terrestrial soils, but could settle in aquatic sediments. Imazamox quickly degrades via aqueous photolysis in clear water with an average half-life of 6.8 hours (0.23 days); however, it is stable in the dark control system. Thus, if not photolytically degraded, imazamox is stable and persistent in anaerobic aquatic sediments (U.S. EPA 2014b).

Imazapyr: This herbicide is both persistent and mobile in soil. Most environmental fate data available for imazapyr are based on dissociation of the isopropylamine salt in water. Imazapyr was essentially stable to aerobic and anaerobic soil metabolism, and no major transformation products were identified during the course of laboratory studies. Field study observations are consistent with imazapyr's intrinsic ability to persist in soils and move via runoff in surface water and leach to groundwater (U.S. EPA 2014c).

Sulfometuron Methyl: The major route of dissipation for sulfometuron methyl is aerobic and anaerobic degradation/metabolism in soil and water (modeled half-life of 2 to 6 months), with hydrolysis potentially dominant under acidic conditions. However, sulfometuron methyl degradation rate and mobility in the environment can be characterized as highly variable – significantly affected by soil and water properties such as pH and organic matter and with often significantly increased resistance to degradation in soil over time (U.S. EPA 2012b).

Triclopyr: Based on adsorption/desorption studies, triclopyr acid and its major degradate TCP, are both expected to be very mobile in soils. In soil, the predominant degradation mechanism for triclopyr acid is biotic metabolism. Triclopyr acid degraded in aerobic soil with half-lives of 8 to 18 days to intermediate degradates; the ultimate degradate is carbon dioxide. Triclopyr TEA degraded with a half-life of 2.9-7.6 days in the soil in rice field dissipation studies. TCP was detected up to 36 weeks after treatment in vegetated soil; it represented a considerable amount at 63 weeks in bare soil. In the field dissipation studies using triclopyr BEE, triclopyr BEE dissipated much faster in North Carolina than in California (with half-lives of 1.1 days and 39 days, respectively). The variation in half lives could be related to the difference in soil pH (6.3 vs. 4.7-5.7). TCP was generally limited to the upper 30 cm of the soil, with sporadic detections in deeper soil depths (U.S. EPA 2014d).

Surfactants: The potential exists for surfactants to affect the environmental fate of herbicides in soil, but any potential effects would be unlikely under normal conditions because of the relatively low concentration of surfactants in the soil/water matrix. Localized effects could be seen if a spill occurred on soil, so that concentrations of surfactant approached or exceeded about 1,000 ppm (Bakke 2007).

Adverse effects to soils and soil biomes from herbicide would be avoided by adherence to the herbicide application BMPs in Appendix G. Therefore, no significant impact to soils would be anticipated as a result of herbicide application under Alternative 2.

Manual/Mechanical Treatments

Manual and mechanical treatments may have minor to moderate, temporary, adverse impacts on soils. Manual methods are hand-pulling or using hand tools. Ground disturbance would occur from drawing up a plant by its roots, digging sufficient to leverage the roots out, or from giant reed removal using an excavator. Other treatments would not result in soil disturbance. Disturbance from manual and mechanical treatments would be short-term, and would not lead to chronic erosion from the relatively small disturbance footprint and retained groundcover. There would be a short-term risk of erosion from disturbed ground if a highly infested area has contiguous bare ground sufficient to initiate surface erosion. The risk would be largely be due to slope of the ground and erosiveness of the soil. Erosion of areas with bare soil would be minimized by implementing restoration treatments including revegetation, and installing temporary erosion control structures where necessary. Therefore, no significant impacts to soils would be expected as a result of manual/mechanical treatments under Alternative 2.

Restoration Treatments

Restoration treatments would have significant, long-term, positive impacts on soils. Restoration treatments would benefit soils by restoring native vegetation, increasing vegetative cover and soil moisture retention, and reducing soil erosion. Restorations sites where disking was used could have temporary negative impacts on soils, but these effects would be short-lived, and soil condition would ultimately be improved. Therefore, no significant impacts to soils would occur as a result of restoration treatments under Alternative 2.

4.10 UTILITIES AND INFRASTRUCTURE

4.10.1 Alternative 1 (No Action Alternative)

The No Action Alternative has the potential for moderate, short-term, adverse effects to utilities and infrastructure because fewer acres would be burned under this alternative and fire risk would be heightened. There would be no direct effects to infrastructure as a result of implementing the No Action Alternative. Utility locations would be identified during the AF EIAP for any activities involving ground disturbance. Prescribed Fire Plans would identify utility lines and other infrastructure near prescribed burn locations and measures needed to avoid adverse effects.

4.10.2 Alternative 2 (Comprehensive Control)

Alternative 2 would have significant, long-term, beneficial effects, but could also have minor to moderate, short-term, adverse effects on infrastructure and utilities. Expansion of the grazing program would benefit utilities and infrastructure by maintaining roads and waterlines, adding fencing, and reducing fire risk. Chemical treatments would have no effect on utilities and infrastructure. Overall, prescribed burns would have beneficial effects on infrastructure by reducing fuel loads, but could negatively affect utilities and infrastructure if they got out of control. Negative effects would be avoided through the implementation of a Prescribed Fire Plan for each burn. Manual, mechanical and restoration treatments could involve excavation which could harm utilities and infrastructure if lines or pipes were broken. This would be avoided by obtaining the proper clearance prior to earth disturbing work.

Grazing

Expansion of the grazing program under Alternative 2 would have minor, long-term, beneficial effects on infrastructure. New fencing and wells/troughs would expand the livestock grazing capacity on the base. Access roads within grazing management areas would be maintained. Supplying water to new cattle troughs would not significantly increase the base-wide water demand, but any existing waterlines used would be maintained. Solar wells would be self-contained and would not affect existing infrastructure. New fencing could slightly increase the time it takes to access existing utilities if new pasture fencing is erected. The removal of biomass via grazing would reduce the likelihood of a high intensity fire under power lines.

The GMG (Beale AFB 2017b; Appendix C) includes the consideration of expanding the existing grazing program based on a study by H.T. Harvey & Associates (2015b) as described in Section 2.5.2.2, *Methodology*. The study identifies approximately 3,332 acres on Beale AFB and 210 acres on the LRS of land that could be utilized for grazing. Of that area, Beale AFB has identified 1,668 acres for permanent cattle grazing pastures (Figures 2.1 and 2.2). Most of these areas do not currently have infrastructure to support livestock grazing, so new fencing and wells/troughs would need to be installed before these areas could be grazed.

Approximately 66,000 feet of linear fencing would be needed to enclose the proposed grazing additions. This would involve modifying existing fencing and installing new, permanent barbed wire fencing, and temporary electric fencing. No new access roads would be installed within the proposed grazing units, but existing access roads would be maintained. Locations have been identified for new water troughs and wells in existing and proposed pastures (ManTech SRS Technologies, Inc. 2017). Four well/trough locations would be in existing pastures, 39 locations would be in new pastures on Beale AFB, and two trough locations would be at the LRS. Twelve of the 39 troughs in would require the installation of solar wells, the rest could be tied into existing water lines. These are proposed locations, and it would be unlikely all 39 trough locations would be needed. Wells/troughs would be added over a number of years as new pastures are constructed. An AF Form 103 and clearance from 811 North would be obtained prior to any construction activities, so that existing utilities could be avoided during excavation. Therefore, grazing under Alternative 2 would have beneficial effects on utilities and infrastructure.

Prescribed Burns

Overall, prescribed burns would have short-term, moderate to significant, beneficial effects on infrastructure by reducing fuel loads. However, prescribed burns have the potential to negatively affect utilities and infrastructure if they got out of control. Wooden powerline poles are particularly vulnerable due to the proximity to wildland fuels. Negative effects would be avoided through the implementation of a Prescribed Fire Plan for each burn.

The Prescribed Fire Plan includes a description of unique features in or near the proposed burn area that could pose a hazard, issue, or constraint including infrastructure items such as fences and power poles. Any power poles that are next to or near containment lines would be identified and located prior to the day(s) of the burn, and prepped prior to ignitions. The location of power poles and other unique features would be included in the Prescribed Fire Briefing Checklist and fire personnel would be informed of locations. Therefore, prescribed burns under Alternative 2 would have overall beneficial effects on utilities and infrastructure.

Chemical Treatments

Chemical treatments would have no effect on utilities and infrastructure

Manual/Mechanical and Restoration Treatments

Manual/mechanical and restoration treatments could involve excavation, and would have the potential to have moderate, short-term, adverse effects on utilities and infrastructure if lines or pipes are broken. An AF Form 103 and clearance from 811 North would be obtained prior to any work involving digging. During this process existing utilities would be identified for avoidance during excavation.

4.11 TRANSPORTATION AND TRAFFIC

4.11.1 Alternative 1 (No Action Alternative)

There would be no effects to transportation and traffic as a result of the No Action Alternative.

4.11.2 Alternative 2 (Comprehensive Control)

Under Alternative 2 short-term, minor impacts to transportation would occur during grazing infrastructure construction, prescribed burns, chemical treatments, and mechanical treatments. During these activities, an increase in traffic would be expected by contractors through the Wheatland Gate for large equipment. Increased traffic would include light construction vehicles and also contractors' personal cars through all gates. Construction vehicles on these roadways could disrupt traffic speeds and increase gate delays.

Smoke from prescribed burns could have temporary adverse effects on transportation and traffic by obscuring visibility for drivers. Prescribed fire signs would be posted along roadways and Security Forces or the Lincoln City Fire Department would conduct traffic control as needed. Impacts would be short term in nature and localized. Therefore, there would be no significant effects on transportation and traffic as a result of Alternative 2.

Grazing

Expansion of the grazing program under Alternative 2 could have negligible, long-term, negative effects on transportation and traffic. If a greater area of land would be available for grazing, the land may be leased to a greater number of people, and a greater number of cattle may be trucked onto the base. This would result in a slight increase in traffic and possible delays at the Wheatland gate truck checkpoint. The effects would be intermittent and limited, and would therefore not be significant.

Prescribed Burns

Smoke from prescribed burns could have temporary, minor to moderate adverse effects on transportation and traffic by obscuring visibility for drivers. Prescribed fire signs would be posted along roadways and, if necessary, flashing vehicle lights would be used to alert traffic. Security forces would conduct traffic control as needed on the main base. At the LRS base fire personnel would coordinate with the Lincoln City Fire Department as needed for traffic control. Therefore, there would be no significant effects to transportation or traffic as a result of prescribed burns.

Chemical Treatments

Chemical treatments conducted using a truck-mounted spray tank could have negligible, intermittent, adverse effects on transportation and traffic on the base and at the Wheatland gate truck checkpoint. A typical treatment would only require one to two vehicles at a time and effects to traffic would be negligible.

Manual/Mechanical and Restoration Treatments

Manual/mechanical and restoration treatments that require the use of heavy equipment could have negligible, intermittent, adverse effects on transportation and traffic on the base roads and at the Wheatland gate truck checkpoint. A typical treatment would only require one to two pieces of equipment at a time and effects to traffic would be negligible.

4.12 ENERGY RESOURCES

4.12.1 Alternative 1 (No Action)

Under the No Action Alternative, current management activities would be maintained, including manual/mechanical activities, chemical applications, grazing, and burning. Energy resources are consumed during transportation to and from field sites. Addtionally, manual and mechanical treatments, covering less than 50 acres annually, use oil and gasoline in equipment such as weed whackers and mowers. Chemical applications on less than 100 acres includes the use of ATV-mounted spray equipment, which uses oil and gasoline resources as well. Little electricity would be used during the course of invasive species management activities. Those activities that do require it, such as cattle watering sources and habitat enhancement projects, typically source it from renewable solar power. Use of energy resources would be much lower than for the majority of activities that take place on the AFB and use of the energy resources is not wasteful, inefficient, or unnecessary. Therefore, the effect is expected to be negligible under the No Action Alternative.

4.12.2 Alternative 2

Under Alternative 2, the scale and range of management activities would increase across all categories (Table 2). Besides the energy resources consumed during transportation to and from field sites, equipment used for manual, mechanical and chemical treatments on up to 4,000 acres annually would use oil and gasoline. Little electricity would be used during the course of invasive species management activities and those activities that do require it, such as cattle watering sources and habitat enhancement projects, typically source it from renewable solar power. The use of energy resources associated with the increased effort to control invasive species would still be still much lower than the majority of activities on Beale AFB and is not wasteful, inefficient, or unnecessary. All energy use would be for temporary weed control projects and would not use energy resources continuously over time. Overall, the project would have minor impacts to local and regional energy supplies.

4.13 CLIMATE CHANGE

As described in Section 3.13.2, for the purposes of this EA, GHG emissions from invasive species management activities can be divided into those produced during implementation or "construction" (e.g., habitat restoration, herbicide application, mechanical control, prescribed burns) and those produced during long-term operation or "operational" (e.g., long-term grazing operations). GHG emission projections are discussed for Alternatives 1 and 2 in Sections 3.3 and 4.3 *Air Quality*.

4.13.1 Alternative 1 (No Action)

Per analysis in Section 3.3.2, carbon dioxide equivalent emissions under the No Action Alternative would be approximately 500 metric tons carbon dioxide equivalent per year, which would be primarily from prescribed burns on 622 acres annually (Tables 3.5 and 3.6). Such GHG emissions levels do not meet significance thresholds for climate change and would not be expected to contribute significantly to a cumulative climate change impact.

4.13.2 Alternative 2

Per analysis in Section 4.3.2, carbon dioxide equivalent emissions under Alternative 2 would range from 1,316 to 4,200 metric tons of carbon dioxide equivalent per year. This is based primarily on proposed prescribed burns on 4,500 acres of grasslands with fuel loads ranging from 300-1,000 lbs. of RDM per acre. While these estimated emissions levels would exceed the significant thresholds established for operational-related non-stationary activities by BAAQMD, it would not exceed those for stationary, operational-related activities or construction-related activities, which, for purposes of this EA, cover prescribed burns. Estimated emissions would not exceed those given by the FRAQMD, the air district to which Beale reports to, as they have yet to set them.

Both the FRAQMD and BAAQMD references do not address project types like the Proposed Action which includes natural resources land management activities such as grazing and prescribed burning. FRQAMD (2010) indicates that it's for "development projects" and BAAQMD (2017) addresses "impacts generated from land development construction and operation activities." Per the guidelines produced by the agencies, they are advisory and can be followed by other agencies at their own discretion.

CAL FIRE identifies five forestry strategies for reducing or mitigating GHG emissions. They include fuels reduction practices to reduce wildfire emissions and utilization of those materials for renewable energy. While prescribed burns at Beale AFB and the LRS would not allow for the utilization of materials for renewable energy, it would target the reduction of wildfire emissions. In 2020, wildfires burned over 1,000 acres at Beale AFB, which could have been reduced with strategic prescribed burns.

Given the variability of fuel load conditions and the highly unlikely scenario that Beale AFB burns 4,500 acres per year, reaching projected levels of carbon dioxide equivalent emissions of over 3,000 metric tons per year is highly unlikely. For instance, the largest annual total acreage for prescribed burns at Beale AFB since 2013 was only 800 acres.

While Alternative 2 would result in GHG emissions during implementation, the proposed project would not conflict with any applicable plan, policy, or regulation adopted for the purpose of reducing the emissions of GHGs. In fact, it's been widely recognized that the use of prescribed burns needs to increase in California to help address and prevent the catastrophic wildfire events that have occurred over the past several years in California that threaten 25% of the state's population who live in high-risk fire areas. Therefore, there would be negligible impacts from Alternative 2 and would not be significant.

4.14 OTHER NEPA CONSIDERATIONS

4.14.1 Unavoidable Adverse Effects

This EA identifies any unavoidable adverse impacts that would be required to implement the Proposed Action and the significance of the potential impacts to resources and issues. Title 40 CFR §1508.27 specifies that a determination of significance requires consideration of context and intensity. Invasive plant treatment would impact the local project area at Beale AFB and the LRS. The severity of potential impacts would be limited by regulatory compliance for the protection of the human and natural environment.

Unavoidable short-term adverse impacts associated with implementing the Proposed Action would include: temporary erosion and sedimentation from soil disturbance, a temporary increase in fugitive dust and air emissions during grazing infrastructure construction, air emissions from prescribed burns and herbicide application, intermittent noise, human and environmental exposure to herbicides, and minor alterations to local traffic and airfield operations. However, these effects are considered minor and would be confined to the immediate area. Use of environmental controls and implementing controls required in permits and approvals obtained would minimize these potential impacts. No unavoidable, long-term, adverse impacts would occur.

For the Proposed Action to be accomplished, these impacts would occur. The action is required to reduce the prevalence of invasive vegetation on Beale AFB and the LRS in order to protect and preserve the military mission, ecosystem function, and valued resources and programs. If allowed to spread unchecked, invasive plant species will degrade the remaining native habitat; interfere with management of sensitive resources, economic activities, and quality of life; and impede the military mission.

4.14.2 Relationship of Short-Term Uses and Long-Term Productivity

The relationship between short-term uses and enhancement of long-term productivity from implementation of the Proposed Action is evaluated from the standpoint of short-term effects and long-term effects. Short-term effects would be those associated with the implementation of invasive plant treatments. The long-term enhancement of productivity would be those effects associated with operation and maintenance of new grazing areas, and the reduction of invasive plants where they currently impede the military mission.

The Proposed Action represents an enhancement of long-term productivity for operations at Beale AFB and the LRS. The negative effects of short-term operational changes during implementation would be minor compared to the positive benefits from invasive plant control. Immediate and long-term benefits would be realized for base operations and maintenance, and natural resources after the first year of implementation of the Proposed Action.

4.14.3 Irreversible and Irretrievable Commitments of Resources

This EA identifies any irreversible and irretrievable commitments of resources that would be involved in the Proposed Action if implemented. An irreversible effect results from the use or destruction of resources (e.g., energy) that cannot be replaced within a reasonable time. An irretrievable effect results from loss of resources (e.g., endangered species) that cannot be restored as a result of the Proposed Action. The short-term irreversible commitments of resources that would occur include planning costs, materials and supplies and their cost, use of energy resources during construction, labor, generation of fugitive dust and air emissions, groundwater extracted for livestock watering, and creation of temporary noise and traffic. No long-term irretrievable commitments of resources would result.

4.15 CUMULATIVE EFFECTS / MANDATORY FINDINGS OF SIGNIFICANCE

This EA also considers the effects of cumulative impacts as required in 40 CFR §1508.7 and concurrent actions as required in 40 CFR §1508.25[1]. A cumulative impact, as defined by the CEQ (40 CFR §1508.7), is the "…impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of which agency (federal or non-federal) or person undertakes such actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

CEQ guidance, in considering cumulative effects, states that the first steps in assessing cumulative effects involve defining the scope for the other actions and their interrelationship with a Proposed Action. The scope must consider other projects that coincide with the location and timetable of a Proposed Action and other actions. Cumulative effects analyses must also evaluate the nature of interactions among these actions (CEQ 1997).

Actions announced for the region of influence for this project that could occur during the same time period as the Proposed Action are:

- Dam Removal/Repair Projects
    - Repair Frisky Lake dam (2021)
    - Repair Upper Blackwelder Lake dam (2022)
    - Demolish and recontour Lower Blackwelder Lake dam (2023)
    - Repair Vassar Lake spillway (2023, 2024)
    - Demolish Hospital Pond Dam (2026)
    - Demolish Broskey Dam (2026)
    - Demolish Goose Lake Dam (2026)
    - Demolish EOD Dam (2026)
    - Demolish Bedsprings Dam (2026)
    - Demolish Small Arms Range Dam (2026)
    - Demolish Mad Dog Dam (2026)
- Bridge Repairs
    - Repair Four Bridges along Dry Creek/Best Slough (2021)
    - Repair A Street bridges (2022)
    - Repair three bridges along Hutchinson Creek (2024)
    - Repair Doolittle Drive at Reeds Creek (2024)

- Water Utility Repair/Installation
  - Repair existing water main and install new water main along Gavin Mandery Rd and J Street (2020,2021)
  - Expand A St treated wastewater storage pond (TBD)
  - Remove island in Pond 4 to increase capacity (TBD)
  - Excavate and install new 18-inch water main from B St to Flightline (2021)
  - Repair/consolidate housing water tanks (2021)
  - Repair waste water collection system infiltration & inflow (2022)
  - Repair water main pumphouse to PAVE PAWS Tank (2024)
  - Repair water main B701 to B11025 (2025)
  - Repair waste water treatment plant equalization pond (2025)
- Electrical Utilities Installation/Upgrades
  - Repair Well-Field power poles (2021)
  - Replace 60 kV power poles from Grass Valley Gate to PAVE PAWS (2021)
  - Connect WAPA utilities line from off-base facilities to flightline (2021)
  - Replace power poles at NAVAID and GATR Sites (2021)
  - Repair high-voltage powerlines to Flightline and Munitions (2022)
  - Repair 60 kV circuit from B Street substation to east switch yard (2022)
  - Construct 60 kV circuit from Grass Valley substation to east switch yard (2023)
  - Repair 12 kV to Gold Country Inn; Facilities 24110, 24114, 24109, 24112; plus 5 pad transformers (2026)
- Facility Demolition
  - Demolish SR-71 shelters (2021)
  - Demolish former T-38 launch rack and storage shed (2021)
  - Demolish electrical utilities (Beale South, Temporary Lodging Facility, Gold Country, Saddle Club and Pave Paws) (2021)
  - Demolish unpermitted landfill between Upper Blackwelder Dam and Lower Blackwelder Lake (2022)
  - Demolish unpermitted landfill at Toxic Buttes (2022)
  - Demolish WWII concrete foundations at J St, Rod & Gun, and C St (2022)
  - Demolish B355 (2023)
  - Remove on-base septic tanks (2024)
  - Demolish vacated portions consolidated Ops/Mx B1086 (2025)
- Facility Construction
  - Construct JP8 Fuel Hydrant Facility (TBD)

  - Construct asphalt pads for Security Forces at Doolittle, Schneider, and Wheatland entry gates (TBD)
  - Construct Logistics Warehouse (2021)
  - Construct airfield lighting maintenance facility (2021)
  - Construct additional corrosion control facility (2021)
  - PCR Construct Installation Resilience Operations Center Addition, B25390 (2021, 2023)
  - Construct Installation Resilience Operations Center and Addition, B25390 (2022)
  - Construct addition to south aircraft parking apron (2024)
  - Construct ISR Campus parking lot (2025)
- Construct Doolittle Drive intersection at Hammonton-Smartville Road (2023)
- Repair Hutchison Creek (2024)
- Repair A Street flood control canal (2022)
- Implementation of the IPMP (Beale AFB 2018b), ongoing:
  - Insect pest control operations including surveillance and insecticide application
  - Vegetation management including yellow starthistle control and as-needed herbicide application
  - Animal pest management including trapping, re-location, and lethal control
- Grounds maintenance and landscaping activities, ongoing, including:
  - Mowing, trimming, and edging turf, landscaped areas, and semi-improved grounds
  - Prune, trim, and remove as-needed, trees and shrubs in developed and semi-improved areas
  - Maintain grass, weeds, and vegetation to prevent woody encroachment in un-improved grounds
  - Maintain ditches free from vegetation and debris
  - Herbicide and fertilizer application in landscaped areas
  - Operate and maintain irrigation systems
  - Cut and maintain firebreaks and disk clear zones around primary alert area, weapons storage area and petroleum, oil and lubricants facilities
  - LRS - firebreak construction and maintenance, mowing antenna pads and roadways
- Repairs and renovations of existing facilities are planned, but projects would not overlap with areas planned for invasive plant control.

For this EA analysis, these announced actions are addressed from a cumulative perspective and are analyzed in this section. These announced future actions would be evaluated under separate NEPA actions conducted by the appropriate involved federal agency. Based on the best available information for these proposals by others, the USAF cumulative impact analysis does consider them. If Alternative 2 is selected the planned projects above would be required to adhere to invasive plant prevention measures (e.g., weed free mulches, sanitation practices, etc.) and therefore would have overall beneficial effects.

In terms of mandatory findings of significance, overall, the Proposed Action would not have the potential to substantially degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory. Additionally, per the analysis below, the Proposed Action would not have impacts that are individually limited but cumulatively considerable.

Descriptions of the cumulative effects for the resource areas follow:

4.15.1 Land Use

Alternative 1 (No Action Alternative)

There would be no changes to land use as described in Section 3, *Affected Environment,* as a result of the No Action Alternative and would therefore not contribute to cumulative impacts.

Alternative 2 (Comprehensive Control)

All Treatments: Invasive species control would not result in changes to land use designation, and all land uses would be compatible with AICUZs. Access to some areas could be temporarily limited following treatments. Combined with other projects planned for the base in the near future this may result in a negligible, temporary, reduction in the area available for recreation or cattle grazing. Any area closures would be temporary, so effects would not be significant. Alternative 2 would not significantly induce future development.

4.15.2 Air Quality

Alternative 1 (No Action Alternative)

Activities conducted under the No Action Alternative have been analyzed individually. None of the activities would contribute emissions at quantities that would cumulatively exceed regional air quality standards.

Alternative 2 (Comprehensive Control)

Grazing: Grazing could contribute to minor, temporary, adverse cumulative effects to air quality. There would be the potential for construction related to building grazing infrastructure to generate fugitive dust. Combined with other planned projects, this could result in reduced air quality. All construction projects on the base must comply with FRAQMD “Standard Mitigation Measures for All Projects” and “Fugitive Dust Control Mitigation Measures” to minimize air quality impacts.

GHGs would primarily be generated from vehicles used to manage cattle operations. Combined with other projects there may be a cumulative increase in GHGs produced from mobile sources. An analysis was run using the ACAM, which found than increased vehicle traffic from grazing activities would not result in an impact to the National Ambient Air Quality Standards or exceedance of General Conformity thresholds.

Prescribed Burns: PCAPCD coordinates planned ignitions in Placer County and FRAQMD coordinates planned ignitions in Yuba and Sutter Counties. Total burn acres are allotted, so as to minimize cumulative adverse smoke effects on sensitive areas (local communities and highways). If prescribed fires were conducted on the same day as agricultural burns on adjacent properties there could be cumulative effects to air quality. Effects would be temporary, adverse, localized, and could range from negligible to moderate because burns are permitted only when the applicable air quality management district believes that adverse effects of smoke on human health and safety would be minimized. Each individual burn would be required to have a Smoke Management Plan, describing how this would be accomplished. Cumulative impacts to air quality from prescribed burns would not affect regional air quality attainment status.

Chemical Treatments: Some of the herbicides proposed for use have the potential to volatilize and contribute to overall VOC levels for the region. All herbicide applicators would be required to follow California Department of Pesticide Regulation BMPs and herbicide label instructions, including measures to minimize the likelihood of chemical volatilization. With adherence to applicable rules, regulations, and BMPs Alternative 2 would not contribute to cumulative adverse impacts to air quality.

Manual/Mechanical Treatments: Emissions from small gasoline powered equipment and construction equipment would contribute slightly to overall air emissions, but would not result in cumulative impacts to the National Ambient Air Quality Standards or exceedance of general conformity standards. All effects would be negligible and temporary, and therefore would not be significant.

4.15.3 Water Resources

Alternative 1 (No Action Alternative)

Under the No Action Alternative giant reed located in Dry Creek and Best Slough would not be treated. Combined with other features that obstruct upstream access, there could be a cumulative impact on the ability of anadromous salmonids to reach spawning grounds.

Alternative 2 (Comprehensive Control)

Grazing: If livestock were allowed to use riparian areas there would be the potential for cumulative impacts to water quality when combined with proposed dam removals and other construction projects. There would be the potential for a cumulative increase in sedimentation and altered hydrology in these waterways. Hydrology alterations from projects such as dam removal are designed to improve safety and/or wildlife habitat. Livestock use of riparian areas would be regularly monitored, and animals would be removed from an area before grazing had a significant impact. Livestock would be excluded from construction sites during and immediately after projects, until vegetation re-established on bare areas. Groundwater extraction from solar wells that feed livestock troughs, combined with regional groundwater pumping could contribute to lower aquifer levels. In general, water would be pumped for livestock during the winter wet season when there is less of a need for groundwater extraction for agricultural irrigation.

Prescribed Burns: If there is a wildfire on or near Beale AFB there would be the potential for multiple areas of bare ground to have a cumulative impact on water quality from increased runoff, erosion, ash, and sedimentation. In addition, burned agricultural fields could contribute to cumulative indirect impacts to water quality. The vegetated buffers left between prescribed burn areas and waterways and waterbodies would prevent significant cumulative impacts to water quality from prescribed burns.

Chemical Treatments: Herbicides proposed for use under Alternative 2 would have negligible impacts to water quality and aquatic lifeforms individually, as discussed in Sections 4.4.2 and 4.7.2, or cumulatively. There are two "Impaired Water Bodies" on California's Clean Water Act §303(d) List (California State Water Resources Control Board 2017) near Beale AFB and the LRS. They are the lower Feather River (Lake Oroville Dam to Confluence with Sacramento River) and lower Bear River (below Camp Far West Reservoir). In both rivers, levels of the pesticide chlorpyrifos have been detected that exceed water quality standards. The primary metabolite of chlorpyrifos is TCP, the same primary metabolite as the herbicide triclopyr. There would be the potential for the improper application, or a spill of triclopyr on the base to cumulatively impact the already impaired water bodies. However, based on its analysis, the EPA concluded that the existing uses of triclopyr are unlikely to result in acute or chronic dietary risks from TCP. In addition, receiving waters on Beale AFB are tributaries to the Bear and Feather Rivers, meaning that significant dilution would occur before any chemical reached an impaired waterway. With the implementation of aquatic resource buffers (Table 1 in Appendix G) and herbicide application AMMs, herbicide application would not contribute to cumulative impacts to water quality or exceedance of herbicide total maximum daily loads on the base or in impaired waterways downstream.

Manual/Mechanical: Manual and mechanical treatments could result in increased bare soil and erosion that could result in cumulative impacts to water quality when combined with other projects planned for the base. With the implementation of erosion control BMPs manual and mechanical treatments would not contribute to cumulative impacts to water quality.

Restoration Treatments: Construction project sites on Beale AFB have specific restoration and mitigation requirements depending on project location and if sensitive habitats or resources are disturbed. Restoration treatments conducted under Alternative 2 and for other projects, would have a positive cumulative impact on wetlands and floodplains and surface water quality.

4.15.4 Safety and Occupational Health

Alternative 1 (No Action Alternative)

No cumulative effects to safety and occupational health would occur as a result of the No Action Alternative.

Alternative 2 (Comprehensive Control)

Grazing, Manual/Mechanical, and Restoration Treatments: These treatments would not be expected to have an effect on safety and occupational health because similar actions would be performed by different shops and staff and would not have a cumulative impact on any one group.

Prescribed Burns: Combined with other fuels treatments located on- and off-base, prescribed fires may have a short-term, cumulative, positive impacts on safety by reducing the likelihood of an unplanned wildfire. If wildfires do occur there would be fewer fine fuels to burn, and allow firefighters to safely engage and attack the fire, thereby reducing the intensity of unplanned fires.

Chemical Treatments: The proposed use of herbicides could result in cumulative doses of herbicides to workers or the general public. Cumulative doses of the same herbicide result from (1) additive doses via various routes of exposure resulting from the management scenarios presented in Alternative 2 and (2) additive doses, if an individual were to be exposed to other herbicide treatments.

Additional sources of exposure include: vegetation management by Beale AFB pest management or grounds maintenance, use of herbicides on adjacent agricultural lands, use of herbicide on utility rights-of-way, or home use by a worker or member of the general public. Table 4.11 displays the total lbs of active ingredient of herbicides used annually in Yuba County.

Under Alternative 2, up to 2,000 acres would be treated annually. Based on the total Yuba County pesticide use from 2015-2017 (which includes herbicide use; Table 4.11), Alternative 2 could result in a 6.7% increase in the countywide use of the specific herbicides proposed for use under

Table 4.11. Reported Herbicide Use (lbs active ingredient) within Yuba County (2015-2017), and Herbicide Use Under Alternative 2.

Chemical	Primary Uses	2015 lbs/yr	2016 lbs/yr	2017 lbs/yr	Total lbs	Ave lbs/yr	Alt 2	Increase to County Use/yr
Aminopyralid	pastures, landscape maintenance	130	89	194	413	138	121	88%
Chlorsulfuron	right-of-way, landscape maintenance	5	6	5	16	5	27	499%
Glyphosate	crops, right-of-way, landscape maintenance	66,297	56,388	53,624	176,309	58,770	2,510	4%
Imazamox	alfalfa	4	0	0	4	1	3	188%
Imazapyr	forests/timberland	426	458	457	1,341	447	137	31%
Sulfometuron Methyl	right-of-way	48	16	33	97	32	91	280%
Triclopyr	rice, right-of-way, landscape maintenance	6,803	6,711	6,057	19,571	6,524	1,468	23%
Total lbs Selected Herbicides		**73,713**	**63,668**	**60,370**	**197,751**	**65,917**	**4,356**	**7%**
Annual lbs Total All Pesticides		1,460,965	1,283,310	1,309,944	4,054,219	1,351,406	4,356	0.32%
Source: CA DPR 2019c. Alt = alternative; lbs = pounds; yr = year								

Alternative 2. However, the maximum herbicide use under Alternative 2 would only represent a 0.33% increase in total pesticide use for Yuba County. This is an overestimation, since this number reflects the amount of each herbicide needed to treat the maximum acres proposed for all invasive plant species under Alternative 2. It does not account for overlap in infestations, or the fact that would be unlikely that more than one or two herbicides would be used on the same area within a given year.

Invasive plant infestations have not been mapped at the LRS, so the number of acres that would be treated with herbicide annually would still need to be determined. The LRS is only 235 acres, so any amount of herbicide applied in accordance with label rates would be negligible compared to overall herbicide use in Placer County (Table 4.12).

Using glyphosate as an example of cumulative effects, the typical levels of exposure for a woman being directly sprayed on the lower legs, staying in contact with contaminated vegetation, eating contaminated fruit, and consuming contaminated fish would not lead to an exposure rate that exceeds a level of concern. From the Human Health Risk Assessment conducted for this EA (Appendix J), these scenarios lead to a combined HQ of 0.02. Similarly, for all of the chronic glyphosate exposure scenarios, the addition of all possible pathways leads to HQs substantially less than one. Similar scenarios can be developed with the other herbicides. This risk assessment specifically considers the effect of repeated exposure in that the chronic RfD is used as an index of acceptable exposure. Consequently, repeated exposure to levels below the toxic threshold of a given herbicide should not be associated with cumulative toxic effects.

Table 4.12. Reported Herbicide Use (lbs active ingredient) within Placer County (2015-2017).

Chemical	2015 lbs/total	2016 lbs/total	2017 lbs/total	Total lbs	Annual Average lbs
Aminopyralid	620	585	539	1,744	581
Chlorsulfuron	61	19	29	109	36
Glyphosate	28,175	24,671	20,654	73,500	24,500
Imazamox	30	16	26	72	24
Imazapyr	214	1,539	112	1,865	622
Sulfometuron Methyl	122	65	51	238	79
Triclopyr	9,210	4,626	3,150	16,986	5,662
Total lbs Selected Herbicides	38,432	31,521	24.561	94,514	31,505
Annual lbs Total All Pesticides	339,471	458,299	300,713	1,098,483	366,161
Source: CA DPR 2019d					

Since these herbicides persist in the environment for a relatively short time (generally less than 1 year), they do not bioaccumulate, and are rapidly eliminated from the body, additive doses to humans from re-treatments in subsequent years would be unlikely. According to work completed by the California Department of Pesticide Regulation, some plant material contained triclopyr residues up to 1.5 years after treatment (glyphosate, up to 66 weeks), however, these levels were less than 1 part per million (Segawa et al. 2001). Based on the re-treatment schedule for Alternative 2, it would be possible that residues from the initial herbicide application could still be detectable during subsequent re-treatments, but these plants would represent a low risk to humans as they would show obvious signs of herbicide effects as so would be undesirable for collection and consumption.

In order to consider the cumulative effects of these other uses, the EPA has developed the theoretical maximum residue contribution. The theoretical maximum residue contribution is an estimate of maximum daily exposure to chemical residues that a member of the general public could be exposed to from all published and pending uses of a pesticide on a food crop (Table 4.13). Adding the theoretical maximum residue contribution to this project's chronic dose estimates would be used as an estimate of the cumulative effects of this project with theoretical background exposure levels of these herbicides. The result of doing this doesn't change the risk conclusions based on the project-related HQ values.

Cumulative effects could be caused by the interaction of different chemicals with a common metabolite or a common toxic action. With the exception of triclopyr and chlorpyrifos discussed below, none of the other herbicides have been demonstrated to share a common metabolite with other pesticides.

The primary metabolite of triclopyr is TCP. TCP is also the primary metabolite of an insecticide called chlorpyrifos. EPA (1998, 2002a) considered exposures to TCP from both triclopyr and chlorpyrifos in their general dietary and drinking water exposure assessments. The upper range of acute exposure to triclopyr was estimated at 0.012 mg/kg/day and the upper range of exposure to chlorpyrifos was estimated at 0.016 mg/kg/day. Thus, making the assumption that both triclopyr and chlorpyrifos are totally converted to TCP, the total exposure would be about 0.028 mg/kg/day, a factor of 8.9 below the level of concern. For chronic exposures, the EPA based the risk assessment on infants – i.e., individuals at the start of a lifetime exposure. The dietary analysis indicated that the total exposure expressed as a fraction of the RfD was 0.044 for TCP from triclopyr and 0.091 for TCP from chlorpyrifos for a total of 0.135, or a factor of about 7.4 below the level of concern. Based on this assessment, the EPA (1998) concluded that: "...the existing uses of triclopyr and chlorpyrifos are unlikely to result in acute or chronic dietary risks from TCP.

.Table 4.13. Theoretical Maximum Residue Contribution Values for U.S. Population.

Herbicide	RfD (mg/kg/bw)	Theoretical Maximum Residue Contribution (mg/kg/day)	% of RfD
Aminopyralid	0.5	0.0033 [1]	6.0
Chlorsulfuron	0.05	0.00386 [2]	19.3
Glyphosate	2	0.02996 [3]	1.5
Imazamox	3	exempt [4]	na
Imazapyr	2.5	<0.025 [5]	<1
Sulfometuron Methyl	0.275	0.00169 [6]	0.6
Triclopyr	0.05	0.00105 [7]	2.1

[1] U.S. EPA 2005 [2] U.S. EPA 2002c [3] U.S. EPA 2000b [7] U.S. EPA 2008, Based on drinking water contamination rates, herbicide is non-food/non-feed only
[4] U.S. EPA 2003 [5] U.S. EPA 1997b [6] U.S. EPA 2002a
RfD = reference dose; mg/kg/bw = miligrams per kilogram of bodyweight

Based on limited available data and modeling estimates, with less certainty, the EPA concludes that existing uses of triclopyr and chlorpyrifos are unlikely to result in acute or chronic drinking water risks from TCP. Acute and chronic aggregate risks of concern are also unlikely to result from existing uses of triclopyr and chlorpyrifos."

This conclusion, however, is based primarily on the agricultural uses of triclopyr – i.e., estimated dietary residues – and does not specifically address potential exposures from wildland application. In wildland applications, the primary concern would be the formation of TCP as a soil metabolite. TCP is more persistent than triclopyr in soil and TCP is relatively mobile in soil (U.S. EPA 1998) and could contaminate bodies of water near the site of application. In order to assess the potential risks of TCP formed from the use of triclopyr, the TCP metabolite was modeled in a risk assessment along with triclopyr (SERA 2011a). This risk assessment specifically includes consideration of exposures to TCP as a result of using triclopyr. Thus, oral exposures to TCP resulting from the use of triclopyr are addressed in the risk characterization for triclopyr

Because of the low toxicity of imazamox and its metabolic degradates, there is no concern regarding the potential for cumulative effects with other substances with a common mode of action (U.S. EPA 2002b). Imazamox belongs to the imidazolinone class of herbicides. Imidazolinones act by inhibiting acetohydroxy acid synthase, an enzyme only found in plants. Animals lack acetohydroxy acid synthase and this biosynthetic pathway. This lack of acetohydroxy acid synthase contributes to the low toxicity of imazamox in mammals. No information to indicates or suggests that imazamox has any toxic effects on mammals that would be cumulative with those of any other chemical (U.S. EPA 2002b). Given the low toxicity of imazamox, concern for cumulative effects would be minimal.

Imazapyr, another imidazolinone, is strikingly similar to imazamox in that doses that cause clear signs of toxicity have not been determined (SERA 2010). While this apparent lack of mammalian toxicity is a similarity, it is not a basis for enhanced concern for cumulative effects. The EPA decision not to assume a common mechanism of action in assessing imazapyr relative to other imidazolinone herbicides appears to be a reasonable and justified approach (U.S. EPA 2006).

The risk assessment for sulfometuron methyl (SERA 2004b) specifically considers the effect of both single and repeated exposures. Based on the HQs generated there is no indication that repeated exposures would exceed the threshold for toxicity.

4.15.5 Hazardous Materials and Wastes

Alternative 1 (No Action Alternative)

All hazardous waste generated from invasive plant control activities under the No Action Alternative would continue to be disposed of in accordance with the Beale Hazardous Waste

Management Plan (Beale AFB 2018d) and the IPMP (Beale AFB 2018b). No cumulative impacts to ERP or MMRP sites would occur.

Alternative 2 (Comprehensive Control)

No cumulative impacts to ERP or MMRP sites would occur.

Grazing, Prescribed Burns, Manual/Mechanical, and Restoration Treatments: These treatments would not contribute to cumulative impacts to hazardous materials or wastes.

Chemical Treatments: Under Alternative 2, the amount of herbicide used on the base would increase. This could have a minor cumulative impact on the amount of hazardous waste generated, in the form of herbicide containers, when combined with existing invasive plant and pest control activities conducted by Beale AFB Pest Management and grounds maintenance personnel. Containers from small in-house applications may be disposed of on the base, but larger applications would be conducted by contractors, who would dispose of containers at appropriate off-base facilities. Therefore, there would not be a significant cumulative impact in the amount of hazardous waste generated.

4.15.6 Biological / Natural Resources

Alternative 1 (No Action Alternative)

Construction projects could easily cause the introduction of new invasive species or the spread of existing infestations. Equipment could bring in seeds or propagules, and the large areas of bare ground associated with construction projects are ideal colonization sites for invasive plants. Under the No Action Alternative, EDRR surveys and control would not be done at construction sites. The number and extent of proposed construction projects, combined with the inability to conduct invasive species control, would likely to lead to an overall increase in invasive plant cover and a reduction in native plant cover and wildlife habitat on the base.

Invasive plants could produce seeds and propagules that could spread off-base to neighboring properties. In the absence of an effective invasive plant control program this would be likely to happen. Combined with existing off-base invasive plant infestations this spread would have a negative cumulative impact on biological resources in the region.

Alternative 2 (Comprehensive Control)

Grazing: The presence of livestock in areas where construction is also occurring could have cumulative impacts on biological resources. Vegetation disturbed during construction could subsequently be trampled by livestock. Soil disturbance and erosion from construction activities could be exacerbated by livestock. Some pastures may be unavailable for grazing during construction projects, thus reducing the area available for grazing and concentrating the impacts of grazing in smaller areas.

Electric fencing would be used to exclude cattle from constructions sites, bare areas and soil piles. Regular monitoring by the natural resource technicians would ensure biological resources were not negatively impacted in high-use areas. Therefore, there would be no cumulative impacts to biological resources from grazing expansion under Alternative 2.

Prescribed Burns: There would be the potential for cumulative adverse impacts to biological resources if wildfires re-burn or burn near prescribed burn areas within 1-2 years of a prescribed burn. This could lead to a longer-term reduction in wildlife habitat and food sources, increase bare areas subject to erosion and run-off, which could potentially impact aquatic habitats. There would be no planned actions that would lead to cumulative impacts from prescribed burns.

Chemical Treatments: As discussed in Section 4.12.1.4, *Health and Human Safety,* there would be the potential for indirect, adverse, cumulative effects as a result of herbicide treatments conducted under Alternative 2 combined with herbicide contamination from other sources. The risk to a given organism is dependent upon multiple factors, including the organism's specific sensitivity, as discussed in Section 4.7, *Biological Resources.* Most ongoing herbicide application on the base occurs in developed areas and directly adjacent roads or utility rights-of-way. Herbicide treatments conducted under Alternative 2 would primarily occur away from developed areas and utilities, and treatments would be unlikely to have cumulative effects. The more likely effect would be a cumulative increase in water contamination and subsequent adverse impacts to aquatic organisms from Alternative 2, other on-base herbicide applications, and nearby agricultural applications. By implementing aquatic resource buffers, water quality sampling, and other herbicide application BMPs (Appendix G), cumulative impacts to biological resources would be minimized.

Manual/Mechanical: Treatments could temporarily create areas of bare ground on the base susceptible to erosion, and alter or eliminate wildlife habitat. This could lead to cumulative impacts when combined with bare areas created during construction projects. Mowing treatments, combined with mowing conducted under the grounds maintenance contract, could have a cumulative adverse impact to vernal pool species if done when the ground is still saturated, especially if the same areas are mown repeatedly. However, properly-timed mowing treatments under Alternative 2 are designed to benefit vernal pools species. In general, grounds maintenance personnel perform limited mowing in semi-improved areas.

Restoration Treatments: Construction project sites on Beale AFB have specific restoration and mitigation requirements depending on project location, and if sensitive habitats or resources are disturbed. Restoration treatments conducted under Alternative 2 and for other projects would have a cumulative positive impact on biological resources.

Adherence to AMMs specified by USFWS during consultations would prevent or minimize adverse effects to special status species. Implementation of erosion control BMPs would reduce the impact of erosion on water quality and aquatic organisms. Habitat restoration and tree mitigation requirements for individual projects would reduce the impacts to native plants and wildlife habitat. Implementing EDRR surveys of construction sites as part of Alternative 2 would further reduce cumulative impacts to habitat quality from construction projects.

4.15.7 Cultural Resources Impacts

Alternative 1 (No Action Alternative)

All invasive plant treatments currently being conducted on the base have been reviewed and approved by the Cultural Resources Manager. Any new actions would be subject to review and approval by the Cultural Resources Manager through cultural resources management procedures (i.e., completing USAF Form 813 and 103). With the implementation of project-specific BMPs, as deemed necessary by the Cultural Resources Manager, no cumulative impacts to cultural resources would occur as a result of the No Action Alternative.

Alternative 2 (Comprehensive Control)

The base Cultural Resources Manager reviews and approves all invasive plant treatments through cultural resources management procedures (i.e., completing USAF Form 103). The primary protection measure for cultural resources would be avoidance. Therefore, invasive plant treatments would not add to cumulative impacts

Grazing: If construction projects are conducted near cultural resources, they would be fenced off to protect the resources from disturbance. If projects are conducted in areas also grazed by cattle fencing would be electrified or otherwise designed to exclude cattle as well. For this reason, there would be no cumulative impacts to cultural resources.

Prescribed Burns: Prescribed burns would be conducted in such a way as to minimize fuel loads at cultural resource sites so there would be no cumulative impacts from prescribed and wildfires. There would be the potential for prescribed fires to lessen the potential impact of wildfires by reducing fuel loads in and around cultural resource sites.

Chemical Treatments: Chemical treatments conducted by the pest management shop and under the grounds maintenance contract are typically limited to developed areas and would not be conducted near cultural resources. Therefore, there would be no cumulative impacts to cultural resources from herbicide application.

Manual/Mechanical and Restoration Treatments: Soil disturbance from invasive plant control combined with soil disturbance from construction projects, and post-construction restoration could have cumulative impacts on cultural resources. Impacts would be avoided by following cultural resources management procedures (i.e., completing USAF Form 103). In general, cultural resources would be avoided, and if treatments were necessary, soil disturbance would be minimized. Construction projects would avoid cultural resources as identified by the Cultural Resources Manager.

4.15.8 Earth Resources

Alternative 1 (No Action Alternative)

Construction projects could easily cause the introduction of new invasive species or spread existing infestations. Equipment could bring in seeds or propagules, and the large areas of bare ground associated with construction projects are ideal colonization sites for invasive plants. Under the No Action Alternative, EDRR surveys and control would not be done at construction sites. The number and extent of proposed construction projects, combined with the inability to conduct invasive species control, would likely lead to an overall increase in invasive plant cover and associated degradation of soil properties.

Alternative 2 (Comprehensive Control)

Grazing: There would be the potential for a cumulative increase in erosion from bare soil from grazing infrastructure installation, grazing, prescribed burns, and manual/mechanical treatments, combined with construction projects. Projects would be staggered temporally, and all projects would follow erosion control BMPs including re-vegetation following project completion. This would minimize cumulative impacts to soils.

Some construction projects would require fill dirt from other areas of the base. Combined with nutrient redistribution caused by grazing, there is the potential for permanent cumulative impacts to soil quality. Grazing would be managed to reduce over or under-utilization of areas, and thus minimize nutrient redistribution. Livestock would also be used to restore soil nutrients to areas where soil is removed for fill.

Prescribed Burns: Prescribed burns could contribute to cumulative adverse effects on soil health in the form of increased erosion when combined with wildfires or soil disturbance from construction projects or grazing. This would be avoided by maintaining some vegetation groundcover post-burn, and increasing remaining vegetation cover as needed if burns are conducted on slopes.

Chemical Treatments: Herbicides applied at construction sites may remain in the soil longer than at undisturbed sites, and may lead to cumulative impacts to the soil microbiome. Disturbed soils tend to have less water availability and scarce soil microbes, and therefore have less potential to metabolize herbicides (USDA 2013). Soils along roadsides and old compacted surfaces from equipment use and excavation may have less water holding capacity and organic matter to support decomposition. If herbicide applications under Alternative 2 were conducted in areas also treated by grounds maintenance or Pest Management, there would be the potential to exceed the maximum annual allowable amount of chemical applied per acre per year. This would be avoided by coordinating herbicide applications through Pest Management, which oversees all herbicide application on the base.

Manual/Mechanical Treatments: There would be the potential for a cumulative increase in erosion from bare soil from manual/mechanical treatments combined with grazing infrastructure installation, grazing, prescribed burns, and construction projects. All projects would follow erosion control BMPs which would minimize cumulative impacts to soils.

Restoration Treatments: Restoration treatments would have beneficial impacts to soil health. Combined with restoration/mitigation efforts required for construction projects, restoration treatments would have a cumulative beneficial impact on soil health.

4.15.9 Utilities and Infrastructure

Alternative 1 (No Action Alternative)

No cumulative effects to utilities and infrastructure would occur as a result of the No Action Alternative.

Alternative 2 (Comprehensive Control)

All Treatments: Invasive plant treatments would have overall beneficial effects on utilities and infrastructure by reducing fire hazards under electrical utility lines. Combined with other planned projects to upgrade and re-route electrical utility lines the Proposed Action would have cumulative beneficial effects on utilities and infrastructure.

4.15.10 Transportation and Traffic

Alternative 1 (No Action Alternative)

No cumulative effects to transportation and traffic would occur as a result of the No Action Alternative.

Alternative 2 (Comprehensive Control)

All Treatments: Invasive plant treatments may lead to minor increases or delays in traffic. When combined with other construction projects the increase would contribute to cumulative effects to transportation and traffic. Overall, cumulative impacts would be minor and adverse within the vicinity of the treatment areas and the Wheatland Gate and truck inspection point. Traffic controls would be used as needed to reduce adverse effects.

4.15.11 Energy Resources

Alternative 1 (No Action Alternative)

No cumulative effects to Energy Resources would occur as a result of the No Action Alternative.

Alternative 2 (Comprehensive Control)

All Treatments: The use of energy resources associated with the increased effort to control invasive species would be minor. All energy use would be for temporary weed control projects and would not use energy continuously over time. Transportation and fire vehicles will be the greatest energy consumers. This increase in consumption will be temporary and will have negligible effects to overall energy use on base, and would not contribute to long term cumulative energy use.

4.15.12 Climate Change

Alternative 1 (No Action Alternative)

There is the potential for GHG emission under the No Action Alternative. However, the total acres burned would be minimal (800 acres or less), and any increase in cumulative GHG would be minor and temporary.

Alternative 2 (Comprehensive Control)

All Treatments: Prescribed burns under Alternative 2 could contribute to a temporary overall increased in GHG on the day of the burn. All non-exempt stationary emissions sources are permitted by FRAQMD or PCAQMD, who also allot burn acres and give out burn-specific air quality permits. Effects would be limited to minor to moderate because burns are permitted only when the applicable air quality management district believes that adverse effects of smoke on human health would be minimized. In addition, all prescribed fires require burn day authorization from the local air district and must be coordinated with the local air district, through the Beale AFB Air Quality Manager.

5.0 LIST OF PREPARERS

This EA has been prepared under the direction of the USAF Civil Engineer Center, USAF, and Beale AFB.

The individuals that contributed to the preparation of this EA are listed below.

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6.0 PERSONS AND AGENCIES CONSULTED/COORDINATED

The following Persons and Agencies were contacted in the preparation of this EA (See Appendix E for additional information on agencies and government coordination):

Table 6.1. Persons and Agencies Consulted/Coordinated

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Local Agencies	
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APPENDIX A

Non-native and Noxious Plant Species List, Watch List, and Management Status of Priority Species

Beale AFB Invasive Species List

Scientific Name	Common name	Stage	Cal-IPC rating	CDFA rating
Aegilops triuncialis	barbed goatgrass	Containment	High	B
Arundo donax	giant reed	Eradication	High	B
Centaurea solstitialis	yellow starthistle	Asset-based protection	High	C
Elymus caput-medusae	medusahead	Asset-based protection	High	C
Rubus armeniacus	Himalayan blackberry	Asset-based protection	High	
Dittrichia graveolens	stinkwort	Eradication	Mod-Alert	
Acroptilon repens	Russian knapweed	Eradication	Moderate	B
Ailanthus altissima	tree-of-heaven	Eradication	Moderate	C
Avena barbata and A. fatua	(slender) wild oat	No action	Moderate	
Brassica nigra	black mustard	Asset-based protection	Moderate	
Bromus diandrus	ripgut brome	No action	Moderate	
Carduus pycnocephalus	Italian thistle	Asset-based protection	Moderate	C
Chondrilla juncea	rush skeletonweed	Containment	Moderate	A
Cirsium vulgare	bull thistle	Eradication	Moderate	C
Conium maculatum	poison-hemlock	No action	Moderate	
Cynodon dactylon	bermudagrass	No action	Moderate	
Cynosurus echinatus	hedgehog dogtailgrass	No action	Moderate	
Festuca myuros	rattail fescue	No action	Moderate	
Festuca perennis	Italian ryegrass	No action	Moderate	
Ficus carica	edible fig	Eradication	Moderate	
Geranium dissectum	cutleaf geranium	No action	Moderate	
Glyceria declinata	waxy mannagrass	Eradication	Moderate	
Hordeum marinum	Mediterranean barley, seaside barley	No action	Moderate	
Hordeum murinum	hare barley, foxtail barley	No action	Moderate	
Hypericum perforatum	common St. John's wort, klamathweed	Containment	Moderate	C
Hypochaeris radicata	rough catsear, hairy dandelion	No action	Moderate	
Phalaris aquatica	harding grass	No action	Moderate	

Scientific Name	Common name	Stage	Cal-IPC rating	CDFA rating
Potamogeton crispus	curlyleaf pondweed	No action	Moderate	
Trifolium hirtum	rose clover	No action	Moderate	
Agrostis avenacea	Pacific bentgrass	No action	Limited	
Briza maxima	big quakinggrass, rattlesnakegrass	No action	Limited	
Bromus hordeaceus	soft brome	No action	Limited	
Carduus tenuiflorus	slenderflower thistle	No action	Limited	C
Erodium cicutarium	redstem filaree	No action	Limited	
Hypochaeris glabra	smooth catsear	No action	Limited	
Lythrum hyssopifolium	hyssop loosestrife	No action	Limited	
Medicago polymorpha	California burclover	No action	Limited	
Olea europaea	olive	No action	Limited	
Parentucellia viscosa	yellow glandweed, sticky parentucellia	No action	Limited	
Phytolacca americana	common pokeweed	Eradication	Limited	
Plantago lanceolata	buckhorn plantain, English plantain	No action	Limited	
Polypogon monspeliensis	rabbitfoot polypogon, annual beardgrass	No action	Limited	
Robinia pseudoacacia	black locust	Eradication	Limited	
Rumex crispus	curly dock	No action	Limited	
Silybum marianum	blessed milkthistle	Containment	Limited	
Rotala indica	Indian toothcup	Eradication	not listed	
Sorghum halepense	Johnson grass	No Action	not listed	C
Verbena litoralis	seashore vervain	Containment	not listed	
Verbena bonariensis	tall vervain	Containment	watch list	
Ludwigia sp.	water-primrose	Eradication	depends on sp.	
Myriophyllum sp.	parrot feather	Containment	depends on sp.	

Beale AFB Early Detection Rapid Response (EDRR) Species List

Scientific Name	Common name	Cal-IPC rating	CDFA rating
Centaurea stoebe ssp. micranthos	spotted knapweed	High	A
Lepidium latifolium	perennial pepperweed	High	B
Lythrum salicaria	purple loosestrife	High	B
Tamarix parviflora	smallflower tamarisk	High	B
Cirsium arvense	Canada thistle	Moderate	B
Cynara cardunculus	artichoke thistle	Moderate	B
Mentha pulegium	pennyroyal	Moderate	
Hydrilla verticillata	hydrilla	High-Alert	A
Alternanthera philoxeroides	alligator weed	High-Alert	A
Limnobium laevigatum	South American spongeplant	High-Alert	A
Eichhornia crassipes	water hyacinth	High-Alert	C
Sesbania punicea	red sesbania, scarlet wisteria	High-Alert	B
Bromus tectorum	downy brome, cheatgrass	High	
Egeria densa	Brazilian egeria	High	C
Acroptilon repens	Russian knapweed	Moderate	B

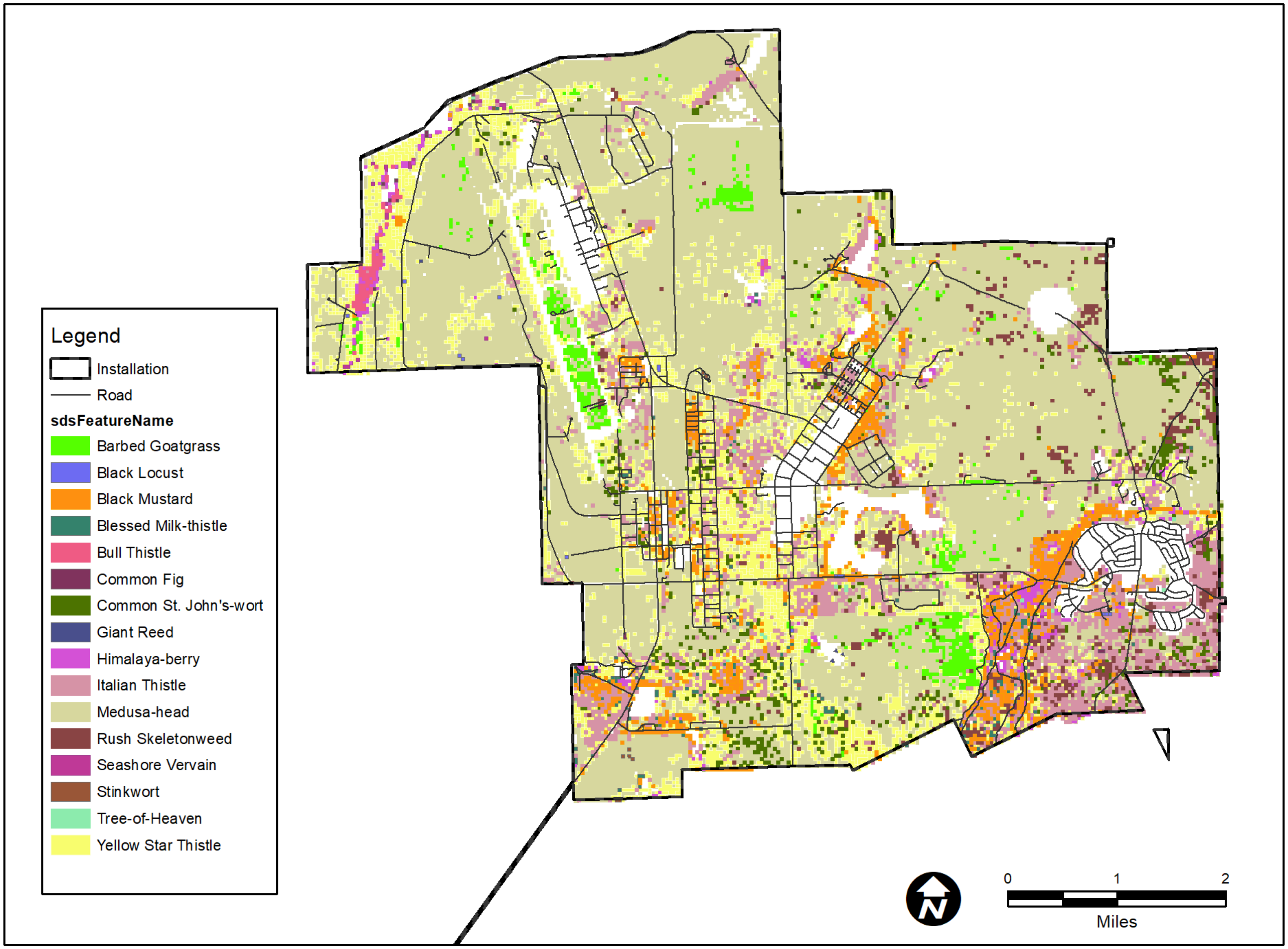
Beale AFB Invasive Plant Species Management Goals (From Beale AFB 2019 INRMP)

Common Name	Scientific Name	Stage	Threats to Mission	Past and Ongoing Control	Current Status[1]	Management Goal
Black locust	*Robinia pseudoacacia*	Eradication	Toxic to livestock.	No control measures taken.	Total infested area on the base is approximately 10 acres.	Zero density within 10+ years.
Bull thistle	*Cirsium vulgare*	Eradication	Reduces forage quality, BASH hazard.	Hand pulling/digging treatments conducted in 2017 and 2019 along Reeds Creek.	Total infested area on the base is approximately 50 acres.	Zero density within 4 years.
Edible fig	*Ficus carica*	Eradication	Fruit attracts birds and other wildlife, causes dermatitis.	No control measures taken.	Total infested area on the base is approximately 50 acres.	Zero density within 5+ years.
Giant reed	*Arundo donax*	Eradication	Can choke waterways causing flooding and blocking anadromous fish passage, highly flammable.	Treatments in 2013, 2017, and 2018. Treatments planned for Dry Creek.	Total infested area on the base in 13 acres. Infestations are located primarily in riparian corridors.	Zero density within 5 years.
Indian toothcup	*Rotala indica*	Eradication	In some years, dominates cover in some Beale AFB vernal pools.	No control measures taken.	To be determined	Zero density but inadequate information to determine time to goal.
Russian knapweed	*Acroptilon repens*	Eradication	Accumulates and deposits zinc on soil surface, toxic to horses, reduces forage quality.	No control measures taken, bio-control beetle present in the state.	To be determined	Zero density within 3 years.
Stinkwort	*Dittrichia graveolens*	Eradication	Causes contact dermatitis.	Hand pulling treatment conducted in 2017 along Reeds Creek and near the Wheatland Gate.	To be determined	Zero density within 3 years.
Tree-of-heaven	*Ailanthus altissima*	Eradication	Can cause contact dermatitis in sensitive individuals; common allergen.	No control measures taken.	Total infested area on the base is approximately 13 acres.	Zero density within 5 years.
Water primrose	*Ludwigia hexapetala* and *L. peploides*	Eradication	Degrades water quality, interferes with mosquito control, and reduces water flow in irrigation channels.	No active control being taken.	Presence on the base is unverified.	Zero density within 2 years.
Waxy mannagrass	*Glyceria declinata*	Eradication	Invades vernal pools.	No control measures taken.	To be determined	To be determined

Common Name	Scientific Name	Stage	Threats to Mission	Past and Ongoing Control	Current Status[1]	Management Goal
Common Pokeweed	*Phytolacca americana*	Eradication		No control measures taken.	To be determined	To be determined
Barbed goatgrass	*Aegilops triuncialis*	Containment	Increases the chance of fire, decreases forage, harmful to vernal pool habitat.	2017 weed whacking treatments west of flightline. 2019 weed whacking spot treatments in GMUs.	Total infested area on the base is 502 acres. Clumped distribution on the base. Invading cattle pastures. Work plan in place.	Reduce to <10% cover in treated areas after 2 years, monitor for and prevent spread into new areas.
Blessed milk thistle	*Silybum marianum*	Containment	Displaces native and forage species, spines can injure livestock.	No control measures taken.	Total infested area on the base is approximately 400 acres. Infestations are mostly found in riparian areas, and occasionally in uplands.	Reduce to <10% cover in upland areas.
Klamathweed	*Hypericum perforatum*	Containment	Causes sunburn in light-colored livestock.	No control measures taken.	Total infested area on the base is approximately 825 acres.	Reduce those sites with >10% cover to < 5% cover.
Parrotfeather	*Myriophyllum aquaticum*	Containment	Impedes water flow and interferes with recreational activities.	No current control.	Limited distribution on the base.	Zero density within 2 years in all identified locations.
Skeletonweed	*Chondrilla juncea*	Containment	To be determined.	No control measures taken.	Infestations found widely across the base with approximately 475 acres infested.	Reduce to 10% cover after 3 years.
Vervain	*Verbena litoralis* and/or *V. bonariensis*	Containment	Invades riparian areas.	Hand pulling treatment conducted in 2017 along Reeds Creek.	Total infested area on the base is approximately 150 acres. Infestations are primarily found in riparian areas at low cover.	Reduce to 0% cover in satellite populations and where previously treated.
Black mustard	*Brassica nigra*	Asset Protection	Increases fire hazard, toxic to livestock.	No control measures taken.	Total infested area on the base is approximately 850 acres. Primarily located in riparian and wetland areas, generally at low cover.	Reduce to <5% cover in areas where it is impacting resources or human activities.
Himalayan blackberry	*Rubus armeniacus*	Asset protection	Creates habitat for birds, increasing BASH hazard.	Mowing/mastication in 2015.Chemical treatments in 2016, 2017, and 2019 along Reeds Creek	Total infested area on the base is approximately 600 acres. Infestations are primarily in riparian and wetland areas.	Reduce to <5% cover in targeted areas, allow little/no fruit production.

Common Name	Scientific Name	Stage	Threats to Mission	Past and Ongoing Control	Current Status[1]	Management Goal
Italian thistle	*Carduus pycnocephalus*	Asset Protection	Spines decrease forage quality.	No control measures taken.	Infestations are widespread across the base with approximately 2,600 acres infested.	Reduce to <5% cover in areas where it is impacting resources or human activities.
Medusahead	*Elymus caput-medusae*	Asset protection	Increases the chance of fire, decreases forage, harmful to vernal pool habitat.	No active control measures. Biomass being passively controlled through grazing.	Infestations are widespread across the base with approximately 20,500 acres infested.	Reduce to <25% cover within 2 years in treated areas.
Yellow star thistle	*Centaurea solstitialis*	Asset Protection	Increases the chance of fire, decreases forage, decrease suitability of open spaces for training, BASH hazard, harmful to vernal pool habitat.	Several treatments in the vicinity of the flightline since 2007. Mowing treatment in 2017 in the scar of a 2015 controlled burn.	Infestations are widespread across the base with approximately 6,800 acres infested.	Reduce to <20% cover within 3 years in areas where it is impacting resources or human activities.

[1]Total number of acres on which at least 1 plant of this species was mapped in 2016.
Cal-IPC: California Invasive Plant Council
Source: 2017 IPSMG (Hopkinson 2017a)



Invasive Plants Mapped on Beale AFB 2014-2016 (Beale AFB 2017c, CEMML 2017c, H.T. Harvey & Associates 2015b)

Methods proposed for invasive and non-native plant control by species

Common name	Scientific Name	Stage	Mapped Infested Acres	# of sites	Manual	Mechanical	Cattle	Goat/sheep	Burning	Tarping	De-watering	Herbicide
black locust	*Robinia pseudoacacia*	Eradication	10.5	15								x
bull thistle	*Cirsium vulgare*	Eradication	110	14	x	x		x				x
common pokeweed	*Phytolacca americana*	Eradication	NA	1	x							
edible fig	*Ficus carica*	Eradication	48	20	x							x
giant reed	*Arundo donax*	Eradication	14.2	16	x	x	x	x	x	x		x
Indian toothcup	*Rotala indica*	Eradication	NA	1	x							x
perennial pepperweed	*Lepidium latifolium*	Eradication	0	NA	x	x	x	x				x
stinkwort	*Dittrichia graveolens*	Eradication	19	5	x	x			x			x
tree-of-heaven	*Ailanthus altissima*	Eradication	13	20	x							x
water-primrose	*Ludwigia hexapetala and L. peploides*	Eradication	0	unk	x	x						
waxy mannagrass	*Glyceria declinata*	Eradication	NA	unk	x	x						x
barbed goatgrass	*Aegilops triuncialis*	Containment	502	203		x	x		x			x
blessed milkthistle	*Silybum marianum*	Containment	405	218		x						x
common St. John's wort, klamathweed	*Hypericum perforatum*	Containment	824	630	x	x						x
parrot feather	*Myriophyllum sp.*	Containment	0	unk	x	x					x	x
rush skeletonweed	*Chondrilla juncea*	Containment	570	402	x	x	x	x				x
vervain	*Verbena bonariensis or V. litoralis*	Containment	452	12	x							x
black mustard	*Brassica nigra*	Asset Protection	863	420		x		x				x
Himalayan blackberry	*Rubus armeniacus*	Asset Protection	596	198	x	x		x				x
Italian thistle	*Carduus pycnocephalus*	Asset Protection	2,611	857	x	x	x	x	x			x
medusahead	*Elymus caput-medusae*	Asset Protection	20,546	many			x	x	x			x
yellow starthistle	*Centaurea solstitialis*	Asset Protection	6,396	904		x	x	x	x			x

Common name	Scientific Name	Stage	Mapped Infested Acres	# of sites	Manual	Mechanical	Cattle	Goat/sheep	Burning	Tarping	De-watering	Herbicide
alligator weed	*Alternanthera philoxeroides*	EDRR	NA	NA	x							x
artichoke thistle	*Cynara cardunculus*	EDRR	NA	NA	x			x				x
Brazilian egeria	*Egeria densa*	EDRR	NA	NA	x						x	x
Canada thistle	*Cirsium arvense*	EDRR	NA	NA	x	x						x
cheatgrass	*Bromus tectorum*	EDRR	NA	NA	x	x			x			x
hydrilla	*Hydrilla verticillata*	EDRR	NA	NA	x						x	x
pennyroyal	*Mentha pulegium*	EDRR	NA	NA	x							x
purple loosestrife	*Lythrum salicaria*	EDRR	NA	NA	x							x
red sesbania, scarlet wisteria	*Sesbania punicea*	EDRR	NA	NA	x	x			x			x
Russian knapweed	*Acroptilon repens*	EDRR	0	unk	x	x		x				x
smallflower tamarisk	*Tamarix parviflora*	EDRR	NA	NA	x	x		x	x			x
South American spongeplant	*Limnobium laevigatum*	EDRR	NA	NA	x							x
spotted knapweed	*Centaurea stoebe ssp. Micranthos*	EDRR	NA	NA	x			x				x
water hyacinth	*Eichhornia crassipes*	EDRR	NA	NA	x	x					x	x

Map extent

This report summarizes invasive plant management opportunities in Map extent. Opportunities are determined from maps of each species' current distribution and suitable range. Species are listed by three types of management opportunity:

- **Surveillance** – surveying to detect new infestations
- **Eradication** – complete removal of infestations
- **Containment** – limiting further spread of infestations

Below is a sample of opportunities in Map extent. This information should be combined with local knowledge to set local priorities (see "Using the Report" at the end of this document.) Click on a plant's name below to view a map of that species.

Opportunities:

These are some opportunities in Map extent. Tables on proceeding pages of this report contain a complete list of invasive plant management opportunities.

Surveillance:


Photo © Regents of the University of California
Alternanthera philoxeroides
alligator weed


Photo © Regents of the University of California
Ammophila arenaria
European beachgrass


Photo courtesy of: Cal-IPC
Brassica tournefortii
Saharan mustard, African mustard


Photo courtesy of: Elizabeth Brusati
Carpobrotus edulis
Hottentot-fig, iceplant


Photo © Regents of the University of California
Cortaderia jubata
jubatagrass

Eradication:


Photo courtesy of: CDFA
Limnobium laevigatum
South American spongeplant


Photo courtesy of: Janet Garcia
Cynara cardunculus
artichoke thistle

Containment:


Photo © Regents of the University of California
Aegilops triuncialis
barb goatgrass

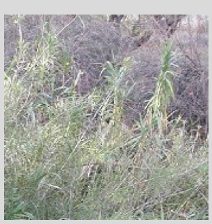


Photo © Regents of the University of California
Arundo donax
giant reed

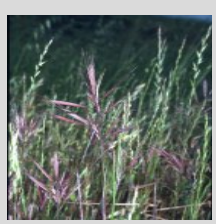


Photo © Regents of the University of California
Bromus madritensis ssp. rubens
red brome

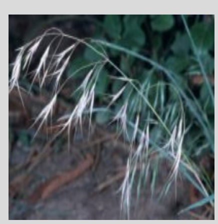


Photo © Regents of the University of California
Bromus tectorum
downy brome, cheatgrass


Photo © Regents of the University of California
Centaurea stoebe ssp. micranthos
(=Centaurea maculosa)
spotted knapweed

Surveillance Opportunities

These opportunities entail regular surveys to detect new infestations of species not known to be present in the region. The strategic potential depends on the proximity of nearby infestations and the suitability of the area. The table below includes species occurring within 50 miles of the selected region.

	Suitable Range	
Plant Species: Grouped by Statewide Cal-IPC Rating	2010	2050
High (9 species)		
Alternanthera philoxeroides alligator weed	-	-
Ammophila arenaria European beachgrass	0 %	▬
Brassica tournefortii Saharan mustard, African mustard	0 %	▬
Carpobrotus edulis Hottentot-fig, iceplant	0 %	▬
Cortaderia jubata jubatagrass	0 %	▬
Ehrharta calycina purple veldtgrass	0 %	▬
Onopordum acanthium Scotch thistle	0 %	▬
Tamarix ramosissima saltcedar, tamarisk	-	-
Ulex europaeus gorse	0 %	▬
Moderate (31 species)		
Acacia dealbata silver wattle	100 %	▬
Acroptilon repens Russian knapweed	63 %	▼▼
Anthoxanthum odoratum sweet vernalgrass	-	-
Arctotheca calendula *(=Arctotheca calendula fertile)* fertile capeweed	-	-
Arctotheca prostrata *(=Arctotheca calendula infertile)* sterile capeweed	-	-
Asparagus asparagoides bridal creeper	0 %	▬
Atriplex semibaccata Australian saltbush	2 %	▬
Carduus nutans musk thistle	0 %	▬
Carthamus lanatus woolly distaff thistle	0 %	▲▲
Centaurea calcitrapa purple starthistle	100 %	▬
Centaurea diffusa diffuse knapweed	70 %	▼▼
Centaurea virgata ssp. squarrosa squarrose knapweed	-	-
Cirsium arvense Canada thistle	8 %	▬
Cotoneaster lacteus Parney's cotoneaster	-	-

Surveillance Opportunities, Continued

Plant Species: Grouped by Statewide Cal-IPC Rating	Suitable Range 2010	Suitable Range 2050
Cotoneaster pannosus silverleaf cotoneaster	18 %	▲▲
Dittrichia graveolens stinkwort	85 %	▼▼
Ehrharta erecta erect veldtgrass	0 %	▬
Elaeagnus angustifolia Russian-olive	-	-
Ilex aquifolium English holly	0 %	▬
Isatis tinctoria dyer's woad	66 %	▼▼
Linaria dalmatica ssp. dalmatica *(=Linaria genistifolia ssp. dalmatica)* Dalmatian toadflax	0 %	▬
Linaria vulgaris yellow toadflax, butter and eggs	0 %	▬
Oxalis pes-caprae Bermuda buttercup, buttercup oxalis	-	-
Pennisetum setaceum crimson fountaingrass	0 %	▲▲
Fallopia japonica *(=Polygonum cuspidatum)* Japanese knotweed	-	-
Fallopia sachalinensis *(=Polygonum sachalinense)* Sakhalin knotweed	-	-
Saccharum ravennae ravennagrass	-	-
Salsola soda oppositeleaf Russian thistle	-	-
Sisymbrium irio London rocket	0 %	▬
Tanacetum vulgare common tansy	-	-
Washingtonia robusta Mexican fan palm	-	-
Limited (29 species)		
Acacia melanoxylon black acacia, blackwood acacia	0 %	▬
Agrostis stolonifera creeping bentgrass	-	-
Bassia hyssopifolia fivehook bassia	-	-
Bellardia trixago bellardia	-	-
Bromus japonicus Japanese brome, Japanese chess		-
Lepidium appelianum *(=Cardaria pubescens)* hairy whitetop	-	-
Cotula coronopifolia brassbuttons	-	-

Surveillance Opportunities, Continued

Plant Species: Grouped by Statewide Cal-IPC Rating	Suitable Range 2010	Suitable Range 2050
Descurainia sophia flixweed, tansy mustard	-	-
Digitalis purpurea foxglove	-	-
Eucalyptus camaldulensis red gum	-	-
Euphorbia oblongata oblong spurge	100 %	▬
Iris pseudacorus yellowflag iris	-	-
*Ligustrum lucidum ** glossy privet	-	-
Lobularia maritima sweet alyssum	-	-
Lythrum hyssopifolium hyssop loosestrife	-	-
Stipa manicata *(=Nassella manicata)* tropical needlegrass	-	-
Pennisetum clandestinum kikuyugrass	0 %	▲▲
Phoenix canariensis Canary Island date palm	-	-
Phytolacca americana common pokeweed	-	-
Helminthotheca echioides *(=Picris echioides)* bristly oxtongue	66 %	▼▼
Stipa miliacea var. miliacea *(=Piptatherum miliaceum)* smilograss	10 %	▲▲
Pyracantha angustifolia, crenulata, seratus, etc. pyracantha, firethorn	-	-
Ranunculus repens creeping buttercup	-	-
Ricinus communis castorbean	0 %	▬
Saponaria officinalis bouncingbet	-	-
Schinus molle Peruvian peppertree	-	-
Sinapis arvensis wild mustard, charlock		-
Tamarix aphylla athel tamarisk	-	-
*Tribulus terrestris ** puncture vine	-	-

Eradication Opportunities

Eradication entails complete removal of all infestations in the area. These opportunities result from a small number of isolated infestations. The spatial pattern for eradication is one infested quad surrounded by at least two concentric bands of absence quads. The strategic importance of an eradication opportunity can be further assessed based on the degree of isolation as well as the suitability of the surrounding area. Determining the feasibility of eradication requires surveying infestations in the field.

	Current Species Distribution (number of quads out of 8 total)				Suitable Range		
Plant Species: Grouped by Statewide Cal-IPC Rating	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
High (1 species)							
Limnobium laevigatum South American spongeplant	1	0	0	0	-	-	-
Moderate (1 species)							
Cynara cardunculus artichoke thistle	1	0	0	1	13 %	25 %	▼

Containment Opportunities

Containment entails limiting the spread from existing infestations. These opportunities result from larger groups of infested quads. The strategic importance of a containment opportunity can be further assessed based on how distinct the boundaries of the infestation are, how isolated it is, and the suitability of the surrounding area. Determining the feasibility of containment requires surveying infestations in the field.

	Current Species Distribution (number of quads out of 8 total)				Suitable Range		
Plant Species: Grouped by Statewide Cal-IPC Rating	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
High (25 species)							
Aegilops triuncialis barb goatgrass	7	5	0	0	100 %	88 %	▬
Arundo donax giant reed	3	0	0	0	100 %	38 %	▬
Bromus madritensis ssp. rubens red brome	6	1	0	0	25 %	86 %	▬
Bromus tectorum downy brome, cheatgrass	3	2	0	0	9 %	100 %	▬
Centaurea stoebe ssp. micranthos (=Centaurea maculosa) spotted knapweed	1	0	1	0	11 %	33 %	▼
Centaurea solstitialis yellow starthistle	8	8	5	0	100 %	100 %	▬
Cortaderia selloana pampasgrass	5	0	0	0	14%	83 %	▼
Cytisus scoparius Scotch broom	3	3	2	0	30 %	75 %	▼
Egeria densa Brazilian egeria	6	0	0	0	-	-	-
Eichhornia crassipes water hyacinth	2	2	2	0	-	-	-
Foeniculum vulgare fennel	3	0	0	0	100 %	38 %	▼▼
Genista monspessulana French broom	1	0	0	0	53 %	17 %	▬
Hedera helix and H. canariensis English ivy, Algerian ivy	1	0	0	0	4%	25 %	▲
Hydrilla verticillata hydrilla	3	0	0	0	-	-	-
Lepidium latifolium perennial pepperweed	3	3	0	0	100 %	38 %	▼
Ludwigia hexapetala and L. peploides Uruguay and creeping water-primrose	6	0	6	0	-	-	-
Ludwigia peploides creeping water-primrose	1	0	0	0	-	-	-
Lythrum salicaria purple loosestrife	3	0	2	0	-	-	-
Myriophyllum aquaticum parrotfeather	8	2	6	0	-	-	-
Myriophyllum spicatum Eurasian watermilfoil	6	0	6	0	-	-	-
Rubus armeniacus (=Rubus discolor) Himalayan blackberry	8	5	2	0	-	-	-
Sesbania punicea red sesbania, scarlet wisteria	5	1	1	0	92 %	63 %	▼
Spartium junceum Spanish broom	3	3	3	0	78 %	38 %	▬
Elymus caput-medusae (=Taeniatherum caput-medusae) medusahead	7	1	0	0	100 %	88 %	▬

Containment Opportunities, Continued

Plant Species: Grouped by Statewide Cal-IPC Rating	Current Species Distribution (number of quads out of 8 total)				Suitable Range		
	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
Tamarix parviflora smallflower tamarisk	2	0	0	0	-	-	-
Moderate (36 species)							
Ailanthus altissima tree-of-heaven	7	7	0	0	100 %	88 %	▬
Avena barbata and A. fatua (slender) wild oat	8	0	0	0	-	-	-
Brachypodium distachyon annual false-brome, false brome	4	0	0	0	98 %	50 %	▼▼
Brassica nigra black mustard	7	5	0	0	-	-	-
Bromus diandrus ripgut brome	8	0	0	0	100 %	100 %	▬
Lepidium chalepense (=Cardaria chalepensis and C. draba) Lepidium chalepensis and L. draba	3	2	2	0	-	-	-
Centaurea melitensis Malta starthistle, tocalote	5	5	0	0	88 %	63 %	▲
Chondrilla juncea rush skeletonweed	6	6	4	0	100 %	75 %	▼▼
Cirsium vulgare bull thistle	8	2	0	0	94%	100 %	▼
Conium maculatum poison-hemlock	8	0	0	0	43 %	100 %	▼▼
Cynodon dactylon bermudagrass	8	0	0	0	-	-	-
Cynosurus echinatus hedgehog dogtailgrass	4	0	0	0	100 %	50 %	▬
Dipsacus fullonum and D. sativus common and Fuller's teasel	3	3	0	0	69 %	38 %	▼▼
Eucalyptus globulus Tasmanian blue gum	2	0	0	0	0 %	-	▬
Festuca arundinacea tall fescue	2	0	0	0	-	-	-
Ficus carica edible fig	4	0	0	0	100 %	50 %	▬
Geranium dissectum cutleaf geranium	8	0	0	0	-	-	-
Glyceria declinata waxy mannagrass	2	0	0	0	100 %	25 %	▬
Hirschfeldia incana shortpod mustard, summer mustard	4	0	0	0	-	-	-
Holcus lanatus common velvet grass	6	0	0	0	57 %	86 %	▲▲
Hordeum marinum Mediterranean barley	5	0	0	0	-	-	-
Hordeum murinum hare barley	5	0	0	0	-	-	-
Hypericum perforatum common St. John's wort, klamathweed	5	5	5	0	-	-	-

Containment Opportunities, Continued

Plant Species: Grouped by Statewide Cal-IPC Rating	Current Species Distribution (number of quads out of 8 total)				Suitable Range		
	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
Hypochaeris radicata rough catsear, hairy dandelion	8	0	0	0	-	-	-
Leucanthemum vulgare ox-eye daisy	5	0	0	0	38 %	83 %	▼
Festuca perennis (=*Lolium multiflorum*) Italian ryegrass	8	2	0	0	99 %	100 %	▬
Mentha pulegium pennyroyal	1	0	0	0	-	-	-
Nicotiana glauca tree tobacco	3	0	0	0	0 %	100 %	▲▲
Phalaris aquatica hardinggrass	1	0	0	0	-	-	-
Potamogeton crispus curlyleaf pondweed	2	2	0	0	-	-	-
Rumex acetosella red sorrel, sheep sorrel	5	0	0	0	-	-	-
Triadica sebifera (=*Sapium sebiferum*) Chinese tallowtree	6	6	0	0	-	-	-
Torilis arvensis hedgeparsley	6	5	0	0	91 %	75 %	▬
Trifolium hirtum rose clover	8	2	0	0	-	-	-
Vinca major big periwinkle	6	5	0	0	89 %	75 %	▼▼
Festuca myuros (=*Vulpia myuros*) rattail fescue	8	0	0	0	-	-	-
Limited (23 species)							
Agrostis avenacea Pacific bentgrass	2	0	0	0	-	-	-
Brassica rapa birdsrape mustard, field mustard	6	0	0	0	-	-	-
Briza maxima big quakinggrass, rattlesnakegrass	5	0	0	0	100 %	63 %	▬
Bromus hordeaceus soft brome	8	0	0	0	-	-	-
Carduus tenuiflorus and C. pycnocephalus slenderflower and Italian thistle	8	2	0	0	-	-	-
Crataegus monogyna hawthorn	5	0	0	0	-	-	-
Dactylis glomerata orchardgrass	5	0	0	0	49 %	71 %	▲▲
Erodium cicutarium redstem filaree	8	0	0	0	-	-	-
Hypochaeris glabra smooth catsear	8	0	0	0	-	-	-
Marrubium vulgare white horehound	6	0	0	0	-	-	-
Medicago polymorpha California burclover	8	0	0	0	-	-	-

Containment Opportunities, Continued

Plant Species: Grouped by Statewide Cal-IPC Rating	Current Species Distribution (number of quads out of 8 total)				Suitable Range		
	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
Olea europaea olive	1	0	0	0	-	-	-
Parentucellia viscosa yellow glandweed, sticky parentucellia	3	0	0	0	100 %	38 %	-
Plantago lanceolata buckhorn plantain, English plantain	8	0	0	0	-	-	-
Poa pratensis Kentucky bluegrass	5	0	0	0	-	-	-
Polypogon monspeliensis rabbitfoot polypogon	2	0	0	0	-	-	-
Prunus cerasifera cherry plum	7	0	0	0	-	-	-
Raphanus sativus radish	8	2	0	0	-	-	-
Robinia pseudoacacia black locust	7	0	0	0	-	-	-
Rumex crispus curly dock	5	0	0	0	-	-	-
Salsola tragus Russian-thistle	6	1	0	0	-	-	-
Silybum marianum blessed milkthistle	8	0	0	0	89 %	100 %	-
Verbascum thapsus common mullein, woolly mullein	8	0	0	0	-	-	-

Legend and Terminology

For each species, statistics are generated from maps. The statistics are divided into two parts: current species distribution and suitable range.

Current Species Distribution

• Infested: Number of quads that are infested with this species (relative to total number of quads in the selected region of interest)
• Spreading: Number of quads where this species is spreading,
• Managed: Number of quads where this species is under management,
• Eradicated: Number of quads where this species has been eradicated,

An asterisk ***** by the species name indicates that the mapped distribution of this species has only been populated using Calflora data, and does not include any expert knowledge by quad data.

Suitable Range

• 2010: Percent of the selected region of interest that currently meets the minimum threshold for suitability for the species,
• Infested: Percent of the current suitable range that is infested.
• 2050: Change in suitability between 2010 and 2050, with an arrow representing an increase or decrease of greater than 10%, and a double arrow indicating change of greater than 40%.

▲▲ Increase of 40% or more
▲ Increase of 10% to 39%
▬ No change (less than 10% change either direction)
▼ Decrease of 10% to 39%
▼▼ Decrease of 40% or more

Using This Report

This report, together with Regional Species Map Reports, summarizes management opportunities for the selected region. This report, together with Regional Species Maps, is designed to inform strategic management decisions at a landscape level. Regional coordinating bodies can use these reports as a starting place for setting priorities and establishing goals. Surveillance priorities can be focused to strengthen early detection. Eradication and containment priorities are based on factors such as how widely a species has spread. This landscape-level view provides a strategic foundation for developing and implementing on-the-ground programs.

Management opportunities are identified in three categories determined by the species' spatial distribution. While each plant species is listed in only one category, multiple management approaches can be appropriate in a given region. Assessing the feasibility of a particular management measure requires additional detailed assessment.

1. Surveillance – Surveillance entails regular surveys to detect new infestations of species not known to be present in a region. The strategic potential depends on the proximity of nearby infestations and the suitability of the area. The table in this report includes species occurring within 50 miles of the selected region.

2. Eradication – Eradication entails complete removal of all infestations in the area. These opportunities result from small, isolated infestations. The spatial pattern for eradication is one infested quad surrounded by at least two concentric bands of absence quads. The strategic importance of an eradication opportunity can be further assessed based on the degree of isolation as well as the suitability of the surrounding area. Determining the feasibility of eradication requires surveying infestations in the field.

3. Containment – Containment entails limiting the spread from existing infestations. These opportunities result from larger groups of infested quads. The strategic importance of a containment opportunity can be further assessed based on how distinct the boundaries of the infestation are, how isolated it is, and the suitability of the surrounding area. Determining the feasibility of containment requires surveying infestations in the field.

For each type of opportunity, plant species are organized by their rating in Cal-IPC's Inventory, which uses a uniform methodology to categorize non-native plants that pose a substantial threat to the state's wildlands. The Cal-IPC rating combines information about ecological impacts, invasive potential and ecological distribution to rate species as High, Moderate or Limited at a statewide level. Regional impacts may differ.

An asterisk ***** by the species name indicates that the mapped distribution of this species has only been populated using Calflora data, and does not include any expert knowledge by quad data.

About This Report

This report is generated from an online mapping system developed by the nonprofit California Invasive Plant Council and hosted at Calflora. The site allows the state's network of local experts to maintain updated data on invasive plant distribution statewide. CalWeed Mapper is integrated with the Calflora invasive plant database to reflect new occurrence data submitted to Calflora. Maps and reports generated are snapshots of a dynamic system and should be revisited on a regular basis to ensure that information is current.

In order to cover 200 species over the entire state, the mapping approach used in this work is necessarily coarse. The maps are not sufficient for planning the details of on-the-ground management, which requires information at a much higher resolution. (As you generate such detailed information, please share your data with Calflora.org. More information may be found at CalWeedMapper under Spatial Data.) Cal-IPC interviewed hundreds of natural resource managers around the state to collect a baseline of “expert knowledge” on abundance, spread and management by USGS 7.5-degree quadrangle (approximately 8 mi x 6 mi). We also incorporated datasets of occurrence observations from Calflora, The Consortium of California Herbaria, and agencies throughout the state. However, the vast majority of the presence documented in these maps comes solely from expert knowledge; no occurrence observations exist in online databases.

We predict suitable range for a given species by using modeling software that combines the species' current distribution with environmental variables (model results are reviewed by invasive plant experts). The resulting maps show areas that have the highest probability of being suitable. Future suitable range is based on commonly used scenarios from the Intergovernmental Panel on Climate Change. Details about modeling methods can be found at CalWeedMapper under About.

The distribution and suitability maps are not expected to be 100% accurate. Data drawn from expert knowledge, while having the great benefit of drawing on the extensive experience of individual local resource managers, can nonetheless be inaccurate. Data drawn from GIS datasets, though of higher precision, may not always be accurate, either, since those conducting the mapping may have misidentified the species or not captured the location correctly. In addition, conditions on the ground may have changed since the observation was filed, making the record out of date.

By engaging local experts statewide to check each others' work, CalWeedMapper can steadily increase the accuracy of the maps. Our goal is to maintain up-to-date statewide maps of invasive plant distribution.

APPENDIX B

Beale Air Force Base Updated Invasive Plant Species Management Guidelines

Updated Invasive Plant Species Management Guidelines

Beale Air Force Base, California

Prepared for the US Air Force by

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July 2017
(final revision November 2017)

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Acronyms and Abbreviations Used in these *Guidelines*

AF:	Air Force
AFB:	Air Force Base
AFI:	Air Force Instruction
BASH:	Bird/Wildlife Aircraft Strike Hazard
BMP:	best management practice
Cal-IPC:	California Invasive Plant Council
CDFA:	California Department of Food and Agriculture
CEMML:	Center for Environmental Management of Military Lands, Colorado State University
CES/CEIEC:	Civil Engineer Squadron/Environmental Contacts
CFR:	Code of Federal Regulations
CIMIS:	California Irrigation Management Information System, California Department of Water Resources
DoD:	United States Department of Defense
DoDI:	Department of Defense Instruction
EDRR:	Early Detection-Rapid Response
EO:	Executive Order
ESCA:	Air Force Civil Engineer Center, Environmental Services Cooperative Agreement
FDS:	functional dataset(s)
GIS:	geographical information system(s)
INRMP:	Integrated Natural Resources Management Plan
IPMC:	Installation Pest Management Coordinator
IPMP:	Installation Pest Management Plan

lb *or* lbs: pound(s) (weight)

NEPA: National Environmental Policy Act

NPDES: National Pollutant Discharge Elimination System

PBA: Programmatic Biological Assessment

pdf: portable document format

pers. comm.: personal communication

POEA: polyethoxylated tallow amine

RDM: residual dry matter

SDSFIE: Spatial Data Standards for Facilities, Infrastructure, and Environment

UC: University of California

UC ANR: University of California Agriculture and Natural Resources

URL: uniform resource locator

US *or* U.S.: United States

USAF: United States Air Force

USFWS: United States Fish and Wildlife Service

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Many thanks to:

- ManTech SRS Technologies, Inc., Lompoc, CA. Their 2017 *Travis Air Force Base updated invasive plant species management plan*, written by Morgan Ball, Emily Howe, John LaBonte, and Katrina Olthof, served as the template for this document, and large sections of text from that plan are reproduced or adapted in these *Guidelines*, with their permission.
- USAF personnel, Lauren Wilson, Kirsten Christopherson, Gwen Vergara, and Ann Bedlion, for all their assistance in preparing these *Guidelines*.
- Behdad Sanai, CEMML, for invasive species maps.

Cover photo: Dense stand of yellow starthistle (*Centaurea solstitialis*) at Beale AFB, 2016. Photo courtesy of Paul Block, CEMML.

1.0 Introduction

1.1 Background

Invasive plant species are those species that are spreading outside their native range, transported to a new region by people either unwittingly or deliberately (Zavaleta et al. 2016). In some cases, invasive plants have serious negative impacts on native species, ecosystem functions, economic activities, and other environmental and human values. A recent report by 16 federal agencies states that "Invasive species pose one of the greatest ecological threats to America's lands and waters. Their control can be complex and expensive and is often conducted in perpetuity; their harm can be irreversible . . . [I]f left to spread, invasive species cost billions of dollars to manage and can have devastating consequences on the Nation's ecosystems" (USDI 2016, v, 1). In a widely cited article, Pimentel et al. (2005) calculated that invasive plants and animals cost the United States economy $120 billion per year in losses and damage and in control costs. They also estimated that 42% of the country's federally listed Threatened and Endangered species are at risk primarily because of the impacts of non-native species. For rangelands and pastures specifically, Pimentel et al. (2005) estimated national forage loss due to non-native weeds at $1 billion per year and invasive weed control costs at $5 billion per year. Using data from a survey of land-management agencies and organizations, the California Invasive Plant Council (Cal-IPC 2008) estimated that weed monitoring and control alone (not considering weed impacts) cost California $82 million each year.

Legislation invoked to justify federal invasive species control programs includes the National Environmental Policy Act, the Endangered Species Act, the Federal Noxious Weed Act (PL 93-629; 7 USC§ 2801 et seq.; 88 Stat. 2148, amended 1990), and Executive Orders (EO) that explicitly direct federal agencies to control non-native species, such as EO 13112, *Invasive species*, (1999) and EO 13751, *Safeguarding the nation from the impacts of invasive species* (2016). EO 13751 states that United States policy is "to prevent the introduction, establishment, and spread of invasive species, as well as to eradicate and control populations of invasive species that are established" and acknowledges the harm that invasive species cause to "the environment and natural resources, agriculture and food production systems, water resources, human, animal, and plant health, infrastructure, the economy, energy, cultural resources, and military readiness", almost all of which are relevant to natural resources management at Beale Air Force Base (AFB).

Control of invasive species is thus driven by expediency and policy on Federal lands. However, land managers faced with extensive infestations of weeds but with only limited budgets must choose strategies that achieve the best possible results within the means of their available resources, rather than attempting to eradicate every invasive species, which is often not a feasible goal anyway (Lodge et al. 2006). It is essential to complete an analysis of the intersection between available funding and staff, characteristics and extent of the invasive problem, and conservation methods for sensitive natural resources before implementing potentially unnecessary or ineffective management actions. On Beale, a long-standing and entrenched suite of weed species (Jones & Stokes 1997, 10, 12, 21, 24-25; RMAT 2000, 18-22) threatens sensitive resources as well as accomplishment of military objectives and missions and quality of life for Base residents.

1.2 Purpose, Goals, and Objectives

This document updates Beale's 2010 Invasive Species Management Plan (EM-Assist 2010), which was itself developed to implement recommendations from a 2004 Invasive species management analysis (EDAW 2004). In addition, these *Guidelines* are informed by the California Invasive Plant Council's recent review of invasive species management at Beale and their recommendations for enhancing the Base's program (Cal-IPC 2015a) and by two recent baseline invasive plant surveys, a partial survey conducted in 2014 (H.T. Harvey & Associates 2015) and a subsequent survey of the remainder of Base in 2016 (Figure 1.1; CEMML 2017). HDR (2016) surveyed the area around the flightline for yellow starthistle (*Centaurea solstitialis*) in 2016 (Figure 1.1).

The chief tool for managing installation ecosystems is the Integrated Natural Resources Management Plan (INRMP). Air Force Instruction (AFI) 32-7064, *Integrated Natural Resources Management*, (DAF 2016, Section 3.8.4) provides the following instructions regarding invasive species:

> The INRMP indicates if any exotic and invasive species are present on an installation, and identifies any existing programs to control and/or eradicate those species. Develop and implement management strategies oriented toward the control of exotic and invasive species when practical and consistent with the military mission.

Sections 8 and 10 of Beale's current INRMP state goals, objectives, and projects to guide natural resources management on Base (Beale AFB 2016, 143-146, 148-157). Table 1.1 lists the INRMP's goals, objectives, and projects that pertain to invasive species management.

The purpose of these *Guidelines* is to present a sustainable long-term strategy for managing the vegetation at Beale to maximize the opportunities for stewardship of sensitive species and natural resources and to reduce the prevalence of undesirable non-native plants. This document is intended to be used by Beale Natural Resource staff and contractors who manage vegetation on Base. It includes protocols for preventing the spread of existing weeds and introduction of new species, methods for controlling specific weed species, and general management strategies for the habitats and sensitive species on Base. Concurrent with the drafting of these *Guidelines*, Beale is working with the Center for Environmental Management of Military Lands (CEMML) to develop invasive species work plans. The work plans will be appendices to these *Guidelines* and are explicit step by step plans to achieve some of the outlined goals and objectives that use the protocols, methods, and strategies outlined in the *Guidelines* for specific areas and species that are immediately actionable.

The INRMP goals, objectives, and projects provide explicit drivers for invasive species control at Beale and frame invasive species control in terms of conserving and benefiting sensitive, threatened and endangered species and their habitats, reducing Bird/Wildlife Aircraft Strike Hazard (BASH) hazards, and maintaining a sustainable rangeland ecosystem to support Beale's livestock grazing program and lower fire hazard. These *Updated Invasive Plant Species Management Guidelines* (hereinafter *Guidelines*) are designed to help achieve the INRMP's goals, objectives, and projects that relate to invasive species control.

Table 1.1: Beale AFB INRMP goals, objectives, and projects relating to invasive plant species management (Beale AFB 2016, 143-146, 148-157).

<table>
<tr><th>Goals</th><th>Objectives</th><th>Projects</th></tr>
<tr><td rowspan="2">INRMP Goal 2: Maintain/increase populations of special-status species, improve habitat conditions</td><td>Objective 2.1: Improve coordination between the natural resources manager and other maintenance and management personnel to avoid disturbing populations of special-status species and their habitat</td><td rowspan="2">Project 2.1.1: Perform annual environmental awareness training to users of off-road vehicles (e.g., Security Forces);

Project 2.3.1: Control giant reed (Arundo donax) in Dry Creek to remove blockage to anadromous fish passage and prevent further spread of the plant;

Project 2.3.2: Manage and control other invasive species (yellow starthistle, tree-of-heaven, etc.) in accordance with the Invasive Species Management Plan</td></tr>
<tr><td>Objective 2.3: Control invasive species that may affect special status species' habitat</td></tr>
<tr><td rowspan="2">INRMP Goal 3: Protect and manage wetlands at Beale AFB in accordance with current laws, regulations, and mitigation obligations</td><td>Objective 3.1: Preserve, restore, create, and monitor wetland areas</td><td rowspan="2">Project 3.1.2: Minimize potential impacts on wetlands resulting from routine land management activities (e.g., firebreak disking, prescribed burning)</td></tr>
<tr><td>Objective 3.2: Preserve, restore, and enhance existing wetland-associated vegetation communities (e.g., riparian forest, riparian scrub, tule marsh)</td></tr>
<tr><td rowspan="4">INRMP Goal 5: Improve management practices and enhance habitat for wildlife species on Beale AFB</td><td>Objective 5.1: Review and revise base-specific procedures, responsibilities, and restrictions for hunting and fishing contained in the base's AFI 32-7064 Supplement (see note below table)</td><td rowspan="4">Project 5.1.6: Develop a plan and design for tricolored blackbird (Agelaius tricolor) habitat enhancement on the east side of the base; request approval from the USFWS;

Project 5.1.7: Implement tricolored blackbird habitat enhancement plan and design;

Project 5.2.2: Reduce aquatic weed problems at Parks Lake, Upper and Lower Blackwelder Lakes, Frisky Lake, and other impoundments through accepted lake management practices;

Project 5.3.2: Continue to identify and implement vegetation enhancement projects that improve habitat for wildlife species in developed areas of the base;

Project 5.5.1: Continue to manage and control pest wildlife species through close coordination between the pest management section and the natural resources manager and implementation of the Beale AFB Installation Pest Management Plan;

Project 5.5.2: Ensure all BASH activities and projects are conducted in accordance</td></tr>
<tr><td>Objective 5.2: Improve habitat for fish and game species</td></tr>
<tr><td>Objective 5.3: Improve habitat for nongame wildlife species at Beale AFB</td></tr>
<tr><td>Objective 5.5: Minimize conflicts between wildlife and base missions. Standardize coordination procedures between the natural resources manager, airfield manager, flight safety, operations, and pest management personnel to enhance the BASH reduction program</td></tr>
</table>

Goals	Objectives	Projects
	Objective 5.9: Protect and restore native vegetative communities that contribute to fish and wildlife biological diversity	with US Fish and Wildlife Service Depredation Permit; Project 5.9.2: Participate in regional restoration efforts along Dry Creek in addition to fisheries program; Project 5.9.3: Initiate blue oak restoration and enhancement efforts on and around the saddle club, and other applicable places across base; Project 5.9.4: Expand the native grassland restoration program in accordance with the grassland restoration plan
INRMP Goal 6: Enhance the visual quality of the base's developed areas through high-quality landscape design and development	Objective 6.1: Improve landscape and land management processes	Project 6.1.1: Establish and implement landscape design guidelines for the base, including measures to enhance the visual quality of the base and ensure BASH safety; Project 6.1.2: Establish grounds maintenance guidelines for the base that adhere to practices commonly accepted in the northern California landscape industry; Project 6.1.5: Use native plant species in landscape plantings on base as first choice; Project 6.2.1: Continue to identify and implement measures to minimize the effects of grazing and firewood cutting on native vegetation. Use of native trees should be given priority for planting in any future firewood plantations or wildland plantings; Project 6.2.2: Continue to identify and implement vegetation enhancement projects in improved and semi- improved areas of the base to improve habitat for native plant and wildlife species; Project 6.2.4: As part of the development of landscape design guidelines for the base, identify plant materials for landscape projects that are native and produce flowers, fruits, and seeds that attract wildlife and that are compatible with guidelines adopted by the Flight Safety office; Project 6.2.5: Increase awareness of base residents and employees regarding proper management of native vegetation and the need to avoid the introduction and spread of nonnative
	Objective 6.2 Enhance wildlife habitat values of landscaping, and preserve and enhance existing native vegetation on the base.	
	Objective 6.3: As part of the development of landscape guidelines, identify plant materials for landscape projects that are native to the region; adapted to northern California climate conditions; and resistant to pests, disease, and drought; and have low maintenance costs.	
	Objective 6.6: Implement land management measures around the airfield that discourage use by wildlife.	

Goals	Objectives	Projects
		plant species; Project 6.3.4: Select pesticides/herbicides that have the lowest possible toxicity, degrade rapidly in the environment, minimize exposure to non-target organisms, and do not contribute to nonpoint-source pollution; Project 6.3.5: Establish guidelines for use of pesticides along roadsides and other areas where they are near natural aquatic resources; Project 6.6.1: Reduce or eliminate yellow starthistle (*Centaurea solstitialis*) around the airfield
INRMP Goal 7: Maintain, enhance, and expand outdoor recreational opportunities at Beale AFB to serve the needs of the base population	Objective 7.1: Manage existing facilities and provide new outdoor recreation opportunities that are compatible with sensitive natural resources in and around recreation sites	Project 7.1.2: Plan and implement nature trail renovation and expansion; Project 7.1.7: Minimize the effects of outdoor recreation activities on the base's natural resources
INRMP Goal 8: Manage rangeland vegetation to provide high quality forage on a sustainable basis and provide a healthy ecosystem	Objective 8.2: Coordinate grazing with prescribed burning to improve range conditions, promote desirable and native forage species, and reduce undesirable species Objective 8.3: Provide additional grazing opportunities on base lands.	Project 8.1.2: Enhance the distribution and abundance of desirable forage species; Project 8.1.3: Monitor grazing intensities to minimize impacts on sensitive resources; Project 8.2.1: Collaborate with Fire Department and Air Quality Manager to conduct prescribed burns to reduce fire load and improve forage in accordance with the Wildland Fire Management Plan; Project 8.3.1: Evaluate and implement opportunities to increase rangelands grazing to generate revenue and support conservation projects such as reduction of invasive plant species
INRMP Goal 9: Use digital spatial data for natural resources management decision making	Objective 9.1: Maintain and update accurate natural resources GIS data layers	Project 9.1.2: As new natural resources data are available, update existing layers

Note that Projects 5.1.6 and 5.1.7, related to tricolored blackbird (*Agelaius tricolor*), are included in Table 1.1 because the bird commonly nests in stands of invasive species, such as black mustard (*Brassica nigra*), Himalayan blackberry (*Rubus armeniacus*), and various thistle species (Beale AFB 2016, 83; Meese 2016); therefore, control of these invasive species must account for tricolored blackbird habitat needs.

Properties surrounding Beale can serve as staging grounds for invasive species to become established on Base, and collaboration with adjacent land managers on prevention, surveillance, and management of invasive species can increase the likelihood of successful, long-term outcomes for Beale's weed management program (Cal-IPC 2012, 10; Cal-IPC 2015a, 17-18). Collaboration with neighboring land managers is one of the Air Force Principles for Ecosystem Management and is a specific directive for invasive species management (DAF 2016, Sections 3.8.1.4 and 14.6).

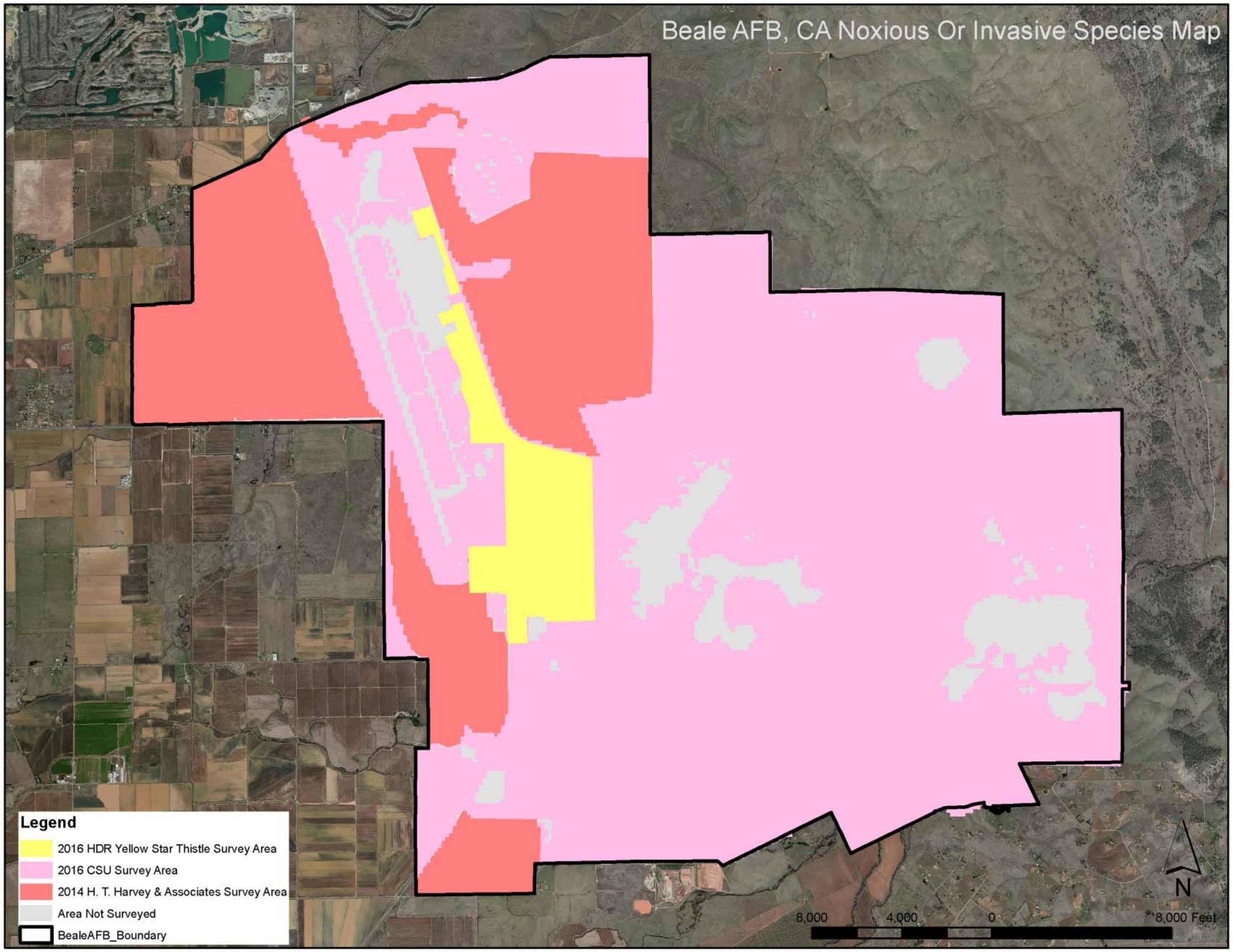

Figure 1.1: 2014-2016 weed surveys coverage at Beale AFB (H.T. Harvey & Associates 2015; HDR 2016; CEMML 2017); map produced by Behdad Sanai, Travis AFB.

1.3 Base Setting

The Beale area has a typical California Mediterranean climate with cool, wet winters and hot, dry summers. Annual average precipitation is 19.88 inches; almost all of the rain falls between October and April (Table 1.2; data courtesy Beale AFB Weather Flight [SSgt Jennifer Smith, pers. comm., August 2017]). Averages can be misleading, however, as rainfall amount and pattern varies significantly from year to year, for example, the two drought years that were just over half the average rainfall and the wet year in which over 50% more rain than average fell (Figure 1.2). Beale's average annual low temperature is 50°F and its average annual high is 74°F. Summer temperatures above 100°F can last for several days. In California's annual grassland, annual weather patterns can have a significant influence on the abundance and spread of invasive plants, with large variations occurring between years.

Table 1.2: Mean monthly and annual rainfall in inches for Beale AFB, 1959-2016; data courtesy Beale AFB Weather Flight (SSgt Jennifer Smith, pers. comm., August 2017).

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
4	3.5	2.9	1.5	0.08	0.2	0	0	0.3	1.2	2.5	3.7	19.88

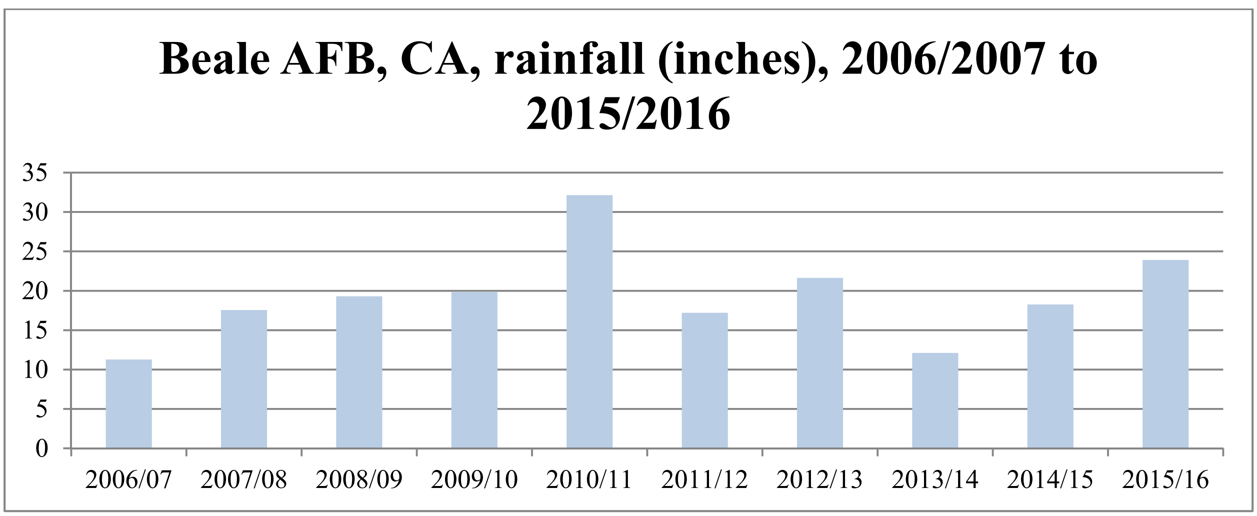

Figure 1.2: Annual (July-June) rainfall in inches for Beale AFB, California, 2006/07 to 2015/16; data courtesy Beale AFB Weather Flight (SSgt Jennifer Smith, pers. comm., August 2017). Data for September through December 2007 unavailable for Beale AFB so data from Browns Valley, California (approximately 10 miles north of Base), substituted (UC ANR Statewide Integrated Pest Management Program, station CIMIS #84, http://ipm.ucanr.edu/WEATHER/index.html, accessed March 2017).

Invasive species management on Beale is driven to a large degree by land management for vernal pool and riparian/wetland conservation and the sensitive plant and animal species associated with these ecosystems, as well as by airfield operations that require BASH hazard reduction (Beale AFB 2016, 88-89; Figure 1.2). Blue oak woodland, valley oak (*Quercus* *lobata*) woodland, and small areas of native perennial grassland also occur on Base and can be negatively affected by invasive plant species, as can forage production for livestock and wildlife on the Base's grasslands and woodlands. Currently, non-native plant species management on Base includes herbicide application, mowing, grazing, prescribed burning, and monitoring of weeds, native plants, plant restoration areas, vernal pool species, and birds (Beale AFB 2016, A2-33; CNLM 2016; HDR 2016).

Figure 1.2: Yellow starthistle (*Centaurea solstitialis*) creates a Bird/Wildlife Aircraft Strike Hazard (BASH) hazard for aircraft by attracting birds near the runway at Beale AFB; photo by Beale AFB (from Brusati 2015).

2.0 Native Species Landscape

2.1 Ecological Communities Background

Valley grassland (Bartolome et al. 2007) was the most prominent pre-European settlement vegetation type on Beale and remains so today (Beale AFB 2016, 44). Valley grassland prior to European settlement is believed to have been characterized by highly diverse communities of annual forbs and geophytes with occasional perennial grasses (Schiffman 2007; Minnich 2008; Evett and Bartolome 2013). The widespread vernal pools contained within the upland grasslands in the western area of the Base supported springtime displays of colorful annual forb species during their brief seasons. Freshwater marsh and riparian woodland were also important vegetation types, and the latter was probably more abundant between Dry Creek and Best Slough before agricultural conversion. Blue and valley oak woodland and savannah in the eastern foothills section of Beale may also have been more extensive than it is today (Beale

AFB 2016, 44). The exact composition of California's pre-European landscapes remains unknown because non-native species were introduced by 18th century explorers and colonists prior to botanical research (Minnich 2008), and agricultural conversion and other land use changes altered the landscape and the native vegetation communities before they had been comprehensively described.

The land currently managed by Beale experienced historic-era disturbances that dramatically altered huge swaths of California, such as herbivores introduced by European immigrants; intensive cultivation for mono-specific crops instead of Native American land management practices that included burning for forage production among other purposes; profound conversion of the region's hydrologic systems; and invasion by many Mediterranean Basin and Eurasian species of annual grasses and forbs (D'Antonio et al. 2007). For example, three hundred non-native plant species occur in California's grasslands, and in many locations, these non-natives dominate almost completely (Zavaleta et al. 2016). Prior to its establishment as a military installation in 1942, the Beale area had been used for livestock grazing and dryland grain farming for a century, and even after procurement by the military, Base property was farmed until 1986 and continues to be grazed by livestock (Jones & Stokes 1997, 5; Beale AFB 2016, 129-138). During this time, crop and forage plants were introduced purposefully, while other species arrived unintentionally. The invasive flora found at Beale today is a mix of these accidental and deliberate introductions spanning over three hundred years. Some came as forage contaminants or clung to livestock, others via agricultural activities, and, more recently, ornamentals were brought to California for landscaping. Riparian invasives have flowed in from upstream areas not under the control of the Base. In addition, air traffic that arrives at Beale through military operations has the potential to introduce new species from anywhere in the world. A subset of all these non-native species become problem invasive weeds.

The vegetation of the Base today is the result of a complex history of disturbance and invasion of the original grassland and woodland systems, as well as varying levels of control of non-native plant species. Despite these disturbances and invasions, Beale retains significant natural resource value and is home to a suite of sensitive, endangered, or rare species. Vegetation types at Beale include Valley grassland (also known as California annual grassland) and the extensive seasonal wetland/vernal pool systems found within the grassland, oak woodland and savannah, riparian forest and riparian scrub, and wetlands vegetation (see the Base INRMP (Beale AFB 2016) for details on Base vegetation types and their associated sensitive species).

2.2 Sensitive Resources

2.2.1 Vernal Pool Tadpole Shrimp and Vernal Pool Fairy Shrimp

Vernal pools at Beale AFB contain two federally listed branchiopods: vernal pool tadpole shrimp (*Lepidurus packardi*; federally endangered) and vernal pool fairy shrimp (*Branchinecta lynchi*; federally threatened; Beale AFB 2016, 71-72; Figure 2.1). Both species occur in numerous locations across the Base (Beale AFB 2016, 58). Vernal pool tadpole shrimp breed exclusively within vernal pools during the wet season. After reproducing, all adults die and their offspring survive as dormant cysts in the soil after seasonal wetlands dry. These cysts then begin a new lifecycle upon rehydration the next year. Vernal pool fairy shrimp has a similar life cycle and dependence on vernal pools.

Figure 2.1: Vernal pool tadpole (left; *Lepidurus packardi*) and vernal pool fairy shrimp (right; *Branchinecta lynchi*); photos courtesy ManTech SRS Technologies, Inc.

The primary threat to these branchiopods is the widespread loss and fragmentation of their habitat (USFWS 2005, I-16-I-18). The United States Fish and Wildlife Service (USFWS) reported that four million acres of vernal pool habitat existed in the Central Valley prior to land-use conversion, but vast areas (~75%) of this habitat have now been urbanized or converted to intensive agricultural production (USFWS 2005, II-192, II-204). An additional threat to the remaining vernal pool habitat is degradation by non-native plant species (USFWS 2007a and b). For example, in its most recent 5-year review for vernal pool fairy shrimp, the USFWS describes vernal pools at Camp Roberts in Monterey and San Luis Obispo counties that were fenced to protect them from military activities and sheep grazing. Subsequently, the invasive grass, medusahead, established in the fenced pools, threatening habitat quality for the shrimp and possibly serving as a seed source for spread into surrounding unfenced areas (USFWS 2007a, 31). Another invasive grass, waxy mannagrass (*Glyceria declinata*)[1], can invade vernal pools and change food web dynamics, which can result in decreasing populations of branchiopods (Rogers 1998). Perennial pepperweed (*Lepidium latifolium*) and pennyroyal (*Mentha pulegium*), neither currently known to occur on Base, can also invade vernal pools, as can other species, such as Indian toothcup (*Rotala indica*), known to occur in Base vernal pools (see Sections 3.2.1 and 3.2.2).

In general, non-native species within and surrounding vernal pools draw down the available water, resulting in a reduced inundation period that may be too short for native invertebrate growth cycles. Furthermore, non-native grasses increase levels of thatch (dead plant biomass) in vernal pool habitats. Non-native plant thatch build-up increases soil organic matter and consequently soil water-holding capacity; as a result, the surrounding soil holds more water, and less is retained in the vernal pool itself, reducing inundation period (Marty 2015). Abundant thatch can also create anoxic conditions as it decays, which negatively affects gill breathing

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[1] The Beale INRMP lists waxy mannagrass as occurring on Base (Beale AFB 2016, A5-76), but it is probably not widespread as the 2016 Beale weed mapping survey did not encounter it (CEMML 2017, 46, 69). The recent Cal-IPC report indicates that it is not known on Beale, although it occurs north and southeast of the Base (Cal-IPC 2015a, 31).

organisms such as large branchiopods (Rogers 1998; USFWS 2007b, 34; Marty 2015). Both branchiopod species benefit from management that favors native species over non-natives, particularly a well-timed and carefully monitored grazing regime. A Sacramento County grazing exclosure study demonstrated that, after nine years without livestock grazing, vernal pools took up to two weeks longer to fill and dried 1-2 weeks earlier on average than comparison grazed pools (Marty 2015).

Pesticides are listed as a potential threat to vernal pool branchiopods by the USFWS (USFWS 2007b). Pesticide overspray and residues may degrade water quality in vernal pools when the runoff and precipitation that fill the vernal pools during the winter contain these substances (USFWS 2007b). In addition, pesticides can travel in atmospheric mist via bulk air movement and directly enter vernal pools via rainfall (Johnson 2006).

Little is known about the effects of pesticides on vernal pool branchiopods. One study conducted on *B. sandiegonensis* found that glyphosate, the active ingredient in Roundup®, could be lethal to this species depending on the concentration of this chemical in the pool water (Ripley et al. 2002/2003). No studies have measured glyphosate concentrations in Central Valley vernal pools, but a study in the northeastern United States found glyphosate levels in some vernal pools well above the range of the lethal dose levels indicated in the Ripley et al. study (Battaglin et al. 2009). These concentrations were found in a pool where the adjacent habitat had been sprayed for a noxious weed seven days before the sample collection.

Studies have found that the surfactants (also called adjuvants or “inert ingredients”) found in some formulations of commercial preparations of glyphosate can be toxic to aquatic life including amphibians (Battaglin et al. 2009; Relyea and Jones 2009), *Daphnia* spp. (Cuhra et al. 2013), and fairy shrimp (Brausch and Smith 2007). In general, aquatic organisms are more negatively impacted by surfactants than terrestrial organisms due to surfactant sorption to biological membranes (skin, gills), which disrupts biological functions. A study on the branchiopod, *Thamnocephalus platyurus*, assessed the acute toxicity of polyethoxylated tallow amine (POEA) and found it to be extremely toxic at low concentrations (Brausch and Smith 2007). Because manufacturers are not required to specify inert ingredients on product labels, it can be difficult to discern which or even whether an adjuvant is present in the formulation, as well as whether or not it is harmful to wildlife (Cuhra et al. 2013).

Sediment toxicity is another concern in vernal pool habitat, especially in areas where pyrethroid insecticides are used. Pyrethroids, including Premethrin, Cyper Eight, and Demand CS, to name a few, are listed in the chemical inventory in Beale’s *Installation Pest Management Plan* (IPMP; Beale AFB 2017a). Pyrethroids bind to the soil and are hard to detect in water samples. Runoff from areas where these insecticides are used may pose a particular problem for species such as vernal pool fairy shrimp and tadpole shrimp that rely on sediment for feeding and reproduction (Johnson 2006).

2.2.2 Western Spadefoot Toad

The western spadefoot toad (*Spea hammondii*; Figure 2.2), a California Species of Special Concern and currently under review for federal listing (USFWS 2015a), may occur in Beale vernal pools: the species may have been detected on Base during 2012 and 2016 surveys (Beale AFB 2016, 60). As with the vernal pool branchiopods, non-native species can prevent the pool inundation period necessary for completion of the toad's metamorphosis, estimated to average 58 days (Morey 1998; USFWS 2005, II-227-II-228; Marty 2005). Longer inundation periods are also thought to improve juvenile survivorship and fitness by permitting longer larval development and fat accumulation (Morey 1998; USFWS 2005, II-228).

Western spadefoot toads prefer areas of open vegetation and short grass (USFWS 2005, II-230-II-231). The increased levels of both live biomass and thatch produced by non-native grasses may degrade habitat values for the toad and interfere with movement, including dispersal by toadlets. As mentioned in the discussion of pesticide effects on vernal pools in Section 2.2.1, pesticides such as Roundup® have been shown to have negative impacts on amphibians (Relyea and Jones 2009; Relyea 2012).

Figure 2.2: Western spadefoot toad (*Spea hammondii*); photo courtesy of David Scriven.

2.2.2 Valley Elderberry Longhorn Beetle

The federally threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*; Figure 2.3) spends most of its life cycle as a larva within the stem of elderberry shrubs (*Sambucus* species). Elderberry occurs in Beale's riparian woodland, and beetle larval exit holes have been found in elderberry shrubs on Base, although adult beetles have not been observed (Beale AFB 2016, 73, A2-2). Recently, the USFWS has acknowledged that invasive plants in riparian zones may threaten valley elderberry longhorn beetle habitat. Invasive species may inhibit reproduction and growth of elderberry shrubs, thereby limiting host plants for the beetle. The USFWS names several riparian invasives found at Beale that may degrade beetle habitat and displace the beetle's host plants, including black locust (*Robinia pseudoacacia*), tree-of-heaven (*Ailanthus altissima*), and Himalayan blackberry (*Rubus armeniacus*; USFWS 2014, 55897-55899). Problematically, herbicides, and pesticides in general, are also considered a threat to the beetle and its host plant (USFWS 2006, 18-19), but, for some of the invasives, herbicides may be the only practical control action. Great care will, therefore, be necessary in planning for and implementing control of these riparian invasives.

Figure 2.3: Female valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*); photo courtesy of the U.S. Fish and Wildlife Service.

2.2.3 Central Valley Steelhead

The federally threatened Central Valley steelhead (*Oncorhynchus mykiss*; Figure 2.4) has been observed upstream of Beale in the Spenceville Wildlife Area, but its status in Dry Creek on Base is unknown (Beale AFB 2016, 74). Steelhead has declined because of loss and degradation of habitat. Changes in flow, migration barriers, water quality declines, and degradation of spawning gravel sites contribute to poorer quality habitat for steelhead (Beale AFB 2016, 74). At least two of Beale's invasive plants, waterprimrose (*Ludwigia* species) and giant reed (*Arundo donax*), causes these kinds of changes in aquatic habitats (DiTomaso et al. 2013; Cal-IPC 2015a).

Figure 2.4: Central Valley steelhead (*Oncorhynchus mykiss*); photo courtesy of National Marine Fisheries Service.

2.2.4 Yellow-Billed Cuckoo

The federally threatened Western Distinct Population Segment of yellow-billed cuckoo (*Coccyzus americanus*; Figure 2.5) may occur on Base. It has been seen in Spenceville Wildlife Area and may have been seen on Beale in 2013 (Beale AFB 2016, A2-3). The cuckoo nests in dense riparian forest with a thick understory of willow but prefers sites with a dominant cottonwood overstory for foraging (Beale AFB 2016, A2-3). Loss of riparian habitat from agricultural conversion, dams and river flow management, stream channelization and stabilization, and livestock grazing is the principal threat to the cuckoo. Replacement of native riparian habitat by invasive plants has also reduced available breeding habitat for the cuckoo; tamarisk (*Tamarix* spp.) is noted as a particular problem (USFWS 2007c), but this species does not currently occur on Base. However, giant reed (*Arundo donax*) and edible fig (*Ficus carica*), both present on Base, also displace native riparian vegetation and are believed to offer limited nesting and foraging value to cuckoos (Laymon 1998). Cuckoos will start using restored riparian forest as soon as four years after restoration (Dettling et al. 2015).

Figure 2.5: Yellow-billed cuckoo (*Coccyzus americanus*); photo courtesy of Mark Dettling, U.S. Fish and Wildlife Service.

2.3 Minimization/Conservation Measures and Permitting

Invasive species management activities avoid effects to listed species through the use of conservation or minimization measures. Conservation measures ensure that, to the extent possible, activities are designed to have no effect on listed or sensitive resources through temporal or spatial avoidance. These measures should be simple, low cost practices that are easily incorporated into a work day, and must be understood and followed by workers and supervisors. Education is the key to compliance with minimization measures. Conservation and minimization measures specific to the listed species on Beale AFB are covered in the Programmatic Biological Assessment (PBA) 2017 Update currently in draft form (Beale AFB 2017b). The PBA may include specific conservation measures that protect the covered species from invasive species control activities.

Various Base planning documents set restrictions on herbicide application in landscaped areas as well as semi-improved and unimproved areas on Beale. The Base INRMP (Beale AFB 2016) states that herbicide use for grounds maintenance activities is only authorized in landscaped areas. The Base *Installation Pest Management Plan* (Beale AFB 2017a, Section 7.1.1) specifies that "application of any pesticide within 250 feet of any vernal pool requires consultation with the Natural Resources Manager".

Currently, some targeted herbicide application at Beale is performed under a Categorical Exclusion. The IPMP states that implementation of the IPMP, including herbicide application, falls under Categorical Exclusion #A2.3.6. However, IPMP Section 7.4.1 states that if pest management activity negatively impacts natural resources, the Categorical Exclusion would not apply, and consultation with regulatory agencies is required. A comprehensive and programmatic National Environmental Policy Act (NEPA) analysis is planned for activities including invasive species control, grazing operations, and fire management activities and will begin in Fall 2017 (Lauren Wilson, pers. comm., October 2017).

Projects should consider all potential treatment methods and assess the potential wildlife and habitat impacts of each. In general, employ the lowest impact method for effective control of invasive species in areas with sensitive resources. For herbicide treatment near vernal pool resources, the proper timing of the treatment is the most important best management practice. In general, do not use herbicides within the watershed of vernal pools during the wet season to avoid run off into the pools. The use of surfactants near wetland resources is of particular concern because of the known toxicity of these chemicals to aquatic life.

2.4 Coordination with Cultural Resources Management

The Base INRMP requires that prescribed burning and off-road travel, for example with a vehicle for mowing or broadcast herbicide application, necessitates coordination with the Base Cultural Resources Manager (Beale AFB 2016, 17). Prescribed livestock grazing activities for weed management, especially those that concentrate animal use, may also require consultation with the Cultural Resources Manager (see Section 4.6 of the Beale *Grazing Management Guidelines* [Hopkinson 2017]). The INRMP states that such coordination "can take up to three months or longer if there are direct impacts and could add additional costs to projects to prepare and implement mitigation measures" (Beale AFB 2016, 17). Incorporate adequate time into weed control planning for coordination with the Cultural Resources Manager.

3.0 Invasive Species Landscape

Invasive species arrive at a site in a variety of ways and at multiple points in the site's history. At Beale, site history, current military use, and neighboring land-use contribute to the invasive flora in complex interactions. The greatest site history influence is crop agriculture. Beginning in the 1850s, the region was settled, grazed, and farmed with dryland wheat (Beale AFB 2016, 22, 129). Over the following 150 years, grains, especially rice, forage species, and ornamental species were deliberately introduced, along with many accidental introductions in seeds and equipment (Beale AFB 2016, A3-10). Although crop agriculture is no longer practiced on Beale itself, much of the surrounding region is still in crop production and capable of maintaining source populations (Beale AFB 2016, 20, 25). Furthermore, the legacy of farming persists long after the last crops are harvested. Disturbed agricultural soils with altered nutrient balances, compaction levels, and soil microbial assemblages, introduced species, and suppressed populations of native species interact to create novel assemblages that may be further invaded as new species arrive. A history of agricultural cultivation is best predictor for the absence of native perennial bunchgrasses and native annual forbs in California grasslands (Bartolome et al. 2007; D'Antonio et al. 2007).

Livestock production has also been implicated in the introduction of weeds into new areas, as invasive species either hitched rides on livestock or contaminated hay fed to livestock (e.g., Chuong et al. 2016). In the 1800s, intensive livestock grazing may also have played a role in the conversion of the original California grassland to today's non-native annual grassland, perhaps by affecting native plants and the competitive relationship between them and the non-native species then invading California (Bartolome et al. 2007). Concentrated livestock use can also increase the cover of bare ground, which can provide favorable germination sites for weeds (Spiegal et al. 2016).

Current Base activities contribute to the invasive flora as well. Military operations, construction and maintenance, and even natural resources management can all result in the introduction of new species to Beale. Vectors associated with military operations include aircraft, personnel, and equipment that are deployed and return from anywhere in the world. Base construction and maintenance can introduce or spread invasive plants through contaminated equipment (especially mowers and earthmoving equipment) or create disturbance for weeds to colonize. Natural resources activities such as grazing, surveys, and restoration can also introduce new species or distribute existing propagules to new locations within Base.

Beale has managed both sensitive species and invasive species for many years, but a concerted effort to manage both together may be more effective. For instance, these two categories of plants intersect in the vernal pool habitats at Beale. As with much of California's Mediterranean influenced vegetation, invasive species pose an significant threat to vernal pool systems. Extreme abiotic fluctuations generally protect vernal pool basins themselves from many non-natives (Gerhardt and Collinge 2003), although a few invasive species such as waxy mannagrass have begun to invade vernal pool basins more recently (DiTomaso et al. 2013, 196-197). Vernal pool systems are embedded within a Valley grassland matrix that tends to be highly invaded by Mediterranean-origin annual grasses such as bromes (*Bromus* species) and fescues (*Festuca* [*Vulpia* and *Lolium*] species). Although California upland grassland is highly non-native, it provides acceptable and functional habitat for many species of native mammals, birds, and amphibians. Of greater concern to natural resource managers is the expansion and increasing abundance of newer plant species that continue to invade California grassland and threaten the grasslands and the vernal pools within them. The three most troublesome invasive plants currently infesting Valley grassland are yellow starthistle, medusahead, and barbed goatgrass (DiTomaso et al. 2007; Spiegal et al. 2016), all of which occur on Base. These invasive plants degrade the quality of upland habitat for many wildlife species. For both vernal pools and upland grassland habitat, managing weeds to maximize the benefit to sensitive resources may yield more successful results than attempting to target all (or even most) weeds for eradication. In addition, proper management of invasive species meets many of Beale's INRMP goals, objectives, and projects for sensitive species management, as discussed in Section 1.2.

3.1 Cal-IPC Invasive Species Rating

The California Invasive Plant Council (Cal-IPC) has developed a standard ranking system of High, Moderate, or Limited impact. The ranking system evaluates the known biological information on a particular species within three subject sections: ecological impacts, invasive potential, and ecological distribution. Each section results in a numerical severity score, and the sections are added to produce the overall rating of High, Moderate, or Limited (Cal-IPC 2017). Cal-IPC (2017) defines the rating categories as follows:

> **High** – These species have severe ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal and establishment. Most are widely distributed ecologically.
>
> **Moderate** – These species have substantial and apparent—but generally not severe—ecological impacts on physical processes, plant and animal communities, and vegetation structure. Their reproductive biology and other attributes are conducive to moderate to high rates of dispersal, though establishment is generally dependent upon ecological disturbance. Ecological amplitude and distribution may range from limited to widespread.
>
> **Limited** – These species are invasive but their ecological impacts are minor on a statewide level or there was not enough information to justify a higher score. Their reproductive biology and other attributes result in low to moderate rates of invasiveness. Ecological amplitude and distribution are generally limited, but these species may be locally persistent and problematic.

3.2 The Invasion Curve

These *Guidelines* recommend a programmatic approach to weed control that is structured around the invasion curve concept depicted in Figure 3.1 (Rodgers et al. 2015). This concept will provide Beale natural resources staff with a framework to structure invasive species planning and make decisions about how to address specific target weeds. The invasion curve is built around the idea that prevention is the most cost-effective form of invasive species control, while treatment of entrenched, pervasive weeds is the most costly (Lodge et al. 2006; USDI 2016). Information on each species' biology and distribution as well as broad management goals are used to determine where to place a target weed along the curve. Four steps of increasingly widespread, more costly but less cost-effective management are described, and each one involves different treatment techniques. As an invasive species moves along the curve through time, the area it infests increases, as does the expense of controlling it. This is not simply due to an increase in area; as the time of residency increases, so does the soil seed bank and any ecosystem-altering effects of the infestation. Invasive species are capable of interfering with many ecosystem processes such as the soil nutrient cycle, fire regime, and hydrologic cycle (D'Antonio et al. 2007), all of which result in increased costs to land managers as restoration becomes more intensive and native habitat becomes degraded (DiTomaso et al. 2007). In addition, the presence of sensitive resources and their interactions with specific invasive species should inform the weed management techniques planned.

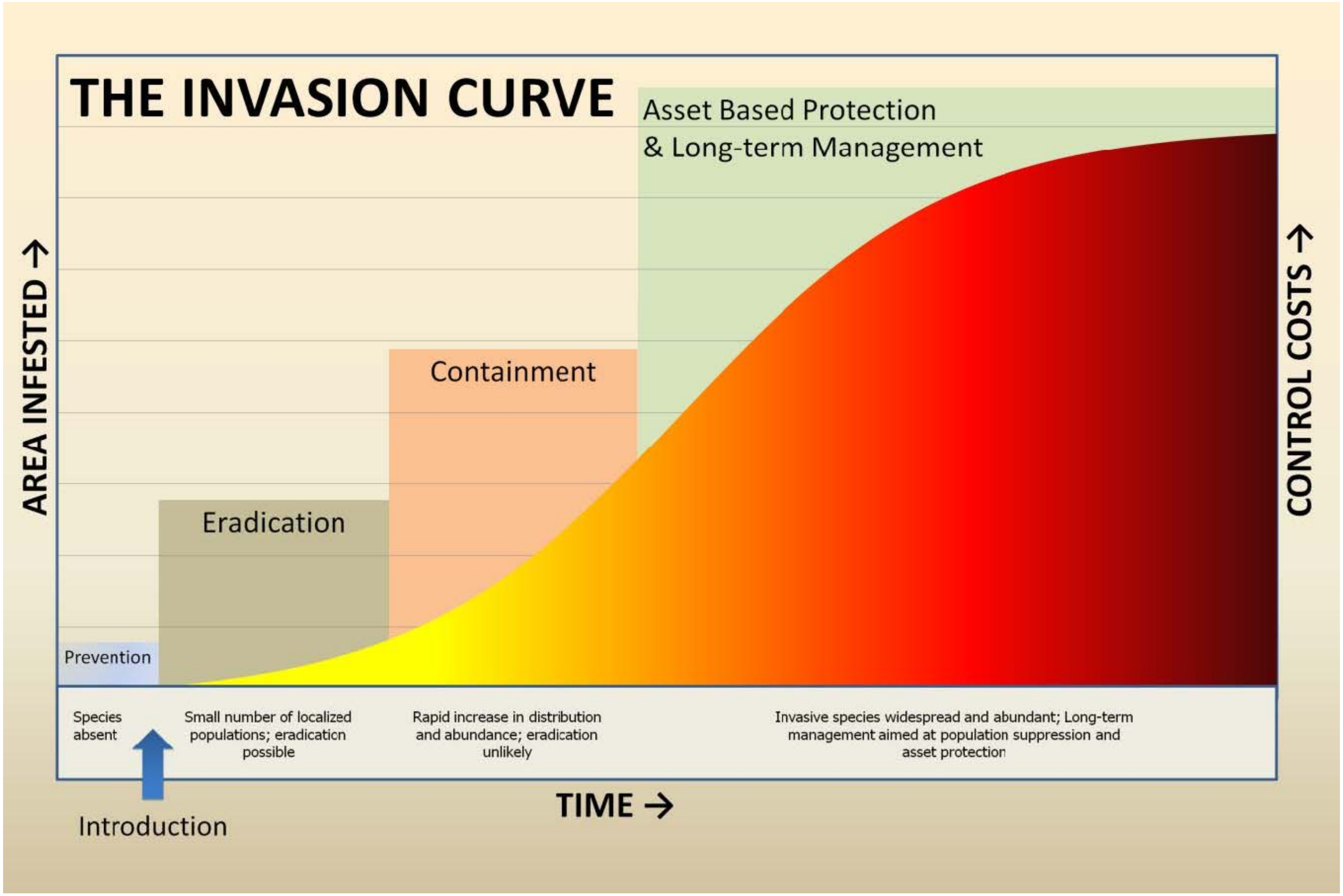

Figure 3.1: Invasion curve (from Rodgers et al. 2015).

The Cal-IPC rating system (Section 3.1), when applied to Beale's invasive species lists (Tables 3.1-3.4 and 6.1) further prioritizes species that need to be managed. The combination of the Cal-IPC rating and the invasion curve stage yields management information on which species to treat and the most effective strategy with which to treat them. An analysis like this that assesses the Cal-IPC rating and the invasive curve stage for all invasive species potentially or actually found on Base is repeatable; revisit the analysis at regular intervals on the order of every five to eight years, as weed populations grow, shrink, or appear (Section 6.1, Action Step 1).

3.2.1 Prevention

Preventing new infestations is generally acknowledged as the most cost-effective method of managing invasive species (Lodge et al. 2006; Zavaleta et al. 2016). Stopping introductions is much less costly than eradicating an established population, and most biosecurity controls apply to a wide range of target species, in contrast to control activities, which are typically species-specific. Biosecurity is the practice of controlling vectors to prevent introduction of harmful species and is the fundamental concept for this area of the invasion curve. In contrast, eradication and containment strategies are much more expensive and must be tailored specifically to the target organism. This early part of the curve represents species that are established in nearby areas and may invade, or species that may be brought in by any of the vectors described in Section 3.0. Base-wide biosecurity protocols will greatly benefit invasive species management at this stage.

Biosecurity

An effective biosecurity program ensures that vehicles, personnel, and equipment are free of weed seeds, non-native invertebrates, and pathogens and pests of any kind. Biosecurity programs may require changes in how entities on Base perform daily tasks, and creating the awareness of the importance of preventing future problems is key. Continuous education, alerts about new species or potential vectors, and consequences for failures to comply with biosecurity measures should all be considered. Development of a full-scale biosecurity plan for Beale is beyond the scope of these *Guidelines*, but described below are best management practices (BMPs) that reduce the likelihood of new invasive plants being introduced onto Beale (Section 4.1.1).

Invasive Plants Watch List

Developing and regularly updating an Invasive Plants Watch List for the Base is an important step in preventing new arrivals. Cal-IPC has developed the Cal WeedMapper tool (http://calweedmapper.cal-ipc.org/) as a method for developing Watch Lists for specific areas. This tool leverages expert knowledge, occurrence information from various plant distribution datasets including Calflora and the Consortium of California Herbaria, and predictive climate models to generate lists of invasive species with the potential to occur in a given area, usually a county. Appendix A lists 47 surveillance species generated by Cal WeedMapper for Yuba County as of July 2017, with no further refinement for habitat or likelihood of arrival at Beale itself. This results in an extensive Watch List, which could be refined or maintained as is. Every two to four years, update the Beale Watch List using the Cal-IPC Weed Mapper tool (Section 6.1, Action Step 2). Refining the list based on habitats at Beale would shorten the list and make it more user-friendly. Consider collaborating with regional experts (for example, invasive plant expert, Dr. Jeremy James at the University of California Sierra Foothill Research and Extension Center in Browns Valley) when revising the Watch List. Use this list in concert with, not instead of, consultation with neighboring landowners and regional weed experts.

In addition, Cal-IPC produced a recent report reviewing invasive species that occur on Base or have the potential to occur on Base (Cal-IPC 2015a). Cal-IPC started with the Cal WeedMapper list for the surrounding area and then refined the list based on invasive species' proximity to Base, ecological impacts, and potential vectors for spread such as creeks, roads, and cattle (Cal-IPC 2015a, 8). This list is presented in Table 3.1, modified with information from the recent Beale weed surveys (H.T. Harvey & Associates 2015; CEMML 2017). If any of the

Table 3.1: Prevention-stage species with potential to arrive on Beale AFB but not yet known to occur on Base.

Invasion Curve	Cal-IPC Rating	Common and Scientific Names	Habitat Infested	Effects
Prevention Stage	High	spotted knapweed (*Centaurea stoebe* ssp. *micranthos*)	uplands	forms dense stands that can exclude native plants, forage species, and wildlife (DiTomaso et al. 2013)
		Canada thistle (*Cirsium arvense*)	uplands, riparian	competes with native plants; possibly allelopathic; reduces forage quality; spines can injure livestock; host plant for agricultural pests (DiTomaso et al. 2013)
		artichoke thistle (*Cynara cardunculus*)	uplands	displaces desirable vegetation; degrades wildlife habitat and forage
		perennial pepperweed (*Lepidium latifolium*)	vernal pools, wetlands, riparian	forms dense stands; shallow roots allow erosion; reduces forage quality; accumulates and deposits salts on soil surface
		purple loosestrife (*Lythrum salicaria*)	wetlands	aggressive colonizer of wetlands; if moisture allows establishment, can persist in uplands for years; displaces native vegetation and wildlife; clogs irrigation systems; reduces forage quality (DiTomaso et al. 2013)
		smallflower tamarisk (*Tamarix parviflora*)	riparian, roadsides	reduces groundwater; accumulates and deposits salts on soil surface; increases fire and flood hazard
	Moderate	waxy mannagrass (*Glyceria declinata*)	vernal pools, wetlands	compromises vernal pool hydrology and nutrient cycles
		pennyroyal (*Mentha pulegium*)	vernal pools, wetlands	reduces forage quality; can cause contact dermatitis (DiTomaso et al. 2013)

species in Table 3.1 or on the larger Cal WeedMapper list (Appendix A) is observed at Beale, document and remove it immediately (see section 3.2.2). If possible, determine the vector that introduced the original propagule so that the pathway can be analyzed and addressed to prevent further introductions (Section 6.1, Action Step 3).

3.2.2 Eradication

Finding and eradicating new species while they are in the second stage of the curve is typically limited to small populations that have not had the opportunity to establish substantial widespread seedbanks or alter ecosystems. For successful management at this stage of the invasive curve, especially on an installation the size of Beale and with its numerous potential pathways and vectors, an Early Detection-Rapid Response program to find and eradicate incipient infestations of new invasive species is essential (USDI 2016). Invasive species experts consider such programs to be key for successful, long-term invasives control, in part because they allow for the possibility of immediate eradication at the stage when the invasive is at low numbers and occupies a small area (DiTomaso et al. 2007; NISC 2016). An early detection-rapid response program may also reduce invasive control costs over the long-term (Lodge et al. 2006). The National Invasive Species Council, of which the Department of Defense is a founding member, recently released a management plan that emphasizes early detection and rapid response as an essential strategy for reducing the adverse impacts of invasive species and lays out the action plan for implementing a national early detection-rapid response program over the next two years (NISC 2016). Also, the recent California Invasive Plant Council report to Beale recommended that the Base develop an early detection-rapid response program (Cal-IPC 2015a, 5, 9).

Early detection-rapid response programs often rely upon reports from users of an area (e.g., lessees or recreational users) and from personnel whose primary function is not invasive species management (e.g., wildlife biologists, road maintenance crews; Lodge et al. 2006). Educational information distributed to these groups and signs at strategic locations such as gates should briefly describe potential invasives, preferably with photographs, and ask users to take georeferenced photographs of any of the invasives they observe (or even of any strange-looking plant they have not seen on the Base previously) and send it to the Beale Natural Resources Manager (Section 6.1, Action Step 4). Cal-IPC (2015b) has already produced a series of identification cards for invasive species either known on Beale or with the potential to be on Base that are designed for these purposes. Appendix J contains the 2017 *Early Detection/Rapid Response Work Plan for Invasive Plant Species at Beale Air Force Base, CA.*

Even species that are well-established in small populations but that have not yet spread over a wide area may be targeted for eradication, as long as resources are set aside for long-term monitoring of sites where they have been removed. Eradication of invasive plants in California has been successful when the invaded area is smaller than 2-3 acres (Zavaleta et al. 2016). Well-maintained and consistently collected data will make eradication programs more efficient and effective. Consistency in treatment over multiple consecutive years is critical for eradication programs, especially for species with persistent long lived seed banks.

Nine species at Beale can be classified as Stage Two Eradication Species: giant reed, waterprimrose, Russian knapweed, tree-of-heaven, bull thistle, stinkwort, edible fig, black locust, and Indian toothcup (Table 3.2). Most of them have been definitively identified on Base but, based on the two recent weed surveys, in a fairly limited number of locations and generally at low cover (H.T. Harvey & Associates 2015; CEMML 2017). Species accounts, treatment options, and Base distribution maps for these species are to be found in Appendix B.

Table 3.2: Eradication-stage species documented as occurring on Beale AFB.

Invasion Curve	Cal-IPC Rating	Common and Scientific Names	Habitat Infested	Effects
Eradication Stage	High	giant reed (*Arundo donax*)	wetlands	obstructs waterways; flammable; high evapotranspiration; agricultural viral pest host
		waterprimrose (*Ludwigia hexapetala* and/or *L. peploides* ssp. *montevidensis*)	ponds, slow-flowing water	forms dense mats that degrade natural communities (including giant garter snake [*Thamnophis gigas*] habitat) and water quality, interfere with mosquito control, and reduce water flow in irrigation channels (DiTomaso et al. 2013; Cal-IPC 2015a)
	Moderate	Russian knapweed (*Acroptilon repens*)	uplands	forms dense, allelopathic stands; accumulates and deposits zinc on soil surface; toxic to horses; reduces forage quality
		tree-of-heaven (*Ailanthus altissima*)	riparian, uplands	forms dense stands that outcompete native species and reduce wildlife habitat; possibly allelopathic; can cause contact dermatitis in sensitive individuals; common allergen (DiTomaso et al. 2013)
		bull thistle (*Cirsium vulgare*)	uplands	reduces forage quality; can outcompete native plants (DiTomaso et al. 2013)
		stinkwort (*Dittrichia graveolens*)	disturbed areas, roadsides; occasionally vernal pools, wetlands	causes contact dermatitis; barbed pappus implicated in livestock deaths (DiTomaso et al. 2013)
		edible fig (*Ficus carica*)	riparian	forms dense clonal stands that can displace native vegetation; causes dermatitis (DiTomaso et al. 2013); can increase rapidly with no management; fruit can attract rats that also prey on birds (Cal-IPC 2004)
	Limited	black locust (*Robinia pseudoacacia*)	riparian	forms dense clonal clusters that exclude native vegetation; toxic to livestock; limited value to wildlife (DiTomaso et al. 2013)
	Not listed	Indian toothcup (*Rotala indica*)	wetlands, vernal pools	minor rice crop weed in CA (DiTomaso and Healy 2003); in some years, dominates cover in some Beale vernal pools (IER 2015, 4-12, 5-1)

Giant reed (*Arundo donax*) is recorded in about six locations on Base at low cover; the most significant population occurs along a mile-long stretch of Dry Creek (H.T. Harvey & Associates 2015; CEMML 2017, 33-34). Because of its 'High' ranking from Cal-IPC, prioritize giant reed for eradication. Giant reed is an ornamental but was also cultivated for erosion control and windbreaks (DiTomaso et al. 2013). To comply with AFI 32-7064 (DAF 2016, Section 12.3.1), plant only those species with low chances of escaping cultivation in landscaped areas of Base. Evaluate the planting lists and practices of Beale's grounds maintenance and housing contractor for potentially invasive species; have invasive species removed from the list in favor of alternative non-invasive species (Section 6.1, Action Step 5). The potential for eradication of giant reed from Base is limited because there is constant re-invasion of Base creeks from upstream off-Base sources (Lauren Wilson, pers. comm., October 2017), and so giant reed may need to be placed on an annual/biennial maintenance list. As noted in Section 1.3, collaboration with adjacent land managers on prevention, surveillance, and management of invasive species can increase the likelihood of successful, long-term weed control (Cal-IPC 2012, 10; Cal-IPC 2015a, 17-18) and is a specific directive for invasive species management in AFI 32-7064 (DAF 2016, Sections 3.8.1.4 and 14.6; Section 6.1, Action Step 6).

According to the Cal-IPC (2015b, 12, 27) report, invasive waterprimrose (*Ludwigia* spp.) has been observed at Beale "in at least one irrigation pond at Beale". The 2016 Beale weed mapping survey, however, did not encounter any invasive waterprimrose (CEMML 2017, 13). The CalFlora database (http://www.calflora.org) records eight observations of the invasive six petal waterprimrose (*L. hexapetala*) in Yuba County in 2012. A second invasive waterprimrose species, floating waterprimrose (*Ludwigia peploides* ssp. *montevidensis*), is not known from Yuba County but has been recorded in Butte County and other locations in the state, primarily in central California. In addition, there are several non-native but not invasive and several native waterprimrose species that occur in or near Yuba County. Given the potential ecological and economic impacts of invasive waterprimroses (Cal-IPC 'High' ranking) but their apparently limited distribution on Base, prioritize invasive waterprimrose for eradication (Section 6.1, Action Step 7).

Russian knapweed (*Acroptilon repens*; Cal-IPC 'Moderate' ranking) was searched for but not found during the 2016 weed survey (it may not have been a target species for the 2014 survey). The Cal-IPC (2015, 11, 20) report stated that the "species may be at Beale Pond 4 (species identification is uncertain)"; Russian knapweed has been found in Yuba County. Confirm whether Russian knapweed is present at Pond 4 and if so, proceed with eradication efforts. If not, move Russian knapweed to the Prevention-stage list (Table 3.1; Section 6.1, Action Step 8).

Another landscape ornamental, tree-of-heaven (*Ailanthus altissima*; Cal-IPC 'Moderate' ranking) occurs in fewer than 20 locations on Base (H.T. Harvey & Associates 2015; CEMML 2017, 35-36). Although it may be possible to eradicate the species from Beale, there is a large population just off Base (CEMML 2017, 49), which may make long-term control difficult, as the species produces a great deal of seed, which disperses by wind (DiTomaso et al. 2013). As with giant reed, collaboration with adjacent land managers may increase the likelihood of successful control of tree-of-heaven (Section 6.1, Action Step 9).

Bull thistle (*Cirsium vulgare*; Cal-IPC 'Moderate' ranking) was not recorded in the 2016 weed survey but was observed in the 2014 weed survey along Reeds Creek and at Goose Lake (sites not surveyed in the 2016 weed survey; H.T. Harvey & Associates 2015) and again in 2017 by H.T. Harvey staff (Charles McClain, pers. comm., July 2017). It may be too abundant along Reeds Creek for eradication, in which case, move bull thistle to the Containment-stage list and ensure it does not spread to suitable habitat at Dry Creek (Table 3.3).

Stinkwort (*Dittrichia graveolens*; Cal-IPC 'Moderate' ranking) was not recorded in the 2016 weed survey but was observed in the 2014 weed survey at several locations (H.T. Harvey & Associates 2015). This species is a fairly new invasive to California but has been spreading rapidly. It is known mostly as a weed of roadsides and disturbed areas and appears to be a poor competitor against annual grasses, but, based on its impact in Australian rangelands, it may have the potential to invade California grasslands (Brownsey et al. 2013). In addition, it causes contact dermatitis, "producing blistering and itchiness equal to that of poison oak" (Leitner 2016), which could affect Beale's ground-based military activities, as well as recreational pursuits. Although H.T. Harvey & Associates staff stated that, in summer 2017, they did not observe stinkwort in the locations on Base at which they had previously seen it, they found and removed the weed on Base in November 2017[2] (Matt Wacker, pers. comm., July and November 2017); re-survey these locations for 2-3 years before moving the species to the Prevention-stage list (Table 3.1).

Edible fig (*Ficus carica*; Cal-IPC 'Moderate' ranking) is somewhat more widespread on Base but is currently at low cover (H.T. Harvey & Associates 2015; CEMML 2017, 33-34). Given its ability to spread rapidly and form dense clonal stands in riparian areas, consider eradicating edible fig, especially in sensitive areas (e.g., Dry Creek and Best Slough).

Black locust (*Robinia pseudoacacia*; Cal-IPC 'Limited' ranking) occurs in about 10 locations on Base at low cover (H.T. Harvey & Associates 2015; CEMML 2017, 35, 37). Black locust is an ornamental that was likely purposefully planted at Beale but has now moved into wildlands (CEMML 2017, 35). If black locust continues to occur on Beale's landscape planting list, remove it from the list (Section 6.1, Action Step 5).

Indian toothcup (*Rotala indica*), a non-native herbaceous species, has been observed, in some years at high cover, in several vernal pools at the Site 2 Phase 2 constructed mitigation vernal pools area near the Wheatland Gate (IER 2015, 4-12, 5-1). It is believed to have entered Beale vernal pools via new rice fields on private property adjacent to the Wheatfield Gate; some of the bordering vernal pools flood with the fields and stay wet all year (Lauren Wilson, pers. comm., May 2016). As of 2017, Indian toothcup does not occur in the restored vernal pools but continues to occur in a large natural pool on the Base boundary[3] (Kirsten Christopherson, pers.

[2] Matt Wacker (pers. comm., November 2017) further notes that stinkwort was abundant on the new Highway 65 from Lincoln towards Beale in 2017, and that he has not observed it there before. He also found stinkwort in the right of way along Ostrom Road adjacent to an infestation that he treated on Base. Because stinkwort seeds are readily dispersed by wind (DiTomaso et al. 2013), collaboration with neighboring land managers will be necessary to limit the invasion of stinkwort onto Base.

[3] Per Kirsten Christopherson (pers. comm. with Lauren Wilson, August 2017), the inundation period of the large, natural pool "changed in ~2010 after the off-base landowner converted a grassland to a rice field. After that, the

comm. with Lauren Wilson, August 2017). The 2016 weed survey did not record the species (CEMML 2017, 62); however, its known location near the Wheatland Gate was not within the 2016 weed survey search area (and it may not have been a target species for the 2014 survey). Cal-IPC has not ranked this species, and there is very limited information about its biology and impacts in California, where it is recorded only in Butte, Sutter, and Yuba counties (DiTomaso and Healy 2003; CalFlora database, July 2017). Although one study suggests Indian toothcup may not spread rapidly in California (Barrett and Seaman 1980), its potential impact on vernal pools (ability to maintain high cover; IER 2015, 4-12, 5-1) make it a candidate for eradication efforts.

3.2.3 Containment

Containment becomes the most cost-effective strategy once an invasive species establishes a viable population and begins to spread outward. At this stage, focus on monitoring the original introduction site, if known, curtailing spread from that site, and targeting any newly established populations for immediate control. Management techniques available at this stage include herbicide application, hand removal, targeted grazing, prescribed burning, and carefully timed mowing. Even if local populations of these species are satisfactorily controlled, there is a high probability of reintroduction. There are few if any natural barriers between Beale and surrounding rangelands, much of which support the same weed species as the Base. Furthermore, seed banks for two of these species, Klamathweed (*Hypericum perforatum*) and blessed milk thistle (*Silybum marianum*), persist for years in the soil so even areas that do not currently exhibit an infestation may be reinvaded from a latent seed source. Six species are in the Stage Three Containment category (Table 3.3). Some of these species represent the legacy of agriculture or well-established ornamental populations, and all but vervain (*Verbena litoralis* and/or *V. bonariensis*) are well-established in California. The aquatic invasive plant, parrotfeather (*Myriophyllum aquaticum*), was not on any Beale invasive species list, although documents from the early to mid-2000s indicate that it was fairly common in Beale ponds and marshes at the time (Beale AFB 2016, A2-15, A2-22, A3-30); it is likely still abundant on Base (Cal-IPC 2015a, 6; Maia Lipschutz, pers. comm., October 2017) but was not surveyed for in either recent weed survey. Its placement in the Containment category is provisional; a survey for the species is necessary (Section 6.1, Action Step 10). Species accounts, treatment options, and Base distribution maps for these species are to be found in Appendix B. Appendix G contains the *Barbed Goatgrass Control Work Plan for Beale Air Force Base, California*.

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natural pool began to hold water for most (or all?) of the year. In 2011, this natural pool was used as source material for the restoration project in that area. For the first ~2 years post-restoration, [Indian toothcup] was found in several restored pools during the veg monitoring. However, now it is no longer being found in the restored pools now that they are established."

Table 3.3: Containment-stage species documented as occurring on Beale AFB.

Invasion Curve	Cal-IPC Rating	Common and Scientific Names	Habitat Infested	Effects
Containment Stage	High	barbed goatgrass (*Aegilops triuncialis*)	uplands	high-silica thatch can suppress natives; late maturing and drought tolerant; barbed awns dangerous to livestock
		parrotfeather (*Myriophyllum aquaticum*)	ponds, usually in still or slow-flowing water	forms dense subsurface or surface mats, which impede water flow, displace native vegetation, and interfere with recreational activities (DiTomaso et al. 2013)
	Moderate	skeletonweed (*Chondrilla juncea*)	uplands	competitive with natives; degrades crops
		Klamathweed (*Hypericum perforatum*)	uplands, riparian	toxic to livestock (DiTomaso et al. 2013); reduces plant species richness (DiTomaso et al. 2007)
	Limited	blessed milk thistle (*Silybum marianum*)	uplands	forms dense stands that displace native and forage species; spines can injure livestock (DiTomaso et al. 2013)
	Unrated but on Cal-IPC Watchlist	vervain (*Verbena litoralis* and/or *V. bonariensis*)	riparian	invades riparian areas (DiTomaso and Healy 2003)

3.2.4 Asset-Based Protection and Long-Term Management

At this stage, management should shift from focusing on the weed species itself to focusing on landscape-scale decision-making. First, consider if the invasive species in question is degrading habitat for any target sensitive species or altering conditions such as fire fuel load, soil erodibility, or hydrology. The naturalized annual grasses of Mediterranean origin that dominate much of the Base's grassland and savannah, although non-native and capable of degrading some habitats, probably provide more ecosystem service benefits than they cause damage. In contrast, yellow starthistle, also common across the Base, depletes deep soil moisture, reduces grazing opportunities for wildlife and livestock, and can affect ground-based military activities (D'Antonio et al. 2007; Figure 1.2). Management at the Asset-Based Protection/Long-Term Management stage must focus on large-scale control measures such as grazing, burning, timed mowing, and restoration planting.

The species in Table 3.4 are the most entrenched and widespread of the Beale invasive flora. Species accounts, treatment options, and Base distribution maps for these species are in Appendix B. In particular, medusahead is not only ubiquitous across Base (see species distribution map in Appendix B) but also most commonly occurs at 26-50% cover (see Figure 4 in CEMML 2017, 14). Himalayan blackberry also occurs at fairly high cover in many of Beale's riparian areas (see species distribution map in Appendix B and Figure 4 in CEMML 2017, 14).

Asset-based protection-level species will be targeted for control when they directly threaten a Base resource, operation, or sensitive species, as they are very likely to continually reinvade any treatment site. An asset-based protection spatial analysis and work plan for each of the species in this stage is needed (Section 6.1, Action Step 11). Treatment of these species will generally be an annual requirement at the site. The effects of prescribed burns to control yellow starthistle or medusahead generally only last 2-4 years before an additional round of treatment is required (James et al. 2015; DiTomaso et al. 2006). Livestock grazing typically must occur every grazing season to provide weed control.

Table 3.4: Asset-based protection-stage species documented as occurring on Beale AFB.

Invasion Curve	Cal-IPC Rating	Common and Scientific Names	Habitat Infested	Effects
Asset-based Protection Stage	High	yellow starthistle (*Centaurea solstitialis*)	uplands	forms dense, spiny stands that impede wildlife passage; toxic to horses
		medusahead (*Elymus [Taeniatherum] caput-medusae*)	uplands	dense stands reduce forage and wildlife habitat; produces thick thatch that changes soil temperature and moisture; suppresses natives; increases RDM
		Himalayan blackberry (*Rubus armeniacus*)	wetlands	creates dense monospecific stands; impedes wildlife access to riparian zones
	Moderate	black mustard (*Brassica nigra*)	uplands	forms dense stands; allelopathic; increases fire hazard; toxic to livestock
		Italian thistle (*Carduus pycnocephalus*)	uplands	spines discourage wildlife and decrease forage quality

4.0 Invasive Species Management

4.1 Weed Program Manager

The first step towards a cohesive and effective weed management program at Beale is the designation of a Weed Program Manager. Designate the existing Natural Resources Manager (NRM) or another Beale staff biologist as the Weed Program Manager. The Weed Program Manager devises and enforces biosecurity prevention measures (Section 4.1.1), implements the Early Detection-Rapid Response program (Appendix J), sets out priorities for each year's work, ensures proper coordination with the Installation Pest Management Coordinator (Section 4.1.2), coordinates and oversees efforts to treat and monitor weed populations (Section 4.3), and reviews these *Updated Invasive Plant Species Management Guidelines* annually (Section 4.1.3). Consolidating the responsibilities for invasive species management into a position would allow for flexibility and quick responses to management needs. The Weed Program Manager should be familiar with the Base's natural resources, operations, and invasive plants, and be able to understand and integrate annual data analysis and reporting into a cohesive on-going adaptive management strategy. Either the NRM or contracted specialist should be able to conduct basic data management and analysis. Key roles for the Weed Program Manager are:

1) acting as a liaison with facilities management, military operations, weed control contractors, grazing lessees and other unimproved grounds user groups to ensure biosecurity is enforced;

2) maintaining awareness of regional invasive species topics such as new control techniques and incipient invaders and working with adjacent land managers to coordinate weed control and monitoring activities;

3) organizing and planning for treatment activities each year and for monitoring control efforts to inform following years' priorities.

The Weed Program Manager should extract information from the Beale *Grazing Management Guidelines* (Hopkinson 2017), vernal pool monitoring research, and weed contractor data as well as information from Base users to determine weed control priorities. Base users who should be consulted regularly include fire and airfield managers, grounds maintenance, roadside mowers, the fire department, grazing lessees and Equestrian Center users, and Base residents. All of these groups have useful input on weed control decisions from their particular perspectives.

4.1.1 Biosecurity

Biosecurity is the practice of controlling vectors to prevent introduction of harmful species. As discussed above, biosecurity is the least costly and most cost-effective form of weed control, and it decreases the risk that a species will embark upon the increasing trajectory of the invasion curve. Biosecurity measures effective at preventing arrival of one species are generally equally effective on many others, and although biosecurity measures may seem costly at first, they will save resources in the long run. Effective biosecurity for the Base would require participation from residents, contractors, and Air Force personnel.

Biosecurity should focus on the main vectors of weed propagule material on Beale: military operations, personnel, and equipment, Base construction and maintenance activities, and natural resources activities, including the Beale grazing program. Controlling these vectors and minimizing their ability to import weed propagules requires a combination of education, on-the-ground inspections, and installation of equipment that prevents invasive species introduction. Consolidating these aspects of biosecurity into a single position is the most effective way to ensure that they are all considered and given equal weight.

4.1.2 Coordination with the Installation Pest Management Coordinator

All pest management activities on Air Force installations are under the purview of the Installation Pest Management Coordinator (IPMC), including vertebrate, invertebrate, and plant pest activities (Beale AFB 2016, 104, 138). The Weed Program Manager will coordinate with the IPMC to ensure that all of the below requirements are met for any invasive plant control work performed:

1. All herbicides and herbicide application shall comply with DoDI 4150.07 DoD Pest Management Program; AFI 32-1053 Integrated Pest Management Program; the Base's *Installation Pest Management Plan* (Beale AFB 2017a); Armed Forces Pest Management Board list of Approved herbicides; and the State of California Pesticide Regulations, and be registered for use in the State of California. Only pesticides approved for use on the Base may be applied (see Appendix E for DoD list of approved pesticides).

2. A list of all herbicides to be applied is to be provided, with Safety Data Sheets and labels, to the IPMC 15 calendar days prior to application. If non-approved herbicide is preferred, the applicator shall submit an AF Approval Request Form for Non-Standard Pesticides to the IPMC 30 calendar days prior to application. Any non-standard herbicides need to have command approval prior to use and will require a longer approval period.

3. Only personnel licensed/certified by the State of California shall apply herbicides. Copies of all herbicide application certifications shall be provided to the IPMC on the applicable base within 30 calendar days. All licenses/certifications must be in the proper category of the type of work being performed. Qualified Applicator Certificate, Qualified Applicator License, and Pest Control business license copies are to be provided.

4. Before any herbicide application is to begin, an AF Form 332 will be staffed through the Base Work Order system by CES/CEIEC and to the IPMC for approval. It will include the pest to be controlled (grass and weed control), a map identifying the location pesticides are to be applied, the number of acres of application, the pesticides that will be applied, and copies of the Material Safety Data Sheets or Safety Data Sheets.

5. Pesticide Mixing, Storage and Disposal: All pesticides shall be stored off-base. All unused pesticides, empty pesticide containers and residue shall be disposed of properly at an approved off-base disposal area. If permitted, chemical mixing for immediate application may be accomplished at the site of application/treatment and only state certified applicators may mix or apply pesticides. Contractor shall provide a spill container at mixing areas to insure that no chemicals impact an area that is not being treated. The contractor shall have an operational emergency eyewash kit available at each mixing location. In the event the contractor spills or releases any hazardous substances (for example, substances listed in 40 Code of Federal Regulations [CFR] 302), the contractor shall immediately notify the Fire Department, ESCA program manager, CES/CEIEC, and IPMC.

6. Safety: The contractor shall comply with all applicable parts of Title 29, CFR, Occupational Safety and Health Standards, Part 1910; Title 29, CFR, Safety and Health Standards for Federal Service Contracts, Part 1925; Title 40, CFR, Parts 150-189, and Title 49, CFR, Hazardous Materials Regulations, Part 171, while on an Air Force installation, to ensure safe working conditions for contract personnel and a safe environment for the occupants of Air Force facilities.

7. The contractor shall establish an Air Force Integrated Pest Management Information System (IPMIS) account to enter and document state pesticide applicator certification categories and expiration dates. Contractors should contact the IPMC for details on initiating the IPMIS process. If necessary, the contractor will provide pesticide use data to the IPMC on a monthly basis by the 5th of the month for input into the IPMIS pesticide management database.

8. The IPMC for Beale changes frequently and is often an active duty military officer; check with the Weed Program Manager for current IPMC contact information. Cooperator may submit questions to the IPMC but shall also copy the Weed Program Manager.

4.1.3 Maintenance of these *Updated Invasive Plant Species Management Guidelines*

Lastly, the Weed Program Manager should review these *Guidelines* annually (Section 6.1, Action Step 12). As implementation reports and monitoring and research results become available, incorporate them into the document as appendices. With increasing allocation of effort, a better understanding of minimization measures can be used to refine and improve the entries in Section 2.3. Cal-IPC updates their Invasive species inventory, watch list, and list of weed-free forage providers periodically, and the Beale *Guidelines* should incorporate those updates when available. Update Beale's invasive plants watch list (Appendix A) through Cal-IPC's WeedMapper website every few years (see Section 3.2.1). Research and applied weed science is constantly evolving and improving, and as new control and monitoring techniques become available, update these *Guidelines* to reflect the best available information.

4.2 Management Prioritization for Containment and Asset Protection Species

The invasive species of Beale range in severity from introduced ornamentals that are possible to eradicate to entrenched populations of noxious weeds that must be managed in the context of the resources they directly threaten. Invasive plants present a significant barrier to conservation of sensitive resources, and if allowed to spread unchecked, they will degrade the remaining native habitat and interfere with management of sensitive resources. In turn, each sensitive resource is subject to deleterious effects of different invasive species. Given that the resources directed toward invasive species and sensitive resource management are always finite, prioritizing which species to actively manage is vital. The 11 species listed in Tables 3-3 and 3-4 are capable of degrading habitat for endangered plants, impeding military missions, or interfering with Base operations such as grazing and should be more aggressively addressed.

Sensitive species, resources, and activities such as vernal pool branchiopods, grazing, and military operations are threatened or impeded by different species and to different degrees at Beale. Therefore, some threshold must be determined to trigger when to direct resources toward controlling a particular infestation. This threshold should be directly tied to the resource in question and should be measurable using currently implemented monitoring of sensitive resources. In some cases, a robust, published threshold is unavailable for a particular resource, and these should be determined over time by the Weed Program Manager.

4.2.1 Weed Management for Military Mission

Threats

The military mission of Beale consists of providing global aerial reconnaissance, reconnaissance air refueling support, and many other activities (Beale AFB 2016, 23-24). These missions can be impeded by invasive species that increase fire risk or provide habitat for pest species (especially birds near the airfield, which can become hazards to aircraft). For instance, yellow starthistle seeds provide a food source for birds, and infestations around the airfield could draw in seed-eating birds, as well as raptors that prey on them, increasing the risk of Bird Air Strike Hazards (Figure 1.2; Beale AFB 2016, 140). Appendix I contains the 2017 *Bird Air Strike Hazard Area Invasive Plant Work Plan for Beale Air Force Base, California*.

Management Threshold

The Weed Program Manager should consult with military operations managers and BASH personnel to determine if invasive plants are increasing fire risks, creating wildlife habitat in dangerous proximity to the flight line, or impeding road visibility. Regular surveys by BASH or natural resources personnel or contractors can be used to gauge phenology and the need for treatment for some airfield weeds. If tricolored blackbird presence is tied to yellow starthistle seed production, focus control of starthistle on preventing seeding, rather than only focusing on lowering the density or a achieving a prescribed vegetation height.

4.2.2 Weed Management for Listed Wildlife Species

Threats

The listed branchiopods and western spadefoot toad that inhabit Beale's vernal pools face threats from invasive plants that can directly alter the hydrology of vernal pools and from improperly managed grazing (Marty 2005, 2015). In particular, timing and duration of the inundation period are critical. Pools must remain wet for long enough for a complete branchiopod life cycle or toad metamorphosis, and then dry sufficiently for the branchiopod cysts to become dormant. Longer inundation periods also improve juvenile toad survivorship. Water quality is an additional factor in branchiopod ecology, and this can be negatively affected by the buildup of litter produced by non-native species (Marty 2015). Litter buildup can both cause anoxic conditions in the pool and may also directly decrease inundation period. As litter builds up and incorporates organic matter into the soil, that soil has a higher water-holding capacity, which leads to more below-ground moisture and less ponding above (Marty 2015). Both of these effects can be detrimental to gill-breathing branchiopods with specific tolerances for inundation period. Excessive live and dead biomass may also reduce toad habitat values and impede dispersal of toadlets.

Yellow starthistle and medusahead threaten to destabilize vernal pool hydrology through thatch buildup, competition, or extremely high evapotranspiration rates. Yellow starthistle has fast-growing roots that can draw deep soil moisture from as far as 6.6 feet deep. The plants can deplete soil moisture early in the season, allowing them to compete with native species and create drought conditions even in normal rain years (DiTomaso et al. 2006). High evapotranspiration rates paired with deep roots allow yellow starthistle to deplete soil moisture, while simultaneously avoiding competition with shallow-rooted neighbors. Although yellow starthistle rarely invades pool basins themselves, this ability to alter hydrology within the basin is a threat to vernal pool-reliant native species. Annual grass species such as medusahead and Italian ryegrass, wild oat, and brome species, produce large quantities of biomass each year that contribute the dense litter that can degrade water quality; medusahead in particular generates "recalcitrant" litter that decomposes slowly and so accumulates over multiple years, forming a persistent thatch layer (DiTomaso et al. 2013). The impact of Indian toothcup on vernal pool branchiopods has not been evaluated; however, it has occupied vernal pool basins at cover values of up to 60% (Lauren Wilson, pers. comm., May 2016) so may have some effect on pool hydrology.

Potential impacts of invasive plants in riparian zones on valley elderberry longhorn beetle are not well-studied (USFWS 2014, 55897-55899), but they may reduce reproduction and growth of the beetle's host plant, elderberry shrubs. At least three invasive plant species on Base, black locust (*Robinia pseudoacacia*), tree-of-heaven (*Ailanthus altissima*), and Himalayan blackberry (*Rubus armeniacus*), are described by the USFWS as potential threats to the beetle (USFWS 2014, 55897-55899). Treatment of the invaders in an early stage is preferable. Herbicides are a concern as they can affect elderberry shrubs, but, for some of the invasives, herbicides may be the only practical control action. Proper identification and flagging of all elderberry shrubs prior to any sort of treatment would be critical because new recruits and sprouts can easily be missed. Weedy grasses can create excessive fuel around elderberry shrubs growing in a savannah setting, which can shrink fire return interval. Mowing may be a good management tool to reduce fuel load.

Aquatic and riparian weeds may impact Central Valley steelhead habitat quality by changing water flow, reducing water quality declines, degrading spawning gravel sites, and creating migration barriers (Beale AFB 2016, 74). Waterprimrose (*Ludwigia* species), parrotfeather (*Myriophyllum aquaticum*), and giant reed (*Arundo donax*) can cause these kinds of changes in aquatic habitats (DiTomaso et al. 2013; Cal-IPC 2015a) and are present on Beale, although only giant reed is recorded as infesting Dry Creek, the primary habitat for steelhead on Base (Beale AFB 2016, 73).

In the Central Valley, riparian breeding habitat for the yellow-billed cuckoo has been reduced by invasive plant species (USFWS 2007c). Two invasive riparian weeds that occur on

Base, giant reed and edible fig (*Ficus carica*), displace native riparian vegetation and probably offer only limited nesting and foraging value to cuckoos (Laymon 1998).

Management Thresholds

For these special status species, there is limited information on which to base thresholds. The fall residual dry matter (RDM) monitoring conducted under the Beale grazing program will indicate if grazing regimes need to be adjusted for branchiopod conservation. Yearly collection of fall RDM will provide data for tracking litter accumulation, while species composition cover monitoring data would indicate how well grazing is suppressing non-native species. If these metrics indicate that grazing is excessive or under-utilizing forage, the next year's grazing parameters should be adjusted accordingly. University of California Agriculture and Natural Resources researchers have published recommended fall RDM minimum targets, categorized by slope (Table 4.1; Bartolome et al. 2006). These minimum targets can be used as management thresholds until species-specific RDM targets are developed[4]. If a problematic species appears that is not adequately reduced by grazing, consider the addition of herbicide application. Appendix B gives the best timing and herbicide formulation for each weed species if herbicide application is required.

Table 4.1: Fall residual dry matter targets for annual grassland recommended by University of California Agriculture and Natural Resources (Bartolome et al. 2006).

0-10 % slope	10-20 % slope	20-40 % slope	>40 % slope
500 lbs/acre	600 lbs/acre	700 lbs/acre	800 lbs/acre

Desired conditions for invasive species cover values are presented in Table 6.1. As more information becomes available about invasive species' impacts on special status species, these desired condition cover values can be updated.

4.2.3 Weed Management for Livestock Grazing

Threats

Grazing represents a valuable resource for Beale. It is an important landscape-level tool for managing vernal pool ecosystems, annual grasslands, vegetative fuel loads, sensitive wildlife habitat, and some invasive plant species, as discussed in previous sections. The grazing program helps maintain open space both on and off Base by providing additional grazing opportunities to ranching operations (Beale AFB 2016, 103) and generates significant revenue that supports Base INRMP implementation and natural resources management (RMAT 2000, 8; Beale AFB 2016, 133). Despite the significant revenue collected, since at least 2013, all revenue from the grazing program has been used to support the grazing program itself and not any other natural resource

[4] For example, a research project is currently being planned for Travis AFB that will examine RDM levels and vernal pool floral conservation.

priorities in the INRMP, and is thus essentially a self-sustaining and independent program. Allowing horses to graze at Beale increases the quality of life for Base residents who can participate in the Dry Creek Saddle Club (Beale AFB 2016, A8-47), and, in general, the grazing program provides opportunities for Base personnel to enjoy observing livestock and traditional ranching activities and provides a peaceful environment to support well-being of Air Force personnel and their families (see for example the Beale AFB website news article by Viglianco [2016]; Lauren Wilson and Ann Bedlion, pers. comm., January 2017).

Threats to the grazing program include plants that injure livestock with spines or awns, reduce forage quality, or poison livestock. Because different livestock species react differently to plant toxins, the type of grazing animal using a given pasture should be taken into account. For instance, sheep and cattle will graze the early stages of yellow starthistle, goats will graze all stages of yellow starthistle, but it can be fatal to horses if they eat an excessive amount (DiTomaso et al. 2006, 5). Other species such as barbed goatgrass can be grazed at very early stages but can cause mechanical damage to livestock and are unpalatable in later phenological stages (Davy et al. 2008). Medusahead in the Beale grazing pastures is of particular concern because its silica-rich tissue significantly degrades forage quality (Kyser et al. 2014, 5). Preliminary results from a study at the UC Sierra Foothill Research and Extension Center in Browns Valley (approximately 10 miles north of Base) indicate that as medusahead abundance increases, steer weight gain decreases significantly, and infested pastures effectively have lower stocking rates as a result (James et al. 2016). As stocking rates decline in medusahead-infested pastures, the pastures accumulate RDM as the unpalatable vegetation is left in the form of thick thatch. This thick thatch layer suppresses native species and desirable forage species, but medusahead is adapted to germinating and growing in its own thatch (Kyser et al. 2014, 5-6), resulting in a feedback loop that worsens the medusahead infestation and reduces the conservation value of grazing. Dr. Jeremy James, a University of California medusahead control expert, has stated that Beale has the worst medusahead infestation of any site he has seen in California (Pers. comm. with Lauren Wilson, 2015, 2017). Barbed goatgrass is a looming threat to Beale's grazing program, as it can spread rapidly and degrade pastures to the point that they are no longer suitable for livestock (Davy et al. 2008).

Management Thresholds

Augment consultation with the grazing lessees and Dry Creek Saddle Club members with data collected for the grazing program to determine if weeds are degrading grazing opportunities. In particular, when fall RDM levels are above target in pastures with medusahead, this may indicate that the infestation has reached a level where the feedback loop of lower forage quality has begun. Although formal fall RDM targets for medusahead control have not been produced, one expert has observed that grazing medusahead to 500 lbs/acre of fall RDM can significantly reduce medusahead cover the following year, although several years of grazing to this level are necessary for long-term impact (Theresa Becchetti, pers. comm., November 2017). A fall RDM target close to the UC ANR guidelines (Table 4.1) may help control medusahead. If the action of the grazing itself is insufficient to control weeds, herbicide application, prescribed burning, or mixed species grazing (use of multiple livestock species with different dietary behaviors) may be needed (Appendix B).

One potential management threshold for medusahead could be based on research conducted at the UC Sierra Foothill Research and Extension Center that found that as medusahead frequency in a pasture increases, steer weight gain decreases significantly, approximately 30 lbs of steer weight per acre over the grazing season for every 10% increase in medusahead frequency in a pasture (James et al. 2016). Discussion with lessees could determine at what point these 30 lb loss increments become financially unsupportable for them; this would indicate what frequency of medusahead in a pasture crosses the management threshold. Note that implementing a medusahead control program using this research would require monitoring medusahead frequency in pastures (see Section 4.3.1).

Barbed goatgrass, while currently fairly limited in distribution across the Base (see Appendix B for species distribution maps), has the capacity to spread rapidly (Davy et al. 2008). Annual surveys of goatgrass distribution should be implemented alongside active control to ensure that it does not spread across the Base.

Desired conditions for invasive species cover values are presented in Table 6.1. As additional information becomes available about specific invasive species' impacts on grazing operations, their desired condition cover values can be updated.

4.2.4 Weed Management for Recreational Activities

Threats

The Base provides housing and recreational opportunities for military families, including equestrian opportunities, wildlife viewing, hunting, the Dry Creek Nature Trail, hiking or running trails, golf, and the Rod & Gun Club (Beale AFB 2016, 111-115, A5-70). Any invasive plant species that may be toxic or irritating to people and pets or cause contact dermatitis (e.g., stinkwort and tree-of-heaven) can become a problem in military housing or recreational areas. Outdoor activities may be curtailed by species such as yellow starthistle, barbed goatgrass, and Himalayan blackberry. The Base also provides recreational fishing opportunities; aquatic weeds such as waterprimrose and parrotfeather degrade water quality or fish habitat and could curtail fishing.

Management Thresholds

Management of weeds that impair recreational opportunities relies on qualitative assessments of trails, ponds, and parks. Regularly survey these areas for invasive species that degrade recreational values. Maintaining recreational facilities not only increases quality of life for residents but can also increase interest and a desire to be good stewards in those residents. Consider consultation with users or surveys of residents to guide weed management in recreation areas.

4.2.5 Weed Management for Grounds Maintenance

Threats

Beale's roads, sidewalks, and trails must be maintained for visibility and fire abatement, as well as aesthetics. Transportation corridors including roads, sidewalks, trails, and parking areas can be degraded by roadside weeds that reduce visibility or increase fire danger and erosion. Roadsides also serve as a vector for weed seeds that occur there and can be transported elsewhere on Base by vehicles; survey roads and treat any invasive species. Grounds maintenance also includes decorative planting areas that may be invaded by wildland weeds.

Grounds maintenance mowing, especially along roadsides, can spread invasive species into uninfested areas of the Base. Mowers should be cleaned before leaving infested areas. One strategy to prevent spread of weeds by grounds maintenance mowing is to create maps of 'no-mow' areas that are infested with particularly troublesome plants (e.g., Early Detection-Rapid Response program species such as stinkwort). In these 'no mow' areas, grounds maintenance could use roadside herbicide spraying instead of mowing (Section 6.1, Action Step 13).

Management Threshold

The Weed Program Manager should consult with grounds maintenance personnel so that the two programs are able to coordinate efforts and leverage each other's resources and presence on the ground. Ensuring grounds maintenance personnel are aware of wildland weeds (including those ornamentals that can establish in natural areas, like tree-of-heaven and black locust) will help conserve Beale's natural resources. Likewise, if wildland weeds are escaping into grounds maintenance areas, a combined effort will be more effective than each group attempting to tackle the problem alone.

4.3 Monitoring

Monitor infestation areas that are the focus of eradication or containment efforts at least yearly. Yearly monitoring and analysis of treatment results will allow Base management to adapt resource allocation and methodology appropriately. In addition, surveys are vital to ensuring that any newly-arrived species is documented and addressed in a timely fashion, as part of an Early Detection-Rapid Response program (see Appendix J). Focus monitoring for new arrivals on the Prevention Stage species listed in Table 3.1 and on the larger Cal WeedMapper list for Yuba County (Appendix A) but also allow for the possibility of arrival of species new to the region or even unknown in California. The international nature of Beale's military mission increases the risk of introductions of entirely new taxa.

Ensure monitoring efforts are designed to measure criteria used in Table 6.1's desired conditions to document program progress and successes. The Weed Program Manager should review all data annually and adjust program priorities within an adaptive management process (Section 6.1, Action Step 14).

Existing monitoring, data collection, and research can be used to track invasive species and their effects. Implementation reports from weed control contractors, grazing program monitoring, and vernal pool and other monitoring all supply useful weed data (for example, the discovery of Indian toothcup on Base during vernal pool mitigation monitoring; IER 2015, 4-12, 5-1). Consider adopting the following surveys and methods for phenology tracking for treatment planning, weed management prioritization, and treatment effectiveness. In considering these disparate monitoring strategies, determine if there are redundancies that could be eliminated to streamline all vegetation monitoring for the Base.

Phenology tracking surveys can be conducted multiple times in informal fashion using driving or brief walking transects and collecting anecdotal data. Multiple visits can ensure that the most appropriate growth stage for weed treatment is accurately predicted, maximizing effectiveness of treatments such as mowing, targeted grazing, or herbicide application. The phenology of sensitive species can also be tracked to minimize impacts of invasive species treatments on the sensitive species.

4.3.1 Monitoring for Treatment Effectiveness

Determining whether a treatment has effectively controlled an invasive species requires effectiveness monitoring, ideally designed specifically for that control project as part of a weed management work plan. Effectiveness monitoring is tied to specific weed management goals, measures specific variables identified within objectives (e.g., reduce yellow starthistle by 50% cover in two years), and answers the question "am I meeting my stated grazing management goals and objectives?" For instance, INRMP Goal 8 in Table 1.1 is to "Manage rangeland vegetation to provide high quality forage on a sustainable basis and provide a healthy ecosystem." Objective 8.2 describes one of the components necessary to achieve this goal: "Coordinate grazing with prescribed burning to improve range conditions, promote desirable and native forage species, and reduce undesirable species" and a specific project leading from that goal and objective might be to reduce barbed goatgrass to <10% cover with a prescribed burn. An effectiveness monitoring protocol for this project would include measuring cover of barbed goatgrass in the burned area and within an unburned control area.

The general approach to effectiveness monitoring is to establish permanent plot locations and measure critical response variables over a period sufficient to determine whether management actions are having the desired effect (often for 2-3 years after treatment). Locate plots in sites undergoing invasive species treatment (e.g., a prescribed burn area) and in similar untreated area(s). Establishing comparison control plots (locations in which treatment is not applied but which are as similar as possible to the areas undergoing treatment) is necessary to differentiate between the effects of the treatment action as compared to those changes that might appear to be the result of treatment but are actually caused by annual weather patterns or other non-management factors. Research-grade statistics and experimental design are not necessary, just a few comparison plots to help determine if treatment is effective.

Note that species in the Prevention and Eradication Stage are likely to consist of just a few individuals. Therefore, sampling methods that determine metrics such as frequency and cover are likely to be unnecessary. Instead, each individual of the target species must be located and eliminated. In some cases, an infestation may be large enough that cover estimates are useful, but after initial treatments, any remaining individuals will need to be individually located and then eliminated. For the larger populations of invasive species in the Containment and Asset-Based Protection stages, sampling metrics such cover and frequency are useful.

Line-point transects, which measure cover, or frequency transects, which measure frequency of occurrence, could be used for effectiveness monitoring in upland and riparian areas (Interagency Technical Team 1999). Similar methods can also be adapted for aquatic weed monitoring (Madsen and Wersal 2012).

Line-point transects

Line-point transects work well to monitor changes in cover of a dominant species like an invasive plant. This method is generally more time-consuming than frequency plots (see below) but results in more precise estimates of abundance (specifically, cover). A point "hit" can be recorded either for all plants intercepted at each point or for only the first plant intercepted (or bare ground, rock, etc. if no plant is intercepted). Much California rangeland research has used the first hit method as it is more precise and more efficient; the first hit method does result in a slight bias towards taller species (James Bartolome, pers. comm., 2017).

For monitoring purposes, a typical design would be a 25m transect with points taken every 50cm for 50 points total or a 50m transect with points taken every 50cm for 100 points total, depending on the size of the area of interest and the degree of precision desired (increasing the number of points within a given area increases precision of cover estimates). Typically, line-point transects would be sited within a single, continuous vegetation type. Randomly locate transects within the area of interest (the treated area and the untreated control area), and randomly select the azimuth of the transect (even if the range of acceptable azimuths is constrained). Permanently mark the beginning of the transect (either with a stake or rebar or take a sub-meter GPS reading), record the azimuth of the transect, and take photographs of the line-point transects in both directions along each transect.

Frequency plots

Frequency monitoring is a time-effective method of monitoring broad changes in abundance of invasive species of interest, following some management action (e.g., control with herbicides or goat grazing). The frequency plot method is "useful for monitoring vegetation changes over time at the same locations or for comparisons of different locations" (Despain et al. 1991) and can provide this information at relatively low cost. Despain et al. (1991, 7) define frequency as:

> the number of times a plant species is present within a given number of sample quadrats of uniform size placed repeatedly across a stand of vegetation . . . It is generally expressed as a percentage of total placements and reflects the probability of encountering a particular species at any location within the stand.

Average frequency values can be followed from year to year and provide an index of a species' density and dispersion (Despain et al. 1991). Frequency can be useful when cover values of the target species are fairly low, although quadrat size will likely need to be large (see below).

Although frequency plot specifics can vary based on monitoring needs, a frequency plot may, for example, comprise a 10 meter transect with 20 quadrats arranged on alternating sides of the transect. Within each quadrat, the field crew determines whether any individual of the species under consideration is rooted within the quadrat. The resulting metric is the species' frequency of occurrence in the 20 quadrats of the plot (for example, if medusahead occurred in 15 of 20 quadrats along a transect, its frequency for that plot is 0.75).

Quadrat size has a significant effect on frequency values (Despain et al. 1991) and so must be carefully selected. Frequency sampling works best when a species' frequency values fall between 20% and 80% (Despain et al. 1991) so quadrat size must be selected to provide values that fall within that range. Typically, larger-sized quadrats will include sparsely distributed species but will result in almost 100% frequencies for common species, reducing one's ability to detect change in common species; smaller quadrats solve this problem but can miss sparsely distributed species (Despain et al. 1991). Because frequency varies based on species size, abundance, and distribution in the plot area, it is necessary to determine in the field which quadrat size is most suitable. A recommended technique is initially to employ nested quadrats of 5x5 cm, 10x10 cm, 25x25 cm, and 50x50 cm and then determine which quadrat size is most appropriate for the situation.

Randomly locate frequency plots within the management and control areas, and randomly select the azimuth of the frequency transect (even if the range of acceptable azimuths is constrained to keep the transect within the area of interest). Permanently mark the beginning of the frequency transect (either with a stake or rebar or take a sub-meter GPS reading) and record the azimuth of the transect, then take two photographs of each frequency plot, the first from the start of the frequency transect to the end of the transect and the second in the reverse direction.

4.3.2 Data Management

An ArcGIS geodatabase that incorporates both spatial and tabular data is ideal for tracking the control program through time and determining future steps (INRMP Goal 9 in Table 1.1). Data that should be collected (by Beale staff or contractors performing weed surveys, weed control, and treatment effectiveness monitoring) and analyzed yearly includes spatial data on where treatments occurred, where new populations were found, and what areas were surveyed. Tabular data should include the type of treatments performed (for example, prescribed burning, herbicide application, prescription grazing, or mowing), amount and type of herbicide used (including concentrations and surfactants), numbers of plants treated, and kill rate. Standardizing the data collected, regardless of who performs the work, will ensure that comparisons across years will have the power to calculate effectiveness and modify resource allocation accordingly. These tables can also be exported for inclusion in annual reports or updates to the Base INRMP.

The Air Force Environmental GIS Support Program maintains 69 functional datasets (FDS) that have been standardized to the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) 3.1 Air Force Adaptation (as of August 2017). These standard FDS data layers were developed with Air Force Civil Engineer Center subject matter experts and approved by Defense Installation Spatial Data Infrastructure as the standard for environmental spatial data. Data layer specifications exist for 38 FDS that belong to the Natural Resources program and include one titled *Noxious or Invasive Species* (Appendix F contains the specifications document). All data collection efforts under these *Guidelines* should use the current version of *Noxious and Invasive Species* FDS data layer. An empty or blank attributes table or geodatabase can be provided for use. New data will be added to the existing database to create a cumulative database record. Unfortunately, the *Noxious and Invasive Species* data layer does not contain all the attributes needed to manage Beale's invasive species program. Additional fields can be added to the database but will not be part of the official spatial dataset and thus need to be maintained by the Weed Program Manager and or contractor on an annual basis. A long-term strategy for updating the SDSFIE 3.1 standards to include these additional fields is likely to take a few years.

4.4 Restoration Treatments

Restoration of any bare soil by replanting or reseeding desirable species must be compatible with future uses and management actions, including future weed control efforts. At Beale, restoration must be designed to address the large scale of many of the infestations, the primary land-use of grazing, the possibility of continual invasion by the same or new invasive species, and any future weed control treatments including herbicide application, burning, and grazing.

Species that could be used for restoration include purple needlegrass (*Stipa pulchra*), which was used in at least one successful restoration project at Beale (Holland and Griggs 2006), blue wildrye (*Elymus glaucus*), creeping wildrye (*Elymus (Leymus) triticoides*), and meadow barley (*Hordeum brachyantherum*), depending on site conditions, seed availability, and other considerations; all four species occur on Base (Beale AFB 2016, A5-71- A5-84). Purple needlegrass is probably the most suitable candidate for upland grasslands; blue wildrye may also work, although it does not tend to provide as dense cover as purple needlegrass. Local sources of purple needlegrass are likely available, as it is the most commonly used native bunchgrass in California grassland restorations. In riparian or wetter sites, creeping wildrye (*Elymus triticoides*) and meadow barley (*Hordeum brachyantherum*) would probably be a good choices. It is important to use locally sourced seeds or plugs (i.e., local germplasm). Carefully analyze the restoration site prior to seeding or planting. Previous weed control activities may impact restoration success: for example, chlorsulfuron, a commonly used broadleaf-specific herbicide, may also kill species of the *Elymus* genus, which contains two of the native grasses mentioned above as well as the invasive grass, medusahead. Follow-up seeding has been effective in controlling both medusahead and yellow starthistle, if the phasing of the combined treatments is well-designed for the specific site (James et al. 2015, Kyser et al. 2013).

Although it may seem as though native species would be the obvious choice with which to restore a treated site, there are some important considerations to make before using them. The first is simply their commercial availability and, related to that, the issue of locally adapted genotypes (Knapp and Rice 1994; McKay et al. 2005). Many native species are either not available in sufficient quantities for large-scale reseeding or are very expensive. Even if a California native species is available, it may not be suitable for restoring a specific wildland site. California poppy (*Eschscholzia californica*) and purple needlegrass (*Stipa pulchra*) seeds, for example, are readily available in large quantities, although they can be expensive, but the seed often originates from and is produced somewhere else in the state and may be essentially a horticultural cultivar. Non-local plants may not thrive in a new location, resulting in the failure of the restoration project. Non-local plants can also contaminate the genome of local, naturally occurring populations of the native species (Stromberg et al. 2007). It may be possible to buy locally sourced seeds, or even harvest seeds from the site and have them agronomically increased. Care must be taken to collect seeds as broadly as possible within a local population, both to maintain the population's genetic variability and to avoid inbreeding depression, which could cause the restoration effort to fail (McKay et al. 2005). Although agronomic increase can potentially cause problems by changing a population's genome (Knapp and Rice 1994; McKay et al. 2005), it is likely to be a better choice than using non-local seeds. Again, however, it may not be possible to obtain seed in large enough quantities, and it is likely to be expensive. Knapp and Rice (1994) provide a useful guide to these issues for restoration practitioners.

Another obstacle is that native species, especially at the germination and seedling stages, tend to be poor competitors against the common non-native annual grasses and forbs that almost certainly will occur at any restoration site. Time and money may be wasted because native species germination and survival will be poor. This difficulty can be ameliorated to some degree by planting plugs instead of seeds; plugs tend to establish at much higher rates than seed, although they will still need watering and weeding for best results (Stromberg et al. 2007; Young and Veblen 2015). Plugs are more expensive than seed of the same species.

Finally, the site itself may not be ideal for restoration. In the context of invasive species management, a site is presumably selected for weed control concerns rather than for its suitability as a restoration site. For example, a site may have soil that was cultivated in the past or was otherwise disturbed. Even if the site is suitable for restoration in general, which native species are appropriate depends on the habitat characteristics of the site (Stromberg et al. 2007).

For these reasons, using non-native species for revegetating weed treatment sites that are already surrounded by non-native species may be the cheaper, easier, and more successful strategy. Soft chess (*Bromus hordeaceus*) and common wild oat (*Avena fatua*) seeds, for example, are both readily available and are cheap; they are ubiquitous across Beale and across the state so their use would not change the species composition of the California annual grassland; they make good forage if the site is to be grazed (grazing can help maintain a site after herbicide application, provided any restrictions on livestock use after application are obeyed); there are no concerns about local gene pool contamination; and they will reliably germinate and occupy the site, reducing the probability of reinvasion by less desirable species.

5.0 Weed Management Toolkit

Having a varied toolkit of available methods to control invasive species allows for a more nuanced approach to selecting and killing only the target species, making each application of herbicide or other removal technique as efficient as possible. Furthermore, a single weed management tool typically does not result in successful control (DiTomaso et al. 2007). To increase the likelihood of successful long-term control, weed management experts recommend combining several weed management methods, tailored to situation-specific goals, constraints, and opportunities (DiTomaso et al. 2007; NISC 2016). Mechanical methods may be preferable in some situations or with certain species, particularly tree species. Some trees and shrubs can be killed by girdling or cutting down at the base, while others may need a combination of mechanical and chemical treatments. Grazing may be the preferred method to control annual grass species, and this has the added benefit of maintenance of sensitive species habitat. Prescribed burning is also a highly effective control technique in many instances, although it can require substantial planning and logistical support. For all control methods, timing of treatment to coincide with the vulnerable phenological stage of the target species is an essential consideration (see Appendix B for species-specific timing). See DiTomaso et al. 2013 for further information on the control methods described below. The Cal-IPC website (http://cal-ipc.org/resources/booksandcds/index.php) also offers many free publications that provide details on control methods used in California.

5.1 General Weed Treatment Methods

- **Hand/Mechanical Removal.** Hand removal methods or the use of small hand-powered or handheld equipment (such as a weed-pulling tool or weed whacker) are often the first methods considered for removing small or new weed infestations. Whole weed plants removed using a weed-pulling tool, and weed material left over from weed-whacking or mowing efforts, should always be collected and disposed of in a manner that prevents spread to other areas; in some species, seed can ripen and disperse from plants that have been pulled up. This step is not critical if the weeds are treated before they produce viable propagules unless the weed is capable of vegetative reproduction (e.g., perennial pepperweed and many floating aquatic weeds).

  Hand removal may also be a good option for containing the leading edge of an infestation where target plants are mixed with desirable native species. Use caution in hand removal efforts that result in turned soil. These disturbed, bare areas can be quickly recolonized by the target weed or other weed species. Minimize disturbance where possible, and consider revegetating or seeding turned soil. For perennial species, especially trees, hand removal can take the form of girdling, but this will only be effective if the species is incapable of resprouting below the girdling cut.

- **Herbicides.** Herbicides are often used to manage dense or large weed infestations. Herbicides can often successfully control infestations that cannot be effectively or reasonably controlled through other management actions. Consider the herbicide's potential effect on surrounding vegetation, habitats, and wildlife (Cal-IPC 2015b). Some herbicides and surfactants should never be used where they may contaminate water bodies or wetlands. Timing of application is an important consideration. Pre-emergent herbicides are applied to the soil before weed seeds germinate, during fall before the rainy season has begun. Post-emergent herbicides are applied directly to the weeds once they have germinated and are actively growing. Selectivity of the herbicide (which types of plants the herbicide affects) is one of the most important considerations when choosing a chemical to apply in a wildland setting. Some herbicides are selectively more toxic to a range of species such as a group of families or broadleaf species only, while others are toxic to the majority of plants. Chemical companies conduct extensive testing on these effects, but actual toxicity in the field to many native plants as well as non-target species is unknown. When adequate background information is lacking, conduct small-scale tests to ensure that desirable or sensitive species are not damaged by the herbicide prior to its application at a large scale.

If herbicide use is being contemplated, it is important to account for the fact that some herbicides have restrictions for use in rangeland and grazing pastures, and treated areas may have to be excluded from livestock grazing for weeks or even an entire season, depending on the herbicide (DiTomaso et al. 2013, 510-511; Hulting 2016; Prather 2017). For example, clethodim, recommended for goatgrass control, is not registered for use on land grazed by livestock unless grazing is halted for 1-2 years (Beitz 2016). Although this trade-off may be well worth making in order to control a weed population, the restriction on livestock use should be planned for, in consultation with the grazing lessee. Herbicide use on rangeland weeds can also result in loss of organic certification for livestock that graze in the treated area; consult lessees with organic livestock operations before herbicides are used in their lease areas. Some organic certification-compatible herbicides are available, but information about their efficacy in range systems is generally limited. Available organic herbicides damage a plant upon contact but are not conveyed through the plant's vascular system so typically do not kill large or perennial plants; control of small, annual plants may be achievable. Available organic herbicides are also non-selective so will damage non-target plants if contact occurs (Cal-IPC 2015b, 9-10; Kyser 2015).

Herbicides must always be applied in accordance with the Air Force Pest Management Program, the Beale *Installation Pest Management Plan* (Beale AFB 2017a), General National Pollutant Discharge Elimination System Permit for Residual Aquatic Pesticide Discharges, and all applicable federal, Department of Defense, United States Air Force, State of California, and local directives and regulations. The Department of Defense maintains a list of approved pesticides, the 2016 version of which is supplied as Appendix E. Cal-IPC (2015b) has produced a useful publication on the use of herbicides in wildlands, especially relating to minimizing impacts on wildlife.

- **Grazing.** Livestock grazing during specific times and at carefully monitored intensity can help control populations of non-native plant species, including medusahead and other annual grassland species. Particularly in grassland/vernal pool complexes, grazing can have direct benefits to sensitive species (Marty 2005; 2015). Moderate grazing of non-native annual grasses reduces cover and thatch that inhibit native plant species from germinating and growing and can prevent the formation of some types of weed infestations. Well-timed, intensive grazing can also help to control infestations of weeds. However, poorly timed and overly heavy livestock use can also contribute to disturbance that may favor weed colonization. Some weed seeds can adhere to the coats of livestock and fall off elsewhere (Chuong et al. 2016) or pass through the digestive system of livestock without harm and be deposited with feces in other areas, creating additional pathways for the spread of infestations.

Using livestock to control invasive plants often requires prescription grazing, which is the application of specified livestock grazing actions to accomplish specific vegetation management goals. Grazing intensity, animal distribution, and grazing period are often rather different from standard, light to moderate intensity grazing, and livestock performance may be significantly reduced. Consequently, finding a lessee willing to implement a grazing prescription can prove difficult and may require reduced grazing fees or even payment to the livestock operator. Furthermore, intensive grazing, sometimes necessary for successful weed control, can have undesirable consequences: concentrated hoof impacts and greatly reduced vegetative cover could result in increased soil erosion, and greater area of bare ground may allow other weed species to thrive. In addition, intensive grazing may significantly impact desirable species in the weed-infested area. Those caveats noted, prescription grazing can work well in controlling some weed species (DiTomaso et al. 2007). An essential planning factor is that prescription grazing has to be timed to the target species' phenology. Grazing must occur when weeds are most vulnerable to defoliation; poorly timed grazing can actually benefit target species, like yellow starthistle (Huntsinger et al. 2007). Timing prescription grazing to avoid vulnerable periods for desirable plants like native bunchgrasses may also be necessary.

Deciding what species of livestock to employ for weed control in any particular area is based on considerations of the vegetation each species eats in relation to weed management goals and forage availability, of the site's topography, of the site's existing infrastructure, and of revenue needs. Cattle prefer to eat grass rather than forbs or shrubs; sheep eat both grass and forbs and can eat shrubs; goats eat shrubs, forbs, grass, and have a wide tolerance for plants that are toxic or too thorny/spiny for other ungulates; horses primarily eat grass and can crop vegetation very close to the ground (Larson et al. 2015). Livestock species also use the landscape differently, with sheep and goats generally able to use steeper terrain than cattle. Stockers (young, weaned cows) may be more willing to scale slopes than adult cows, especially those that are pregnant and/or lactating. Sheep and goats are typically herded and fenced in with mobile, often electric, fencing so they can be spatially and temporally controlled much more easily than cattle and horses. In addition, their water needs can often be met by mobile water sources. Sheep and goat operators are likely to be concerned about predators, including domestic dogs. Sheep and goats typically require a herder onsite with them at all times, and herding dogs may also be a necessary component of a sheep operation. As heavier animals, cattle and horses can have an impact on soil stability and creek banks (large numbers of smaller ungulates can also cause soil erosion). Cattle, in particular, are attracted to riparian areas, which can result in undesirable impacts. Sheep can be kept away from riparian areas, and goats tend to avoid water. Bedding locations for sheep can also be a concern and generally should be moved every few days to avoid damage to natural resources. Finally, cattle and sheep operators typically pay for the use of grazing land, whereas goat herd owners frequently charge land managers for employing their goats to control vegetation.

For details on grazing at Beale, consult the Base's *Grazing Management Guidelines* (Hopkinson 2017).

- **Prescribed Burning.** Prescribed burns are highly effective for controlling some species, particularly those present over large areas (e.g., over 100 acres). Beale has a *Wildland Fire Management Plan* (see Beale AFB 2016, A6-213-A6-221[5]), and one of its goals is to "[r]educe the abundance of undesirable plant species base-wide". Beale's three most troublesome grassland weeds, yellow starthistle, medusahead, and barbed goatgrass, can all be successfully controlled with prescribed burning. In addition, prescribed fire reduces hazardous fuel loads, removes thatch, recycles nutrients back into the soil, promotes several native fire-adapted species, and may help reduce the reestablishment of invasive species (DiTomaso and Johnson 2006). Because of air quality issues and concerns about fire escapes, prescribed burns require careful planning, coordination, and implementation to ensure success and may not be feasible in some portions of Beale because of potential conflicts with mission-critical operations. Prescribed burning is also likely to reduce forage production by as much as half in the first year or two following the fire and should be planned for in consultation with grazing lessees (RMAT 2000; Becchetti et al. 2011).

  As with other weed control methods, timing of treatment is an essential consideration. Grassland fires typically do not burn hot enough to kill the seeds once they have entered the soil so prescribed burns must occur while seeds are still held aloft and vulnerable to the fire's heat. Fire effects are often short-lived and so consecutive annual burns are often necessary for longer term control. Conversely, another control method, such as herbicide application, may be used to follow up the prescribed burn (DiTomaso et al. 2013). Some species cannot be controlled with burning; black mustard (*Brassica nigra*), for example, often flourishes following a fire. DiTomaso and Johnson (2006) is a useful handbook on burning for weed control.

- **Torching (Also Known as Flaming)**. Some weed infestations may be effectively treated using handheld propane torches to treat seedlings (DiTomaso et al. 2013, 471-472). Apply this method carefully and use only in winter or spring during or following rain events to limit the risk of wildfire. Torching may be best employed as a retreatment method to control new individuals germinating from a latent seed bank where an infestation was identified and treated the previous year. This method can be used to kill small seedlings that have recently germinated, before the seedlings have begun to flower or have gotten too large to easily kill using brief heat. This treatment can reduce the seed bank in the soil by killing the germinated seeds and preventing weed reproduction that would lead to additional seed production during that year. The method has the advantages of requiring relatively low effort and being precise. It kills weeds before

[5] A new version of the Base *Wildland Fire Management Plan* is in progress (Maia Lipschutz, pers. comm., October 2017).

propagules have been set and therefore does not require the collection and disposal of weed material. Also, it does not involve the use of chemicals that could affect surrounding vegetation and wildlife.

- **Mowing.** Regular mowing performed for fuels control and grounds maintenance is not an effective invasive species control technique and should be distinguished from a carefully timed and precisely executed weed mowing treatment. Mowing using tractors or hand-held string trimmers can be used to control annual species, but is generally less effective in controlling perennials (DiTomaso et al. 2013, 462-463). When mowed, many perennial species respond with rapid regrowth, although reproduction can be depressed if mowing is timed correctly or with sufficient frequency. For annual species control, mowing must be carefully timed to coincide with the target species' phenology. Ideal timing for annual grasses, including barbed goatgrass and medusahead, coincides with the earliest stages of seed-set when embryos are still milky and vegetation is no more than six inches tall (Stromberg and Kephart undated; Brownsey et al. 2016). If performed after this stage, when new seeds have become viable, mowing is likely to make the infestation more severe by spreading the seeds. In the case of barbed goatgrass, early mowing will stimulate rapid growth of new tillers that will produce more seed, while mowing that is performed too late will disperse the seeds (DiTomaso et al. 2013).

  Mowing presents a biosecurity threat from equipment that is used off Base that may transport weed seeds or vegetative propagules, as well as equipment that moves on Base from an area infested with a weed to an area that does not yet support it. In general, mowing is a technique for temporarily limiting the height of vegetation, and as such is not a recommended weed control strategy for Beale. Where its use is absolutely necessary, mow at the correct phenological stage and with appropriate cleaning best management practices implemented between sites.

5.2 Best Management Practices for Weed Management

Best management practices (BMP) range from programmatic recommendations for how goals are accomplished to specific protocols for executing tasks (Cal-IPC 2012; 2015b). Weed control BMPs can be recommended to contractors, residents, or Base divisions to guide their work and reduce the possibility that projects will introduce, spread, or increase weed infestations. Some BMPs will apply to all groups, while others are very specific to Base residents, grounds maintenance personnel, or grazing lessees. The BMP sections below are intended to be easily separated out from the larger document and provided to the appropriate user groups.

5.2.1 Prevention BMPs

- **Prevention BMP 1**: All livestock forage, seed, and erosion control materials should be certified weed free. To prevent the spread of invasive plants, County Agricultural Commissioners and the California Department of Food and Agriculture (CDFA) offer inspection services to certify materials as "weed free". Weed-free forage is defined as hay, feed, straw, or straw mulch that has been inspected and certified not to contain propagative plant parts or seeds found on the California noxious weed list, as listed in the California Code of Regulations, Title 3, Division 4, Chapter 6, Section 4500 (Appendix C). Appendix D contains the Cal-IPC list of weed free forage providers.

- **Prevention BMP 2**: Consider installing "shaker plates" or similar devices in roads near entrances to construction sites and other areas of ground disturbance and construction equipment access on Beale. Vehicle can also be washed (see Cal-IPC 2012 for details and vehicle washing checklist). Shaker plates are corrugated plates that vibrate and loosen seeds and soil attached to vehicles and equipment. Seeds and soil shaken loose from the vehicles and equipment are collected below the shaker plates. Monitor the plates for the growth of weedy species and spray any weeds observed to be germinating with an appropriate herbicide to prevent growth and the formation of seeds. Periodically remove soil accumulating below the shaker plates to retain their effectiveness.

- **Prevention BMP 3**: Tools used to manage or control vegetation, such as chainsaws, hand clippers, and pruners, should be washed before being used on Beale and before being moved from one location to another (i.e., from one weed treatment site to another).

- **Prevention BMP 4**: Earth-moving equipment brought onto Beale should be washed before use and before being moved from one location on the installation to another (i.e., from one construction site to another). Use water or compressed air to remove any visible plant material, soil or compacted mud, gravel, sand, etc.

Incorporate Prevention BMPs 1–5 into permits (e.g., work orders, NEPA documents, dig permits), leases, contracts, and similar agreements between Beale and its contractors, as appropriate (Section 6.1, Action Step 15).

- **Prevention BMP 5**: Base residents, grounds maintenance, and landscaping teams should not plant any invasive weed species listed on the Beale invasive plant species watch list (Appendix A), the State of California noxious weed list (Appendix C), or Tables 3.1 to 3.4 in these Beale *Updated Invasive Plant Species Management Guidelines* (2017).

- **Prevention BMP 6**: Develop and distribute biosecurity pamphlets or other instructional materials to applicable personnel including, but not limited to, the Grounds Maintenance Shop, Dry Creek Saddle Club, cattle grazing lessees, sheep or goat contractors, and Civil Engineering Shops that handle base construction and landscaping contracts. Install instructional material as posted signs at access points such as gates, corrals, trail heads, and near the stables of the Dry Creek Saddle Club. The instructional materials could consist of "Wanted" style posters for Watch List or Eradication-level invasive species, general information about weed prevention, and contact information for the responsible Base personnel. Cal-IPC (2015b) has already produced a series of identification cards for invasive species either known on Beale or with the potential to be on Base that are designed for this purpose. Also, consider the CalFlora weed observer smart phone app for weed reporting on Base (http://www.calflora.org/entry/applications2.html#smartphone).

- **Prevention BMP 7**: Dispose of all plant debris potentially containing reproductive plant parts (i.e., seeds or plant fragments for species that reproduce vegetatively) removed using mechanical methods at an offsite landfill or green waste facility in such a manner as to prevent the potential spread of seeds or other propagules from the collected materials to other locations. This action may require, but is not limited to, bagging the material before it is transported within or off the site.

5.2.2 Grazing BMPs

- **Grazing BMP 1:** Graze pastures in accordance with the Beale *Grazing Management Guidelines* and monitoring data, e.g., fall RDM monitoring.

- **Grazing BMP 2:** All supplemental feed should be certified weed free forage (see Prevention BMP 1 above).

- **Grazing BMP 3:** Regularly consult with the Dry Creek Saddle Club to ensure that management of species toxic to horses (for example, yellow starthistle and Russian knapweed) is effective.

- **Grazing BMP 4:** Regularly monitor horse riding trails for invasive species that may be introduced on tack, in hooves, or in supplemental feed.

- **Grazing BMP 5:** Grazing animals disperse seeds via their dung and their hides or coats (Chuong et al. 2016). If livestock graze in invasive-infested pastures, consider holding the animals in a weed-free transitional pasture for three or more days before moving them to uninfested locations (Cal-IPC 2012).

- **Grazing BMP 6**: Explicitly include grazing lessees in biosecurity and early detection efforts. Weed reporting could be by the methods suggested in Prevention BMP 7 or as part of the required monthly Animal Unit Month reports. Include weed reporting requirements in the Grazing Land Use Rules attached to Beale's grazing leases.

5.2.3 Mowing BMPs

- **Mowing BMP 1.** Mowers should be cleaned prior to arrival at Beale. Cleaning between locations while on Base is strongly recommended.

- **Mowing BMP 2.** Schedule mowing events to coincide with the correct phenological stage for the target species to prevent dispersal of seed or rapid regrowth of the target weed or other species.

- **Mowing BMP 3.** Ensure that mower height is appropriate for target weed species and desired effect.

- **Mowing BMP 4.** Because mowing often results in the subsequent transport of seeds to other locations, avoid grounds maintenance mowing in areas that are infested with particularly troublesome weeds.

5.1.4 Herbicide BMPs

- **Herbicide BMP 1:** Schedule herbicide application to maximize kill rate with regard to weather conditions and target species' phenology. The Weed Program Manager should be familiar with target species biology and seasonality of the Base and take these into account when scheduling herbicide application.

- **Herbicide BMP 2:** In areas with sensitive resources, use low-volume applications and reduce the amount of herbicide applied per acre. Consider spot applications versus broadcast applications whenever feasible to limit the effects of contamination of small mammals' insect-based diets (Cal-IPC 2015b).

- **Herbicide BMP 3:** When possible, time herbicide application to coincide with multiple species' phenology window to maximize efficiency.

- **Herbicide BMP 4:** Ensure that the most effective herbicide for the target species is used. If necessary, submit an AF Approval Request Form for Non-Standard Pesticides to the IPMC 30 calendar days prior to application to request herbicides be added to the list of DoD approved pesticides. Effectiveness includes the assumption that the chemical will not have deleterious effects on any sensitive resources near the application site.

- **Herbicide BMP 5:** Care must be taken on Beale where invasive species co-occur with sensitive wetland, amphibian, plant, and invertebrate resources. Consultation with the Beale NRM will occur if herbicide/surfactant use is planned within 250 feet of a wetland. Herbicide application at Beale within Clean Water Act jurisdictional wetlands or Waters of the US will require coverage under a National Pollutant Discharge Elimination System (NPDES) Aquatic Pesticide Permit (Section 6.1, Action Step 16). Any herbicide application within jurisdictional or biological wetlands may require an Aquatic Pesticide Applicator License.

- **Herbicide BMP 6:** Do not spray herbicides in wetlands or waters of the US when water is present unless specifically targeting aquatic weeds and all permits and permissions have been obtained for such use.

- **Herbicide BMP 7:** Do not use herbicides within the effective catchment or natural drainage area (as indicated by micro- and macro-topography) of a wetland where the herbicides may potentially run off into the wetland during the wet season (approximately 1 November to 1 May) or when the 2-week chance of rainfall is greater than 70% (Ripley et al. 2002/2003).

- **Herbicide BMP 8:** Ensure that all herbicide applicators know and can recognize sensitive resources including listed wildlife and plants, vernal pools, and nesting birds.

- **Herbicide BMP 9:** Protect nearby non-target vegetation by minimizing drift and applying only enough herbicide to effectively treat the target plants. Minimize drift by applying herbicide under low wind conditions, and within the heat tolerances of herbicides that may be volatile.

- **Herbicide BMP 10:** All pesticide applicators must hold current Qualified Applicator Certificates (minimum qualification) from the California Department of Pesticide Regulation and submit copies to the IPMC within 30 days of contract award date.

- **Herbicide BMP 11:** Herbicides can be used up to the edge of a wetland during the dry season, where edges are marked or monitored in the field by the NRM or other qualified biologist. Consultation with the USFWS may be required if herbicides are to be used inside a vernal pool at any time of year.

5.2.5 Monitoring BMPs

- **Monitoring BMP 1:** The Weed Program Manager or contractor, as assigned by the Weed Program Manager, should conduct regular inspections for weeds at infestation locations that are the focus of eradication or containment efforts, along major travel corridors, in active construction sites and other areas of ground disturbance, and along waterways, per the monitoring program outlined in the Early Detection-Rapid Response Work Plan (Appendix J). The frequency and intensity of weed inspections are expected to vary each year, based on the amount and timing of precipitation. In general, conduct inspections in late winter/early spring and late summer/early fall. These surveys should be feasible to conduct in approximately five days and should be a general area survey rather than detailed mapping of infestations. Perform detailed infestation mapping only for Eradication-level species or when a species may be directly threatening a sensitive resource (see Section 4.2 above). Map all weed inspection survey areas and identified weed problems using GIS equipment and add them to the ArcGIS database for tracking and management purposes.

- **Monitoring BMP 2:** The Weed Program Manager and/or contractor should determine protocols and scheduling for specific weed control actions based on the regular inspections and should determine the effectiveness of ongoing weed control actions to determine whether contingency actions are needed. Initially, this should consist of a review of existing data collection (2014 and 2016 weed surveys, and monitoring and implementation reports from contractors performing invasive species control work). If this existing information is determined to be insufficient to address the Weed Program's data needs, incorporate the monitoring methodology outlined in Section 4.3.

- **Monitoring BMP 3:** The contractor should maintain and regularly update a database of spatial and tabular data that allows tracking of weed populations and control efforts that the Weed Program Manager can review annually. Spatial data should include both general area surveys from Monitoring BMP 1 and any detailed infestation mapping data that are available (see Section 4.3).

6.0 Integrated Weed Management

These *Guidelines* address control of invasive plants across the Base as a whole. However, as described in Section 1.3, for natural resources management purposes, the Base is divided in various management and conservation areas. For some of these areas, the Weed Program Manager may find it useful to have work plans developed for the particular circumstances of that area, e.g., specific weed control issues, concerns about sensitive species or other resources found in the area, or military mission considerations such as BASH around the flightline. Concurrent with the drafting of these *Guidelines*, Beale is working with CEMML to develop weed control work plans for riparian areas (Appendix H) and for BASH Management Areas near the airfield (Appendix I); work plans for barbed goatgrass control (Appendix G) and an Early Detection-Rapid Response program (Appendix J) are also being produced. The area-specific work plans will address the current conditions, desired conditions, and management goals specific to the management areas they are addressing. This section addresses Base-wide conditions and goals.

Current invasive plant species management on Base includes herbicide application, mowing, grazing, prescribed burning, and monitoring (Beale AFB 2016, A2-33; CNLM 2016; HDR 2016). Yellow starthistle within the flightline has been treated with herbicide and weed-whacked (HDR 2016). Livestock grazing provides control for some of the Base's rangeland invasive species, such as medusahead, black mustard, and yellow starthistle. Giant reed has been treated in Dry Creek to improve aquatic habitat (Cal-IPC 2015a, 6). Prescribed burns have been used to control weeds on hundreds of acres near the Base's southern boundary (HDR 2016, 6), and burns for fuel reduction on Beale's weapons ranges and bomb disposal areas may have also controlled invasive species (Cal-IPC 2015a, 6). Medusahead, yellow starthistle, and barbed goatgrass have been monitored as part of the Grazing program's monitoring protocol (CNLM 2016).

Current conditions on Base are described in Sections 1 through 4 of these *Guidelines*. The 20 invasive species known or believed to occur on Beale are listed in Table 6.1, along with desired conditions for each species. Species descriptions, treatment options, and Base distribution maps for most of the species are to be found in Appendix B.

The desired condition for the Prevention and Eradication Stage species in Table 6.1 is zero density, that is, not one single individual remaining. When there are very few individuals during an early stage of invasion, metrics such as cover and frequency are unlikely to prove useful (see Section 4.3). In such instances, the manager is not sampling a population but censusing it, in other words, locating every single individual, and then eliminating it. In some cases, an infestation may be large enough that cover estimates are useful, but after initial treatments, any remaining individuals will need to be individually located and eliminated.

For larger populations of invasive species in the Containment and Asset-Based Protection stages, sampling metrics such cover and frequency are useful and usually essential, as a population census (a complete enumeration) is generally infeasible and likely to be inaccurate. Their desired conditions, therefore, are stated in terms of cover values.

Table 6.1: Invasion curve positions and desired conditions for Beale AFB invasive plant species; Base distribution information primarily from 2014 and 2016 Beale weed surveys (H.T. Harvey & Associates 2015; CEMML 2017); species information primarily from DiTomaso et al. (2013).

Invasion Curve Position	Common Name	Scientific Name	Cal-IPC Rating	Desired Condition	Rationale for Desired Condition
PREVENTION STAGE Zero Density Management: Section 3.2.1	Watch list species not currently recorded on Base (see Table 3.1 and Appendix A for full species list)			Monitor with Early Detection-Rapid Response surveys; if found, add to Eradication Stage section of this table and eradicate immediately	Cost-effectiveness of biosecurity approach
ERADICATION STAGE Zero Density Management: Section 3.2.2	giant reed	*Arundo donax*	High	Zero density within 5 years in all identified locations; collaborate with adjacent land managers to prevent re-infestation	Fairly limited distribution on Base; no viable seed but resprouts from rhizome and stem fragments
	waterprimrose	*Ludwigia hexapetala* and/or *L. peploides* ssp. *montevidensis*	High	Zero density within 2 years in all identified locations	Limited distribution on Base; seedlings rare but resprouts from stem fragments
	Russian knapweed	*Acroptilon repens*	Moderate	Zero density within 3 years in all identified locations	Limited distribution on Base; seeds last for 2-3 years, and seedlings uncommon, but resprouts from small root fragments

Invasion Curve Position	Common Name	Scientific Name	Cal-IPC Rating	Desired Condition	Rationale for Desired Condition
	tree-of-heaven	*Ailanthus altissima*	Moderate	Zero density within 5 years in all identified locations; collaborate with adjacent land managers to prevent re-infestation	Limited distribution on Base; seeds last 1 year but resprouts from creeping roots; may be invading from Spenceville Wildlife Area (Cal-IPC 2015a, 7)
	bull thistle	*Cirsium vulgare*	Moderate	Zero density within 4 years in all identified locations	Fairly limited distribution on Base; seeds last for 3+ years
	stinkwort	*Dittrichia graveolens*	Moderate	Zero density within 3 years in all identified locations	Limited distribution on Base; seeds last for < 3 years
	edible fig	*Ficus carica*	Moderate	Zero density within 10+ years in all identified locations	Limited distribution on Base; resprouts from roots and stem fragments
	black locust	*Robinia pseudoacacia*	Limited	Zero density within 10+ years in all identified locations	Limited distribution on Base; seedbank lasts for 10+ years and resprouts from roots
	Indian toothcup	*Rotala indica*	Unlisted	Zero density in all identified locations	Limited distribution on Base; under good conditions, can resprout from stem fragments; inadequate information to determine time to desired condition (Section 6.1, Action Step 17)

Invasion Curve Position	Common Name	Scientific Name	Cal-IPC Rating	Desired Condition	Rationale for Desired Condition
CONTAINMENT STAGE Long-Term Management: Section 3.2.3	barbed goatgrass	*Aegilops triuncialis*	High	Reduce and maintain cover at < 10% in treated areas after 2 years; monitor for and prevent spread into new areas	Clumped distribution on Base; literature suggests goal is achievable; seeds last for 2+ years
	skeletonweed	*Chondrilla juncea*	Moderate	Reduce and maintain cover at 10% after 3 years; monitor for and prevent spread into new areas	Scattered widely across Base, mostly at low cover; seeds last for < 3 years but can resprout from root fragments
	Klamathweed	*Hypericum perforatum*	Moderate	Reduce and maintain those sites with > 10% cover to < 5% cover; monitor for and prevent spread into new areas	Widespread across Base, mostly at low cover; seeds last for 50+ years and can resprout from rhizomes
	parrotfeather	*Myriophyllum aquaticum*	High	Insufficient information about abundance of weed on Base to determine feasible desired condition	May be abundant in Base ponds - survey necessary (Section 6.1, Action Step 18); does not develop seed but reproduces from rhizomes and stem fragments
	blessed milk thistle	*Silybum marianum*	Limited	Reduce and maintain cover at < 10% in upland areas within 10+ years	Fairly common in Base riparian areas, occasional in uplands; seeds last for at least 9 years
	vervain	*Verbena litoralis* and/or *V. bonariensis*	Unlisted but on Cal-IPC Watchlist	Reduce to 0% cover in satellite populations and where previously treated	Widespread in Base riparian areas at low cover; reproduces by seed

Invasion Curve Position	Common Name	Scientific Name	Cal-IPC Rating	Desired Condition	Rationale for Desired Condition
ASSET-BASED PROTECTION STAGE Long-tterm management: Section 3.2.4	yellow starthistle	*Centaurea solstitialis*	High	Reduce to < 20% cover within 4 years in areas where species is impacting sensitive natural resources or human activities (mission or recreational)	Widespread across Base, sometimes at high cover; literature suggests goal is achievable; most seeds last for 4 years but may last for 10 years
	medusahead	*Elymus [Taeniatherum] caput-medusae*	High	Reduce to < 25% cover within 2 years in areas that 1) have existing cover over 25%, 2) contain grazing operations unable to reduce RDM to target levels (600 lbs/ac fall RDM) over three years, or 3) contain Special Area Management Plan (SAMP) high value vernal pools and/or listed branchiopod populations	Ubiquitous across Base, commonly at high cover; literature suggests goal is achievable; seeds last for 2 years
	Himalayan blackberry	*Rubus armeniacus*	High	Reduce to < 5% cover in targeted areas; allow little/no fruit production	Widespread in Base riparian and wetland areas; seeds last only a few years in soil but resprouts from root fragments and stem tip rooting; NOTE: important nesting habitat for tricolored blackbird

Invasion Curve Position	Common Name	Scientific Name	Cal-IPC Rating	Desired Condition	Rationale for Desired Condition
	black mustard	*Brassica nigra*	Moderate	Reduce to < 5% cover in areas where species is impacting sensitive natural resources or human activities (mission or recreational)	Widespread in Base riparian and wetland areas, generally at low cover; seeds last for 50+ years
	Italian thistle	*Carduus pycnocephalus*	Moderate	Reduce to < 5% cover in areas where species is impacting sensitive natural resources or human activities (mission or recreational)	Widespread across Base, generally at low cover; seeds last only a few years in soil but are readily wind dispersed from untreated areas

6.1 Weed Management Action Steps

1. Update every five to eight years the analysis that assesses the Cal-IPC rating and the invasive curve stage for all invasive species potentially or actually found on Base.

2. Update every two to four years the Beale invasive plant species Watch List (Appendix A) using the Cal WeedMapper for Yuba County.

3. If any of the species in Table 3.1 or on the larger Cal WeedMapper list (Appendix A) is observed at Beale, document and remove it immediately (see section 3.2.2). If possible, determine the vector that introduced the original propagule so that the pathway can be analyzed and addressed to prevent further introductions.

4. Implement the Beale AFB Early Detection-Rapid Response (EDRR) Work Plan (Appendix G). Consider the CalFlora weed observer smart phone app for EDRR weed reporting on Base (http://www.calflora.org/entry/applications2.html#smartphone). Design and print biosecurity pamphlets; distribute to appropriate Beale departments, Base contractors, grazing lessees, other users. Design, produce, and install EDRR signage at strategic locations on Base (e.g., gates, corrals, recreational trails). Develop invasive plant educational announcements (including any future success stories), reproduce annually, and include on signage.

5. Assess Beale's landscaping plant and no-plant lists. Add giant reed and black locust to list of species that should not be planted.

6. Investigate opportunities for collaboration on giant reed control with upstream land managers.

7. Given the potential ecological and economic impacts of invasive waterprimroses but their apparently limited distribution on Base, promptly:
   - determine waterprimrose location(s) on Base,
   - positively identify the species and its current extent, and
   - if it is an invasive species, implement control measures with the goal of eradication.

8. Confirm whether Russian knapweed is present at Pond 4 and if so, proceed with eradication efforts. If not, move Russian knapweed to the Prevention-stage list (Table 3.1).

9. Collaborate on tree-of-heaven control with land manager of adjacent property that contains large population of tree-of-heaven.

10. Survey open-water in ponds, creeks, etc. for parrotfeather (*Myriophyllum aquaticum*) to establish its extent and abundance on Base.

11. Produce an asset-based protection spatial analysis and work plan for each of the species in the Asset-Based Protection Stage (Table 3.4).

12. Review these *Updated Invasive Plant Species Management Guidelines* annually and update as necessary.

13. To prevent spread of weeds by grounds maintenance mowing, create maps for the grounds maintenance shop of 'no-mow' areas that are infested with particularly troublesome plants that are likely to be spread by mowing (e.g., Early Detection-Rapid Response program species such as stinkwort). In these 'no mow' areas, grounds maintenance could use roadside herbicide spraying instead of mowing.

14. Ensure monitoring efforts are designed to measure criteria used in Table 6.1's desired conditions to document program progress and successes. Review all data annually and adjust program priorities within an adaptive management process.

15. Incorporate Prevention BMPs 1–5 into permits (e.g., work orders, NEPA documents, dig permits), leases, contracts, and similar agreements between Beale and its contractors, as appropriate.

16. Apply for a National Pollutant Discharge Elimination System (NPDES) Aquatic Pesticide Permit.

17. There is inadequate control information to determine time to desired condition for Indian toothcup (*Rotala indica*). Consult with experts to determine time to desired condition.

18. Survey Base ponds and marshes for parrotfeather (*Myriophyllum aquaticum*). Determine extent and abundance of species, assign it to an invasive stage, and develop treatment plan.

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URLs correct as of July 2017.

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Personal communications

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Theresa Becchetti, Farm Advisor, University of California Cooperative Extension, November 2017.

Ann Bedlion, Natural Resources Manager, Beale AFB, January 2017.

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Charles McClain, Restoration Ecologist, H. T. Harvey & Associates, July 2017.

SSgt Jennifer Smith, Weather Forecaster, Beale AFB, August 2017.

Matt Wacker, Senior Associate Ecologist, H. T. Harvey & Associates, July and November 2017.

Lauren Wilson, Regional Biologist, Travis Installation Support Team, multiple occasions, 2016-2017.

Appendix A: Beale AFB Invasive Plant Species Watch List – the Cal-IPC WeedMapper Report for Yuba County

Appendix D contains the Beale AFB invasive plant species watch list. These are plants that are not known to occur on the Base but are known to occur within Yuba County or in the surrounding region. The list was generated in July 2017 from the California Invasive Plant Council's (Cal-IPC) Cal WeedMapper tool (http://calweedmapper.cal-ipc.org/), which compiles plant occurrence reports from Calflora, The Consortium of California Herbaria, and agencies throughout the state with data on invasive plant distribution from a statewide network of local experts (see final page of this Appendix for further details). Invasive species occurrences are mapped at a resolution of the United States Geological Survey 7.5-degree quadrangle (approximately 8 miles by 6 miles) so distribution information is coarse, and many of the species that appear on this county list are highly unlikely to appear at a particular site because the available habitat is unsuitable. This watch list should be updated every two to four years, using the Cal WeedMapper tool, and may be further refined for characteristics such as habitat and likelihood of arrival on Base.

This watch list is intended to be used by Beale weed managers and contractors during monitoring and control activities, and any species on the list that are detected should be prioritized for eradication as soon as phenology allows. If possible, the vector that introduced the original propagule should be determined so that it can be analyzed and possibly addressed to prevent further introductions. A full integration of this tool with Beale weed management would also include feeding information back in to the Cal WeedMapper system by submitting weed distribution reports to CalFlora (see http://calweedmapper.cal-ipc.org/spatial-data/ for instructions on submitting weed data).

INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN Yuba County

This report summarizes invasive plant management opportunities in Yuba County. Opportunities are determined from maps of each species' current distribution and suitable range. Species are listed by three types of management opportunity:

- **Surveillance** – surveying to detect new infestations
- **Eradication** – complete removal of infestations
- **Containment** – limiting further spread of infestations

Below is a sample of opportunities in Yuba County. This information should be combined with local knowledge to set local priorities (see "Using the Report" at the end of this document.) Click on a plant's name below to view a map of that species.

Opportunities:

These are some opportunities in Yuba County. Tables on proceeding pages of this report contain a complete list of invasive plant management opportunities.

Surveillance:

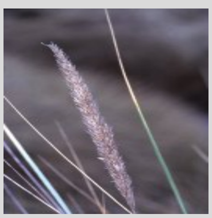
Photo © Regents of the University of California
Ammophila arenaria
European beachgrass


Photo courtesy of: Cal-IPC
Brassica tournefortii
Saharan mustard, African mustard


Photo courtesy of: Elizabeth Brusati
Carpobrotus edulis
Hottentot-fig, iceplant


Photo © Regents of the University of California
Cortaderia jubata
jubatagrass


Photo © Regents of the University of California
Ehrharta calycina
purple veldtgrass

Eradication:

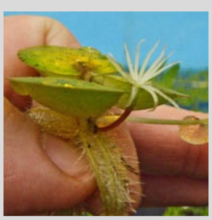
Photo courtesy of: CDFA
Limnobium laevigatum
South American spongeplant


Photo courtesy of: Janet Garcia
Cynara cardunculus
artichoke thistle


Photo © Regents of the University of California
Saccharum ravennae
ravennagrass

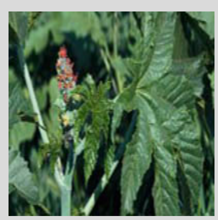
Photo © Regents of the University of California
Ricinus communis
castorbean

Containment:


Photo © Regents of the University of California
Aegilops triuncialis
barb goatgrass

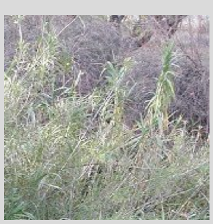
Photo © Regents of the University of California
Arundo donax
giant reed

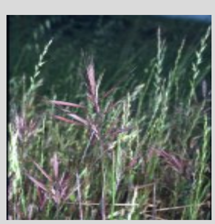
Photo © Regents of the University of California
Bromus madritensis ssp. rubens
red brome

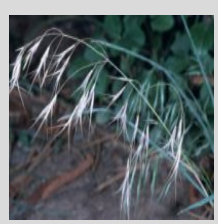
Photo © Regents of the University of California
Bromus tectorum
downy brome, cheatgrass


Photo © Regents of the University of California
Centaurea stoebe ssp. micranthos
(=*Centaurea maculosa*)
spotted knapweed

Cal WeedMapper

INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN
Yuba County

Surveillance Opportunities

These opportunities entail regular surveys to detect new infestations of species not known to be present in the region. The strategic potential depends on the proximity of nearby infestations and the suitability of the area. The table below includes species occurring within 50 miles of the selected region.

Plant Species: Grouped by Statewide Cal-IPC Rating	Suitable Range 2010	Suitable Range 2050
High (7 species)		
Ammophila arenaria European beachgrass	0 %	▬
Brassica tournefortii Saharan mustard, African mustard	0 %	▬
Carpobrotus edulis Hottentot-fig, iceplant	0 %	▬
Cortaderia jubata jubatagrass	0 %	▬
Ehrharta calycina purple veldtgrass	0 %	▬
Onopordum acanthium Scotch thistle	0 %	▬
Ulex europaeus gorse	0 %	▬
Moderate (28 species)		
Acacia dealbata silver wattle	84%	▬
Alhagi maurorum camelthorn	-	-
Arctotheca calendula *(=Arctotheca calendula fertile)* fertile capeweed	-	-
Arctotheca prostrata *(=Arctotheca calendula infertile)* sterile capeweed	-	-
Asparagus asparagoides bridal creeper	0 %	▬
Atriplex semibaccata Australian saltbush	1 %	▬
Carduus nutans musk thistle	12 %	▼
Carthamus lanatus woolly distaff thistle	0 %	▲
Centaurea calcitrapa purple starthistle	84%	▲
Centaurea diffusa diffuse knapweed	90 %	▼▼
Centaurea virgata ssp. squarrosa squarrose knapweed	-	-
Cotoneaster lacteus Parney's cotoneaster	-	-
Cotoneaster pannosus silverleaf cotoneaster	9 %	▲
Cynoglossum officinale houndstongue		-
Ehrharta erecta erect veldtgrass	0 %	▬
Elaeagnus angustifolia Russian-olive	-	-

Cal WeedMapper

INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN

Yuba County

Surveillance Opportunities, Continued

Plant Species: Grouped by Statewide Cal-IPC Rating	Suitable Range 2010	Suitable Range 2050
Halogeton glomeratus halogeton	0 %	▬
Ilex aquifolium English holly	0 %	▬
Isatis tinctoria dyer's woad	72 %	▼▼
Linaria dalmatica ssp. dalmatica *(=Linaria genistifolia ssp. dalmatica)* Dalmatian toadflax	21 %	▼
Linaria vulgaris yellow toadflax, butter and eggs	14 %	▼
Pennisetum setaceum crimson fountaingrass	0 %	▲▲
Fallopia japonica *(=Polygonum cuspidatum)* Japanese knotweed	-	-
Fallopia sachalinensis *(=Polygonum sachalinense)* Sakhalin knotweed	-	-
Salsola soda oppositeleaf Russian thistle	-	-
Sisymbrium irio London rocket	0 %	▬
Tanacetum vulgare common tansy	-	-
Washingtonia robusta Mexican fan palm	-	-
Limited (12 species)		
Acacia melanoxylon black acacia, blackwood acacia	0 %	▬
Bassia hyssopifolia fivehook bassia	-	-
Lobularia maritima sweet alyssum	-	-
Stipa manicata *(=Nassella manicata)* tropical needlegrass	-	-
Pennisetum clandestinum kikuyugrass	0 %	▲
Phoenix canariensis Canary Island date palm	-	-
Phytolacca americana common pokeweed	-	-
Stipa miliacea var. miliacea *(=Piptatherum miliaceum)* smilograss	6 %	▲▲
Ranunculus repens creeping buttercup	-	-
Salsola paulsenii barbwire Russian-thistle	-	-
Schinus molle Peruvian peppertree	-	-
Tamarix aphylla athel tamarisk	-	-

INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN

Yuba County

Eradication Opportunities

Eradication entails complete removal of all infestations in the area. These opportunities result from a small number of isolated infestations. The spatial pattern for eradication is one infested quad surrounded by at least two concentric bands of absence quads. The strategic importance of an eradication opportunity can be further assessed based on the degree of isolation as well as the suitability of the surrounding area. Determining the feasibility of eradication requires surveying infestations in the field.

Plant Species: Grouped by Statewide Cal-IPC Rating	Current Species Distribution (number of quads out of 21 total)				Suitable Range		
	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
High (1 species)							
Limnobium laevigatum South American spongeplant	1	0	0	0	-	-	-
Moderate (2 species)							
Cynara cardunculus artichoke thistle	1	0	0	1	7 %	20 %	-
Saccharum ravennae ravennagrass	1	0	0	0	-	-	-
Limited (1 species)							
Ricinus communis castorbean	1	0	0	0	0 %	-	-

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INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN
Yuba County

Containment Opportunities

Containment entails limiting the spread from existing infestations. These opportunities result from larger groups of infested quads. The strategic importance of a containment opportunity can be further assessed based on how distinct the boundaries of the infestation are, how isolated it is, and the suitability of the surrounding area. Determining the feasibility of containment requires surveying infestations in the field.

	Current Species Distribution (number of quads out of 21 total)				Suitable Range		
Plant Species: Grouped by Statewide Cal-IPC Rating	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
High (26 species)							
Aegilops triuncialis barb goatgrass	13	9	1	0	89 %	62 %	▬
Arundo donax giant reed	9	3	1	0	76 %	47 %	▬
Bromus madritensis ssp. rubens red brome	16	3	0	0	15 %	100 %	▲
Bromus tectorum downy brome, cheatgrass	9	3	0	0	34%	82 %	▬
Centaurea stoebe ssp. micranthos (=Centaurea maculosa) spotted knapweed	1	0	0	1	40 %	10 %	▼
Centaurea solstitialis yellow starthistle	21	18	11	0	97 %	100 %	▬
Cortaderia selloana pampasgrass	5	0	0	0	5 %	100 %	▬
Cytisus scoparius Scotch broom	11	9	3	0	46 %	92 %	▬
Egeria densa Brazilian egeria	11	0	0	0	-	-	-
Eichhornia crassipes water hyacinth	3	3	3	0	-	-	-
Foeniculum vulgare fennel	6	0	0	0	71 %	32 %	▼▼
Genista monspessulana French broom	10	3	3	0	50 %	67 %	▬
Hedera helix and H. canariensis English ivy, Algerian ivy	4	1	0	0	10 %	31 %	▲▲
Hydrilla verticillata hydrilla	4	0	2	1	-	-	-
Lepidium latifolium perennial pepperweed	6	5	0	0	88 %	29 %	▼
Ludwigia hexapetala and L. peploides Uruguay and creeping water-primrose	12	0	12	0	-	-	-
Ludwigia peploides creeping water-primrose	1	0	0	0	-	-	-
Lythrum salicaria purple loosestrife	6	2	4	0	-	-	-
Myriophyllum aquaticum parrotfeather	14	1	12	0	-	-	-
Myriophyllum spicatum Eurasian watermilfoil	12	0	11	0	-	-	-
Rubus armeniacus (=Rubus discolor) Himalayan blackberry	21	8	1	0	-	-	-
Sesbania punicea red sesbania, scarlet wisteria	10	3	2	0	60 %	63 %	▼
Spartium junceum Spanish broom	10	6	6	0	64%	56 %	▲
Elymus caput-medusae (=Taeniatherum caput-medusae) medusahead	14	3	1	0	100 %	67 %	▬

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INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN
Yuba County

Containment Opportunities, Continued

Plant Species: Grouped by Statewide Cal-IPC Rating	Current Species Distribution (number of quads out of 21 total) Infested	Spreading	Managed	Eradicated	Suitable Range 2010	Infested	2050
Tamarix parviflora smallflower tamarisk	4	0	0	0	-	-	-
Tamarix ramosissima saltcedar, tamarisk	1	0	0	0	-	-	-
Moderate (41 species)							
Acroptilon repens Russian knapweed	1	0	1	0	53 %	5 %	▼▼
Ailanthus altissima tree-of-heaven	17	14	1	0	78 %	81 %	▬
Anthoxanthum odoratum sweet vernalgrass	7	0	0	0	-	-	-
Avena barbata and A. fatua (slender) wild oat	21	0	0	0	-	-	-
Brachypodium distachyon annual false-brome, false brome	9	1	1	0	65 %	50 %	▼▼
Brassica nigra black mustard	17	6	0	0	-	-	-
Bromus diandrus ripgut brome	21	0	0	0	93 %	100 %	▬
Lepidium chalepense (=Cardaria chalepensis and C. draba) Lepidium chalepensis and L. draba	6	4	4	0	-	-	-
Centaurea melitensis Malta starthistle, tocalote	12	7	1	0	64%	63 %	▬
Chondrilla juncea rush skeletonweed	12	10	10	0	96 %	57 %	▼▼
Cirsium arvense Canada thistle	3	0	0	0	27 %	30 %	▼
Cirsium vulgare bull thistle	21	0	0	0	92 %	100 %	▼
Conium maculatum poison-hemlock	15	0	0	0	21 %	100 %	▼
Cynodon dactylon bermudagrass	21	0	0	0	-	-	-
Cynosurus echinatus hedgehog dogtailgrass	15	0	0	0	93 %	71 %	▬
Dipsacus fullonum and D. sativus common and Fuller's teasel	6	3	0	0	47 %	46 %	▼▼
Dittrichia graveolens stinkwort	4	1	1	0	55 %	31 %	▼▼
Eucalyptus globulus Tasmanian blue gum	5	0	0	0	0 %	-	▬
Festuca arundinacea tall fescue	6	0	0	0	-	-	-
Ficus carica edible fig	11	5	0	0	75 %	58 %	▲
Geranium dissectum cutleaf geranium	18	0	0	0	-	-	-
Glyceria declinata waxy mannagrass	4	0	0	0	84%	21 %	▬

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INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN Yuba County

Containment Opportunities, Continued

Plant Species: Grouped by Statewide Cal-IPC Rating	Current Species Distribution (number of quads out of 21 total): Infested	Spreading	Managed	Eradicated	Suitable Range: 2010	Infested	2050
Hirschfeldia incana shortpod mustard, summer mustard	15	0	0	0	-	-	-
Holcus lanatus common velvet grass	13	0	0	0	56 %	81 %	▬
Hordeum marinum Mediterranean barley	14	0	0	0	-	-	-
Hordeum murinum hare barley	14	0	0	0	-	-	-
Hypericum perforatum common St. John's wort, klamath weed	16	8	12	0	-	-	-
Hypochaeris radicata rough catsear, hairy dandelion	21	0	0	0	-	-	-
Leucanthemum vulgare ox-eye daisy	15	0	0	0	16 %	100 %	▼
Festuca perennis (=Lolium multiflorum) Italian ryegrass	20	1	0	0	63 %	100 %	▬
Mentha pulegium pennyroyal	4	0	0	0	-	-	-
Nicotiana glauca tree tobacco	5	0	0	0	0 %	100 %	▲▲
Oxalis pes-caprae Bermuda buttercup, buttercup oxalis	3	0	0	0	-	-	-
Phalaris aquatica hardinggrass	4	0	0	0	-	-	-
Potamogeton crispus curlyleaf pondweed	6	0	0	0	-	-	-
Rumex acetosella red sorrel, sheep sorrel	16	0	0	0	-	-	-
Triadica sebifera (=Sapium sebiferum) Chinese tallowtree	12	12	0	0	-	-	-
Torilis arvensis hedgeparsley	17	8	0	0	84%	81 %	▲
Trifolium hirtum rose clover	21	0	0	0	-	-	-
Vinca major big periwinkle	14	12	1	0	42 %	88 %	▼
Festuca myuros (=Vulpia myuros) rattail fescue	21	0	0	0	-	-	-
Limited (38 species)							
Agrostis avenacea Pacific bentgrass	8	0	0	0	-	-	-
Agrostis stolonifera creeping bentgrass	11	2	0	0	-	-	-
Bellardia trixago bellardia	1	0	0	0	-	-	-
Brassica rapa birdsrape mustard, field mustard	21	0	0	0	-	-	-
Briza maxima big quakinggrass, rattlesnakegrass	11	2	0	0	72 %	58 %	▬

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INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN Yuba County

Containment Opportunities, Continued

Plant Species: Grouped by Statewide Cal-IPC Rating	Current Species Distribution (number of quads out of 21 total)				Suitable Range		
	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
Bromus hordeaceus soft brome	19	0	0	0	-	-	-
Bromus japonicus Japanese brome, Japanese chess	4	0	0	0	-	-	-
Lepidium appelianum (=Cardaria pubescens) hairy whitetop	4	0	0	0	-	-	-
Carduus tenuiflorus and C. pycnocephalus slenderflower and Italian thistle	17	5	1	0	-	-	-
Cotula coronopifolia brassbuttons	1	0	0	0	-	-	-
Crataegus monogyna hawthorn	6	0	0	0	-	-	-
Dactylis glomerata orchardgrass	16	0	0	0	64%	89 %	▲
Descurainia sophia flixweed, tansy mustard	2	0	0	0	-	-	-
Digitalis purpurea foxglove	3	0	0	0	-	-	-
Erodium cicutarium redstem filaree	21	0	0	0	-	-	-
Eucalyptus camaldulensis red gum	3	0	0	0	-	-	-
Euphorbia oblongata oblong spurge	1	1	1	0	78 %	5 %	▬
Hypochaeris glabra smooth catsear	21	0	0	0	-	-	-
Iris pseudacorus yellowflag iris	1	0	0	0	-	-	-
Lythrum hyssopifolium hyssop loosestrife	5	1	0	0	-	-	-
Marrubium vulgare white horehound	16	0	0	0	-	-	-
Medicago polymorpha California burclover	21	0	0	0	-	-	-
Olea europaea olive	4	2	0	0	-	-	-
Parentucellia viscosa yellow glandweed, sticky parentucellia	7	0	0	0	75 %	37 %	▬
Helminthotheca echioides (=Picris echioides) bristly oxtongue	1	0	0	0	46 %	8 %	▼▼
Plantago lanceolata buckhorn plantain, English plantain	21	0	0	0	-	-	-
Poa pratensis Kentucky bluegrass	20	0	0	0	-	-	-
Polypogon monspeliensis rabbitfoot polypogon	13	0	0	0	-	-	-
Prunus cerasifera cherry plum	16	0	0	0	-	-	-
Pyracantha angustifolia, crenulata, seratus, etc. pyracantha, firethorn	3	0	0	0	-	-	-

Containment Opportunities, Continued

Plant Species: Grouped by Statewide Cal-IPC Rating	Current Species Distribution (number of quads out of 21 total)				Suitable Range		
	Infested	Spreading	Managed	Eradicated	2010	Infested	2050
Raphanus sativus radish	20	0	0	0	-	-	-
Robinia pseudoacacia black locust	17	1	0	0	-	-	-
Rumex crispus curly dock	20	0	0	0	-	-	-
Salsola tragus Russian-thistle	10	0	0	0	-	-	-
Saponaria officinalis bouncingbet	5	1	0	0	-	-	-
Silybum marianum blessed milkthistle	13	0	0	0	58 %	93 %	-
Sinapis arvensis wild mustard, charlock	1	0	0	0	-	-	-
Verbascum thapsus common mullein, woolly mullein	21	0	0	0	-	-	-

Legend and Terminology

For each species, statistics are generated from maps. The statistics are divided into two parts: current species distribution and suitable range.

Current Species Distribution

- Infested: Number of quads that are infested with this species (relative to total number of quads in the selected region of interest)
- Spreading: Number of quads where this species is spreading,
- Managed: Number of quads where this species is under management,
- Eradicated: Number of quads where this species has been eradicated,

Suitable Range

- 2010: Percent of the selected region of interest that currently meets the minimum threshold for suitability for the species,
- Infested: Percent of the current suitable range that is infested.
- 2050: Change in suitability between 2010 and 2050, with an arrow representing an increase or decrease of greater than 10%, and a double arrow indicating change of greater than 40%.

▲▲ Increase of 40% or more
▲ Increase of 10% to 39%
▬ No change (less than 10% change either direction)
▼ Decrease of 10% to 39%
▼▼ Decrease of 40% or more

Cal WeedMapper

INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN

Yuba County

Using This Report

This report, together with Regional Species Map Reports, summarizes management opportunities for the selected region. This report, together with Regional Species Maps, is designed to inform strategic management decisions at a landscape level. Regional coordinating bodies can use these reports as a starting place for setting priorities and establishing goals. Surveillance priorities can be focused to strengthen early detection. Eradication and containment priorities are based on factors such as how widely a species has spread. This landscape-level view provides a strategic foundation for developing and implementing on-the-ground programs.

Management opportunities are identified in three categories determined by the species' spatial distribution. While each plant species is listed in only one category, multiple management approaches can be appropriate in a given region. Assessing the feasibility of a particular management measure requires additional detailed assessment.

1. Surveillance – Surveillance entails regular surveys to detect new infestations of species not known to be present in a region. The strategic potential depends on the proximity of nearby infestations and the suitability of the area. The table in this report includes species occurring within 50 miles of the selected region.

2. Eradication – Eradication entails complete removal of all infestations in the area. These opportunities result from small, isolated infestations. The spatial pattern for eradication is one infested quad surrounded by at least two concentric bands of absence quads. The strategic importance of an eradication opportunity can be further assessed based on the degree of isolation as well as the suitability of the surrounding area. Determining the feasibility of eradication requires surveying infestations in the field.

3. Containment – Containment entails limiting the spread from existing infestations. These opportunities result from larger groups of infested quads. The strategic importance of a containment opportunity can be further assessed based on how distinct the boundaries of the infestation are, how isolated it is, and the suitability of the surrounding area. Determining the feasibility of containment requires surveying infestations in the field.

For each type of opportunity, plant species are organized by their rating in Cal-IPC's Inventory, which uses a uniform methodology to categorize non-native plants that pose a substantial threat to the state's wildlands. The Cal-IPC rating combines information about ecological impacts, invasive potential and ecological distribution to rate species as High, Moderate or Limited at a statewide level. Regional impacts may differ.

Cal WeedMapper

INVASIVE SPECIES MANAGEMENT OPPORTUNITIES IN

Yuba County

About This Report

This report is generated from an online mapping system developed by the nonprofit California Invasive Plant Council and hosted at Calflora. The site allows the state's network of local experts to maintain updated data on invasive plant distribution statewide. CalWeed Mapper is integrated with the Calflora invasive plant database to reflect new occurrence data submitted to Calflora. Maps and reports generated are snapshots of a dynamic system and should be revisited on a regular basis to ensure that information is current.

In order to cover 200 species over the entire state, the mapping approach used in this work is necessarily coarse. The maps are not sufficient for planning the details of on-the-ground management, which requires information at a much higher resolution. (As you generate such detailed information, please share your data with Calflora.org. More information may be found at CalWeedMapper under Spatial Data.) Cal-IPC interviewed hundreds of natural resource managers around the state to collect a baseline of "expert knowledge" on abundance, spread and management by USGS 7.5-degree quadrangle (approximately 8 mi x 6 mi). We also incorporated datasets of occurrence observations from Calflora, The Consortium of California Herbaria, and agencies throughout the state. However, the vast majority of the presence documented in these maps comes solely from expert knowledge; no occurrence observations exist in online databases.

We predict suitable range for a given species by using modeling software that combines the species' current distribution with environmental variables (model results are reviewed by invasive plant experts). The resulting maps show areas that have the highest probability of being suitable. Future suitable range is based on commonly used scenarios from the Intergovernmental Panel on Climate Change. Details about modeling methods can be found at CalWeedMapper under About.

The distribution and suitability maps are not expected to be 100% accurate. Data drawn from expert knowledge, while having the great benefit of drawing on the extensive experience of individual local resource managers, can nonetheless be inaccurate. Data drawn from GIS datasets, though of higher precision, may not always be accurate, either, since those conducting the mapping may have misidentified the species or not captured the location correctly. In addition, conditions on the ground may have changed since the observation was filed, making the record out of date.

By engaging local experts statewide to check each others' work, CalWeedMapper can steadily increase the accuracy of the maps. Our goal is to maintain up-to-date statewide maps of invasive plant distribution.

Appendix B: Species-Specific Treatment Options

Barbed Goatgrass

Barbed goatgrass (*Aegilops triuncialis*) is an annual grass (Poaceae family) native to Mediterranean Europe and western Asia. It has a severe impact on California ecosystems (Cal-IPC 2014). Barbed goatgrass germinates with the onset of fall rains and matures between May and August. It produces dense stands and slowly decomposing thatch that outcompetes and excludes desirable rangeland plants. Its jointed inflorescence produces long, barbed awns that can cause injury to livestock and other wildlife. This species invades disturbed sites typically in dry fields, pastures, and roadsides, including undisturbed grassland and rangeland and lower elevation oak woodlands. Seeds are dispersed when barbed awns attach to livestock and wildlife and when they are transported in hay. Seeds can remain dormant for 2–5 years (Davy et al. 2008). Control of goatgrass is typically achieved with prescribed fire or with herbicides because this annual grass species is mostly unpalatable to livestock. Recent research indicates that the goatgrass genotype present in Yuba County is largely resistant to competition with other species and so attempts to control the species by increasing native plant populations are not likely to be successful (Gomola et al. 2017).

- **Mechanical control**: Barbed goatgrass is best controlled mechanically by intensive grazing or mowing at early stages of seed head emergence (Davy et al. 2008). Grazing or mowing early in the growing season may favor barbed goatgrass over desirable species because barbed goat grass matures more slowly than other rangeland grasses and forbs.
- **Herbicides**: Herbicide should be applied from fall through spring (September through March) to new seedlings exhibiting at least the three-leaf growth state but before 8-inch plant canopy height. For dense, large, primarily contiguous infestations, aerial or ground applications with broadcast boom technology should be used. For scattered individual plants or isolated patches, or where sensitive plant species are present, handheld or backpack applications should be used for spot treatment. See Table B.1 for herbicide application recommendations.
- **Prescribed fire**: A barbed goatgrass seed is often twinned with a smaller seed that is inhibited from germinating by its larger sibling seed. This second, smaller seed tends to germinate the year after its larger twin. Consequently, several studies have recommended that multiple burns, ideally two consecutive annual burns, are needed for effective control of goatgrass (DiTomaso et al. 2001, Hopkinson et al. 1999). A single burn is unlikely to kill the small seeds that then germinate the following season. A recent report by Marty et al. (2015), however, suggests that in a year with high biomass production and therefore high fuel loading, a prescribed fire will likely burn hot enough to kill most of the seeds and achieve control for several years after the burn. Goatgrass seedheads remain on the plant later into the summer than seedheads of most other annual grassland species. Therefore, an appropriately timed burn can kill goatgrass seeds aboveground but not affect more desirable forage and/or native species seeds that have already shattered and entered the soil. Marty et al. (2015) burned in June and saw not only reduced goatgrass germination and cover (1% and 3% respectively) but also an increase in native species richness. DiTomaso et al. (2001) noted that goatgrass phenology “varied dramatically depending on seasonal climatic conditions” so their 1st burn occurred in May and their 2nd in July.

Black Locust (*Robinia pseudoacacia*)

Black locust (*Robinia pseudoacacia*) is a fast-growing tree in the legume family (Fabaceae), native to the eastern United States. It has been widely planted as an ornamental and has subsequently become invasive in many areas of the country. It excludes native vegetation with dense clonal growth (DiTomaso et al. 2013). Leaves, bark, and seeds can be toxic.

- **Mechanical Control**: Hand pulling of seedlings can be ineffective due to rhizomes. Mechanical control is not effective for mature plants.
- **Herbicides**: Cut stump and basal bark applications are effective year-round. Foliar treatment is best when leaves are fully emerged and open. See Table B.1 for herbicide application recommendations.

Black Mustard

Black mustard (*Brassica nigra*) is an annual forb in the mustard family (Brassicaceae) that is native to Eurasia. It has a moderate impact on California ecosystems (Cal-IPC 2014). Black mustard matures quickly in the spring and produces a large amount of biomass in infested areas, potentially outcompeting native species through shading or an early reduction in soil moisture. Reproduction occurs by seeds, which are sticky when wet and are thus easily transferred by equipment, vehicles, or people working in or traveling through infested areas when moisture is present (Cal-IPC 2014). Like other invasive mustard species, black mustard can build up a large, long-lived seed bank at infestation sites. For example, deeply buried black mustard seeds may remain viable for as much as 50 years under field conditions (DiTomaso and Healy 2007). This species often invades areas dominated by non-native annual grasses and can contribute to type conversion of woodlands and scrublands into annual grasslands by adding to the early season fuel load of an area, which can increase the amount of fuel available for fires. Burning favors black mustard and so is an ineffective control method (DiTomaso et al. 2013). Although this species is generally considered a successional plant, and thus might be expected to decrease in density or extent with increasing time since the last site disturbance, the typically large seed bank, in combination with the repeated disturbance associated with heavy grazing, can favor the establishment of long-term infestations (Cal-IPC 2014). Moderate grazing, however, is believed to provide some measure of control, as black mustard is usually found only at low cover on grazed sites (DiTomaso et al. 2013).

- **Mechanical Control**: Black mustard is best controlled mechanically by weed whacking or mowing plants (or hand pulling if feasible) each year after they have bolted but before they produce seed (dependent on annual climate, but likely February and March). The plants have a fairly weak root system, and, as annuals, they do not resprout from root fragments left in the soil. Over time, this can deplete the seed banks and allow native or grassy vegetation to dominate previously infested areas. Mowing, particularly at the wrong time, can produce plants that branch heavily from the base, and could produce even more seed than undisturbed plants. However, weed-whacking or mowing, timed to occur after bolting but before mature seed has been produced, may be the most feasible way to control infestations occurring over large areas.
- **Herbicides**: Because black mustard emerges early in the growing season, often before native vegetation has broken dormancy, early post-emergence herbicidal treatments may be

the most effective chemical treatment (Bossard et al. 2000), but more research is needed to develop a standardized, optimized herbicide-based methodology for control. See Table B.1 for herbicide application recommendations.

Blessed Milk Thistle

Blessed milk thistle (*Silybum marianum*) is an annual or biennial forb in the Asteraceae family that is native to the Mediterranean region (DiTomaso and Healy 2007). Cal-IPC rates it as of limited impact on California ecosystems (Cal-IPC 2014). It can form dense patches that exclude other plant species. Growing 6-9 feet tall, its spines can injure livestock and generally deter grazing (DiTomaso et al. 2013). Most seeds germinate in the fall, but germination continues into the winter and early spring (DiTomaso and Healy 2007). Seedlings prefer disturbed soils, and thatch can inhibit blessed milk thistle germination (Bean 1985). Seeds can disperse short distances by wind but much longer distances via livestock or humans and can persist in the soil for at least 9 years (DiTomaso and Healy 2007). Prescribed burning can actually encourage seed germination and establishment, and some forms of control can result in foliage nitrate levels that are toxic to cattle (DiTomaso and Healy 2007).

- **Mechanical control**: Mowing before flowers open is an effective method of control (DiTomaso and Healy 2007).
- **Herbicides**: Herbicide treatments can provide effective control, if applied at the seedling and rosette stages and in multiple treatments during the extended germination period (Bean 1985; DiTomaso et al. 2013). See Table B.1 for herbicide application recommendations.

Bull Thistle

Bull thistle (*Cirsium vulgare*), a member of the Asteraceae family, is found in every state of the US, generally in already disturbed areas such as rangelands and road edges. It reduces the quality of forage and outcompetes native plants. Its large size (up to 7 feet tall), prickly hairs and deep green foliage with large purple flowers make it unmistakable. Livestock (other than cattle) will consume young plants (DiTomaso et al. 2013). Seed dispersal mechanisms include wind, water and animals, making this species easy to spread, particularly in agricultural areas. Biosecurity controls are important in preventing the spread or reintroduction of this species (Graham et al. n.d.).

- **Mechanical control:** pulling, hoeing, etc. must be performed before flowering to prevent seeding, but if the root is severed below the surface, they will be effective. Mowing must be repeated throughout the flowering season as plants that are mowed too early will recover and flower.
- **Herbicides:** As a member of the Asteraceae family, the family-specific herbicides are likely to perform well (e.g., Milestone®), and most herbicides should be applied to rapidly growing plants. See Table B.1 for herbicide application recommendations.

Giant Reed

Giant reed (*Arundo donax*) is a perennial member of the grass family (Poaceae) native to the Mediterranean region and Asia (DiTomaso et al. 2013). Primarily problematic in riparian zones, this species can grow up to 25 feet tall with thick canes and rhizomes that choke channels, increase flooding and siltation and degrade wildlife habitat. The bamboo-like canes bear leaves up to 3 feet long. Plants reproduce vegetatively by rhizomes and stem fragments that disperse by water movement. Giant reed increases biomass in riparian corridors, which must be removed during control efforts.

- **Mechanical control**: Small plants (less than 6 feet in height) and new infestations can be hand-removed if all rhizomes are extracted. Removal of more entrenched populations can be done with backhoe or similar equipment, but this can damage desirable riparian vegetation and create disturbance for other invasive species to colonize. Mowing or cutting can be used to decrease biomass and expose surfaces for herbicide application.
- **Herbicides**: Herbicide should be applied in mid-summer to fall after flowering but before plants enter dormancy. Two to three years of treatment may be necessary in well-established infestations. See Table B.1 for herbicide application recommendations.

Edible Fig

Edible fig (*Ficus carica*) is a tree in the Moraceae family, native to the Mediterranean region. Introduced into California by Spanish missionaries, it has been widely cultivated in the state, both as an ornamental and for its fruit. This species spreads from cultivation especially in areas with available soil moisture. It can produce new shoots from shallow roots. In woodlands and riparian areas, it can form a dense clonal thicket. This monoculture can exclude native vegetation and grow up to 30 feet tall (DiTomaso et al. 2013).

- **Mechanical Control**: Seedlings can be hand pulled. Frequent cutting may work on more mature plants but has not been proven successful.
- **Herbicides**: Herbicides are most effective in the late summer before leaf fall. Stem injection, basal bark, and cut-stump treatments are used. See Table B.1 for herbicide application recommendations.

Himalayan Blackberry

Himalayan blackberry (*Rubus armeniacus*) is a member of the rose family (Rosaceae). It was introduced as a cultivar from Eurasia and escaped to disturbed areas, moist sites such as canals, open fields and natural areas (DiTomaso et al. 2013). It is highly competitive and quickly crowds or shades out native vegetation, replacing riparian vegetation with a thorny barrier that blocks passage by wildlife and livestock. Roots can reach over six feet deep, and are capable of resprouting. Fruit may be dispersed by wildlife.

- **Mechanical Control**: Any mechanical control techniques must remove the canes, roots and root crowns to prevent resprouting. If resprouts are regularly cut back while flowering, root reserves can be exhausted.

- **Herbicides**: Herbicide can be applied in a basal bark, foliar or dormant stem leaf treatment. Because the fruits are harvested by people, avoiding herbicide during fruit set is advised. See Table B.1 for herbicide application recommendations.

Indian Toothcup

Indian toothcup (*Rotala indica*) is an annual or perennial forb in the Lythraceae family, native to southeast Asia (DiTomaso and Healy 2003). It is a minor rice weed in California, possibly originally introduced via the Biggs rice field station in Butte County in the 1940s, where it became an abundant weed by the 1970s (Barrett and Seaman 1980). That it may not spread rapidly from the location of its initial introduction is suggested by Barrett and Seaman (1980) who, following an extensive search, were able to find only one population of the weed outside Biggs; unfortunately, that population was in Marysville. It apparently is no longer a significant weed at the Rice Experiment Station in Biggs (Kent McKenzie, personal communication, August 2017). In vernal pools at Beale and in Tehama County, population size appears to vary with interannual weather (IER 2015, 4-12, 5-1; Jaymee Marty, pers. comm., August 2017). Cal-IPC has not ranked this species, and there is very limited information about its biology and impacts in California, where is recorded only in Butte, Sutter, Yuba counties (DiTomaso and Healy 2003; CalFlora database, July 2017) and Tehama County (Jaymee Marty, pers. comm., August 2017).

- **Mechanical Control**: In restored/created vernal pools in Tehama County, hand-pulling has been used to control Indian toothcup (Jaymee Marty, pers. comm., August 2017).
- **Herbicides**: No information on chemical control of Indian toothcup was found. Because this weed occurs in vernal pools on Base, herbicide use is unlikely to be an available option. However, chemical control information is provided in case herbicide use is considered. A University of California Cooperative Extension rice weed control expert suggested that chemical control methods used on *Rotala rotundifolia*, a congener that is an aquatic weed in southern Florida, would likely also control Indian toothcup (Whitney Brim-DeForest, pers. comm., September 2017). See Table B.1 for herbicide application recommendations.

Italian Thistle

Italian thistle (*Carduus pycnocephalus*) is an annual or biennial forb in the Asteraceae family that is native to the Mediterranean, southern Europe, and North Africa to Pakistan. It has a moderate impact on California ecosystems (Cal-IPC 2014). Italian thistle is a competitive invader that can dominate sites and exclude native and desirable rangeland plants. Reproduction occurs by seeds. Plants germinate after the first substantial rains in fall, overwinter as rosettes, and produce flowering stalks in late spring before the dry season. Plants grow 1-6 feet tall, have winged stems, and have thimble-sized rose to pink to purple flowers that bloom from February through July. Seeds disperse by wind, vehicles, and animals. Italian thistle invades open disturbed sites of various types, including roadsides, firebreaks, and grasslands. Seeds can remain dormant for 8–10 years (Cal-IPC 2014).

- **Mechanical Control**: Italian thistle is best controlled mechanically when infestations are small. Efforts should be made to minimize soil disturbance if plants are dug out by hand. Repeated cutting before seed set may also effectively control Italian thistle, but only if repeated until the seed bank is depleted (up to 10 years). Sheep or goat grazing can control infestations after germination and before flowering when plants are 4–6 inches tall.

- **Herbicides**: Herbicide should be applied in spring and/or early summer (March through June) to actively growing plants through bolting (before flowering). For dense, large, primarily contiguous infestations, aerial or ground applications with broadcast boom technology should be used. For scattered individual plants or isolated patches, or where sensitive plant species are present, handheld or backpack applications should be used for spot treatment. See Table B.1 for herbicide application recommendations.

Klamathweed

Klamathweed, also known as common St. Johnswort, (*Hypericum perforatum*) is a perennial forb in the Hypericaceae, native to Eurasia and North Africa. It is invasive in most of the contiguous states. Poisonous to livestock, it reduces forage availability on the landscape (DiTomaso et al. 2013). Plants are herbaceous and grow up to 5 feet tall. The leaves have tiny oil glands which are visible when the leaf is held up to the light. Seeds may remain viable in the soil for as long as 50 years.

- **Mechanical Control**: Not recommended due to underground reserves. Repeat mowing every two weeks has seen success.
- **Herbicides**: Foliar post-emergent treatment until flowering. See Table B.1 for herbicide application recommendations.

Medusahead

Medusahead (*Elymus* [*Taeniatherum*] *caput-medusae*) is an annual grass (Poaceae family) that is native to Spain, Portugal, southern France, Morocco, and Algeria. It has a severe impact on California ecosystems (Cal-IPC 2014). Medusahead germinates with the onset of fall rains and matures usually in May, 2–4 weeks later than most other annual grasses. It produces dense stands and slowly decomposing thatch that outcompetes and excludes desirable rangeland plants, ties up nutrients, and contributes to fire danger. Medusahead has high silica content, making it unpalatable to livestock and wildlife, except early in the growing season. This high-silica thatch is highly resistant to decomposition, resulting in dense layers that can change soil moisture and temperature (Kyser et al. 2014). Its inflorescence produces long, compressed awns that twist and spread upon drying. This species invades disturbed sites in grassland and rangeland, chaparral, oak woodlands, and occasionally fallow fields. Seeds are dispersed when awns attach to livestock (particularly sheep), wildlife, machinery, vehicles, and clothing and when they are transported in hay. Most seeds germinate within three years, so two to three years of control are required.

- **Mechanical Control**: Medusahead is best controlled mechanically by mowing before seed development or in combination with grazing before maturation, but the period of effectiveness of either mowing or grazing is extremely short. Control measures must be completed when other species are senescent but before medusahead flowers. If mowing is performed, the mower must cut low enough to clip below incipient flowerheads. Flail mowers or weed whacking in small areas is recommended over disc mowers. Mechanical control can improve thatch conditions to allow competitors to establish, but should be implemented in combination with herbicide application. Where populations are thinned but not eradicated, individual remaining plants are freed from intra-specific competition and produce similar cover values to dense infestations (Kyser et al. 2014).

- **Prescribed Burning**: Medusahead response to burning has been positive in the Central Valley and foothills, especially with two consecutive years of burning (DiTomaso et al. 2013). As with many techniques, timing is critical and fire should be timed to fall between early seed set but before seed maturity (Kyser et al. 2014). Burning also serves to remove the high-silica thatch that prevents germination and establishment of more desirable species. However, burning two years consecutively may present a challenge if weather conditions preclude the second burn or if insufficient fuel is left to carry it.
- **Grazing**: Manager-applied prescribed cattle grazing at the pasture-scale (rather than small-scale research plots) from January through May reduced medusahead cover but not in years with significant late spring rainfall (Davy et al. 2015). Davy et al. (2015) suggest that medusahead can recover from heavy grazing when soil moisture is available; therefore, late season grazing may be necessary to achieve control in years with significant late spring rainfall, but grazing at that time of year is likely to be constrained by availability of water for livestock and reduced forage quality. Experiments in Yolo County tested different sheep grazing timings (Di Tomaso et al. 2008). At high stocking rates resulting in 75% of the biomass removed, mid-spring grazing (April-May) was most effective in controlling medusahead, reducing cover by 86-100% relative to ungrazed plots. Medusahead phenology was at stem elongation stage or just beginning anthesis. Control did not last into the following year. High intensity sheep grazing may be useful for areas that cannot be burned or are not suitable for herbicide application; however, the need for large numbers of animals during a short window of opportunity probably limits this control method to fairly small areas.
- **Herbicides**: Herbicide should be applied in fall through spring (September through March) to new seedlings exhibiting at least the three-leaf growth state but before 8 inch plant canopy height. For dense, large, primarily contiguous infestations, aerial or ground applications with broadcast boom technology should be used. For scattered individual plants or isolated patches, or where sensitive plant species are present, handheld or backpack applications should be used for spot treatment. Integration of herbicide treatment with mechanical and/or pyric measures will enhance treatment efficacy. In a meta-analysis of medusahead control research, following herbicide treatments with reseeding extended the effectiveness of initial control, probably because the lack of a native seedbank precluded recovery of desirable natives to compete with resurging medusahead (James et al. 2015). See Table B.1 for herbicide application recommendations.

Skeletonweed

Skeletonweed (*Chondrilla juncea*; Asteraceae family) is well-dispersed across the western states, including California, where it invades roadsides, croplands and rangelands. It is a long-lived perennial plant, but it overwinters as a rosette. It reproduces vegetatively and with asexual seed production; these seeds may persist up to eight years (US Forest Service 2014). The easily-fragmented roots can produce new rosettes from a depth of up to 3 feet (DiTomaso *et al.* 2013).

- **Mechanical Control:** the ability to resprout from small, deep fragments makes mechanical control ill-advised for all but the youngest of plants. Grazing may increase this species as hooves turn and rebury root fragments that regenerate.
- **Herbicides:** Asteraceae-specific herbicides (e.g., Milestone®) give good control when applied before flowering. A two-stage treatment consisting of an early spring application followed by a later fall application may provide the best control, but this may need to be replicated for up to three years (US Forest Service 2014). See Table B.1 for herbicide application recommendations.

Stinkwort

Stinkwort (*Dittrichia graveolens*), a member of the Asteraceae family, is native to southern Europe and the Middle East. Unlike many of California's invasive plants, the history of introduction of stinkwort is well-described. In 1984, the plant was collected as an undetermined specimen and later identified, then began appearing more frequently in the mid-1990s (Preston 1997). Currently, stinkwort infests large portions of central California and coastal portions of southern California and is rapidly expanding (DiTomaso et al. 2013). Commonly found in disturbed sites such as roadsides, this unpleasant plant causes contact dermatitis in humans and the pappus bristles can kill livestock by puncturing intestines. Stinkwort is an annual with a long lifecyle beginning with wintertime germination and persisting until as late as December when it flowers and seeds.

- **Mechanical Control:** Contact with stinkwort can result in contact dermatitis so workers should wear protective clothing when pulling, hoeing, or spraying it. Pulling and hoeing are effective prior to flowering, after which the plants should also be bagged and removed from the site. Mowing is unlikely to be effective, as the lowest flower-producing branches are below the height of mowers.
- **Herbicides:** The plant's sticky foliar oils can impede effectiveness of non-ester formulations of herbicides such as triclopyr (DiTomaso et al. 2013). Apply herbicides during rapid growth stages, which is generally after senescence of desirable natives. See Table B.1 for herbicide application recommendations.

Vervain

Vervain species (*Verbena litoralis* and/or *V. bonariensis*) are annuals, biennials, or short-lived perennials in the Verbenaceae, native to Central and South America. There is very limited information on control.

- **Herbicides:** See Table B.1 for herbicide application recommendations.

Waterprimrose

Waterprimrose (*Ludwigia hexapetala* and/or *L. peploides* ssp. *montevidensis*) are floating to emergent perennials in the Onagraceae, native to the eastern and central United States or to South America, respectively.

- **Mechanical Control**: Mowing typically leaves plant fragments that can disperse. If combined with a herbicide treatment, and completed before seed set, mowing can provide some control.
- **Herbicides**: Several herbicides provide control. Application is usually from spring through early summer; some herbicides can be applied in late summer and fall (DiTomaso et al. 2013). See Table B.1 for herbicide application recommendations.

Yellow starthistle

Yellow starthistle (*Centaurea solstitialis*) is an annual, or sometimes a short-lived perennial, of the Asteraceae family, native to southern Europe and western Eurasia. It has a severe impact on California ecosystems (Cal-IPC 2014). It produces dense stands that displace native and desirable species. Yellow starthistle germinates from seed with the onset of fall rains. It forms rosettes and deep tap roots over winter. Mature plants are 1-3 feet tall and produce numerous spiny yellow flower heads from April through September. It invades grasslands, woodlands, open hillsides, rangeland, pastures, riparian zones, and disturbed areas. This species is toxic to horses, and the mature spines can cause mechanical injury to livestock. In addition, yellow starthistle forms a very deep taproot that can access deep soil moisture. In combination with its high rate of transpiration, this causes depletion of soil moisture reserves that would be utilized by other deep-rooted native taxa.

- **Mechanical Control**: Mowing can provide effective treatment of infested areas only if it is conducted at the correct time, which is immediately after the earliest 2–5% of plants have begun to produce flower heads (Benefield et al. 1999; DiTomaso et al. 2013) and the lowermost branches are above the mower blades (Thomsen et al. 1996; DiTomaso et al. 2013). Mowing too early may cause plants to become bushier and produce more flower heads. Treatments must continue for at least 2–3 years, after which spot eradication may be required indefinitely.
- **Grazing**: Responsible rangeland management, whereby range is grazed by sheep, goats, or cattle to a moderate degree, can help prevent establishment or spread of populations in grasslands. Infested areas can be treated by high-intensity grazing, typically in May and June (Cal-IPC 2014), just before the production of the spiny flower heads. Manager-applied prescribed cattle grazing at the pasture-scale (rather than small-scale research plots) from January through May did not reduce yellow starthistle cover (Davy et al. 2015). Control likely failed because the grazing season did not extend into summer when yellow starthistle is most vulnerable to grazing (in the study, grazing past May was constrained by availability livestock water and reduced forage quality). In years with significant late spring rainfall, grazing should, if possible, be continued into the summer to maintain control of yellow starthistle.
- **Herbicides**: Herbicide treatments by foliar spray or wick application generally are used to control or reduce spot infestations or as a follow-up to more intensive mechanical or

grazing-based treatments. See Table B.1 for herbicide application recommendations. A combination, phased treatment consisting of October burning, drill seeding with native grasses in December, and a January application of Milestone® at 3 fluid ounces per acre was particularly effective at Fort Hunter Liggett (Kyser et al. 2013). This treatment could be replicated in small-scale test plots to determine appropriate timing, and if successful could be replicated at Beale.

An overview of all control methods including mechanical/manual, grazing, chemical, and biological control is provided in Table B.1 below.

Table B.1: Treatment options for Beale AFB weed species, including those at the prevention stage (i.e., not yet known to occur on Base). ***Herbicides in red lettering are not currently authorized in the DoD herbicide use list.***

Common/ Scientific Name	Mechanical / Manual	Prescribed Fire	Grazing	Chemical
artichoke thistle (*Cynara cardunculus*)	Only when a large portion of the taproot is removed. Removal of above-ground material stimulates resprouting	Burning alone will not kill plant; burning can facilitate herbicide application and cause seedling flush for control	Goats will graze and can reduce seed production; no other livestock will graze	**Aminopyralid: Timing-** Postemergence in winter to spring, ideally before bolting. **Spectrum:** Broadleaf selective. **Effectiveness-** One of the most effective in treating thistles.
				Triclopyr: Timing- Postemergence to rapidly growing, up to bud stage. **Spectrum-** Broadleaf selective, may injure desirable species. **Effectiveness-** most effective on smaller plants.
				Imazapyr: Timing- Postemergence at flowering. **Spectrum-** Non-selective. **Effectiveness-** best as spot treatment, residual activity can harm desirable species.
barbed goatgrass (*Aegilops triuncialis*)	Close (4") mowing after flowering but before seeds reach soft boot stage; weedwhack if not accessible to mower	Burn before joints disarticulate; second year herbicide improves control	No	**Glyphosate: Timing-** Postemergence in late winter to early spring to rapidly growing non-stressed plants before flowering. **Spectrum-** Non-selective, may kill desirable plants. **Effectiveness-** Increased by adding ammonium sulfate.
				Propoxycarbazone-sodium: Timing- Postemergence from 2-leaf to 2-tiller stage when plants are growing rapidly. **Spectrum-** Broad-spectrum, perennial grass species vary in tolerance. **Effectiveness-** Only partial control.
				Sulfometuron: Timing- Preemergence or early postemergence in fall or late winter before grass is 3". **Spectrum-** Mixed selectivity, fairly safe on native perennial grasses. **Effectiveness-** Not stated.
				Sulfometuron+chlorsulfuron: **Timing-** Preemergence in fall. **Spectrum-** Mixed selectivity, fairly safe on native perennial grasses. **Effectiveness-** Not stated.

Common/ Scientific Name	Mechanical / Manual	Prescribed Fire	Grazing	Chemical
black locust (*Robinia pseudoacacia*)	Not recommended	Unknown	Unknown	**Aminopyralid: Timing**- Most times of the year for cut stump. For post emergence, once leaves have expanded.
				Clopyralid: Timing- For post emergence, once leaves have expanded.
				Triclopyr: Timing- late summer/early fall.
				Glyphosate: Timing- Foliar once leaves are expanded. Cut stump in late summer.
				Imazapyr + glyphosate: Timing- Postemergence. Soil residue herbicide.
				Hexazinone: Timing- Late winter/early summer. Residual herbicide.
				Tebuthiuron: Timing- before seasonal rainfall. Soil active.
black mustard (*Brassica nigra*)	Weed whack or mow (or hand pull if feasible) each year after bolting but before seeds produced (likely February and March)	No, fire generally favors increase of mustards; grassland fire unlikely to kill seeds on the soil	Palatable to goats, sheep	**Dicamba: Timing**- Postemergence when weeds are small. **Spectrum**- Broadleaf selective. **Effectiveness**- Increased when mixed with Diflufenzopyr.
				Triclopyr: Timing- Postemergence when weeds are small. **Spectrum**- Broadleaf selective, may injure desirable species. **Effectiveness**- Ester formulation more effective than amine formulation.
				Glyphosate: Timing- Postemergence before flowering. **Spectrum**- Broad spectrum. **Effectiveness**- Only fair control of mustards. Best on seedlings.
				Chlorsulfuron: Timing- Preemergence or early postemergence when weeds are germinating or activly growing. **Spectrum**- Primarilly active on broadleaf species. **Effectiveness**- Good control on most mustards.

Common/ Scientific Name	Mechanical / Manual	Prescribed Fire	Grazing	Chemical
				Propoxycarbazone-sodium: **Timing**- Postemergence when plants are growing rapidly. **Spectrum**- Broad-spectrum. **Effectiveness**- Good control on most mustards.
				Rimsulfuron: Timing- Preemergence in spring or fall. **Spectrum**- Controls several annual grasses and broadleaves. **Effectiveness**- Degrades rapidly in dry conditions, moisture is necessary for activation.
				Sulfometuron: Timing- Preemergence or early postemergence. **Spectrum**- Broad-spectrum. **Effectiveness**- Higher in areas with 20 inches of rainfall or more.
blessed milk thistle (*Silybum marianum*)	Mowing before flowering can help control stands	Burning not effective and can encourage germination and establishment	No, spines typically deter livestock; under some circumstances, can be toxic to cattle	**2,4-D: Timing**- Postemergence in spring or fall to rapidly growing young plants before flower stalk lengthens; in fall, for rosettes. **Spectrum**- Broadleaf selective; injures legumes. **Effectiveness**- May be necessary to repeat applications for several years to control seedlings (DiTomaso et al. 2013)..
				Aminopyralid: Timing- Postemergence in spring to early summer in rosette to bolting stage, or in fall to seedlings. **Spectrum**- Broadleaf selective, generally safe on grasses. **Effectiveness**- Residual activity will kill emerging seedlings.
				Clopyralid: Timing- Postemergence in spring up to flower bud stage. **Spectrum**- Broadleaf selective, very safe on grasses; may injure legumes. **Effectiveness**- not stated.
				Chlorsulfuron: Timing- Postemergence to rapidly growing plants up to bud stage. **Spectrum**- Broadleaf selective; safe for most grasses. **Effectiveness**- not stated.
				Dicamba: Timing- Postemergence for seedlings or before flower stalk lengthens on established plants; in fall, for rosettes. **Spectrum**- Broadleaf selective; safe on grasses. **Effectiveness**- May be necessary to repeat applications for several years to control seedlings.

Common/ Scientific Name	Mechanical/ Manual	Prescribed Fire	Grazing	Chemical
bull thistle (*Cirsium vulgare*)	Mowing **i**mmediately before flowering or when plants are just starting to flower, with repeated mowing throughout the season	Burning alone may not kill plant and may create conditions that favor establishment; burning can facilitate herbicide application and cause seedling flush for control	Sheep, goats and horses will eat young plants, and can have significant effect on in the early stages of infestation. Goats will eat flowerhead, and can completely eliminate seed dispersal from mature plants. Light grazing by sheep can increase problem	**Aminopyralid: Timing**- Postemergence in spring to early summer in rosette to bolting stage, or in fall to seedlings. **Spectrum**- Broadleaf selective, generally safe on grasses. **Effectiveness**- Residual activity will kill emerging seedlings. **Clopyralid: Timing**- Postemergence in spring up to flower bud stage. **Spectrum-** Broadleaf selective, very safe on grasses. **Effectiveness-** not stated. **Triclopyr: Timing**- Postemergence to rapidly growing plants. **Spectrum-** Broadleaf selective, safe for most grasses. **Effectiveness**- More effective on smaller plants. **Chlorsulfuron: Timing**- Postemergence to rapidly growing plants up to bud stage. **Spectrum**- Broadleaf selective, safe for most grasses. **Effectiveness**- not stated. **Imazapyr: Timing**- Postemergence at flowering. **Spectrum**- Non-selective. **Effectiveness**- Long residual activity, best used as a spot treatment.

Common/ Scientific Name	Mechanical/ Manual	Prescribed Fire	Grazing	Chemical
Canada thistle (*Cirsium arvense*)	Mow every 3 to 4 weeks over several growing seasons	No, not effective	No, livestock avoid Canada thistle	**Aminopyralid: Timing**- Postemergence in spring after all plants have fully emerged until plants enter full flower stage. **Spectrum**- Broadleaf selective, safe on grasses; injures legumes. **Effectiveness**- One of the most effective herbicides for Canada thistle; longer residual and higher activity than clopyralid; may need to treat for 1-2 more years (DiTomaso et al. 2013).
				Clopyralid: Timing- Postemergence in spring up to flower bud stage; also can apply in fall. **Spectrum**- Broadleaf selective, very safe on grasses; may injure legumes. **Effectiveness**- 1 or more treatments per season for 1-3 consecutive years for complete control
				Chlorsulfuron: Timing- Postemergence from bolting to blooming stage; also can apply in fall. **Spectrum**- Broadleaf selective; safe for most grasses. **Effectiveness**- not stated.
				Glyphosate: Timing- Postemergence to rapidly growing thistles when most plants are past flower bud stage. **Spectrum**- Non-selective, may kill desirable plants. **Effectiveness**- More than 1 year may be necessary for complete control.
edible fig (*Ficus carica*)	Seedlings can be hand pulled. Frequent cutting may work on more mature plants but has not been proven successful	Not effective control due to vigorous resprouting	Not effective control due to vigorous resprouting	**Triclopyr: Timing**- Late in growing season before leaves fall. Spectrum- Broadleaf selective, safe on grasses. Effectiveness- Low soil residual. Basal bark has been effective in trials.
				Glyphosate: Timing- Late in growing season before leaves fall.
				Imazapyr: Timing- Late in growing season before leaves fall. Effectiveness- Has soil residual activity and can damage restoration efforts.

Common/ Scientific Name	Mechanical/ Manual	Prescribed Fire	Grazing	Chemical
giant reed (*Arundo donax*)	Mowing can be useful if followed by herbicide treatment	Flame thrower or weed burner for spot treatments at base of plant, comparable effectiveness to manual cutting; burning helps remove standing mature plants but is more effective when followed by herbicide application	Goats most effective, especially Angoras and Spanish goats	**Glyphosate: Timing**- Postemergence, mid-summer to fall application after flowering, before dormancy. Follow-up in spring to germinating seedlings. **Effectiveness**- Best option for control in pure stands, 2-3 years treatment necessary. Can be used after repeated mowing. Dense stands best treated via aerial application. Undiluted, can be used to treat cut stumps with no regrowth.
				Imazapyr: Timing- Postemergence fall, similar to glyphosate. **Spectrum**- Broad spectrum. **Effectiveness**- Has soil residual activity and can damage restoration efforts.
				Glyphosate+Imazypyr: Timing- Postemergence in fall is most effective. **Spectrum**- Broad spectrum. **Effectiveness**- Combo is thought to provide better control at lower rates of each herbicide.

Common/ Scientific Name	Mechanical/ Manual	Prescribed Fire	Grazing	Chemical
Himalayan blackberry (*Rubus armeniacus*)	No	Fire only effective if root sprouts controlled by other methods; short-term canopy reduction, useful if herbicide is applied after new growth begins	Goats	**Triclopyr: Timing**-Aug-Nov. **Spectrum:** Broadleaf selective, safe on grasses. **Effectiveness**- Not stated
				Fluroxypyr: Timing- Postemergence to rapidly growing plants. **Spectrum**- Broadleaf selective, safe for most grasses. **Effectiveness**- Reduced control if plants are under stressed conditions.
				Aminopyralid+Triclopyr: Timing- Postemergence, mid-summer or early fall after flowering and start of fruit set. Basal bark treatment- Any time of year (mid fall if plants are commonly harvested to avoid human contact). Dormant stem leaf treatment- Late fall/winter. Safe for most grasses. **Spectrum**- Broad spectrum, broadleaf, woody plants. **Effectiveness**- Better control in combination.
				Glyphosate: Timing- Postemergence in late summer, when canes are growing rapidly, full leaf maturity and after berries are formed. **Spectrum**- Broad spectrum of grasses, broadleaf and woody plants. **Effectiveness**- Complete foliage coverage to obtain good control. Burning or mowing 40-60 days after spraying increases control.
				Sulfometuron: Timing- Early postemergence when germinating or activly growing. **Spectrum**- Broad spectrum to non-selective. **Effectiveness**- Only effective on small/not fully mature plants. Add surfactant for increased control.
				Hexazinone: Timing- Pre or postemergence when germinating or actively growing. **Spectrum**- Non-selective in non-cropland and selective in reforestation practices. **Effectiveness**- High rates can cause bare ground, only suppresses Himalayan blackberry growth; can be mixed with triclopyr for better control.

Common/ Scientific Name	Mechanical/ Manual	Prescribed Fire	Grazing	Chemical
				Tebuthiuron: Timing- Preemergence before the start of spring growth or before expected rainfall. **Spectrum**- Used for woody plant control. **Effectiveness**- May injure non-target species.
Indian toothcup (*Rotala indica*)	Hand-pulling has been used in vernal pools	No information	No information	Note: Chemical control methods below are for congener, dwarf rotala (*Rotala rotundifolia*; Della Torre et al. 2017), but are likely to control Indian toothcup too. **2,4-D: Timing**- Emergent foliar application. **Spectrum**- Broadleaf selective. **Effectiveness**- 90% control. **Aminopyralid: Timing**- Emergent foliar application. **Spectrum**- Broadleaf selective. **Effectiveness**- Almost 100% control. **Triclopyr: Timing**- Emergent foliar application. **Spectrum**- Broadleaf selective, safe for most grasses. **Effectiveness**- 100% control.
Italian thistle (*Carduus pycnocephalus*)	Mowing after plants have bolted and about to flower, requires repeated treatment for 4-7 weeks	Can be effective if fire is hot enough to kill root crown but can also cause increased invasion; individual plants can be killed by flamer	Goats, cattle, horses and sheep will eat parts of flower or rosette	**Aminopyralid: Timing**- Preemergence in winter to early spring and postemergence to seedling in spring. **Spectrum**- Broadleaf selective. **Effectiveness**- One of the most effective in treating thistles. **Clopyralid: Timing**- Postemergence in spring up to flower bud stage. **Spectrum**- Broadleaf selective, very safe on grasses. **Effectiveness**- not stated, but very effective for yellow star-thistle. **Dicamba: Timing**- Postemergence to rapidly growing plants. **Spectrum**- Broadleaf selective. **Effectiveness**- Increased effectiveness on other types of thistle when mixed with Diflufenzopyr. More effective on smaller plants. **Fluroxypyr: Timing**- Postemergence to rapidly growing plants. **Spectrum**- Broadleaf selective, safe for most grasses. **Effectiveness**- not stated.

Common/ Scientific Name	Mechanical/ Manual	Prescribed Fire	Grazing	Chemical
				Triclopyr: Timing- Postemergence to rapidly growing plants. **Spectrum**- Broadleaf selective, safe for most grasses. **Effectiveness**- More effective on smaller plants.
				Glyphosate: Timing- Postemergence to rapidly growing plants in bud stage. **Spectrum**- Non-selective. **Effectiveness**- Repeat application may be necessary, more effective with ammonium sulfate.
Klamathweed (*Hypericum perforatum*)	Need digging or repeated mowing to deplete underground root storage	Not recommended	No, poisonous to livestock	**2,4-D: Timing**- soon after emergence but before flowering. Spectrum- Broadleaf selective with no soil activity.
				Aminopyralid: Timing- soon after emergence but before flowering. Spectrum- Broadleaf selective
				Glyphosate: Timing- soon after emergence but before flowering. Spectrum- Non-selective.
medusahead (*Elymus caput-medusae*)	Late season mowing at boot to early flowering stage can help to suppress, but will distribute seed if after seed set	Burning can be extremely effective if conducted before grass begins to head out but before seed drop. Two years of burning can nearly eliminate an infestation	Heavy grazing at boot to flowerhead emergence can suppress medusahead	**Aminopyralid: Timing**- Preemergence in fall. **Spectrum**- Broadleaf selective. **Effectiveness**- 14% *Milestone* (spot treatment rate)/acre gave ~90% control
				Glyphosate: Timing- Postemergence for selective control in spring before heading. Non-selective control in late season before seeds are produced. **Spectrum**- Non-selective. **Effectiveness**-not stated.
				Sulfometuron: Timing- Pre to early postemergence. **Spectrum**- Broad spectrum. **Effectiveness**- More effective when applied in fall (preemergence).

Common/ Scientific Name	Mechanical/ Manual	Prescribed Fire	Grazing	Chemical
parrotfeather (*Myriophyllum aquaticum*)	Effective but challenging to remove sufficient material and reduce movement of stem fragments	Not feasible	Not feasible	**2,4-D: Timing**-spring to summer. Surfactant needed. **Triclopyr: Timing**-spring to summer. Surfactant needed. **Bispyribac-sodium: Timing**-spring to summer. **Imazamox: Timing**-spring to summer. Surfactant needed. **Imazapyr: Timing**-spring to summer. **Penoxsulam: Timing**-spring to summer. **Fluridone: Timing**-spring to summer. Apply to water. **Diquat: Timing**-spring to summer. Repeat every 3-5 weeks.
pennyroyal (*Mentha pulegium*)	Hand pulling and mowing can be successful, but extensive effort is needed to remove all of the plant	Unlikely that fire will control sub-surface portions of plants	Unpalatable to livestock	**2,4-D: Timing**- Between bolt and seed production. Broadleaf selective. **Triclopyr: Timing**- Between bolt and seed production. Broadleaf selective. **Glyphosate: Timing**- Between bolt and seed production. Non-selective.
purple loosestrife (*Lythrum salicaria*)	Hand pulling is effective on small scales and young plants. Mowing is difficult due to typical plant locations	May not burn well	Has poor palatability	**Triclopyr: Timing**- Just before seed production. Broadleaf selective. **Glyphosate: Timing**- Just before seed production. Non-selective. **Imazapyr: Timing**- Emergence until killing frost. Non-selective.

Common/ Scientific Name	Mechanical/ Manual	Prescribed Fire	Grazing	Chemical
perennial pepperweed (*Lepidium latifolium*)	Mowing at bolting or flower bud stage followed by herbicide application to resprouting shoots at flower bud stage	Not effective at reducing stands but useful for reducing accumulated thatch in winter or spring during dry conditions	Cattle, sheep, and goats will graze, especially rosettes in early spring to suppress, but once livestock removed, plants quickly resprout	**Triclopyr: Timing**-Mar-Jun or in Fall after 1st rain. **Spectrum:** Broadleaf selective, does not kill grasses. **Effectiveness**- not stated
				Glyphosate: Timing- Postemergence from seedling to bloom stage. Most effective at flower bud or flowering stage. **Spectrum**- Non-selective. **Effectiveness**- Good control option if reseeding is planned shortly after application.
				Chlorsulfuron: Timing- Postemergence from seedling to flowering stage. Most effective at flower bud or flowering stage. **Spectrum**- Mixed selectivity, generally safe on grasses. **Effectiveness**- Not stated.
				Imazapyr: Timing- Postemergence from seedling to flowering stage. Most effective at bud to late flowering stage. **Spectrum**- Non-selective. **Effectiveness**- Leaves more bare ground than other treatments. Also effective following early season mowing and/or disking.
Russian knapweed (*Acroptilon repens*)	Mowing in summer followed by herbicide application in fall can be effective	Not effective at controlling species but useful for reducing accumulated thatch in winter or spring during dry conditions	Generally, livestock avoid, but goats may graze; toxic to horses	**Aminopyralid: Timing**- Postemergence, bud stage to senescence. **Spectrum**- Broad-spectrum, generally safe on grasses. **Effectiveness**- One of the most effective herbicides for Russian knapweed, can provide up to 2 years of control.
				Clopyralid: Timing- Postemergence, bud stage to senescence. **Spectrum**- Selective, safe on grasses and other broadleaf species. **Effectiveness**- Can be mixed with aminopyralid for more effective control.
				Glyphosate: Timing- Postemergence, bud stage to senescence. **Spectrum**- Non-selective. **Effectiveness**- Does not control as well as other treatments, will not kill seeds or inhibit germination.

Common/ Scientific Name	Mechanical/ Manual	Prescribed Fire	Grazing	Chemical
				Chlorsulfuron: Timing- Postemergence at flower bud stage, fall rosette stage, or winter. **Spectrum**- Broad-spectrum. **Effectiveness**- not stated.
skeletonweed (*Chondrilla juncea*)	Frequent mowing may exhaust root storage, suppressing weed	No	Continual grazing can reduce populations if seed germination is prevented. However, shallow burial of seeds by grazing animals can increase population	**Aminopyralid: Timing**- Spring from rosette to flowering stage. **Spectrum**- Broadleaf-selective, safe on grasses. **Effectiveness**- Longer residual and higher activity than clopyralid.
				Dicamba: Timing- Postemergence to rapidly growing plants. May require repeat treatment. **Spectrum**- Broadleaf selective. **Effectiveness**- Increased effectiveness when mixed with Diflufenzopyr.
				Clopyralid: Timing- Postemergence to rosettes in fall, or up to bolting in spring. **Spectrum**- Broadleaf selective. Very safe for grasses. **Effectiveness**- Can be mixed with dicamba.
				Glyphosate: Timing- Rapidly growing plants in bud stage. **Spectrum**- Non-selective. **Effectiveness**- Repeat applications may be necessary. Effectiveness may be increased when mixed with ammonium sulfate.
				Imazapyr: Timing- Preemergence or postemergence to rapidly growing plants. **Spectrum**- Non-selective. **Effectiveness**- not stated.

Common/ Scientific Name	Mechanical/ Manual	Prescribed Fire	Grazing	Chemical
smallflower tamarisk (*Tamarix parviflora*)	Cutting followed by herbicide	Repeated annual burns or burn followed by herbicide treatment. Best to burn during hot, dry summer months	Cattle and goats will graze if there is no other vegetation; has little nutritional value; goats may be able to provide some control after a cutting or burn	**Triclopyr: Timing**- Any time but best in summer or fall and not water stressed. **Spectrum**- Woody and herbaceous broadleaf selective. **Effectiveness**- Cut stump treatment very effective. Basal bark treatments to smaller trees with thin bark. Foliar treatment to trees 3-4 feet tall.
				Glyphosate: Timing- Any time but best in summer or fall and not water stressed. **Spectrum**- Non-selective. **Effectiveness**- Only provides partial control. Foliar application most effective after a rain event.
				Imazapyr: Timing- Any time but best in summer or fall. **Spectrum**- Non-selective. **Effectiveness**- Very effective control.
				Imazapyr + Glyphosate: **Timing**- Any time but best in summer or fall. **Spectrum**- Non-selective. **Effectiveness**- not stated.
spotted knapweed (*Centaurea stoebe* ssp. *micranthos*)	Hand-pulling of entire tap root repeated during the growing season for several years; torching seedlings early in the season	Little information on burning but may be ineffective	Sheep grazing in early spring to reduce flowering and in fall to reduce seedlings	**Aminopyralid: Timing**- Preemergence; also postemergence from rosette to bolting stage, or in fall to new regrowth. **Spectrum**- Broadleaf selective, generally safe on grasses; may injure legumes. **Effectiveness**- One of the most effective herbicides for spotted knapweed; longer residual and higher activity than clopyralid (DiTomaso et al. 2013).
				Clopyralid: Timing- Preemergence to seedlings; postemergence in spring to seedlings and rapidly growing mature plants from beginning of bolting to flower bud stage; in fall to regrowth. **Spectrum**- Broadleaf selective, very safe on grasses; may injure legumes. **Effectiveness**- not stated.
				Glyphosate: Timing- Postemergence to rapidly growing plants in flower bud stage. **Spectrum**- Non-selective. **Effectiveness**- Repeat applications may be necessary.

Common/ Scientific Name	Mechanical/ Manual	Prescribed Fire	Grazing	Chemical
stinkwort (*Dittrichia graveolens*)	Mowing multiple times during a growing season may provide control	Fire followed by herbicide could potentially provide control	No	**Dicamba: Timing**- Postemergence to rapidly growing plants. **Spectrum**- Broadleaf selective. **Effectiveness**- Dicamba + MCPA is a standard treatment for stinkwort in Australia. **Triclopyr: Timing**- Postemergence to rapidly growing plants; smaller plants are easier to control. **Spectrum**- Broadleaf selective, safe for most grasses. **Effectiveness**- not stated. **Glyphosate: Timing**- Postemergence to rapidly growing plants in late spring to early summer after desirable competitors have senesced. **Spectrum**- Non-selective. **Effectiveness**- Can be increased with the addition of ammonium sulfate.
tree-of-heaven (*Ailanthus altissima*)	Hand pulling can work on small seedlings only	Unknown	Not likely to be feasible	**Triclopyr: Timing**- When leaves are expanded, cut stump and basal bark best in late summer/early fall. Spectrum: Selective to broadleaf species. **Glyphosate: Timing**- When leaves are expanded. Non-selective. **Imazapyr: Timing**- Late summer-early fall. Soil residual.
vervain (*Verbena litoralis* and/or *V. bonariensis*)	Unknown	Unknown	Unknown	**2,4-D, Glyphosate, Hexazinone, Imazapic, Imazapyr,** and **Sulfometuron** are expected to be effective on *V. litoralis*.

Common/ Scientific Name	Mechanical/ Manual	Prescribed Fire	Grazing	Chemical
waterprimrose (*Ludwigia hexapetala* and/or *L. peploides* ssp. *montevidensis*)	Mowing/removing plants with large equipment can have success	Not feasible	Not feasible	**2,4-D: Timing**- Spring through fall.
				Triclopyr: Timing- Spring through fall.
				Glyphosate: Timing- Spring through fall. Non-selective.
				Imazamox: Timing- Spring through fall.
				Imazapyr: Timing- Spring through summer.
				Diquat: Timing- Spring through summer.
waxy mannagrass (*Glyceria declinata*)	Repeated hand-pulling before plants produce seed over several years; mowing with line trimmers in fall to kill young plants in their upright terrestrial stage; great care must be exercised to minimize soil disturbance in vernal pools (DiTomaso et al. 2013)	Not recommended in vernal pools	Not recommended in vernal pools	**Clethodim: Timing**- Postemergence before plants produce viable seeds. **Spectrum**- Grass selective. **Effectiveness**- Do not use in vernal pools with any native grass species (DiTomaso et al. 2013).
				Fluazifop: Timing- Postemergence before plants produce viable seeds. **Spectrum**- Grass selective. **Effectiveness**- Do not use in vernal pools with any native grass species (DiTomaso et al. 2013).
				Glyphosate: Timing- Postemergence before plants produce viable seeds. **Spectrum**- Non-selective. **Effectiveness**- In vernal pools, broadcast application would cause too much damage to native plants, but a "wiper application" directly to weed may avoid non-target impacts (DiTomaso et al. 2013).

Common/ Scientific Name	Mechanical/ Manual	Prescribed Fire	Grazing	Chemical
Yellow starthistle (*Centaurea solstitialis*)	Mowing most effective when 2-5% of population of seedheads in bloom; too early (before seedheads have reached spiny stage, and damaging competitive grass) or too late (after seed set) will increase infestation. Best used in integrated approach, in later years of long term management program. Best results when by mowing once in early flowering stage and again 4-6 weeks later during floral bud stage. Not always successful- can damage biocontrol agents, injure late growing forbs and reduce fall/ winter forage for wildlife/livestock	Prescribed burns can provide effective control if conducted at the very early flowering stage; burning at other times can enhance survival. 2-3 years of consecutive burns result in good control; if fuel loads are too low for consecutive burns, fire best used in integrated approach. Flaming can provide control if followed by droughty spring	High intensity, short duration- sheep, goats, cattle when plants have bolted, before they produce spiny heads. Goats continue to browse in flower stage. Best used in an integrated management plan. Must be continued for at least 3 years in severe infestation; toxic to horses	**Aminopyralid: Timing**- Pre to postemergence when plants are in seedling to mid rosette stage. **Spectrum**- Broadleaf selective. **Effectiveness**- one of the most effective for thistles and is safe on grasses. Preemergence application can cause severe suppression of invasive annual grasses.
				Clopyralid: Timing- Pre and postemergence from seedling to mid-bolting, later rosette stage. Earlier application may not provide full season control. **Spectrum**- Selective. **Effectiveness**- Very effective on thistles but can damage legumes as well. Safe for most grasses.
				Triclopyr: Timing- Postemergence from seedling to bolting stage. **Spectrum**- Broadleaf selective, typically does not harm grasses. **Effectiveness**- not stated.
				Glyphosate: Timing-Postemergence to plants from bolting to beginning flowering. **Spectrum**- Nonselective. **Effectiveness**- Most effective herbicide for late season control.

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Personal communications

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Dr. Jaymee Marty, Marty Ecological Consulting, Sacramento, CA, August 2017.

Dr. Kent McKenzie, Director, Rice Experiment Station, Biggs, CA, August 2017.

Lauren Wilson, Regional Biologist, Travis Installation Support Team, May 2016.

Appendix B Maps: Beale AFB Invasive Species Maps for Species Known to Occur on Base

The following species were mapped on Beale AFB by two recent baseline invasive plant surveys, a partial survey conducted in 2014 (H.T. Harvey & Associates 2015) and a subsequent survey of the remainder of Base in 2016 (CEMML 2017). The figures below combine the 2014 and 2016 surveys into single maps for each of the following 16 of the 19 invasive species recorded on Beale:

1. barbed goatgrass *Aegilops triuncialis*
2. tree-of-heaven *Ailanthus altissima*
3. giant reed *Arundo donax*
4. black mustard *Brassica nigra*
5. Italian thistle *Carduus pycnocephalus*
6. yellow starthistle *Centaurea solstitialis*
7. skeletonweed *Chondrilla juncea*
8. bull thistle *Cirsium vulgare*
9. stinkwort *Dittrichia graveolens*
10. medusahead *Elymus* [*Taeniatherum*] *caput-medusae*
11. edible fig *Ficus carica*
12. Klamathweed *Hypericum perforatum*
13. black locust *Robinia pseudoacacia*
14. Himalayan blackberry *Rubus armeniacus*
15. blessed milk thistle *Silybum marianum*
16. vervain *Verbena litoralis* and/or *V. bonariensis*

The four remaining species were not observed/not searched for and so not mapped during these two survey efforts:

1. Indian toothcup *Rotala indica*
2. Russian knapweed *Acroptilon repens*
3. waterprimrose *Ludwigia hexapetala* and/or *L. peploides* ssp. *montevidensis*
4. parrotfeather *Myriophyllum aquaticum*

Indian toothcup's general location is shown on a map following the weed survey figures (Arreola and Kirk 2017).

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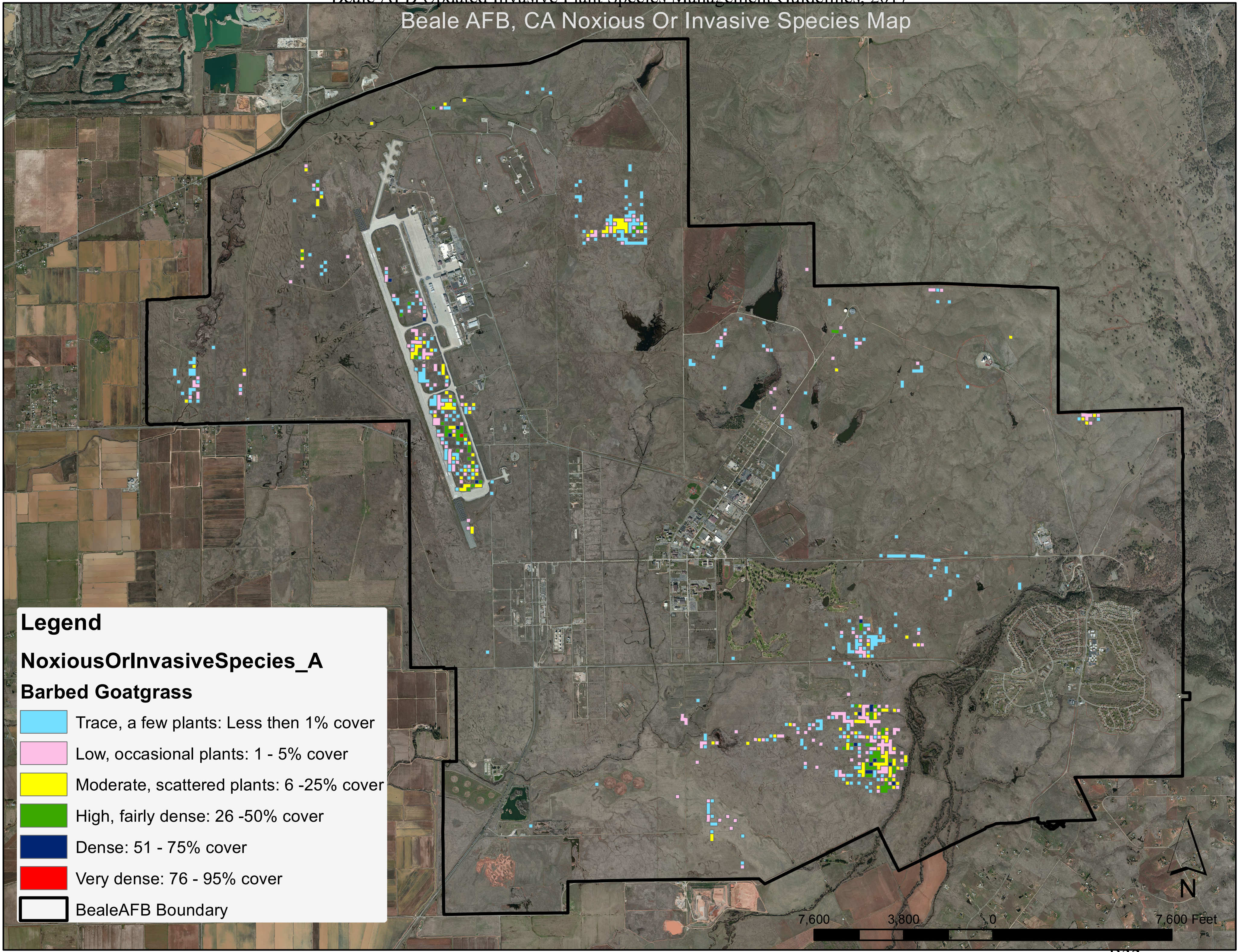
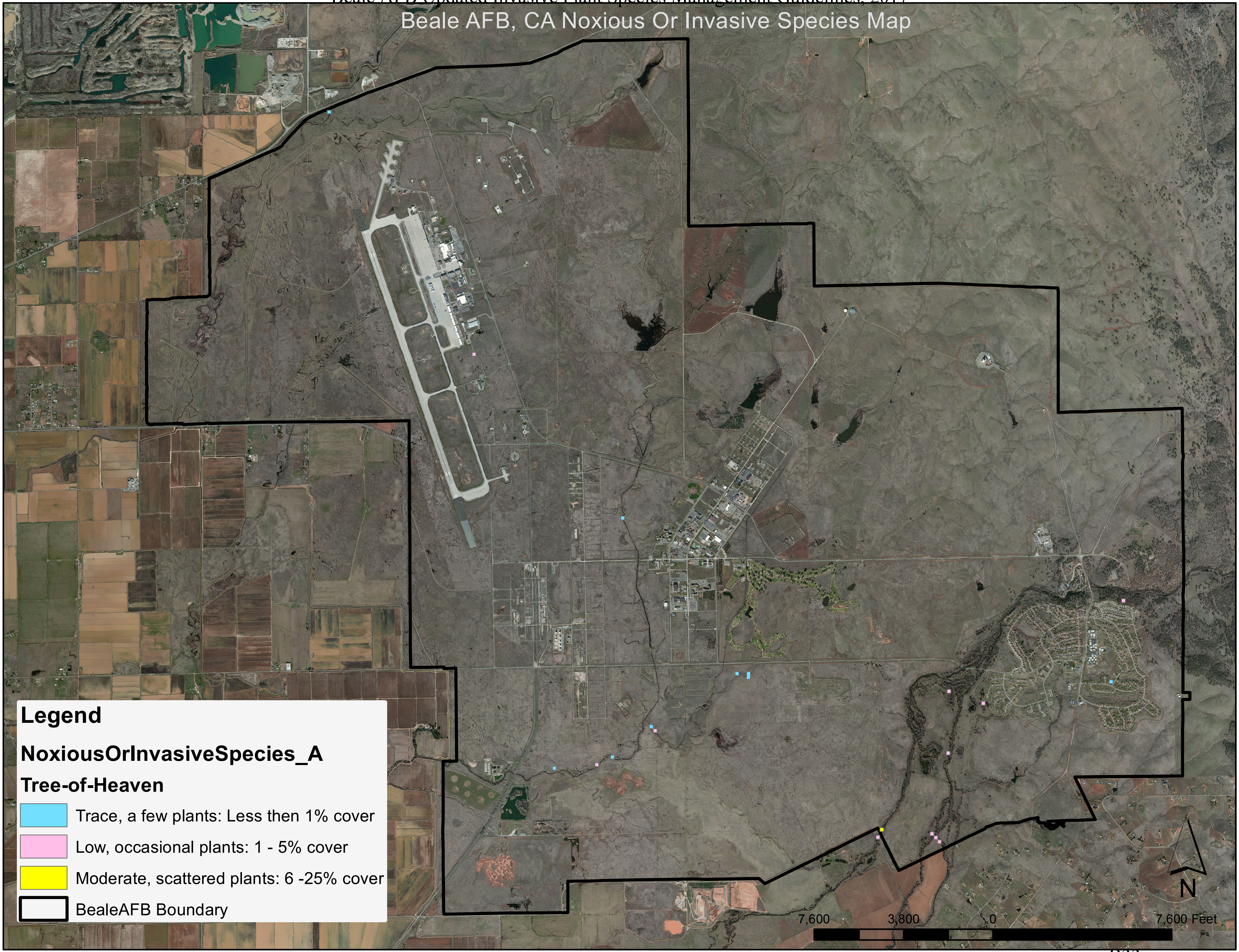
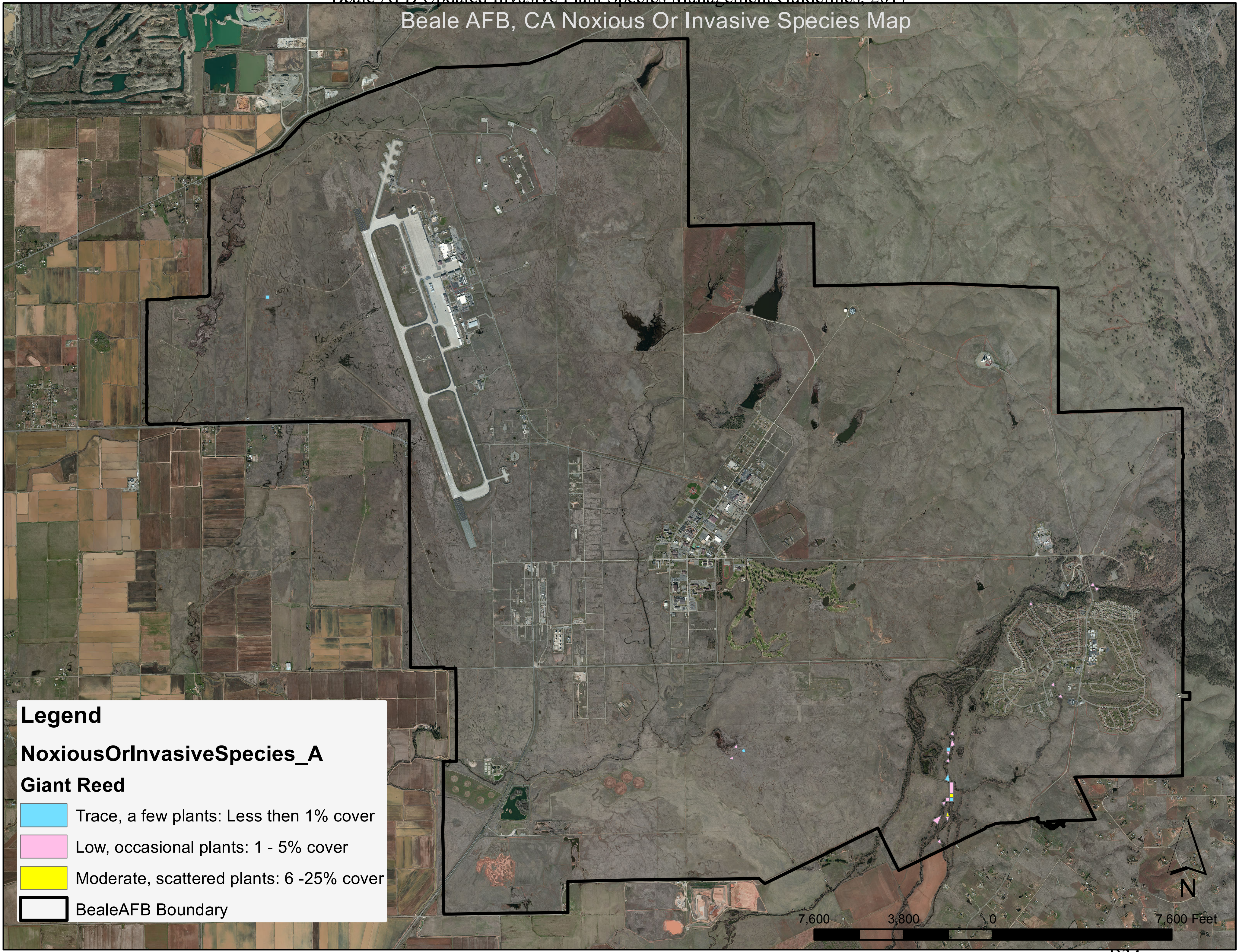
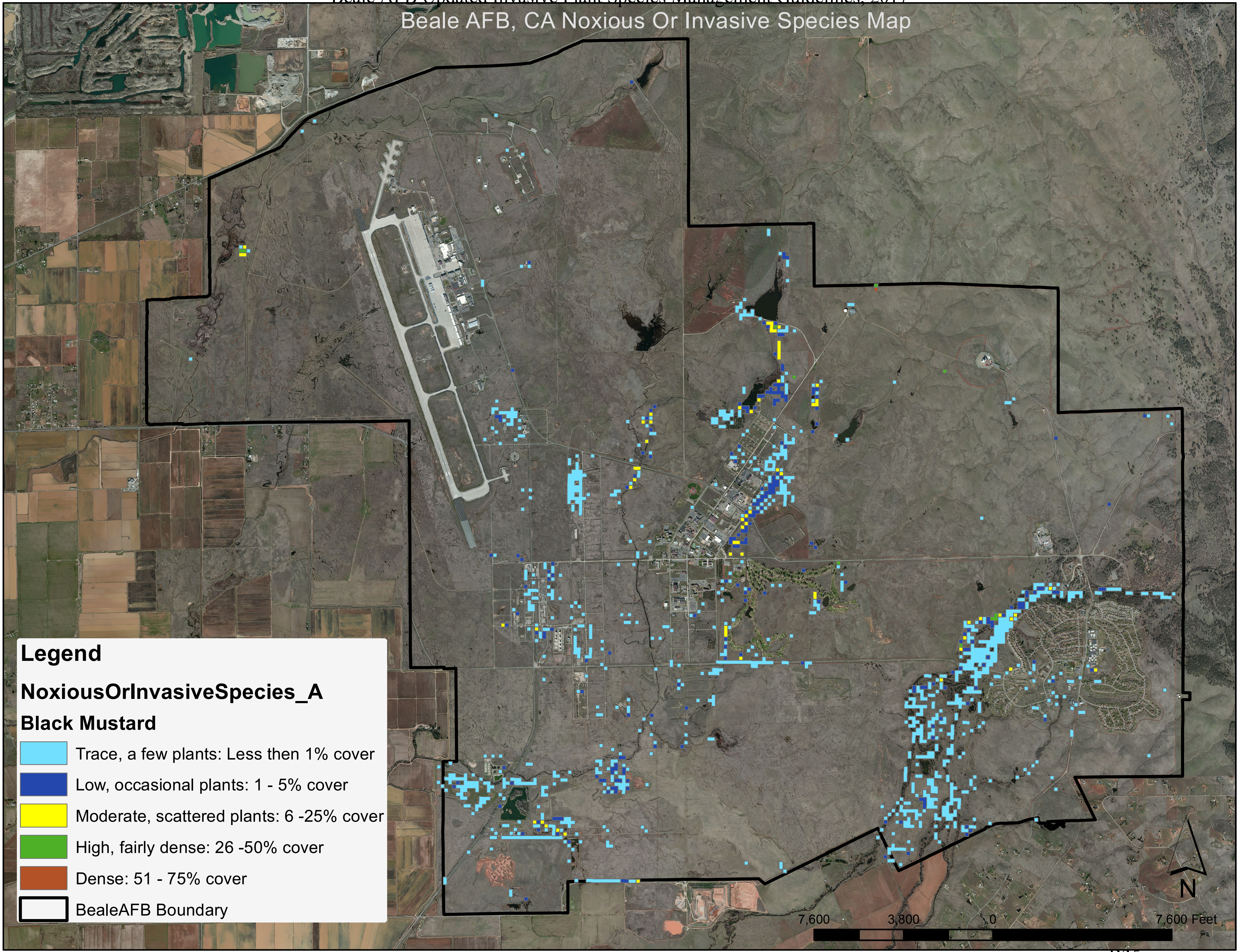
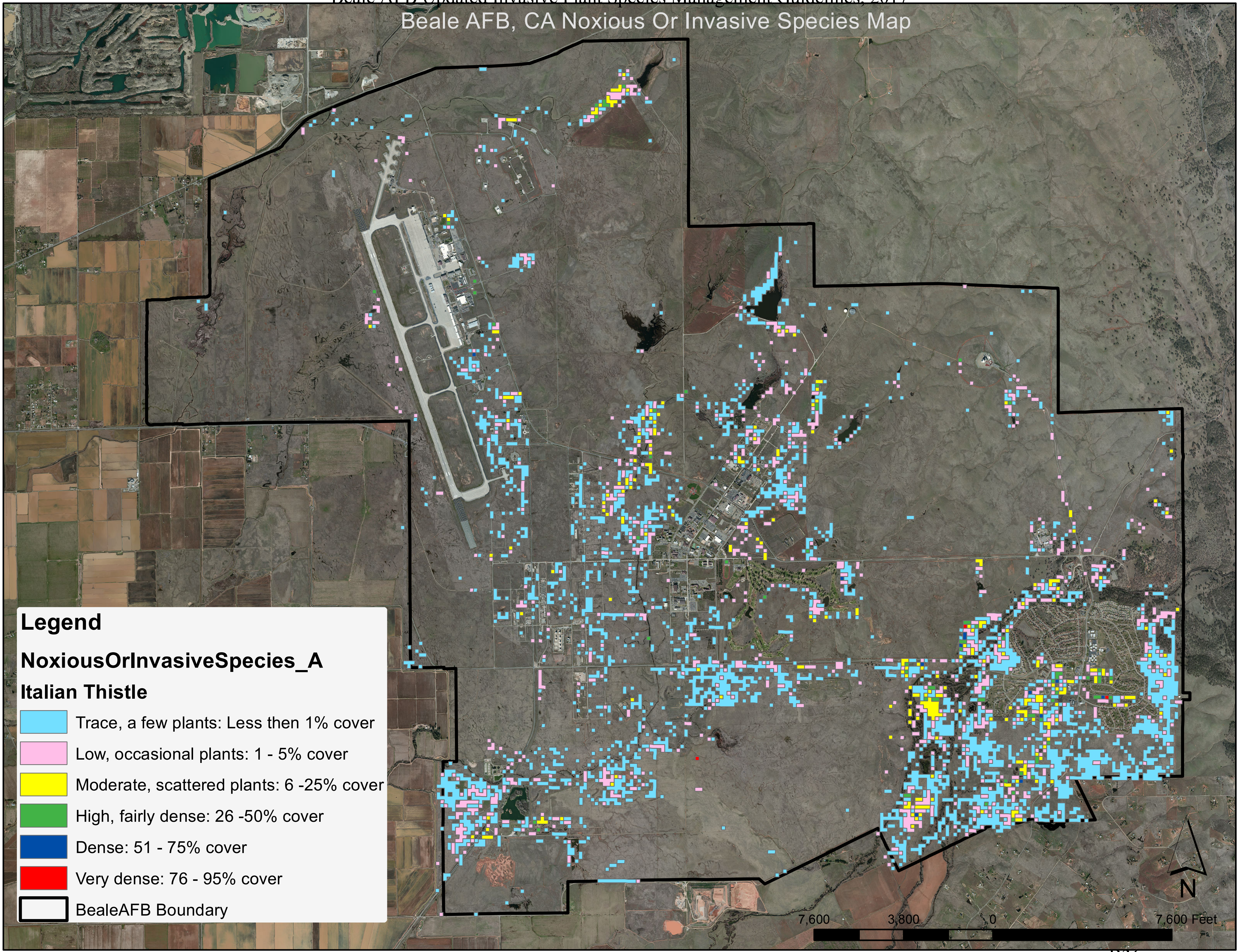

Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Barbed Goatgrass
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
High, fairly dense: 26 -50% cover
Dense: 51 - 75% cover
Very dense: 76 - 95% cover
BealeAFB Boundary
7,600
3,800
0
7,600 Feet
N

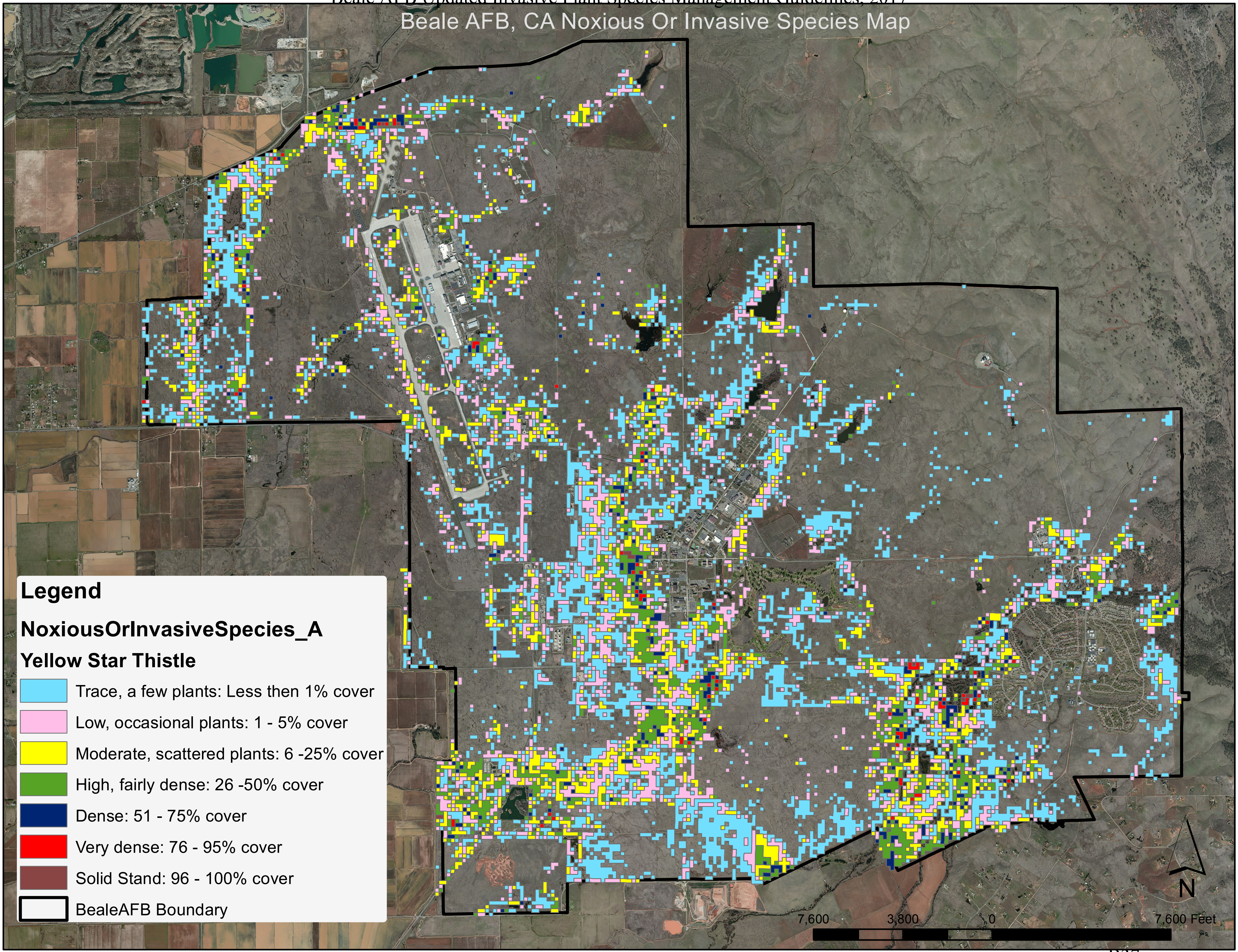


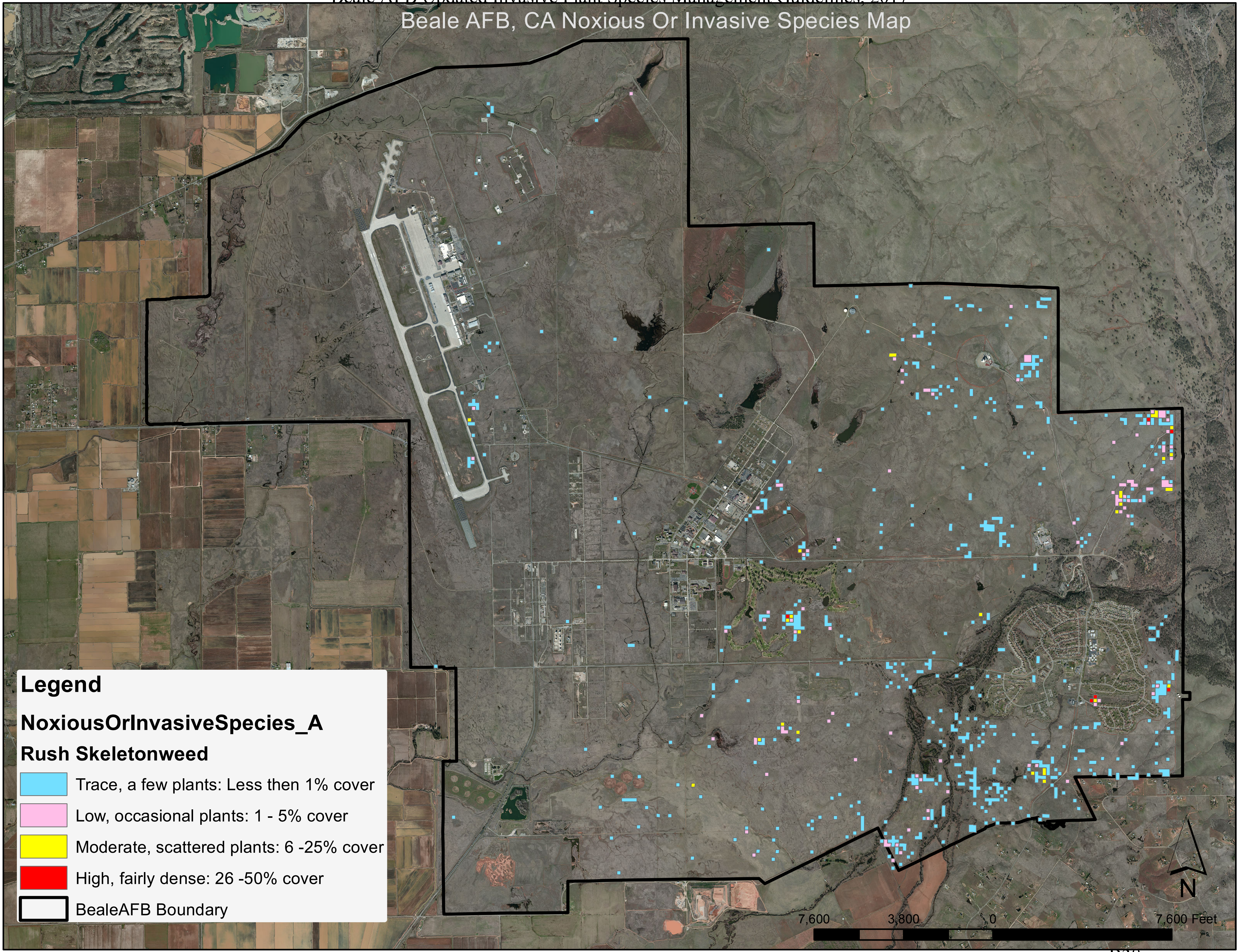
Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Tree-of-Heaven
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
BealeAFB Boundary
7,600
3,800
0
7,600 Feet
N

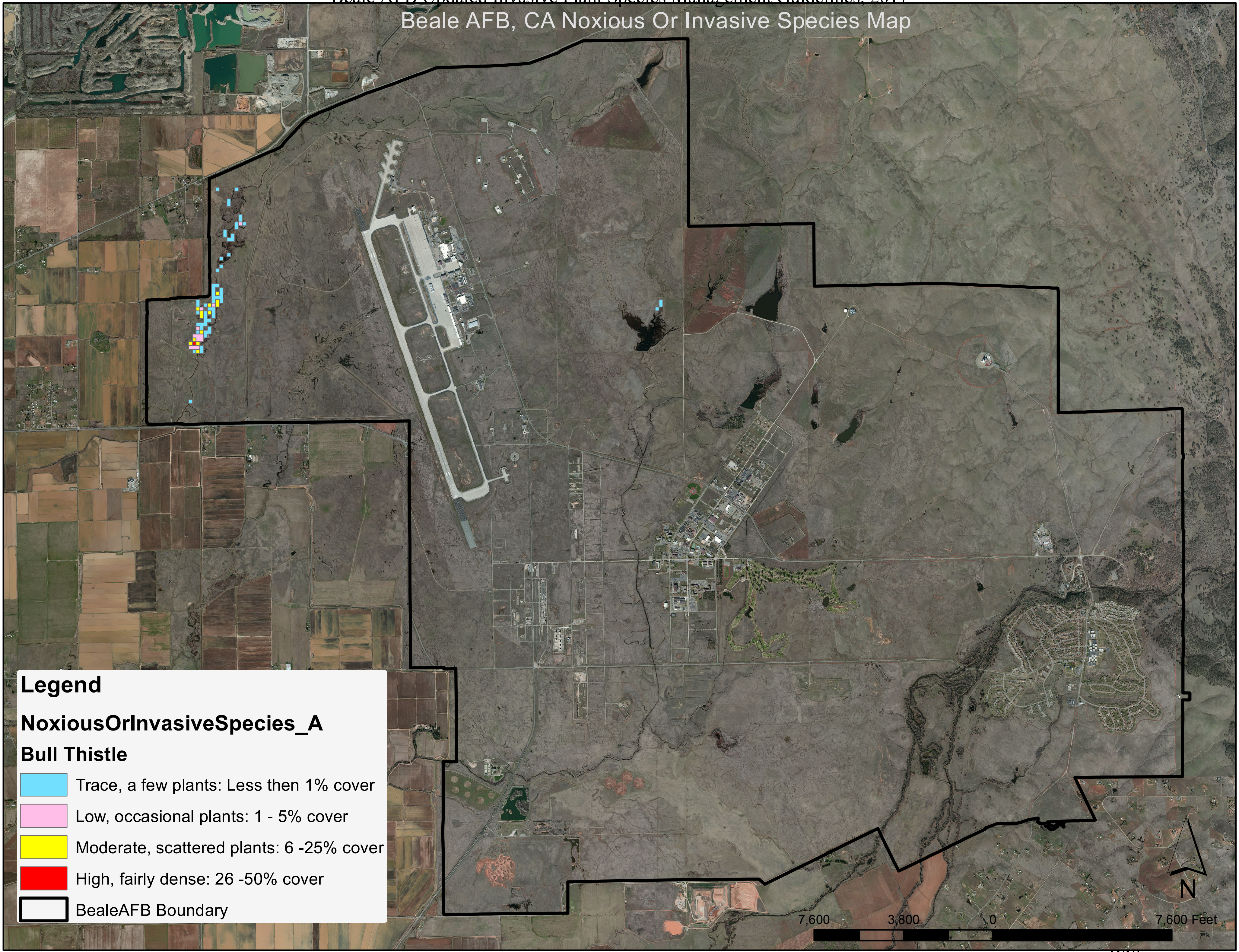

Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Giant Reed
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
BealeAFB Boundary
7,600
3,800
0
7,600 Feet
N


Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Black Mustard
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
High, fairly dense: 26 -50% cover
Dense: 51 - 75% cover
BealeAFB Boundary
7,600
3,800
0
7,600 Feet
N

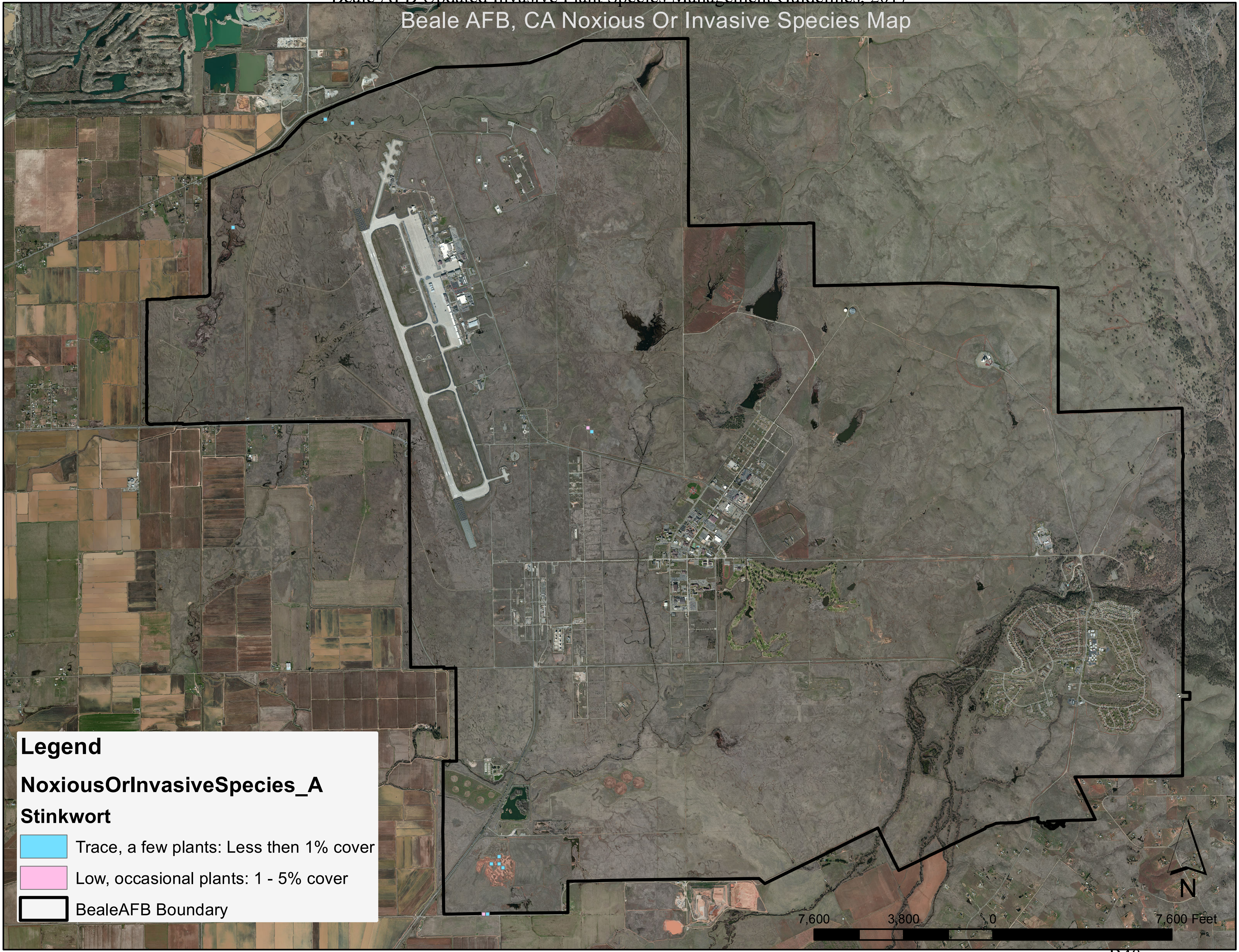

Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Italian Thistle
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
High, fairly dense: 26 -50% cover
Dense: 51 - 75% cover
Very dense: 76 - 95% cover
BealeAFB Boundary
N
7,600
3,800
0
7,600 Feet


Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Yellow Star Thistle
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
High, fairly dense: 26 -50% cover
Dense: 51 - 75% cover
Very dense: 76 - 95% cover
Solid Stand: 96 - 100% cover
BealeAFB Boundary
7,600
3,800
0
7,600 Feet
N

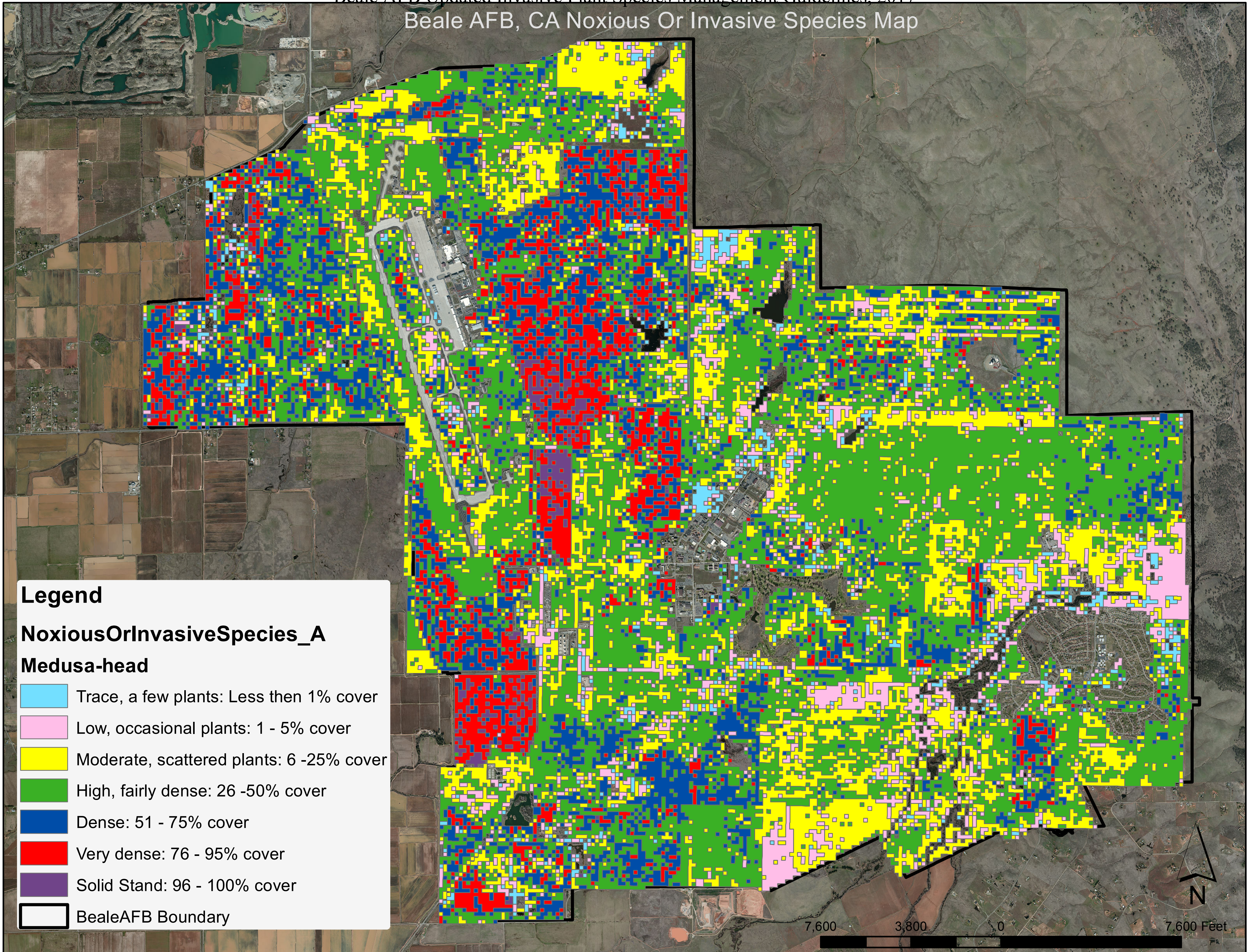

Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Rush Skeletonweed
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
High, fairly dense: 26 -50% cover
BealeAFB Boundary
7,600
3,800
0
7,600 Feet
N

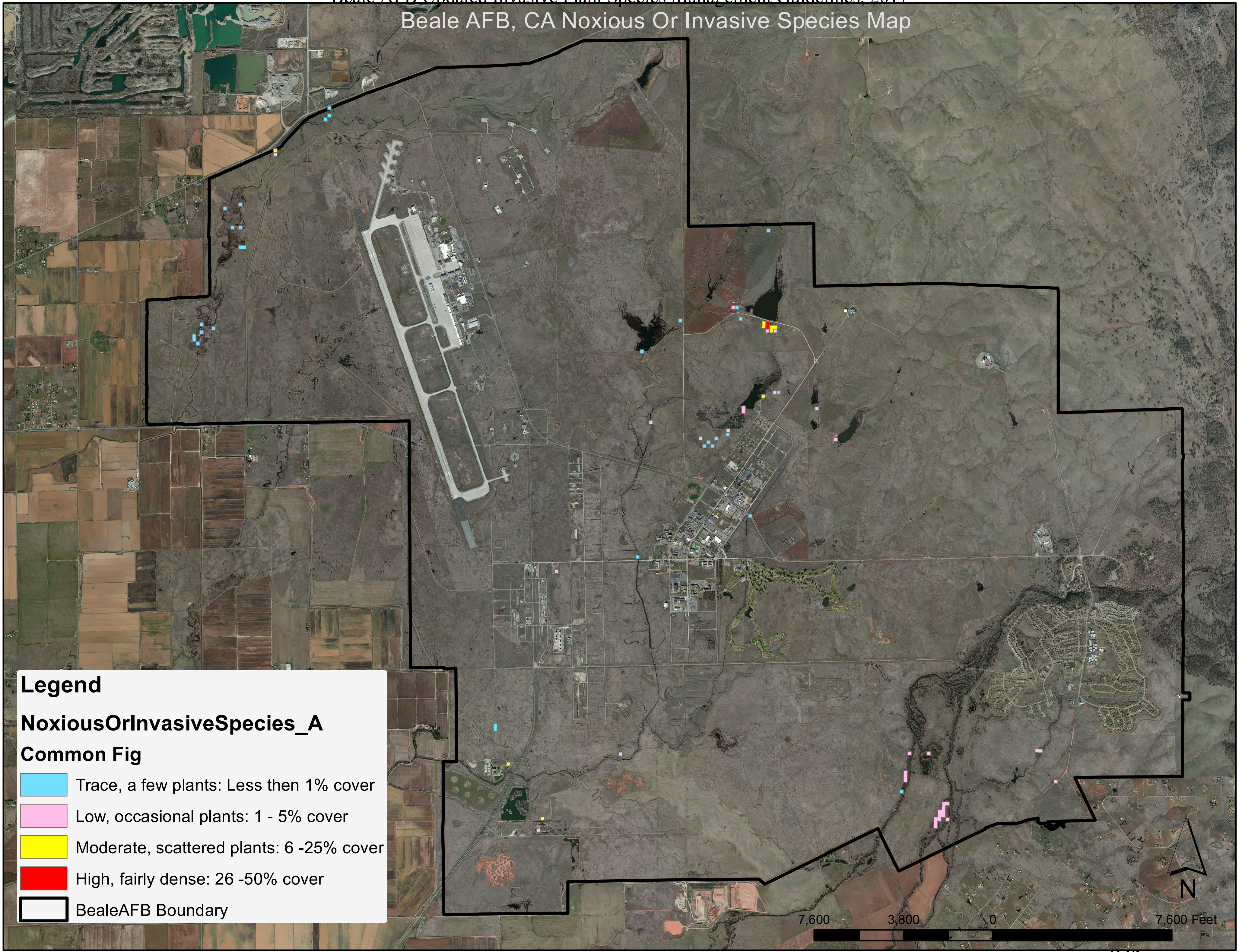


Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Bull Thistle
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
High, fairly dense: 26 -50% cover
BealeAFB Boundary
7,600
3,800
0
7,600 Feet
N

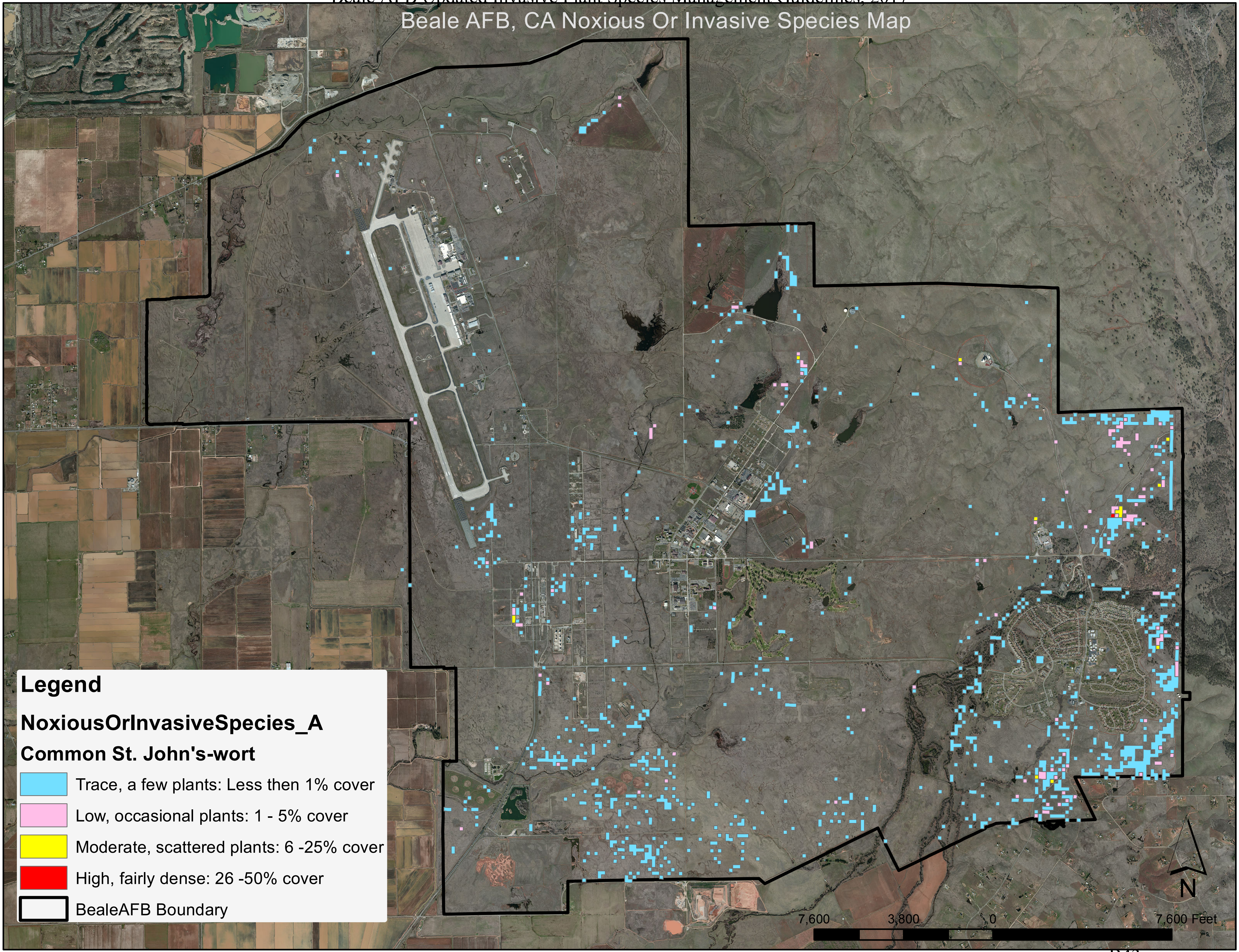


Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Stinkwort
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
BealeAFB Boundary
N
7,600
3,800
0
7,600 Feet

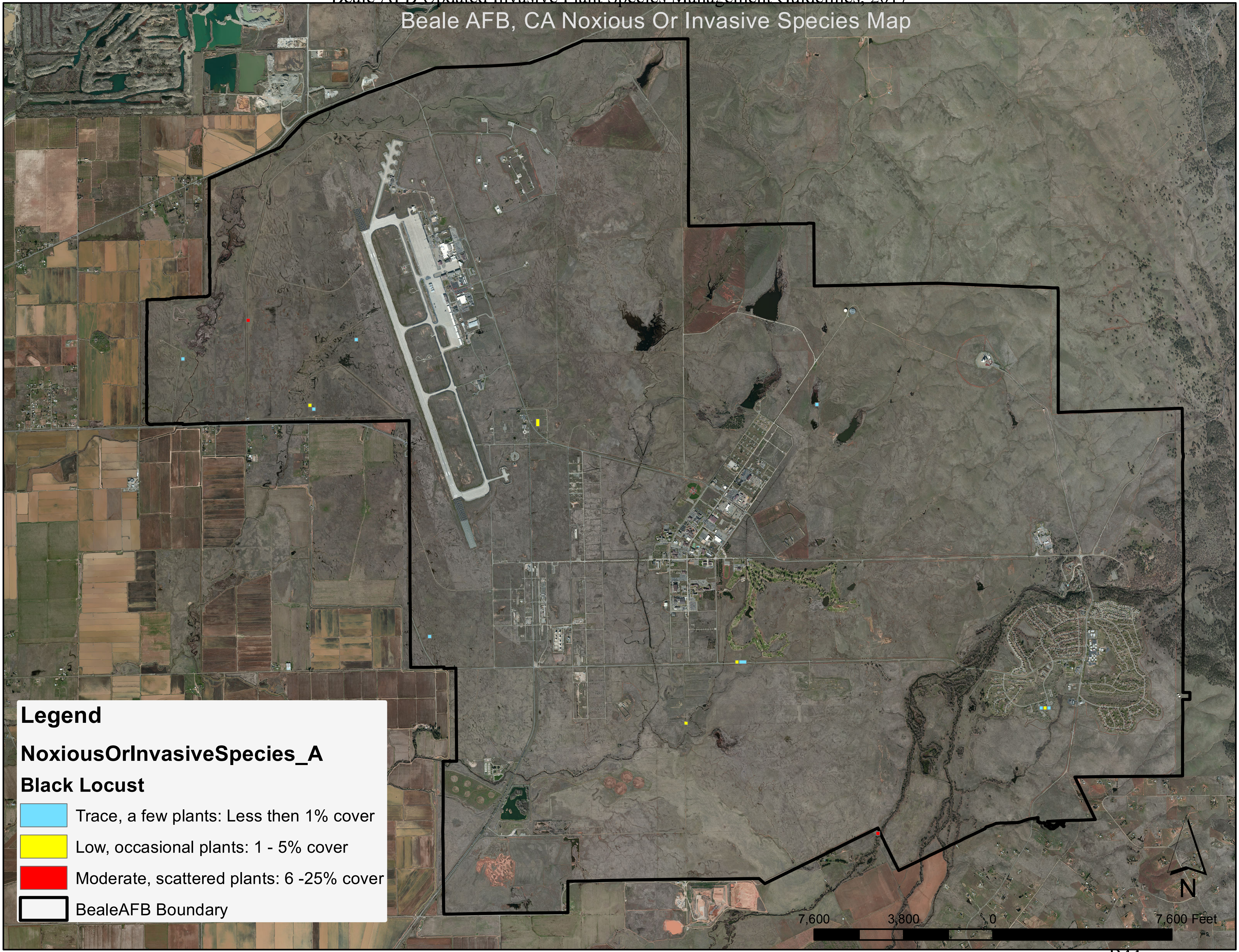

Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Medusa-head
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
High, fairly dense: 26 -50% cover
Dense: 51 - 75% cover
Very dense: 76 - 95% cover
Solid Stand: 96 - 100% cover
BealeAFB Boundary
N
7,600
3,800
0
7,600 Feet

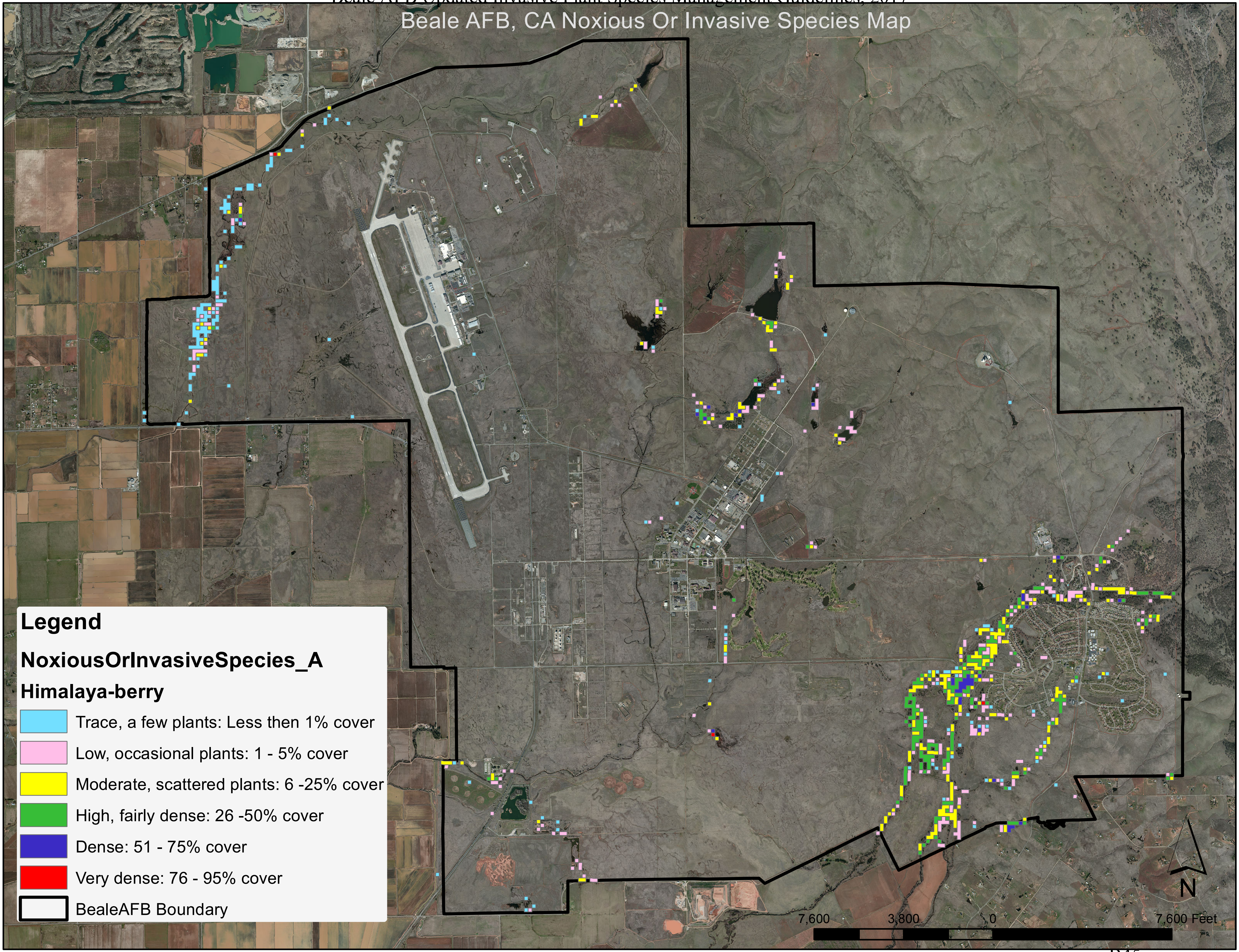


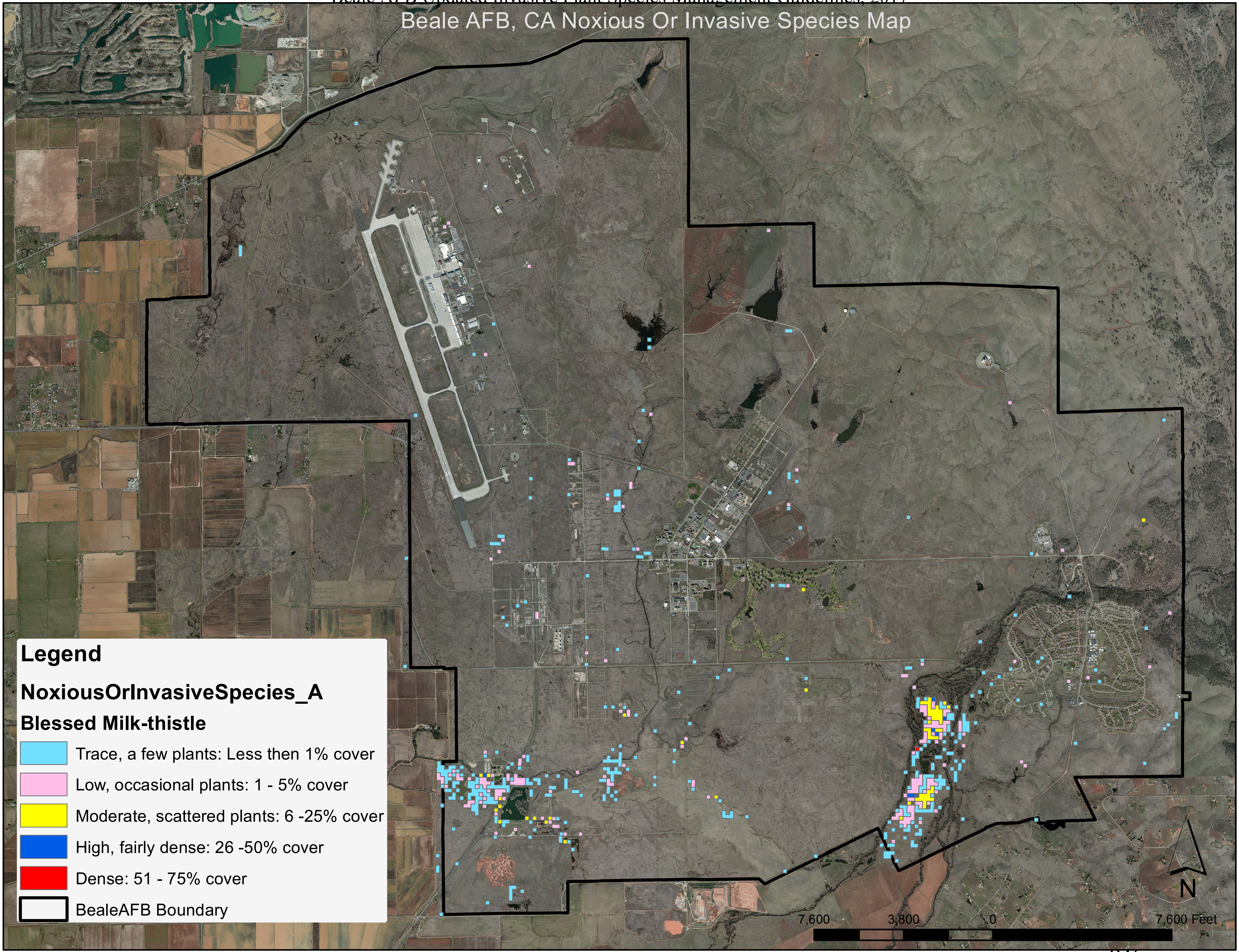
Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Common Fig
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
High, fairly dense: 26 -50% cover
BealeAFB Boundary
N
7,600
3,800
0
7,600 Feet



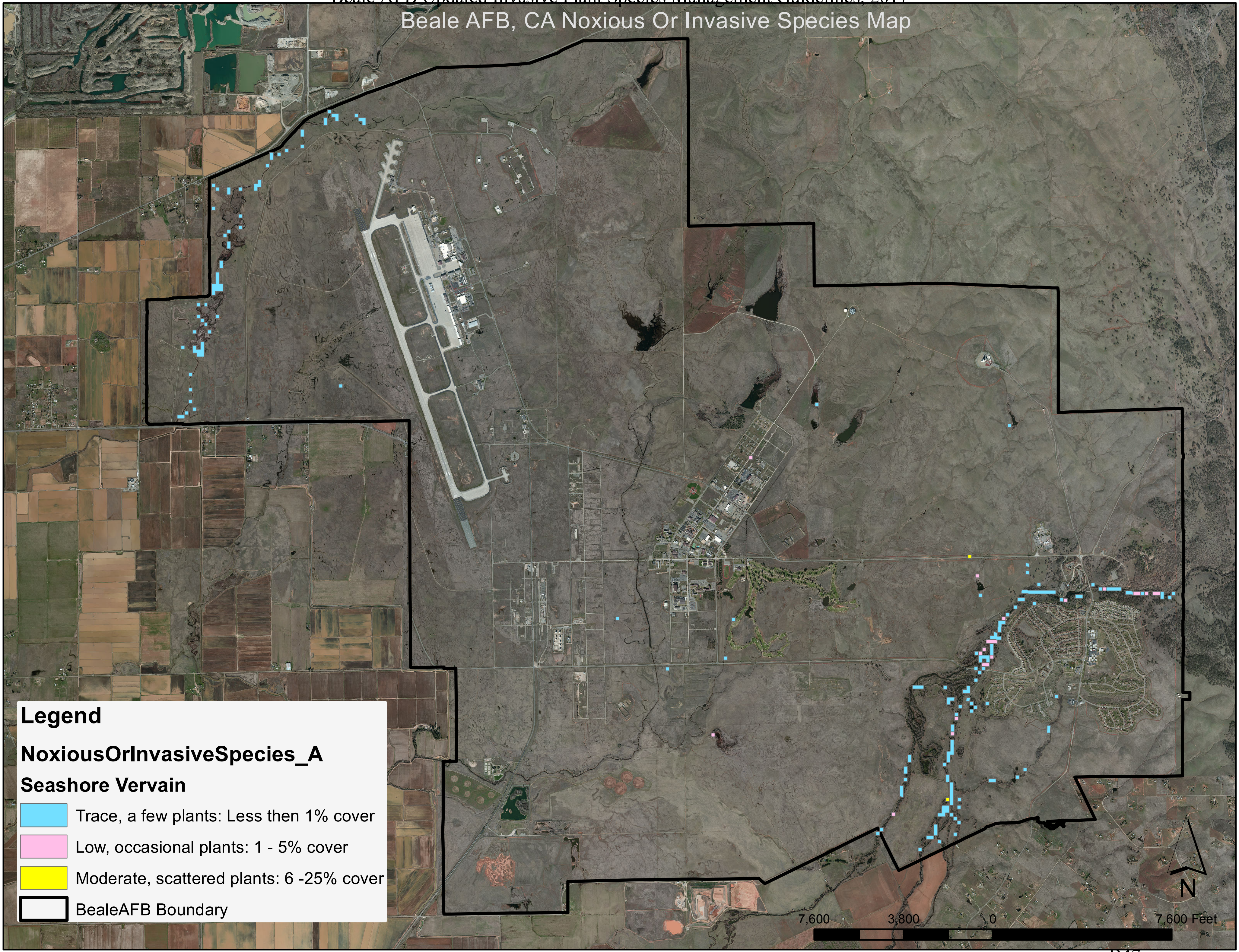
Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Common St. John's-wort
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
High, fairly dense: 26 -50% cover
BealeAFB Boundary
7,600
3,800
0
7,600 Feet
N


Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Black Locust
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
BealeAFB Boundary
N
7,600
3,800
0
7,600 Feet

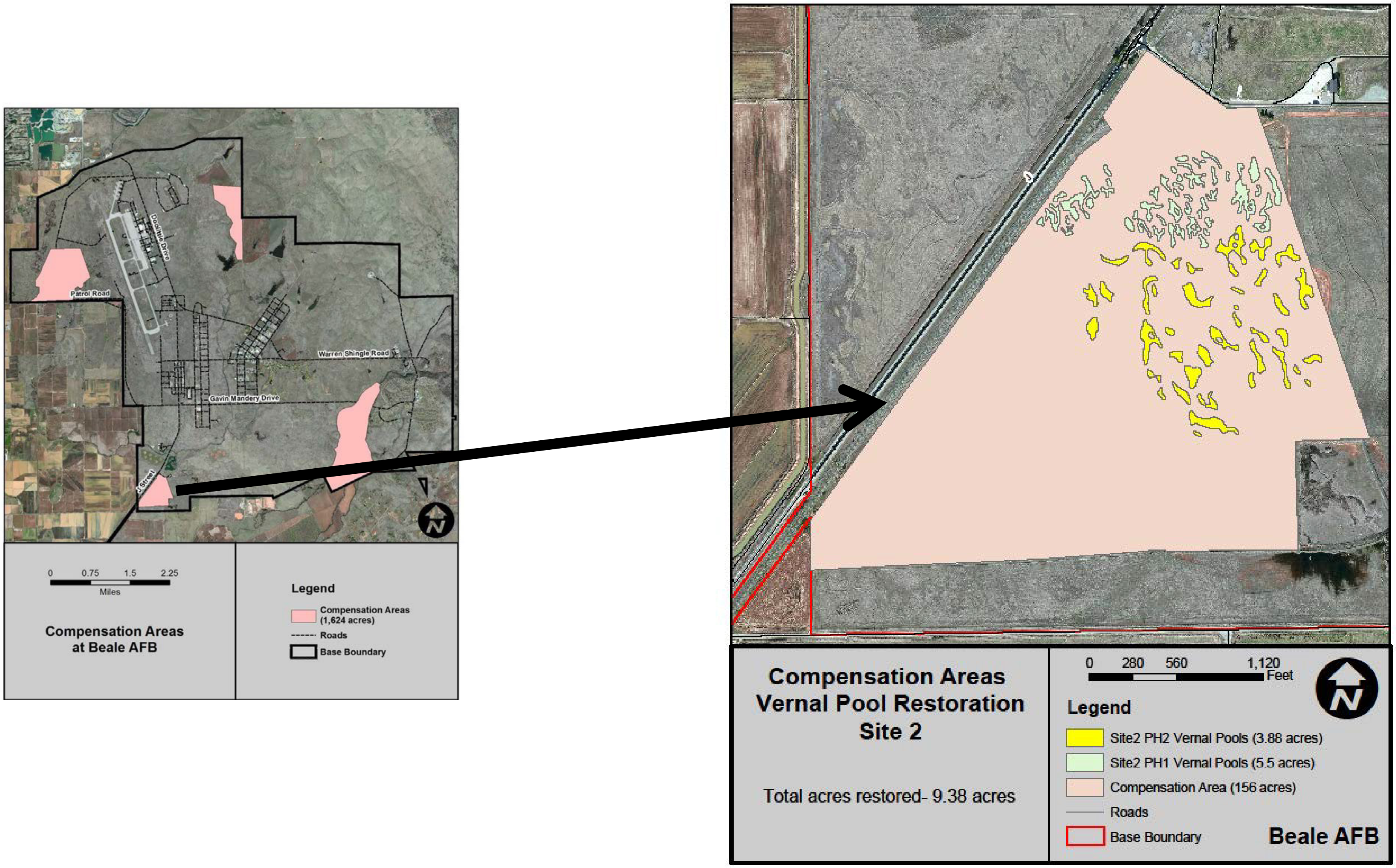

Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Himalaya-berry
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
High, fairly dense: 26 -50% cover
Dense: 51 - 75% cover
Very dense: 76 - 95% cover
BealeAFB Boundary
7,600
3,800
0
7,600 Feet
N



Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Blessed Milk-thistle
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
High, fairly dense: 26 -50% cover
Dense: 51 - 75% cover
BealeAFB Boundary
7,600
3,800
0
7,600 Feet
N



Beale AFB, CA Noxious Or Invasive Species Map
Legend
NoxiousOrInvasiveSpecies_A
Seashore Vervain
Trace, a few plants: Less then 1% cover
Low, occasional plants: 1 - 5% cover
Moderate, scattered plants: 6 -25% cover
BealeAFB Boundary
7,600
3,800
0
7,600 Feet
N



General location of Site 2 Phase 2 vernal pools (in yellow) containing Indian toothcup (*Rotala indica*) on Beale AFB (from Arreola and Kirk 2017).

Appendix C: State of California Noxious Weed List

California state law defines a noxious weed as follows:

"Noxious weed" means any species of plant that is, or is liable to be, troublesome, aggressive, intrusive, detrimental, or destructive to agriculture, silviculture, or important native species, and difficult to control or eradicate, which the director, by regulation, designates to be a noxious weed. In determining whether or not a species shall be designated a noxious weed for the purposes of protecting silviculture or important native plant species, the director shall not make that designation if the designation will be detrimental to agriculture. (State of California, Food and Agricultural Code, Division 4, Part 1, Chapter 1, Article 1. Definitions 5004;https://leginfo.legislature.ca.gov/faces/codes_displaySection.xhtml?lawCode=FAC&sectionNum=5004).

The noxious weeds list is compiled by the California Department of Food and Agriculture (CDFA) and so is not binding on the US Air Force. Nonetheless, the list can be used as an indicator of which weeds are most likely to have detrimental impact and can be used to guide management on Air Force lands in California. Although the CDFA noxious weeds list is primarily targeted at non-native species that cause direct economic harm to crops, these species may also cause harm in wildlands and should be eradicated where found.

California Code of Regulations
Title 3. Food and Agriculture
Division 4. Plant Industry
Chapter 6. Weed Free Areas and Weed Eradication Areas
Subchapter 6. Noxious Weed Species (Refs & Annos)
[current as of July 21, 2017; https://govt.westlaw.com/calregs/index]

3 CCR § 4500

§ 4500. Noxious Weed Species.

It has been determined that the following species of plants are noxious weeds within the meaning of Section 5004 of the Food and Agricultural Code:

Acacia paradoxa (Kangaroo thorn)
Acaena anserinifolia (biddy biddy)
Acaena novae-zelandiae (biddy biddy)
Acaena pallida (biddy biddy)
Acroptilon repens (=Rhaponticum r.) (Russian knapweed)
Aegilops cylindrica (jointed goatgrass)
Aegilops ovata (ovate goatgrass)

Aegilops triuncialis (barb goatgrass)
Aeschynomene spp. (joint-vetch)
Alhagi maurorum (camelthorn)
Ailanthus altissima (tree of heaven)
Allium paniculatum (panicled onion)
Allium vineale (wild garlic)
Alternanthera philoxeroides (alligatorweed)
Alternanthera sessilis (sessile joyweed)
Ambrosia trifida (giant ragweed)
Araujia sericifera (bladderflower)
Arctotheca calendula (capeweed, as seed or fertile plants)
Arundo donax (giant reed)
Asphodelus fistulosus (onionweed)
Atriplex amnicola (swamp saltbush)
Berteroa incana (hoary alyssum)
Brachypodium sylvaticum (slender false-brome)
Cabomba caroliniana (Carolina fanwort)
Carduus acanthoides (plumeless thistle)
Carduus crispus (curly plumeless thistle)
Carduus nutans (musk thistle)
Carduus pycnocephalus (slender-flowered thistle)
Carduus tenuiflorus (Italian thistle)
Carthamus baeticus (smooth distaff thistle)
Carthamus lanatus (woolly distaff thistle)
Carthamus leucocaulos (whitestem distaff thistle)
Cenchrus echinatus (southern sandbur)
Cenchrus incertus (coast sandbur)
Cenchrus longispinus (mat sandbur)
Centaurea calcitrapa (purple starthistle)
Centaurea diffusa (diffuse knapweed)
Centaurea iberica (Iberian starthistle)
Centaurea jacea s.l. (including *C. pratensis, C. nigra*, and *C. nigrescens*) (meadow knapweed, black knapweed, brown knapweed)
Centaurea melitensis (tocalote)
Centaurea solstitialis (yellow starthistle)
Centaurea squarrosa (squarrose knapweed)
Centaurea stoebe (=*C. maculosa*) (spotted knapweed)
Centaurea sulphurea (Sicilian starthistle)
Ceratopteris thalictroides (watersprite)
Chondrilla juncea (skeletonweed)
Chorispora tenella (purple mustard)
Cirsium arvense (Canada thistle)
Cirsium japonicum (Japanese thistle)
Cirsium ochrocentrum (yellowspine thistle)
Cirsium undulatum (wavyleaf thistle)
Cirsium vulgare (bull thistle)

Coincya monensis (star-mustard)
Convolvulus arvensis (field bindweed)
Cortaderia jubata (jubata grass)
Crupina vulgaris (bearded creeper)
Cucumis melo var. *dudaim* (dudaim melon)
Cucumis myriocarpus (paddy melon)
Cuscuta spp. (dodder)
Cynara cardunculus (artichoke thistle)
Cyperus esculentus (yellow nutsedge)
Cyperus rotundus (purple nutsedge)
Cytisus scoparius (Scotch broom)
Diodia virginiana (buttonweed)
Dittrichia graveolens (stinkweed)
Drymaria cordata (whitesnow, tropical chickweed)
Egeria najas (anacharis)
Elymus repens (=Elytrigia repens) (quackgrass)
Euphorbia esula (leafy spurge)
Euphorbia graminea (grassleaf spurge)
Euphorbia dendroides (tree spurge)
Euphorbia oblongata (oblong spurge)
Euphorbia serrata (serrate spurge)
Euphorbia terracina (carnation spurge)
Fallopia ^{X}bohemica (=Reynoutria ^{X}bohemica; Polygonum ^{X}bohemica) (Bohemian knotweed)
Fallopia japonica (=Polygonum cuspidatum; Reynoutria j.) (Japanese knotweed)
Fallopia sachalinensis (=Polygonum s.; Reynoutria s.) (giant knotweed)
Fatoua villosa (hairy crabweed)
Galega officinalis (goatsrue)
Genista monspessulana (French broom)
Halimodendron halodendron (Russian salt tree)
Halogeton glomeratus (halogeton)
Helianthus ciliaris (blueweed)
Heteropogon contortus (tanglehead)
Hydrilla verticillata (hydrilla)
Hydrocharis morsus-ranae (frogbit)
Hygrophila polysperma (Indian swampweed)
Hyoscyamus niger (black henbane)
Hypericum canariense (Canary Island St. Johnswort)
Hypericum perforatum (Klamath weed)
Isatis tinctoria (dyer's woad)
Lagarosiphon major (oxygen weed, African elodea)
Lepidium appellanum (=Cardaria appellanum) (globe-podded hoary cress)
Lepidium chalepensis (=Cardaria chalepensis) (lens-podded hoary cress)
Lepidium coronopus (=Coronopus squamatus) (swinecress)
Lepidium draba (=Cardaria draba) (heart-podded hoary cress)
Lepidium latifolium (perennial peppercress)
Leptochloa chinensis (=Dinebra c.) (Chinese sprangletop)

Limnobium laevigatum (South American spongeplant)
Limnobium spongia (American spongeplant, American frog's-bit)
Limnophila indica (Indian marshweed)
Limnophila sessiliflora (Asian marshweed)
Linaria dalmatica (Dalmatian toadflax)
Ludwigia decurrens (winged water-primrose)
Ludwigia hexapetala (water-primrose)
Ludwigia peruviana (Peruvian primrose-willow)
Lythrum salicaria (purple loosestrife)
Mercurialis ambigua (Spanish mercury)
Muhlenbergia schreberi (nimblewill)
Myosoton aquaticum (giant chickweed)
Nothoscordum gracile (false garlic)
Nymphaea mexicana (banana waterlily)
Nymphoides peltata (yellow floating heart)
Oenothera xenogaura (=Gaura drummondii) (Drummond's gaura)
Oenothera sinuosus (=Gaura sinuata) (wavyleaf gaura)
Ononis alopecuroides (foxtail restharrow)
Onopordum spp. (including Scotch thistle, Illyrian thistle and Taurian thistle)
Orobanche ramosa (branched broomrape)
Oryza rufipogon (red rice)
Panicum antidotale (blue panicgrass)
Parthenium hysterophorus (Santa Maria feverfew)
Peganum harmala (harmel)
Persicaria wallichii (=P. polystachyum; Rubrivena polystachya) (Himalayan knotweed)
Pennisetum clandestinum (Kikuyugrass)
Physalis virginiana var. *sonorae* (smooth groundcherry)
Physalis viscosa (grape groundcherry)
Potentilla recta (sulphur cinquefoil)
Prosopis strombulifera (creeping mesquite)
Retama monosperma (bridal veil broom)
Rhagadiolus stellatus (star endive)
Rorippa austriaca (Austrian fieldcress)
Rorippa sylvestris (creeping yellowcress)
Saccharum ravennae (ravennagrass)
Salsola tragus (common Russianthistle)
Salsola collina (spineless Russianthistle)
Salsola damascena (=S. vermiculata) (wormleaf salsola)
Salsola paulsenii (barbwire Russianthistle)
Salvia aethiopis (Mediterranean sage)
Salvia virgata (meadow sage)
Salvinia auriculata s.l. (giant salvinia)
Scolymus hispanicus (golden thistle)
Senecio jacobaea (=Jacobaea vulgaris) (tansy ragwort)
Senecio linearifolius (fireweed groundsel)
Senecio squalidus (Oxford ragwort)

Sesbania punicea (red sesbania, rattlebox)
Setaria faberi (giant foxtail)
Solanum cardiophyllum (heartleaf nightshade)
Solanum carolinense (Carolina horsenettle)
Solanum dimidiatum (Torrey's nightshade)
Solanum elaeagnifolium (white horsenettle)
Solanum lanceolatum (lanceleaf nightshade)
Solanum marginatum (white-margined nightshade)
Sonchus arvensis (perennial sowthistle)
Sorghum halepense (Johnsongrass and other perennial *Sorghum* spp. including but not limited to
Sorghum almum (perennial sweet sudangrass)
Spartina alterniflora and hybrids (smooth cordgrass and hybrids)
Spartina anglica (common cordgrass)
Spartina densiflora (dense-flowered cordgrass)
Spartina patens (saltmeadow cord grass)
Spartium junceum (Spanish broom)
Sphaerophysa salsula (Austrian peaweed)
Stipa brachychaeta (=Achnatherum b.; Amelichloa b.) (punagrass)
Striga lutea (witchweed)
Symphytum asperum (rough comfrey)
Taeniatherum caput-medusae (medusahead)
Tagetes minuta (wild marigold)
Tamarix chinensis (salt cedar)
Tamarix gallica (salt cedar)
Tamarix parviflora (salt cedar)
Tamarix ramosissima (salt cedar)
Tribolium obliterum (Capegrass)
Tribulus terrestris (puncture vine)
Ulex europaeus (gorse)
Viscum album (European mistletoe)
Volutaria canariensis (Canary Island knapweed)
Zostera japonica (dwarf eelgrass)
Zygophyllum fabago (Syrian beancaper)

Appendix D: Cal-IPC List of Weed-Free Hay, Straw, and Pellet Providers

Appendix D contains the California Invasive Plant Council's (Cal-IPC) list of weed-free hay, straw, and pellet providers, current as of July 2017. The list is organized by county and includes certified hay and straw vendors in the first table (updated October 2016) and pellet vendors in the second table (updated September 2015). As the lists are periodically updated by Cal-IPC, this Appendix should be updated with the current lists when necessary (see http://cal-ipc.org/ip/prevention/weedfreeforage.php).

Weed-Free Hay and Straw Providers - California and Nevada

October 2016 Update

CALIFORNIA (Alphabetized by and within county)				
Alpine	**Phone**	**Address**	**City, ZIP Code**	**Product Details (hay, straw, wattles, etc.)**
Gansberg Ranch	530-694-2268	2277 Foothill Rd.	Markleeville, 96120	grass hay
Colusa				
Hay Connection (John Foster Hay)	530-681-0306	352 Vawter Rd.	Arbuckle, 95912	erosion control straw, hay
Shadinger Arbuckle Ranch	530-476-0725	633 Gabby Rd.	Arbuckle, 95912	rice straw, wheat straw, straw wattles (erosion control)
Cal-Vista Erosion	530-476-0706	459 State Hwy. 99 W.	Arbuckle, 95912	certified rice straw wattles
Glenn				
K & R Farming	530-934-4500	6439 County Rd. 48	Willows, 95988	rice straw
Rick Green	530-570-0459	2130 County Rd. S.	Willows, 95988	rice straw
Inyo-Mono				
Curti Ranch	775-291-4073	999 Cunningham Wy.	Coleville, 96107	grass hay
All Five Ranch	760-920-2265	P.O. Box 597	Big Pine, 93513	alfalfa, Hay
Kern				
Western Fiber Co.	661-747-5581	4234 Sandrini Rd.	Arvin, 93203	straw wattles
Merced				
Hugh Yamshon	209-769-4494	2821 Healy Rd.	Merced, 95341	alfalfa hay
Karen Macedo (Broker)	209-722-7911	935 Northwood Dr.	Merced, 95348	alfalfa hay and possibly other products
Placer				
Echo Valley Ranch	530-823-8320	205 Nevada St.	Auburn, 95603	rice straw, alfalfa pellets
San Joaquin				
Lee's Lockeford Hay Station	209-727-0131	18503 N. Hwy. 88	Lockeford, 95237	wheat straw, alfalfa pellets
John Vander Meulen	209-484-7202	12784 Carrolton Ave	Escalon, 95320	Wheat straw
Stanilaus				
Scott LaMunyon Farms	209-535-8164	Will deliver locally	Waterford, 95386	oat hay
Shasta				
Hawes Ranch & Farm supply	530-365-2332	21923 Dersch Rd.	Anderson, 96007	wheat, rice straw
McArthur Ranch, Inc.	530-336-6815	26312 Jim Day Rd.	McArthur, 96007	alfalfa grass, alfalfa straw
Siskiyou				
Clint Custer	530-598-0732	2212 South Hwy	Etna, 96027	38 ac alfalfa/grass hay Cert. # 72215-1, and 77 ac wheat straw Cert. # 90315-1, **NAISMA certified**, baled with NAISMA twine
Brandon Fawaz	530-524-0354	349 Collier Way	Etna, 96027	6 ac wheat straw Cert # 80715-1, **NAISMA certified**, baled with NAISMA twine
Jeff Boyd	530-667-4828	692 Second St.	Tulelake, 96134	63 ac Wheat straw Cert. # 81815-1, **NAISMA certified**, baled with NAISMA twine
Sonoma				
Frizelle-Enos	707-992-0144	10035 Main St.	Penngrove, 94951	rice straw, alfalfa pellets
Tuolumne				
Hurst Ranch	209-984-3016	17415 State Hwy. 108	Jamestown, 95327	rice straw ©
Yolo				
Chamberlain Farms	530-662-2620	34530 County Road 29	Woodland, 95695	wheat straw, rice straw
NEVADA				
**For Nevada Weed Free Forage Producers, see here:* *http://agri.nv.gov/Plant/Noxious_Weeds/NV_Certified_Weed_Free_Producer_Links/*				

For more information about weed free certification go to:
http://www.cal-ipc.org/ip/prevention/weedfreeforage.php

1. If you need a large amount of material for the coming year, contact vendors early in the growing season to make sure sufficient weed free forage /straw will be certified and available for your project needs.
2. Ask your vendor for a proof of certification, in the form of a copy of CDFA Form 66-079 "Certificate of Quarantine Compliance (CQC)" associated with the inspection of the specific forage/straw materials. This is the legal document verifying that the materials have been inspected and certified.
3. Many vendors can order these materials upon request.
4. For upland restoration or mulching projects, certified weed free rice straw is considered the most weed free option.

Pellet Providers (not certified) - California				
September 2015 Update				**Pelletized Feed**
CALIFORNIA (Alphabetized by and within county)				
Alameda	**Phone**	**Address**	**City, ZIP Code**	**Product**
Bay Area Hay & Feed	925-389-6005	101 N. Greenville Rd.	Livermore, 94550	alfalfa pellets
EJ Cattle & Feed Supply	925-960-9074	7900 Carneal Rd.	Livermore, 94551	alfalfa pellets
Livermore Feed & Farm	925-447-4203	3170 Fourth St.	Livermore, 94550	alfalfa pellets
Western Saddlery	800-833-5085	7038 Commerce Cir.	Pleasanton, 94588	alfalfa pellets
Amador				
Feed Barn	209-223-2809	11261 Prospect Dr.	Jackson, 95642	alfalfa pellets
Rancher's Outlet	209-245-6631	6980 Hwy. 16	Plymouth, 95669	alfalfa pellets
Butte				
Northern Star Mills	530-342-7661	510 Esplanade	Chico, 95926	alfalfa pellets
Skyview Feed & Pet	530-877-1019	677 Birch St.	Paradise, 95969	alfalfa pellets
Calaveras				
Country Feed & More	209-754-9100	833 G Hwy. 49	San Andreas, 95249	alfalfa pellets
McDillard's Feed	209-785-8000	3566 Spangler Ln., #1	Copperopolis, 95228	alfalfa pellets
Spence Ranch Feed & Supply	209-736-4310	1291 N. Hwy. 49	Altaville, 95221	alfalfa pellets
Valley Springs Feed	209-772-3589	10 Main St.	Valley Springs, 95252	alfalfa pellets
Contra Costa				
Alamo Hay & Grain	925-837-4994	3196 Danville Blvd.	Alamo, 94507	alfalfa pellets
Byron Feed	925-634-4353	3800 Holway Dr.	Byron, 94514	alfalfa pellets
Concord Feed & Fuel	925-940-1211	228 Hookston Rd.	Pleasant Hill, 94561	alfalfa pellets
Rodie's Feed	925-672-4600	8863 Marsh Creek Rd.	Clayton, 94517	alfalfa pellets
El Dorado				
Clifton & Warren	530-622-6771	574 Placerville Dr.	Placerville, 95667	alfalfa pellets
Coloma Feed & Hardware	530-626-6300	7170 Hwy. 49, #1	Lotus, 95651	alfalfa pellets
Cool Feed & Ranch Supply	530-887-0200	2968 Hwy. 49, Ste. M	Cool, 95614	alfalfa pellets
Double Diamond Feed	530-622-4001	692 Pleasant Valley Rd.	Diamond Springs, 95619	alfalfa pellets
Garden Valley Feed	530-333-2320	4702 Marshall Rd.	Garden Valley, 95633	alfalfa pellets
Hay Lady	530-333-1550	2977 Church St.	Georgetown, 95634	alfalfa pellets
Lee's Feed	530-677-4891	4110 Mother Lode Dr.	Shingle Springs, 95682	alfalfa pellets
Mt. Aukum General Store	530-620-3015	8080 Mount Aukum Rd.	Mount Aukum, 95656	alfalfa pellets
R & S Hay Barn	530-295-3990	4451 Missouri Flat Way	Placerville, 95667	alfalfa pellets, rice straw
Fresno				
Academy Feed	559-875-2855	494 S. Academy Ave.	Sanger, 93657	alfalfa pellets
Auberry Feed	559-855-8555	32970 Auberry Rd.	Auberry, 93602	alfalfa pellets
Bucke's Feed & Grain	530-865-4427	1308 Railroad Ave.	Orland, 95963	alfalfa pellets
Canyon Feed	559-855-7480	29533 Auberry Rd., #101	Prather, 93651	alfalfa pellets
Clovis Feed	559-299-9596	1490 Tollhouse Rd.	Clovis, 93611	alfalfa pellets
D & D A1 Feed	559-322-3333	5092 N. Academy Ave.	Clovis, 93619	alfalfa pellets
Western Farm Supply	559-266-3276	445 N. Brawley, Ste. C	Fresno, 93706	alfalfa pellets

Pellet Providers (not certified) - California

September 2015 Update				**Pelletized Feed**
CALIFORNIA (Alphabetized by and within county)				
Humboldt	**Phone**	**Address**	**City, ZIP Code**	**Product**
Fortuna Feed	707-725-3333	126 Dinsmore Dr.	Fortuna, 95540	alfalfa pellets
The Farm Store	707-443-7397	3956 Jacobs Ave.	Eureka, 95501	alfalfa pellets
Kern				
Granite Station Saddlery/Feed	661-399-3186	7156 Golden State, B	Bakersfield, 93308	alfalfa pellets
Lake				
Ag Unlimited	707-278-3131	2532 Big Valley Rd.	Lakeport, 95453	alfalfa pellets
CJ's Ranch Supply	707-987-9771	21713 Hwy. 29	Middletown, 95461	alfalfa pellets
Rainbow Ag	707-279-0550	1975 Argonaut Rd.	Lakeport, 95453	alfalfa pellets
Madera				
3-V Feed	559-661-0038	28342 Hwy. 145	Madera, 93638	alfalfa pellets
Box Feed	559-877-4787	32941 Rd. 222, #1	North Fork, 93643	alfalfa pellets
Mountain Feed	559-683-7383	35424 Hwy. 41	Coarsegold, 93614	alfalfa pellets
Valley Feed	559-674-6735	121 N. Gateway Dr.	Madera, 93637	alfalfa pellets
Marin				
Novato Horse & Pet Supply	415-892-1030	7546 Redwood Blvd.	Novato, 94945	alfalfa pellets
Toby's Feed Supply	415-663-1223	11250 CA-1	Point Reyes Station, 94956	alfalfa, oat, timothy pellets
Marin Tack and Feed	415-456-2929	6880 Sir Francis Drake Blvd.	Forest Knolls, 94933	oat pellets
Merced				
Ford's Farm Supply	209-854-3805	1302 South Ave.	Gustine, 95322	alfalfa pellets
Monterey				
Hawkins Ranch	805-937-1567	812 Hawkins Wy.	Santa Maria, 93908	alfalfa pellets
California Hay Barns	831-757-5088	1031 Industrial St.	Salinas, 93901	alfalfa pellets
Napa				
Wilson's Feed & Supplies	707-252-0316	1700 Yajome St.	Napa, 94558	alfalfa pellets
Nevada				
CJ's Hay	530-273-5249	18381 McCourtney Rd.	Grass Valley, 95949	alfalfa pellets
Featherlite Trailer	530-273-8870	13317 Hwy. 49	Grass Valley, 95949	alfalfa pellets
Pearson Feed	530-432-1420	17905 Penn Valley Rd.	Penn Valley, 95946	alfalfa pellets
Ridge Feed & Supply	530-273-3886	12892 Ridge Rd.	Grass Valley, 95949	alfalfa pellets
Placer				
California Hay Barns	916-652-7301	3031 Penryn Rd.	Penryn, 95663	alfalfa pellets
Colfax Feed & Country Store	530-346-2600	140 North Main St.	Colfax, 95713	alfalfa pellets
Echo Valley Ranch	530-823-8320	205 Nevada St.	Auburn, 95603	alfalfa pellets, rice straw
Foothill Feed & Gift	916-652-7121	3293 Taylor Rd., A	Loomis, 95650	alfalfa pellets
Sierra Hay & Feed	916-645-3638	150 Flocchini Cir., #100	Lincoln, 95648	alfalfa pellets
Sierra Mountain Feed/Supply	559-338-2729	35625 E. Kings Canyon Rd.	Squaw Valley, 95675	alfalfa pellets
Superior Livestock Supply	916-434-8174	641 H St.	Lincoln, 95648	alfalfa pellets
The Hay Barn	530-268-1122	10101 Streeter Rd., Ste. H	Auburn, 95602	alfalfa pellets

Pellet Providers (not certified) - California

September 2015 Update				Pelletized Feed
CALIFORNIA (Alphabetized by and within county)				
Sacramento	**Phone**	**Address**	**City, ZIP CODE**	**Product**
Elk Grove Milling, Inc.	916-684-2056	8320 Eschinger Rd.	Elk Grove, 95757	alfalfa pellets
Elverta Feed Pet & Tack	916-991-5048	7831 Rio Linda Blvd.	Elverta, 95626	alfalfa pellets
Nick Nimmo Hay	209-745-4712	13208 Stockton Blvd.	Galt, 95632	alfalfa pellets
Paul Wagner Feed	916-991-3659	1331 Claire Ave.	Sacramento, 95838	alfalfa pellets
River Valley Feed	916-991-0077	6549 16th St.	Rio Linda, 95673	alfalfa pellets
Sheldon Feed & Supply	916-686-6400	8928 Grantline Rd.	Elk Grove, 95624	alfalfa pellets
Western Feed & Supply	916-643-1864	5935 Don Wy.	Carmichael, 95608	alfalfa pellets
Western Feed & Pet Supply	916-988-1011	8980 Greenback Ln.	Orangevale, 95838	alfalfa pellets
San Benito				
Tres Pinos Ranch Supply	831-628-3718	6980 Airline Hwy.	Tres Pinos, 95075	alfalfa pellets
San Bernardino				
Standing Bar G Productions	760-240-5870	9233 Deep Creek Rd.	Apple Valley, 92308	alfalfa pellets
San Diego				
East County Feed	619-562-2208	10845 Woodside Ave.	Santee, 92071	alfalfa pellets
Terry's Hay & Grain	760-749-9328	27350 Valley Center Rd.	Valley Center, 92082	alfalfa pellets
San Joaquin				
Frontier Feed & Supply	530-365-8072	5544 Deschutes Rd.	Anderson, 96007	alfalfa pellets
Lee's Lockeford Hay Station	209-727-0131	18503 N. Hwy. 88	Lockeford, 95237	alfalfa pellets, wheat straw
Old McGowen Feed	209-824-8074	6910 E. Lathrop Rd.	Manteca, 95336	alfalfa pellets
Vaca Hay Service	209-271-6674	21007 Hansen Rd.	Tracy, 95304	alfalfa pellets
San Mateo				
Azevedo Feed	650-726-6160	1815 Miramontes Point Road	Half Moon Bay, 94019	alfalfa cubes
Half Moon Bay Feed & Fuel	650-726-4814	331 Main St.	Half Moon Bay, 94019	alfalfa pellets
Pastorino Hay & Ranch	650-726-6155	921 Miramontes St.	Half Moon Bay, 94019	alfalfa pellets
Portola Valley Feed	650-851-1750	884 Portola Rd.	Portola Valley, 94028	alfalfa pellets
Santa Clara				
Dave's Hay Barn	408-292-3337	1055 Commercial	San Jose, 95116	alfalfa pellets
Express Hay	408-779-6621	14905 Olive Ave.	Morgan Hill, 95037	alfalfa pellets
Ganado Feed	408-286-4655	2331 S. 7th St.	San Jose, 95112	alfalfa pellets
Sam's Downtown Feed & Pet	408-287-9090	759 W San Carlos St.	San Jose, 95126	alfalfa pellets, rice straw
Silva Ranch	408-683-2348	12310 Santa Teresa Blvd.	San Martin, 95046	alfalfa pellets
Santa Cruz				
Corralitos Feed	831-722-7884	2895 B Freedom Blvd.	Watsonville, 95076	alfalfa cubes
Santa Clara				
Sam's Downtown Feed & Pet	408-287-9090	759 W. San Carlos St.	San Jose, 95126	alfalfa pellets
Shasta				
Frontier Feed & Supply	530-365-8072	5544 Deschutes Rd.	Anderson, 96007	alfalfa pellets
Solano				
Higby's Country Feed	707-678-9007	8470 Currey Rd.	Dixon, 95620	alfalfa pellets
Western Ranch Supply	707-448-6568	103 Aegan Wy.	Vacaville, 95687	alfalfa pellets

Pellet Providers - California and Nevada

September 2015 Update				**Pelletized Feed**
CALIFORNIA (Alphabetized by and within county)				
Sonoma	**Phone**	**Address**	**City, ZIP CODE**	**Product**
Dave's Hay Barn	707-546-6677	3395 Petaluma Hill Rd.	Santa Rosa, 95404	alfalfa pellets
Farm Yard Feed	707-894-5992	27705 Dutcher Creek Rd.	Cloverdale, 95425	alfalfa pellets
Frizelle-Enos	707-992-0144	10035 Main St.	Penngrove, 94951	alfalfa pellets, rice straw
Western Farm Center	707-545-0721	21 W. 7th St.	Santa Rosa, 95401	alfalfa pellets
RiverTown Feed and Pet Country Store	707-762-4505	200 1st St.	Petaluma, 94952	alfalfa pellets
Stanislaus				
Melvin T Wheeler & Son	209-526-9770	5301 Woodland Ave.	Modesto, 95356	alfalfa pellets
Modesto Feed	209-526-9589	5437 McHenry Ave.	Modesto, 95356	alfalfa pellets
Oakdale Feed & Seed	209-847-7581	141 N. Yosemite Ave.	Oakdale, 95361	alfalfa pellets
Stanislaus Farm Supply	209-538-7070	624 E. Service Rd.	Modesto, 95358	alfalfa pellets
Turlock Feed & Livestock	209-669-0133	290 S. 1st St.	Turlock, 95380	alfalfa pellets
Sutter				
Sutter Orchard Supply	530-673-8068	573 Bridge St.	Yuba City, 95991	alfalfa pellets
Tehama				
Richfield Feed	530-824-4633	5605 Hwy. 99 W.	Corning, 96021	alfalfa pellets
Tuolumne				
Bolton Feed	209-533-2083	20117 Hwy. 108	Sonora, 95370	alfalfa pellets
Hurst Ranch	209-984-3016	17415 State Hwy. 108	Jamestown, 95327	alfalfa pellets, rice straw
Radovich Hay & Lumber	209-984-4463	18389 Main St.	Jamestown, 95327	alfalfa pellets
Sonora Feed & Supply	209-532-5046	13765 Terrace Dr.	Sonora, 95370	alfalfa pellets
Yolo				
Harlan Feed	530-662-8994	37587 Harlan Ln.	Woodland, 95695	pellets
Yuba				
Whitehorse Ranch & Feed	530-675-0420	16558 Frenchtown Rd.	Brownsville, 95919	alfalfa pellets
NEVADA				
Eastern Sierra Feed	775-782-3143	1245 Waterloo Ln.	Gardnerville, 89410	alfalfa pellets
Foothill Feed & Trailer Sales	775-852-0999	1330 Geiger Grade Rd.	Reno, 89521	alfalfa pellets
Green's Feed, Inc.	775-323-1502	4701 N. Virginia St.	Reno, 89506	alfalfa pellets, wheat straw
One Stop Ranch & Feed	775-284-0377	760 Glendale Ave.	Sparks, 89431	alfalfa pellets
Sierra Feed	775-853-6700	7460 S. Virginia St.	Reno, 89511	alfalfa pellets, alfalfa, hay
Silverado Mercantile	775-463-5577	15 US Hwy. 95A N.	Yerington, 89447	alfalfa pellets

For more information about weed free certification go to:

http://www.cal-ipc.org/ip/prevention/weedfreeforage.php

1. If you need a large amount of material for the coming year, contact vendors early in the growing season to make sure sufficient weed free forage/straw will be certified and available for your project needs.
2. Ask your vendor for a proof of certification, in the form of a copy of CDFA Form 66-079 "Certificate of Quarantine Compliance (CQC)" associated with the inspection of the specific forage/straw materials. This is the legal document verifying that the materials have been inspected and certified.
3. Many vendors can order these materials upon request. Send updates to Bobbi_Simpson@nps.gov.
4. For upland restoration or mulching projects, certified weed free rice straw is considered the most weed free option.

Appendix E: Armed Forces Pest Management Board Standard Pesticides List

Appendix E contains the current Armed Forces Pest Management Board Standard Pesticides List from October 2016. The most current version of the list should be substituted in when it becomes available in the fall.

ARMED FORCES PEST MANAGEMENT BOARD (AFPMB) STANDARD PESTICIDES LIST AVAILABLE TO DOD COMPONENTS AND AGENCIES

October 1, 2016

This list contains pesticides that the Armed Forces Pest Management Board (AFPMB) has approved for DLA Aviation/DSCR stockage. DoD policy (DoD Instruction 4150.07) requires that the use of most of these pesticides whether procured from DLA or locally, must be pre-approved by a professional pest management consultant. This is usually done when the consultant approves the Installation's pest management plan. DoD policy also requires that only trained and certified applicators may apply pesticides on DoD installations. Only authorized personnel should procure and use these pesticides. Note: For Contingencies, see the Contingency Pesticide List and AFPMB Technical Guide 24. Changes on List are highlighted in bold red.

NSN 6840-	Item (Alternative Trade Name)	Unit Package	AAC *	Price	Unit Issue	Users+

Table of Contents

1. HERBICIDES/FUNGICIDES/ALGACIDES						
The following herbicides must be applied by a DoD certified pesticide applicator or under the direct supervision of a DoD Certified pesticide applicator.						
01-360-4741 SDS Label	Fungicide, Methylisothiocyanate (MITC-FUME) *****RESTRICTED USE PESTICIDE*****	18 tubes	J	**46.99**	CO	A, N, F
01-457-6588 SDS Label	Fungicide, Azoxystrobin, 50% (Heritage)	(6) 1- lb. cont.	H	**6560.52**	BX	A, N, M
01-643-0704 SDS Label	Herbicide Aminoclopyrachlor, 39.5% and Chlorsulfuron, 15.8% (Perspective)	(12) 1.25 lb. bt	Z	**983.52**	BX	A, N, M, F
01-643-0697 SDS Label	Herbicide Aminoclopyrachlor, 39.5% and Metsulfuron methyl, 12.6% (Streamline)	(8) 3-lb. bt	Z	**2212.92**	BX	A, N, M, F
01-643-0702 SDS Label	Herbicide Aminoclopyrachlor, 22.8%; Metsulfuron methyl, 7.3% and Imazapyr 31.6% (Viewpoint)	(8) 5-lb. bt	Z	**2868.60**	BX	A, N, M, F
01-561-9603 SDS Label	Herbicide, Aminopyralid, 40.6% (Milestone VM)	(2) 2.5-gal co	J	**2175.32**	BX	A, N, M, F
00-392-7593 SDS Label	Herbicide, Bromacil, 21.9% lithium salt of bromacil, liquid (Hyvar X-L)	(4) 1-gal co	H	**492.87**	BX	A, F, M, N
01-408-9079 SDS Label	Herbicide, Bromacil, 80%, wettable powder (Hyvar- X)	(12) 4-lb bags	H	**2273.82**	BX	A, M, N
01-005-7523 SDS Label	Herbicide, Diquat, 35.3%, water soluble liquid (Reward)	1-gal co	H	**477.25**	GL	F, N
00-815-2799 SDS Label	Herbicide, Diquat, 35.3%, water soluble liquid (Reward)	(2) 2.5-gal co	H	**1031.17**	BX	A, N, F
01-341-9346 SDS Label	Herbicide, Diuron, mínimum 80% diuron, granular	25-lb bag	H	**265.16**	BG	A, N, F, M
00-001-7710 SDS Label	Herbicide, Diuron-Bromacil mixture, 40% bromacil, 40% diuron, granular (Krovar I DF)	6-lb bag	H	**127.51**	BG	A, N, F, M
01-630-3501 SDS Label	Herbicide, Diuron-Bromacil mixture, 40% bromacil, 40% diuron, granular (Krovar I DF)	25 lb. bag	Z	**307.50**	BG	F

ARMED FORCES PEST MANAGEMENT BOARD (AFPMB) STANDARD PESTICIDES LIST AVAILABLE TO DOD COMPONENTS AND AGENCIES

October 1, 2016

NSN 6840-	Item (Alternative Trade Name)	Unit Package	AAC *	Price	Unit Issue	Users+
01-356-6001 SDS Label	Herbicide, Fluridone, 5%, pellets (Sonar SRP)	40-lb co	J	**646.37**	CO	A, N
01-356-8888 SDS Label	Herbicide, Fluridone 41.7% liquid (Sonar A.S.)	1 qt co	H	**1171.45**	QT	A, N
01-525-5869 SDS Label	Herbicide, Imazapic ammonium salt 23.6% liquid (Plateau)	(2) 1-gal co	J	**1427.63**	BX	A, N, M, F
01-108-9578 SDS Label	Herbicide, Isopropylamine salt of glyphosate, 41%, water soluble liquid (Roundup Pro/Ranger Pro/Razor Pro/Glyfos Pro)	(2) 2.5-gal co	H	**186.14**	BX	A, N, F, M
01-388-0142 SDS Label	Herbicide, Isopropylamine salt of glyphosate, 41%, water soluble liquid (Roundup Pro/Ranger Pro/Razor Pro/Glyfos Pro)	30-gal drum	H	**1154.13**	DR	A, F, N
01-356-8893 SDS Label	Herbicide, Isopropylamine salt of glyphosate**,** 53.8**%**, water soluble liquid (Rodeo/Aquamaster)	(2) 2.5-gal co	H	**428.80**	BX	A, F, M, N
01-377-7113 SDS Label	Herbicide, Isopropylamine salt of glyphosate, 2.0**%**, water soluble liquid (Roundup Ready-to-Use)	24-oz pump spray bottle	H	**8.80**	BT	N, F
01-399-0673 SDS Label	Herbicide, Ammonium salt of glyphosate, 73.3% and 2.9% Diquat dibromide, water soluble liquid (Quik Pro)	5 pkg.	H	**22.49**	BX	A, F, M
01-545-4540 SDS Label	Herbicide, Ammonium salt of glyphosate, 73.3% and 2.9% Diquat dibromide, water soluble liquid (Quik Pro)	6.8 lb. co	H	**247.01**	CO	A, N, M, F
01-356-8902 SDS Label	Herbicide, Isopropylamine salt of imazapyr, **26.7% (Arsenal Powerline)**	(2) 2.5-gal co	H	**2898.94**	BX	A, N, F, M
01-532-5403 SDS Label	Herbicide, Isopropylamine salt of imazapyr, 28.7% (Habitat)	(2) 2.5-gal co	H	**2210.88**	BX	A, N, M
01-318-7417 SDS Label	Herbicide, Oryzalin, 40.4% (Surflan A.S.)	**(2) 2.5-gal co**	H	**389.68**	**BX**	A, N, F, M
00-145-0013 SDS Label	Herbicide, Prometon, 25% prometon, emulsifiable concéntrate (Pramitol 25E)	(2) 2.5-gal co	H	**301.40**	BX	A, F, N
01-356-8891 SDS Label	Herbicide, Methyl Sulfometuron, 75% (Oust XP)	48-oz co	H	**280.10**	CO	A, N, M
01-319-2890 SDS Label	Herbicide, Tebuthiuron (Spike 80 DF)	4-lb bag	J	**138.42**	BG	A, N, F
01-457-6576 SDS Label	Herbicide, Tebuthiuron-Diuron, 1% Tebuthiuron, 3% Diuron (Spraykil SK-13)	40 lb. container	H	**233.86**	CO	A, N, M
01-552-1822 SDS Label	Herbicide, Triclopyr, 60.45% (Garlon 4 Ultra)	(2) 2.5-gal co	H	**707.08**	BX	A, N, M, F
00-577-4194 SDS Label	Herbicide, 2,4-Dichlorophenoxy-acetic acid (2,4-D), oil miscible/water emulsifiable liquid (low volatile ester form)	(2) 2.5-gal co	H	**196.53**	BX	A, N, M
00-664-7060 SDS Label	Herbicide, 2,4-Dichlorophenoxy-acetic acid (2,4-D), water soluble liquid (amine salt form)	(2) 2.5-gal co	H	**141.90**	BX	A, N, M
01-377-7110 SDS Label	Herbicide, 2,4-Dichlorophenoxy-acetic acid (2,4-D), 0.128%, 0.22% MCPP and 0.05% Dicamba water soluble liquid (Weed-B-Gon MAX)	24-oz pump spray bottle	H	**11.44**	BT	F, N

2. REPELLENTS						
The following repellents must be applied by trained personnel or a DoD certified pesticide applicator.						
01-334-2666 SDS Label	Insect Repellent, clothing application, 40% permethrin, liquid (2-Gal sprayer)	(12) 151-ml bot	H	**147.99**	BX	A, N, F, M
All DoD personnel following label and SDS familiarization may apply the following repellents.						
01-284-3982 SDS Label	Insect Repellent, personal application, Ultrathon (3M/EPA 58007-1)	(12) 2-oz tubes	H	**94.74**	BX	A, N, F, M
01-278-1336 SDS Label	Insect Repellent, clothing application, aerosol (Permethrin Arthropod Repellent)	(12) 6-oz cans	H	**78.55**	BX	A, N, F, M
01-137-8456 SDS Label	Insect Repellent, personal application, 5% benzocaine, 10% precipitated sulfur (Chigg-Away)	118-ml bot	H	**6.43**	BT	A, N, F, M
01-345-0237 SDS Label	Insect Repellent, clothing application, permethrin (IDA)	12 kits	H	**58.33**	BX	A, N, F, M
01-584-8393 SDS Label	Insect Repellent, personal application, 30% DEET (SP532-Ultra30/LippoDEET)	(12)-2 oz. tubes	H	**72.77**	BX	A, N, M, F

ARMED FORCES PEST MANAGEMENT BOARD (AFPMB) STANDARD PESTICIDES LIST AVAILABLE TO DOD COMPONENTS AND AGENCIES

October 1, 2016

NSN 6840-	Item (Alternative Trade Name)	Unit Package	AAC *	Price	Unit Issue	Users+
01-584-8598 SDS Label	Insect Repellent, personal application, 25% DEET, pump spray bottles (Cutter Backwoods DEET Insect Repellent)	(12)-6 oz. bt	H	75.08	BX	A, N, F, M
01-619-4795 SDS Label	**Insect Repellent, personal application, 20% Picaridin, pump spray bottle (NATRAPEL Insect Repellent)**	**(12)-3.4 oz. bt**	**H**	**104.35**	**BX**	**A, N, M, F**
01-656-7707 SDS Label	**Insect Repellent, IR3535 pump spray bottle (Bullseye Bug Repellent)**	**(12)- 4 oz. bt**	**J**	**70.00**	**BX**	**A, N, F, M**

3. INSECTICIDES						
The following insecticides must be applied by a DoD certified pesticide applicator or under the direct supervision of a DoD Certified pesticide applicator.						
01-642-8892 SDS Label	**Insecticide, Acetamiprid 4.4% (End Zone Insecticide Stickers)**	**(12) pkg. 20 stickers per pkg.**	**Z**	**512.25**	**BX**	**A, N, F, M**
01-543-0662 SDS Label	Insecticide, Abamectin, 0.011%, (Advance 360A Dual Choice Ant Bait Stations)	72 bait stations	H	83.65	BX	A, N, M, F
01-561-9766 SDS Label	Insecticide, Abamectin, 0.05% (Avert Dry Flowable Cockroach Bait Formula 1)	12-30 gram tubes	H	373.84	BX	A, N, M, F
01-561-9649 SDS Label	Insecticide, Abamectin, 0.05% (Avert Cockroach Bait Stations Formula 1)	4 bags. Each bag contains 72 bait stations	H	293.90	BX	A, N, F, M
00-145-0016 SDS Label	Insecticide, Aluminum phosphide, 55 % tablets (Phostoxin/Fumitoxin) *****RESTRICTED USE PESTICIDE*****	100 tablets	H	39.10	CN	A, N, F
00-442-5698 SDS Label	Insecticide, Aluminum phosphide, 55 % pellets (Phostoxin/Fumitoxin) *****RESTRICTED USE PESTICIDE*****	1660 pellets	H	70.99	BT	A, N, F, M
01-377-7049 SDS Label	Insecticide, *Bacillus thuringiensis*, 10% (Summit BTI. Briquets)	100 Briquets	H	123.26	BX	A, N, F, M
01-565-8243 SDS Label	**Insecticide, *Bacillus thuringiensis (Vectobac GR)***	**40 lb. bag**	**Z**	**120.89**	**BG**	**A, N, F, M**
01-565-8241 SDS Label	Insecticide, *Bacillus thuringiensis (Vectobac WDG)*	24-1 lb. bags/CO	H	1350.93	CO	A, N, M, F
01-287-3938 SDS Label	Insecticide, Boric Acid, aerosol (Perma-Dust PT 249)	(12) 9 oz. cans	V	112.92	BX	A, N, F, M
01-525-6888 SDS Label	Insecticide, Bifenthrin, 7.9% liquid (**Talstar P Professional**)	1-qt co	H	64.23	QT	A, N, M, F
01-104-0887 SDS Label	Insecticide, Carbaryl, 43.4%, liquid (Carbaryl 4L)	(2) 2.5-gal co	H	395.41	BX	F, N
01-525-7139 SDS Label	Insecticide, Chlorfenapyr, 21.45% liquid (Phantom)	(4) 75-oz co	H	1023.51	BX	A, N, F, M
01-313-7359 SDS Label	Insecticide, beta-cyfluthrin, 11.8% (Tempo SC Ultra)	(12) 240-ml bot	H	597.63	BX	A, N, F, M
01-383-6251 SDS Label	Insecticide, beta-cyfluthrin, 10% (Tempo Ultra WSP)	(32) 50 gm packs	H	433.25	BX	A, N, F, M
01-561-9717 SDS Label	Insecticide, Cyfluthrin, 0.1%, aerosol (PT CY-KICK CS)	12 x 17.5 oz. cans/box	H	158.45	BX	A, M, F, N
01-561-9669 SDS Label	Insecticide, Lambda-cyhalothrin, 0.05% aerosol (PT 221L Residual)	12 x 17.5 oz. cans/box	H	149.28	BX	A, M, N, F
01-390-4822 SDS Label	Insecticide, Cypermethrin, 40% (Demon WP)	1-lb jar	H	79.72	LB	A, N, M
01-573-5024 SDS Label	Insecticide, Deltamethrin, 0.03% (Kills Bedbugs II)	(4) 1- gal jugs	Z	108.47	BX	A, N, M
01-431-3345 SDS Label	Insecticide, Deltamethrin, 0.05% (Delta Dust)	1-lb co	H	15.87	LB	A, N, F, M
01-642-9286 SDS Label	**Insecticide, Deltamethrin, 0.1% granules (DeltaGard G)**	**20-lb. bag**	**Z**	**38.93**	**BG**	**A, N, F, M**
01-561-9745 SDS Label	Insecticide, Deltamethrin, 0.06%, aerosol (D-Force Residual)	8 x 14 oz. cans/box	H	99.44	BX	A, N, M, F

ARMED FORCES PEST MANAGEMENT BOARD (AFPMB) STANDARD PESTICIDES LIST AVAILABLE TO DOD COMPONENTS AND AGENCIES

October 1, 2016

NSN 6840-	Item (Alternative Trade Name)	Unit Package	AAC *	Price	Unit Issue	Users+
00-142-9438 SDS Label	Insecticide, Dichlorvos, 20% (plastic strips)	48 strips	V	**223.97**	BX	A, N, F, M
01-603-5650 SDS Label	Insecticide, Dichlorvos, 20% (NUVAN PROSTRIPS + 65 Gram)	6 packs per box (3 strips per pack)	H	**432.11**	BX	A, N, M, F
01-603-5654 SDS Label	Insecticide, Dichlorvos, 20% (NUVAN PROSTRIPS 16 Gram)	6 packs per box (12 strips per pack)	J	**512.25**	BX	A, N, M
01-628-4751 SDS Label	Insecticide, Dichlorvos,10.75% (Ovitrap Mosquito Trap-N-Kill)	12 traps per box	H	**118.90**	BX	A, F, N, M
01-647-8840 SDS Label	Insecticide, 0.5% Dichlorvos (Nuvan Directed Spray Aerosol)	12 -17 oz. aerosols per box	Z	**512.25**	BX	A, N, M, F
01-647-8844 SDS Label	Insecticide, 0.50% Dinotefuran, % (Quikstrike Fly Bait)	5- lb. co	Z	**36.88**	CO	A, N, M, F
01-412-4634 SDS Label	Insecticide, D-Phenothrin, 2%, aerosol	12-oz can	H	**16.06**	CN	A, N, F, M
66-131-2263 SDS Label	**Insecticide, D-Phenothrin 2% and Permethrin 2% (Callington 1-Shot Aircraft Insecticide)** ***** For use in Disinsection of Aircraft Cargo Holds**	150-gram can	H	**56.17**	CN	N, F
01-586-8718 SDS Label	Insecticide, Allethrin-Permethrin Mixture 0.25% and 0.15%, aerosol (Ace House & Garden Bug Killer 2)	15-oz can	**Y**	**7.38**	CN	A, N, M, F
01-067-2137 SDS Label	Insecticide, D-trans Allethrin and Resmethrin, 0.125% and 0.2%, aerosol (Kill Zone House & Garden Insect Killer Formula 4)	14-oz can	**Y**	**3.63**	CN	A, N, F, M
01-573-4964 SDS Label Supplemental	Insecticide, Etofenprox, 20% (Zenivex E20)	(2) 2.5-gal co	H	**2815.48**	BX	A, N, M
01-619-6396 SDS Label	Insecticide, Etofenprox 1.0%; Tetramethrin 0.5% and Piperonyl Butoxide 1.5% (ZENPROX Aerosol)	(6) 16-oz cans	H	**97.87**	BX	A, N, F, M
01-183-7244 SDS Label	Insecticide, Methomyl, 1.1%, Fly bait (Golden Malrin/Stimukil)	5-lb can	H	**20.77**	CN	A, N, F, M
01-287-3913 SDS Label	Insecticide, Hydramethylnon (Amdro Fire Ant Bait; PROBAIT Fire Ant Bait)	(12) 6-oz bot	H	**498.14**	BX	A, N, F, M
01-501-2905 SDS Label	Insecticide, Hydroprene, 90.6% (Gentrol Point Source)	20 devices/box	H	**49.28**	BX	A, M, N
01-585-9976 SDS Label	Insecticide, Hydroprene, 0.36%(Gentrol Aerosol)	(12) 16 –oz. cans	H	**197.21**	BX	A, N, M F
01-424-2494 SDS Label	Insecticide, Fenoxycarb (Award Brand of Logic)	25-lb bag	H	**432.69**	BG	A, N, F, M
01-585-9950 SDS Label	Insecticide, Fipronil, 0.0143% (Top Choice Fire Ant Granules) *****RESTRICTED USE PESTICIDE*****	50-lb bag	H	**294.51**	BG	A, N, M, F
01-224-1269 SDS Label	Insecticide, Fipronil, cockroach, large size (Combat Source Kill Max R2)	8 bait stations/ box/ 12 boxes	H	**161.79**	PG	A, N, F, M
01-180-0167 SDS Label	Insecticide, Fipronil, cockroach, regular size (Combat Source Kill Max R1)	12 bait stations/ box/ 12 boxes	H	**145.74**	PG	A, N, F, M
01-483-3065 SDS Label	Insecticide, Fipronil (Maxforce FC Roach Killer Bait Gel)	24-60 gram reservoirs/ box	H	**336.86**	BX	A, N, M
01-471-5650 SDS Label	Insecticide, Fipronil (Maxforce FC Roach Killer Bait Gel)	4-30 gram reservoirs/box	H	**27.50**	BX	N, M
01-500-4579 SDS Label	Insecticide, Fipronil (Maxforce FC Ant Killer Bait Gel)	4 reservoirs/box	H	**32.36**	BX	A, N, M
01-602-8269 SDS Label	Insecticide, Fipronil (Maxforce FC Magnum Roach Killer Bait Gel)	12-33 gram reservoirs per box	H	**318.18**	BX	A, N, M, F
01-298-1122 SDS Label	Insecticide, Fipronil (MaxForce FC Ant Bait)	96 stations	H	**118.73**	PG	A, N, F, M
01-483-3072 SDS Label	Insecticide, Fipronil (Termidor 80WG)	24 co/box	H	**3793.03**	BX	A, N, M
01-483-3068 SDS Label	Insecticide, Fipronil (Termidor SC)	4-78 oz. BT/box	H	**1280.77**	BX	A, N, M

ARMED FORCES PEST MANAGEMENT BOARD (AFPMB) STANDARD PESTICIDES LIST AVAILABLE TO DOD COMPONENTS AND AGENCIES

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NSN 6840-	Item (Alternative Trade Name)	Unit Package	AAC *	Price	Unit Issue	Users+
01-318-7416 SDS Label	Insecticide, Hydroprene, 9.0**%**, emulsifiable concentrate (Gentrol IGR)	(10) 1-oz bot	H	77.68	BX	A, N, F, M
01-591-2150 SDS Label	Insecticide, Imidacloprid (Temprid SC)	400 ml CO	H	145.60	CO	A, N, F, M
01-642-9292 SDS Label	**Insecticide, Imidacloprid 0.05% and Cyfluthrin 0.025% (Temprid READYSPRAY)**	**15 fl oz.**	**Z**	18.44	**CN**	**A, N, F, M**
01-518-5807 SDS Label	Insecticide, Imidacloprid (Maxforce Granular Fly Bait)	5 lb. co	H	48.76	CO	A, N, F, M
01-555-9369 SDS Label	Insecticide, Imidacloprid (Maxforce Fly Spot Bait)	(50) 2 oz. pkg/box	H	373.53	BX	A, N, M, F
01-457-6580 SDS Label	Insecticide, Imidacloprid, 0.5% granular (Merit 0.5 g)	30 lb. bag	H	228.11	BG	A, N, F, M
01-647-8857 SDS Label	Insecticide, Imidacloprid, 0.025% (Kaput Rodent Flea Control Bait) ****Restricted Use Pesticide****	25-lb co	Z	102.45	CO	A, N, M, F
01-428-6646 SDS Label	Insecticide, Lambda-cyhalothrin, 9.7% (Demand CS)	(8) 8 oz. bottle	H	465.93	BX	A, N, M
00-655-9222 SDS Label	Insecticide, Malathion, 57.0%, emulsifiable concentrate, class 2	1-gal co	H	61.24	GL	A, N, F, M
00-685-5438 SDS Label	Insecticide, Malathion, 57.0%, emulsifiable concentrate, class 2	5-gal can	H	280.51	CN	A, N, F, M
00-926-1481 SDS Label	Insecticide, Malathion, 96.5%, liquid, (Fyfanon ULV)	54-gal drum	H	3934.68	DR	A, N, F, M
01-169-1842 SDS Label	Insecticide, Malathion, 96.5%, liquid, (Fyfanon ULV)	5-gal can	H	346.75	CN	A, N, F, M
01-424-2495 SDS Label	Insecticide, Methoprene (Altosid XR Briquets)	220 Briquettes	H	1135.26	BX	A, N, F, M
01-511-0535 SDS Label	Insecticide, Methoprene (Altosid Pellets)	(2) 22 lb. co/box	H	2090.49	BX	A, N, F, M
01-424-2493 SDS Label	Insecticide, Methoprene (Altosid Liquid Larvicide Conc.)	(2) 2.5-gal co	H	9239.78	BX	A, N, F, M
01-591-2155 SDS Label	Insecticide, Methoprene (Precor 2000 Plus)	12 aerosols/box	H	219.49	BX	A, N, M, F
01-270-9765 SDS Label	Insecticide, Naled, 87.4, liquid (Dibrom)	30-gal drum	H	7455.33	DR	A, F, N
01-532-5414 SDS Label	Insecticide, Naled, 78%, liquid (Trumpet EC)	30-gal drum	J	8784.12	DR	A, N, F, M
00-597-6111 SDS Label	Insecticide, Naphthalene, ball form	14-oz box	H	7.33	BX	A, N, F, M
01-467-0994 SDS Label	Insecticide, Nithiazine, Fly Strips (Quikstrike), 2 strips per package	(12) PG/box	H	250.25	BX	A, N, F
00-174-1825 SDS Label	Insecticide, P-Dichlorobenzene, crystal/flake	100-lb drum	J	381.85	DR	A, N, F
00-174-1824 SDS Label	Insecticide, P-Dichlorobenzene, crystal **GSA**	1-lb can	J	17.04	LB	N, F
01-606-8581 SDS Label	Insecticide, Permethrin-Piperonyl Butoxide (20.6+ 20.6%), All Pro Aqualuer 20-20	(2)-2.5 gal co/box	H	1559.15	BX	A, N, F, M
01-550-5660 SDS Label	Insecticide, Permethrin-Piperonyl Butoxide (4.6+4.6%), (Kontrol 4-4)	(2) 2.5-gal co	H	321.83	BX	A, N, F, M
01-104-0780 SDS Label	Insecticide, Pyrethrins, 3% pyrethrins with synergists, liquid (ULV fog concentrate)	1-gal bot	H	214.81	GL	A, N, F, M
00-459-2443 SDS Label	Insecticide, Prallethrin 0.1% aerosol (Wasp-Freeze II)	(12) 17.5-oz cans	H	109.57	BX	A, N, F, M
01-619-6467 SDS Label	Insecticide, Etofenprox 0.50%; Tetramethrin 0.2% and Piperonyl Butoxide 1.0% (Zoecon Wasp-X Wasp and Hornet Spray)	(12) 16-oz cans	H	99.24	BX	A, N, F, M
00-823-7849 SDS Label	Insecticide, Pyrethrins, aerosol (PT 565 Plus XLO)	(12) 20-oz cans	H	233.50	BX	A, N, F

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NSN 6840-	Item (Alternative Trade Name)	Unit Package	AAC *	Price	Unit Issue	Users+
01-359-8533 SDS Label	Insecticide, Resmethrin (Scourge) ***Restricted Use Pesticide***	5-gal can	H	723.40	CN	A, N, F
01-457-6583 SDS Label	Insecticide, Spinosad, 11.6% (Conserve SC)	1 quart co	H	218.28	QT	A, N, M
01-617-0886 SDS Label	Insecticide, Spinosad, 0.50% and (Z)-9-tricosene (Pheromone) (Conserve Fly Bait)	4 lb. co	J	35.25	CO	N, M, F
01-474-7751 SDS Label	Insecticide, Sumithrin-Piperonyl Butoxide, 10%-10%, (Anvil 10+10 ULV)	(2) 2.5-gal co /box	H	2224.38	BX	A, M, N
01-474-7706 SDS Label	Insecticide, Sumithrin-Piperonyl Butoxide, 10%-10%, (Anvil 10+10 ULV)	250 gal co	J	----------	CO	A, N
01-657-8033 SDS Label	**Insecticide, Tau-fluvalinate, 22.3% liquid (Mavrik Perimeter)**	**8 oz. co**	**D**	**40.00**	**CO**	**A, N, F, M**
01-424-3132 SDS Label	Insecticide, Temephos (Abate 4E; ALLPRO Provect 4E Larvicide)	2.5-gal co	H	1565.32	CO	A, N, F, M
01-652-1530 SDS Label	**Mosquito Larvicide (CocoBear Oil)**	**(2) 2.5-gal co/box**	**Z**	**204.90**	**BX**	**A, N, F, M**

4. EPA 25 (b) EXEMPT PESTICIDE PRODUCTS						
The following are EPA 25(b) exempt pesticides that have been approved by the AFPMB for stock listing.						
01-606-9951 SDS Label	Insecticide, Geraniol, 1.3%; aerosol (Terminix Natural Pest Control Flying Insect Killer)	(6) 14 oz. cans	J	51.23	BX	A, N, M
01-607-0000 SDS Label	Insecticide, Thyme Oil, 4.1%; (TyraTech Tech Dust Natural Insecticide)	10 lb. pail	J	87.08	CO	A, N, M

5. EPA SECTION 18 PUBLIC HEALTH EMERGENCY EXEMPTION 16DD01 PESTICIDES						
The following are the EPA Section 18 Public Health Emergency Exemption 16 DD01 pesticides that have been approved by the AFPMB for use in Aircraft Disinsection.						
66-133-0081 SDS Label TDS	**Insecticide, Permethrin aerosol (Callington PreSpray)**	**(12) 100-gram aerosol per box**	**Z**	**512.93**	**BX**	**A, N, F, M**
13-122-1768 SDS Label TDS	**Insecticide, Permethrin aerosol (ASP-100 Aircraft Insecticide)**	**100-gram aerosol**	**J**	**40.00**	**CN**	**A, N, F, M**

ARMED FORCES PEST MANAGEMENT BOARD (AFPMB) STANDARD PESTICIDES LIST AVAILABLE TO DOD COMPONENTS AND AGENCIES

October 1, 2016

NSN 6840-	Item (Alternative Trade Name)	Unit Package	AAC *	Price	Unit Issue	Users+

6. RODENTICIDES						
The following rodenticides must be applied by trained personnel or a DoD certified pesticide applicator.						
00-089-4664 SDS Label	Rodenticidal Bait, Anticoagulant, 0.005% Diphacinone	40 blocks	H	**109.04**	BX	A, N, F, M
01-577-2202 SDS Label	Rodenticide, Anticoagulant, (Kaput Combo Bait Pellets), 0.020% Imidacloprid and 0.025% Warfarin	250 packets/box	H	**110.26**	BX	A, N, F, M
01-598-2617 SDS Label	Rodenticidal Bait, Anticoagulant, 0.005% Bromadiolone (Maki), pellets	175 pkgs/CO	H	**149.29**	CO	A, N, M. F
01-598-4840 SDS Label	Rodenticidal Bait, Anticoagulant, 0.005% Brodifacoum (Talon-G), pellets	2 pails each w/150 pkgs per box	H	**170.22**	BX	A, N, M, F
01-501-2858 SDS Label	Rodenticidal Bait, Anticoagulant, 0.005% Bromadiolone, (Contrac Blox), 1 oz. bait blocks	18-lb co	H	**88.45**	CO	A, N, M, F
01-503-5348 SDS Label	Rodenticidal Bait, Anticoagulant, 0.005% Brodifacoum, (Final Blox), 20-gram bait blocks	18-lb co	H	**97.18**	CO	A, M, N
00-753-4972 SDS Label	Rodenticide, Anticoagulant, concentrate 0.106% sodium salt of diphacinone (LIQUA-TOXII)	50 pouches	V	**84.61**	BX	A, N, F, M
01-598-4844 SDS Label	Rodenticide, Anticoagulant, concentrate 0.106% sodium salt of diphacinone (LIQUA-TOXII)	4 packages per box (8 packets per package)	H	**124.50**	PG	A, N, M, F
01-435-9318 SDS Label	Rodenticide, 10% zinc phosphide (ZP Tracking Powder) *****RESTRICTED USE PESTICIDE*****	(4) 500-g bot	H	**46.49**	BX	N
01-619-6419 SDS Label	Rodenticide, Anticoagulant, Difethialone 0.0025% (First Strike Soft Bait Rodenticide)	16 lb. co	H	**245.62**	CO	A, N, M, F

7. SURFACTANTS						
Surfactants are not pesticides, but are wetting agents that lower the surface tension, allowing easier spreading, and lower the interfacial tension between two liquids. Some pesticides, particularly herbicides, either require the use of a surfactant or performance may be improved by the addition of a surfactant. Refer to the pesticide label to determine if a surfactant is recommended by manufacturer.						
01-546-3053 SDS Label	Surfactant, Pesticide, Spray Adjuvant (Cygnet Plus)	(2) 2.5-gal co	H	**144.92**	BX	A, N, M, F
01-356-8896 SDS Label	Surfactant, Pesticide, Spray Adjuvant (Cide-Kick II)	(2) 2.5-gal co	H	**251.56**	BX	A, N, M, F
01-356-8897 SDS Label	Surfactant, Pesticide, Spray Adjuvant (Cide-Kick)	(2) 2.5-gal co	H	**228.60**	BX	A, N, M, F

+User Code A=Army, N=Navy, F=Air Force, M=Marines   SOS (DSCR-Richmond/DLA Aviation) =SMS

***ACQUISITION ADVICE CODES (AAC)**

D. DOD INTEGRATED MATERIAL MANAGER (IMM) STOCKED, AND ISSUED. Issue, transfer, or shipment is not subject to specialized controls other than those imposed by the Integrated Material Manager/Military Service supply policy.
1. The item is centrally managed, stocked, and issued.
2. Requisitions will be submitted in accordance with Military Service requisitioning procedures.

G. GENERAL SERVICES ADMINISTRATION (GSA) INTEGRATED MATERIAL MANAGED, STOCKED AND ISSUED. Identifies GSA managed items available from GSA Supply Distribution Facilities. Requisitions and fund citations will be submitted in accordance with GSA/Military Service requisitioning procedures.

H. CENTRAL CONTRACT - NOT STOCKED ITEM. Direct delivery under central contract # (non-stocked items) issue, transfer, or shipment is not subject to specialized controls other than those imposed by IMM/Service/Agency supply policy.
1. The item is centrally managed and procured.
2. Normal issue is by direct shipment from the vendor to the user at the order of the ICP or IMM. However, orders for quantities less than the vendor's minimum order of quantity may be issued from stock by ICP or IMM supply distribution facilities.
3. Requisitions and fund citations will be submitted in accordance with IMM/Service/Agency requisitioning procedures.
4. Generally, delivery will be made within applicable Service/Agency guidelines addressing customer-required time frame.

I. DIRECT ORDERING FROM A CENTRAL CONTRACT/SCHEDULE. Issue, transfer, or shipment is not subject to specialized controls other than those imposed by Integrated Material Manager/Military Service supply policy. The item is covered by a centrally issued contractual document, or by a multiple award Federal Supply schedule for GSA managed items, which permits using activities to place orders on vendors for direct delivery to the user.

J. NOT STOCKED, CONTROLLED PROCURED. Identifies IMM/Military Service centrally managed but not stocked items. Long lead times must be anticipated, since procurement will be initiated only after receipt of a requisition. Requisitions will be submitted in accordance with IMM/Military Service requisitioning procedures.

K. CENTRALLY STOCKED FOR OVERSEAS ONLY. Main means of supply is local purchase. Item is stocked in domestic supply system for those overseas activities unable to procure locally due to non-availability of procurement sources or where local purchase is prohibited. Requisitions will be submitted by overseas activities in accordance with Service/Agency requisitioning procedures. NOTE: CONUS activities will obtain supply support through local procurement procedures.

L. LOCAL PURCHASE. IMM/Military Service managed items authorized for local purchase, as a normal means of support, by the Military Service, or base, post, camp, or station level. Items not stocked in wholesale distribution system of IMM/Military Service ICP. The local purchase forms authorized by the individual IMM/Military Service must be used. NOTE: GSA FSS items are included.

V. TERMINAL ITEM. Identifies items in stock; but future procurement is not authorized. Requisitions may continue to be submitted until stocks are exhausted. Preferred items National Stock Number (NSN) normally provided by the application of the phrase, "When Exhausted Use (NSN)". Requisitions will be submitted in accordance with IMM/Military Service requisitioning procedures as applicable.

X. SEMIACTIVE ITEM-NO REPLACEMENT. A potentially inactive NSN which must be retained in the supply system as an item of supply because (1) stocks of the item are on hand or in use below the wholesale level and (2) the NSN is cited in equipment authorization documents TO&E, TA, TM, etc. or in-use assets are being reported.
1. Items are authorized for central procurement but not authorized for stockage at wholesale level.
2. Requisitions for in-use replacement will be authorized in accordance with individual Military Service directives.
3. Requisitions may be submitted as requirements generate. Repetitive demands may dictate at ACC change to permit Wholesale stockage.

Y. TERMINAL ITEM. Further identifies AAC V items on which wholesale stocks have been exhausted. Future procurement not authorized.
1. Requisitions will not be processed to the wholesale suppliers.
2. Internal Services' requisitioning may be continued in accordance with Military Service requisitioning policies.

Z. INSURANCE/NUMERIC STOCKAGE OBJECTIVE ITEM. Items, which may be required occasionally or intermittently and prudence requires that a nominal quantity of material be stocked due to the essentiality or the lead-time of the item.
1. The item is centrally managed, stocked and issued.
2. Requisitions will be submitted in accordance with IMM/Military Service requisitioning procedures.

In order to provide the most current information to the DoD Pest Management Community, the Armed Forces Pest Management Board and DLA Aviation/Defense Supply Center Richmond (DSCR) jointly publish this list. Comments and questions are welcome. Please send them to:

E-mail: osd.pentagon.ousd-atl.mbx.afpmb@mail.mil

Telephone: Commercial (301) 295-7476, DSN 295-7476

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US Army Garrison Forest Glen
2460 Linden Lane, Bldg. 172
Silver Spring, MD 20910

Appendix F: USAF Data Layer Specifications for: Noxious or Invasive Species

Appendix F contains the current United States Air Force Environmental GIS Support Program *Data Layer Specifications for: Noxious or Invasive Species*, from March 2016. Keep these specifications current as they are updated.

March 9, 2016

Data Layer Specifications for:

Noxious or Invasive Species

United States Air Force
Environmental GIS Support Program

This Data Layer Specification (DLS) defines geospatial data specifications for the NoxiousOrInvasiveSpecies_A, NoxiousOrInvasiveSpecies_L, and NoxiousOrInvasiveSpecies_P data layer implemented under the United States Air Force Civil Engineer Center (AFCEC) Environmental GIS Support Program.

Definition

Locations where noxious or invasive species are present, either currently or historically.

Data Layer Details

Proposed SDSFIE 3.1 AF Adaptation Feature Class Name:	NoxiousOrInvasiveSpecies_A NoxiousOrInvasiveSpecies_L NoxiousOrInvasiveSpecies_P
Proposed SDSFIE 3.1 AF Adaptation Feature Dataset:	environmentalNaturalResources
Previous Layer Names:	NuisanceSpecies NuisanceSpecies_L NuisanceSpecies_P
Geometry Type:	Polygon, Line, Point
Data Steward Organization (Program Area):	Program Area: Natural Resources
Data Steward POC:	Specific position at installation that collects, edits and manages data layer.
Representation:	• All noxious or invasive species locations shall represent the latitude longitude location of an identified species. Noxious or invasive species locations may differ by season and breeding habits of a particular species. • Noxious or invasive species areas are represented as closed polygons depicting the outermost extent of the species area. • Each individual noxious or invasive species area is represented by a single area feature. • Noxious or invasive species locations will be represented as a continuous unbroken line.

Implementing Authorities and Regulations

Implementing Program(s):	Driver(s):
HQ AF/A7CAN	• AFI32-1053, Integrated Pest Management Program, 23 June 2009 • AFI32-10112, Installation Geospatial Information and Services (IGI&S), 19 October 2007 • AFI32-7062, Comprehensive Planning, 27 June 2013

Implementing Program(s):	Driver(s):
	• AFI32-7064, Integrated Natural Resources Management, 18 November 2014 • AFI32-7065, Cultural Resources Management Program, 19 November 2014 • AFH32-9007, Managing Air Force Real Property, 1 May 1999 • AFI32-1084, Facility Requirements; Chapter 11-16, 1 September 1996 • EO 13112, Invasive Species, 3 February 1999 • Garrison Mapping Concept of Operations (CONOPS) Version 2.0, 12 June 2003 • USAF Installation Geospatial Information and Services (IGI&S) Data Model, 15 December 2009 • Real Property Inventory Management (RPIM), v2.0 extracted • RPIM 3.0, extracted 4/2009 • EO 13112 Invasive Species

Geometry/Topology

Polygon Features:
Polygons must be larger than cluster tolerance (.001 meter).
Line Features:
Lines must be larger than cluster tolerance (.001 meter).
Point Features:
A site point must fall entirely inside any polygon feature that represents that feature.
Point features must use the centroid of the polygon feature of the site unless the centroid of the site lies outside the area of the site, then the point must be adjusted to lie within its respective area boundary.

Sources and Source Selection

Information for this geospatial data layer must be obtained and/or validated at the installation level. The Data Steward will have overall responsibility for completing and updating the spatial, attribute and metadata features of this geospatial data layer in accordance with this DLS.

Possible sources for the data layer are: planimetric data extracted from stereo or ortho-imagery, differential GPS survey, conventional surveys using a survey grade GPS, computer aided design (CAD), imagery, hardcopy documents, attribute or tabular data.

Positional Accuracy

Horizontal Accuracy: Data within this layer should be within **3 meters** of the actual location at the **95% confidence level**. Accuracy reported at the 95% confidence level means that 95% of the positions in the dataset would have an error with respect to true ground position that is equal to or smaller than the stated accuracy threshold value.

Vertical Accuracy: Not applicable.

Note: Accuracy should be recorded within the "Horizontal Accuracy Report" or "Vertical Accuracy Report" sections of the metadata. Where positional accuracy has not been measured, the data steward should populate this section with "Not Recorded".

Coordinate System

The bounding coordinates to capture the north, south, east, and west most spatial extents of the NoxiousOrInvasiveSpecies_A, NoxiousOrInvasiveSpecies_L, and NoxiousOrInvasiveSpecies_P layers will be based on the Universal Transverse Mercator (UTM) Zone, meters. Datasets within the database should have a spatial reference with a precision of 1000. The horizontal datum to be utilized for all data is World Geodetic System 1984 (WGS84), the vertical datum shall be Mean Sea Level (MSL, Height), and the projection is the Universal Transverse Mercator (UTM) zone for the installation.

Attributes

The following table lists the attributes for the NoxiousOrInvasiveSpecies_A, NoxiousOrInvasiveSpecies_L, and NoxiousOrInvasiveSpecies_P data layers.

Proposed SDSFIE 3.1 Air Force Adaptation Attributes

Domain (D)	Attribute Name	Definition	Allowed Values	Data Type (Length)	Advocate
	noxiousOrInvasiveSpecIDPK	Primary Key. A unique, user defined identifier for each record or instance of an entity. The value should be calculated as follows: INST_SITE00010000001, where INST is the 4 character installation ID, SITE0001 is the 4 character 4 digit site ID, followed by a 7 digit unique number starting with 0000001.		String (20)	AF
	sdsID	A unique identifier for all features and objects in the SDSFIE.		GUID	SDSFIE

Data Layer Specification – Noxious or Invasive Species

Domain (D)	Attribute Name	Definition	Allowed Values	Data Type (Length)	Advocate
	sdsFeatureName	The common name of the feature.	Any common name used to describe the noxious or invasive species.	String (80)	SDSFIE
	sdsFeatureDescription	A narrative describing the feature.	Any descriptive information about the noxious or invasive species that is not already included in the attribute table.	String (255)	SDSFIE
	sdsMetadataID	The foreign key to a metadata record.		String (80)	SDSFIE
	areaSize *(Polygon geometry)*	The area of the feature.	Recorded to the 1/1000 of an acre.	Double	AF
D	areaSizeUOM *(Polygon geometry)*	The unit of measure for the area of the feature.	acre	String (20)	AF
	perimeterSize *(Polygon geometry)*	The perimeter of the feature.	Recorded to the 1/1000 of a foot.	Double	AF
D	perimeterSizeUOM *(Polygon geometry)*	The unit of measure for the perimeter of the feature.	foot	String (20)	AF
	lengthSize *(Line geometry)*	The length of the feature.	Recorded to the 1/1000 of a foot.	Double	AF
D	lengthSizeUOM *(Line geometry)*	The unit of measure for the length of the feature.	foot	String (20)	AF
	latitude *(Polygon and Point geometry)*	The latitude coordinate representing the feature in decimal degrees.	decimal degrees	Double	AF
	longitude *(Polygon and Point geometry)*	The longitude coordinate representing the feature in decimal degrees.	decimal degrees	Double	AF
	MGRS *(Polygon and Point geometry)*	The MGRS coordinate for the feature.		String (20)	AF
	elevation *(Point geometry)*	The elevation of the feature in feet.		Double	AF

Domain (D)	Attribute Name	Definition	Allowed Values	Data Type (Length)	Advocate
	latitudeFrom *(Line geometry)*	The latitude coordinate of the beginning (upstream/up gradient) coordinate point in decimal degrees.	decimal degrees	Double	AF
	latitudeTo *(Line geometry)*	The latitude coordinate of the ending (downstream/down gradient) coordinate point in decimal degrees.	decimal degrees	Double	AF
	longitudeFrom *(Line geometry)*	The longitude coordinate of the beginning (upstream/up gradient) coordinate point in decimal degrees.	decimal degrees	Double	AF
	longitudeTo *(Line geometry)*	The longitude coordinate of the ending (downstream/down gradient) coordinate point in decimal degrees.	decimal degrees	Double	AF
	elevationFrom *(Line geometry)*	The elevation component of the beginning (upstream/upgradient) coordinate point in feet.	feet	Double	AF
	elevationTo *(Line geometry)*	The elevation component of the ending (downstream/downgradient) coordinate point in feet.	feet	Double	AF
D	elevationUOM *(Line and Point geometry)*	The unit of measure for the elevation of the feature.	foot	String (20)	AF

Data Layer Specification – Noxious or Invasive Species

Domain (D)	Attribute Name	Definition	Allowed Values	Data Type (Length)	Advocate
D	isManagedSpecies	Indicates whether the species is under active management.	**NA, no, TBD, yes**	String (5)	AF
D	mgtAction	The management action, if any, being taken to control the species.	**For a list of domain values, see MgtAction in Appendix 1.**	String (20)	AF
D	isNative	The species is a native species. If false, the assumption is that the species is exotic.	**NA, no, TBD, yes**	String (5)	SDSFIE
D	kingdom	A descriptor identifying one of the five taxonomic kingdoms into which scientists place all living organisms.	**For a list of domain values, see KingdomType in Appendix 1.**	String (10)	SDSFIE
	natureServeID	The unique identifier for the NatureServe record of the species (http://www.natureserve.org).		String (10)	SDSFIE
D	isNoxious	Indicates whether the species is considered noxious.	**NA, no, TBD, yes**	String (5)	AF
D	isInvasive	Indicates whether the species is considered invasive.	**NA, no, TBD, yes**	String (5)	AF
D	speciesCat	The code indicating the class of flora or fauna.	**For a list of domain values, see SpeciesCat in Appendix 1.**	String (15)	AF
	scientificName	The scientific name of the species.		String (255)	SDSFIE
	countCover	The population count or percent cover of the species at the site.		Integer (Long)	AF
	countCoverDate	The date on which the population count or percent cover measurement was made. Format for date is YYYYMMDD (i.e., September 15, 1994 = 19940915).		Integer (Long)	AF

Domain (D)	Attribute Name	Definition	Allowed Values	Data Type (Length)	Advocate
	narrative	Any additional comments or notes.		String (255)	AF
D	installationID	Installation identifier assigned to the Installation by real property.	**For the list of domain values see the Air Force GeoBase Data Working Group AF Adaptation 3.1.0 Data Dictionary.**	String (16)	AF
D	installationName	The actual name of the installation that is associated with the installation ID defined by real property.	**For the list of domain values see the Air Force GeoBase Data Working Group AF Adaptation 3.1.0 Data Dictionary.**	String (100)	AF
D	siteID	Installation identifier assigned to the Site by real property.	**For the list of domain values see the Air Force GeoBase Data Working Group AF Adaptation 3.1.0 Data Dictionary.**	String (36)	AF
D	majorCommand	Service Major Command of the installation.	**For the list of domain values see the Air Force GeoBase Data Working Group AF Adaptation 3.1.0 Data Dictionary.**	String (10)	AF
D	realPropertySiteUniqueID	The unique identifier (UID) used to permanently identify a Site. This UID will be a Real Property Site Unique Identifier (RPSUID). Source: RPIM, v3.0, extracted 4/2009.	**For the list of domain values see the Air Force GeoBase Data Working Group AF Adaptation 3.1.0 Data Dictionary.**	String (20)	AF
	wacInnrCode	The NGA World Airfield Identifier.	The NGA World Airfield Identifier Code: List of codes can be accessed at the following site: https://www.extranet.nga.mil/	String (10)	AF

Domain (D)	Attribute Name	Definition	Allowed Values	Data Type (Length)	Advocate
	dataSteward	The data steward is the entity that oversees the data content, context, and associated business rules of the feature class.		String (20)	AF
D	country	The country code is an abbreviation for the country that owns the specific feature class.	**For the list of domain values see ISO ALPHA-2 Code / FIPS 10-4 standard.**	String (5)	AF
D	owner	The military service, country, government that owns that specific feature.	**For the list of domain values see the Air Force GeoBase Data Working Group AF Adaptation 3.1.0 Data Dictionary.**	String (10)	AF
	createDate	Date the feature was originally acquired, created or generated. If the day is unknown, default to the first day of the month. If only the year is known, default to the first day of the year.		Date	AF
	creator	Person who created the feature. Last name of the person and first initial. Example: Jane Smith would be attributed as "SmithJ."		String (30)	AF
D	dataCollection	Coded domain value which identifies the collection methodology used to calculate, create or record the feature.	**For the list of domain values see the Air Force GeoBase Data Working Group AF Adaptation 3.1.0 Data Dictionary.**	String (20)	AF

Domain (D)	Attribute Name	Definition	Allowed Values	Data Type (Length)	Advocate
	dataSource	Identifies the installation office, government agency, contractor or vendor that acquired, created or generated the feature.		String (100)	AF
	editor	Person who edited the feature attribution or geometry from its original or previous value. Last name of the person and first initial. Example: Adam Johnson would be attributed as "JohnsonA".		String (30)	AF
	dateEdited	Date the feature was edited from its original or previous geometry/value. If the day is unknown, default to the first day of the month. If only the year is known, default to the first day of the year.		Date	AF
	metaNotes	Describes other details about what was created or edited and why. Usage of the metaNotes field does not preclude the completion of the other metadata fields.		String (255)	AF
	mediaLink	Used to link the record to associated multimedia records that reference data such as imagery, video, audio, scanned documents, drawings, and other digital media.		String (255)	AF

Domain (D)	Attribute Name	Definition	Allowed Values	Data Type (Length)	Advocate
	SHAPE_Length *(Polygon and Line geometry)*	ESRI-generated field.			ESRI
	SHAPE_Area *(Polygon geometry)*	ESRI-generated field.			ESRI

Business Tables

The business tables will contain information that goes beyond the attribute table information, which will be related to the data layer using a Feature Key or other Identifier found in both the attribute table and business table. Additional attributes to be determined by the Program Area Manager. The business tables for NoxiousOrInvasiveSpecies_A, NoxiousOrInvasiveSpecies_L, and NoxiousOrInvasiveSpecies_P are:

Table Name	Identifier	Source
nr_NoxiousOrInvasiveSpecies	noxiousOrInvasiveSpecIDFK	Program Area Manager
nr_NoxiousOrInvasiveSpecies_L	noxiousOrInvasiveSpecIDFK	Program Area Manager
nr_NoxiousOrInvasiveSpecies_P	noxiousOrInvasiveSpecIDFK	Program Area Manager

"No Data" Value in Attributes

Directions for populating required attributes for which no data/information is available. Use the appropriate values below:

For Empty Text Values	
TBD	(To Be Determined) – A value is required but the value has yet to be determined.
Unknown	The value cannot be reasonably determined.
NA	(Not Applicable) No value exists.

For Empty Integer Values	
99999	(To Be Determined) – A value is required but the value has yet to be determined.
88888	The value cannot be reasonably determined.
77777	(Not Applicable) No value exists.

For Empty Date Values	
9/9/9999	(To Be Determined) – A value is required but the value has yet to be determined.
8/8/8888	The value cannot be reasonably determined.
7/7/7777	(Not Applicable) No value exists.

Extent

The data layer's extent will be to the installation boundary, unless otherwise noted by the program area manager.

Metadata

Complete Federal Geographic Data Committee (FGDC) compliant metadata for the data layer using the *Procedures for Creating Metadata* document. Update the metadata Lineage section as edits are made or as necessary.

Theme Keywords: Natural Resources, Noxious or Invasive Species

Appendix 1: Proposed SDSFIE 3.1 AF Adaptation Attribute Domain Tables

DOMAIN TABLE NAME: KingdomType	
ATTRIBUTE NAME: kingdom	
CODED DOMAIN	DEFINITION
animalia	Animals are a major group of multicellular, eukaryotic organisms of the kingdom Animalia.
fungi	A fungus is a eukaryotic organism that is a member of the kingdom Fungi.
monera	Monera are bacteria and other mostly tiny, single-celled organisms whose genetic material is loose in the cell. Once Monera were briefly understood to be one of five biological kingdoms. Now it comprises two kingdoms: Eubacteria and Archaebacteria.
NA	Not Applicable: No value exists.
other	Other. Must be described in the sdsFeatureDescription attribute.
plantae	Plants are a major group of multicellular, eukaryotic organisms of the kingdom Plantae.
protista	Protists are unicellular eukaryotes that either exist as independent cells, or if they occur in colonies, do not show differentiation into tissues and are members of the kingdom Protista.
TBD	To Be Determined: A value is required but the value has yet to be determined.

DOMAIN TABLE NAME: MgtAction	
ATTRIBUTE NAME: mgtAction	
CODED DOMAIN	DEFINITION
aerialSpraying	Action taken to manage the species is aerial spraying.
biological	Action taken to manage the species is biological control.
broadcastSpraying	Action taken to manage the species is broadcast spraying.
burning	Action taken to manage the species is prescribed burning.
cutStump	Action taken to manage the species is cut stump treatment.
electrofishing	Action taken to manage the species is electro-fishing.
fumigation	Action taken to manage the species is fumigation.
gillnetting	Action taken to manage the species is gillnetting.
manual	Action taken to manage the species is manual removal.
mechanical	Action taken to manage the species is mechanical control.
NA	Not Applicable: No value exists.
other	Other. Must be described in the sdsFeatureDescription attribute.
pesticide	Action taken to manage the species is general pesticide application.
spotSpraying	Action taken to manage the species is spot spraying.
TBD	To Be Determined: A value is required but the value has yet to be determined.
trapping	Action taken to manage the species is trapping.

DOMAIN TABLE NAME: SpeciesCat	
ATTRIBUTE NAME: speciesCat	
CODED DOMAIN	DEFINITION
amphibia	Amphibian species.
aves	Avian (Birds) species.
crustacea	Crustacean species.
general	An aggregate of more than one species.
insecta	Insect species.
mammalia	Mammal species.
mollusca	Mollusk species.

DOMAIN TABLE NAME: SpeciesCat	
ATTRIBUTE NAME: speciesCat	
NA	Not Applicable: No value exists.
other	Other. Must be described in the sdsFeatureDescription attribute.
pisces	Pisces (Fish) species.
reptilia	Reptile species.
bryoid	Bryoid species.
epiphyte	Epiphyte species.
herb	Herb species.
liana	Liana species.
shrub	Shrub species.
TBD	To Be Determined: A value is required but the value has yet to be determined.
thallophyte	Thallophyte species.
tree	Tree species.

Appendix G: Barbed Goatgrass Control Work Plan for Beale Air Force Base, California

Appendix G contains the Barbed Goatgrass Control Work Plan for Beale Air Force Base, California.

Barbed Goatgrass Control Work Plan for Beale Air Force Base, California

Prepared for the US Air Force by
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November 2017

Purpose

The purpose of the *Barbed Goatgrass Control Work Plan* (hereinafter, *Goatgrass Work Plan*) is to describe the operational tasks necessary to control the invasive weed, barbed goatgrass, on Beale Air Force Base (AFB). This *Goatgrass Work Plan* is developed from the Beale *Updated Invasive Plant Species Management Guidelines* (hereinafter, *Guidelines*; Hopkinson et al. 2017) and is an appendix to the *Guidelines*. A detailed species account and control options are available in the *Guidelines*. That information is only briefly summarized here.

Goal

The goal of barbed goatgrass control on Base is to contain the infestation, reduce cover to less than 10% 2 years after treatment, and to prevent its spread to uninfested areas of the Base (see Hopkinson et al. 2017, Table 6.1).

Background Information on Barbed Goatgrass

- Barbed goatgrass (*Aegilops triuncialis*) is a noxious annual grass (Poaceae) invading northern California's rangelands. It can displace native plants and desirable forage species. Its awns are inconvenient for people and can severely injure animals, both domestic and wildlife.

- Control of goatgrass is typically achieved with prescribed fire or with herbicides (or mowing where feasible) because this annual grass is mostly unpalatable to livestock.

- Goatgrass matures later than most other annual grasses in the Valley grassland. As with control of many weeds, it is essential to time treatments to match goatgrass' vulnerable phenological stages (Beitz 2016). Goatgrass must be burned while its seedhead is still on the stem, but if conducted too early, a prescribed burn may not be sufficiently hot to kill the seeds (DiTomaso et al. 2001). It must be mown after flowering but before seeds fully develop. The 'window of susceptibility' during which goatgrass is vulnerable varies from year to year (Brownsey et al. 2016) so goatgrass must be observed at a site during the growing season each year that treatment is planned. For mowing, the window is only about five weeks long. Review the brief University of California publication, *Barb Goatgrass and Medusahead: Timing of Grazing and Mowing* (Brownsey et al. 2016), available at http://anrcatalog.ucanr.edu/Details.aspx?itemNo=8567, for clear descriptions and photographs of the important phenological stages of goatgrass.

- A goatgrass seed is generally twinned with a smaller seed that is inhibited from germinating by its larger sibling seed in the first year. This second, smaller seed tends to germinate the year after its larger twin. Consequently, in most circumstances, treatment needs to occur in two consecutive years to be effective. The smaller seeds may persist in the soil for up to 5 years (Davy et al. 2008; Aigner and Woerly 2011), necessitating monitoring and 'mop-up' treatment for several years following the primary treatments.

Considerations Regarding Livestock Pasture Units

Treating goatgrass in grazed areas of the Base may temporarily negatively affect grazing:
- Prescribed burning is likely to reduce forage production in the burned area by as much as half in the first year or two following the fire.
- Some herbicides have restrictions for use in rangelands, and treated areas may have to be excluded from livestock grazing for weeks or even an entire season, depending on the herbicide.
- Also, herbicide use on rangeland weeds can result in loss of organic certification for livestock that graze in the treated area.

Consult with lessees before the start of the grazing season in November so that they can plan for the impacts of weed control.

Planning and implementing goatgrass treatments by Management Area Lease will limit spreading of goatgrass by cattle within a particular lease/rotation system. Note that lessees lease multiple Management Areas on Base and may move cattle between those Management Areas (in 2016/17, one lessee held the leases for Management Areas A and F, a second lessee held the leases for Management Areas B and C, and a third lessee held the lease for Management Area D); consider this when planning treatments.

Extent of Goatgrass Infestation on Base

Data from the 2014 and 2016 baseline weed surveys indicate that total goatgrass-infested acreage[1] on Base is approximately 502 acres (Figure 1; H.T. Harvey & Associates 2015; CEMML 2017). Large patches of goatgrass occur in Beale Pasture Units B-1 (approximately 57 infested acres), D-4 (approximately 41 infested acres), and F-1 (approximately 143 infested acres); the airfield area also contains a large patch of goatgrass (approximately 129 infested acres; see Figure 2 for patch polygons). Several other Pasture Units (Table 1) and ungrazed areas on Base have smaller satellite patches, mostly mapped at low cover values.

Table 1: Acreage of barbed goatgrass (*Aegilops triuncialis*)-infested plots[1] within Beale AFB's grazing Pasture Units. This table does not include goatgrass-infested acreage in Beale's ungrazed land (e.g., the airfield area).

Pasture Unit	Total Acreage for Pasture Unit	Acreage of Goatgrass-Infested Plots within Pasture Unit	% of Pasture Unit Acreage with Goatgrass-Infested Plots
A-1	832	19	2.3%
A-2	471	14	3.0%
A-3	359	1	0.2%
A-4	746	0	0.1%
A-5	207	1	0.3%
A-6	284	0	0.0%
A-7	114	0	0.0%
A-9	167	0	0.0%
B-1	825	49	5.9%
B-2	1,101	17	1.5%
B-3	182	0	0.0%
B-5	584	6	1.0%
B-6	360	0	0.0%
B-8	15	0	0.0%
C-1	2,553	23	0.9%
C-2	374	7	1.8%
C-3	147	0	0.0%
C-4	25	0	0.0%
C-5	4	0	0.0%
C-6	131	0	0.2%
D-1	37	0	0.0%
D-2	23	1	2.7%

[1] These estimates of infested acres represent the sum of the 50 by 50 meter (0.6 acre) weed survey plots that had at least 1 goatgrass plant observed within them. Note that the infested acreage for the three Pasture Unit patches is larger than the corresponding Pasture Unit infested acreage in Table 1 because some of each patch occurs outside the Pasture Unit boundaries (Figure 2).

Pasture Unit	Total Acreage for Pasture Unit	Acreage of Goatgrass-Infested Plots within Pasture Unit	% of Pasture Unit Acreage with Goatgrass-Infested Plots
D-3	111	0	0.0%
D-4	281	37	13.0%
D-5	259	5	2.1%
D-6	90	1	1.4%
E-1	21	0	0.0%
E-2	21	0	0.0%
E-3	55	0	0.0%
E-4	11	0	0.0%
E-5	24	0	0.0%
E-6	26	0	0.0%
F-1	1,333	109	8.1%
F-2	387	1	0.2%
F-3	360	0	0.0%
F-4	269	0	0.0%
Total	**12,787**	**290**	**2.3%**

Treatment Actions

The initial step is to determine areas for treatment, using the spatial and plant cover data from the 2014 and 2016 baseline weed surveys of the Base (H.T. Harvey & Associates 2015; CEMML 2017). As part of the planning for goatgrass control, visit areas targeted for treatment before treatment to determine whether the baseline survey mapping continues to represent the goatgrass patches accurately (annual grass populations fluctuate in size and cover from year to year). Treating both large, high-density patches as well as satellite patches to the extent possible is the recommended approach (Skaer Thomason and Rice 2017). The objective for large patches is to contain goatgrass cover at less than 10% and prevent its spread on an on-going basis; the objective for smaller, satellite patches is to eliminate goatgrass at those locations.

Prescribed burning is likely to be the most effective method of controlling goatgrass on Base. The goatgrass patch in Pasture Unit F-1 is an obvious candidate for a prescribed burn, based on the size of the patch and the fairly high cover values. However, prescribed burning is difficult to schedule and implement reliably, especially given the limited ‘window of susceptibility’ during which fire is an effective treatment and the need to burn in two consecutive years (in years with high biomass production, the resulting hot fire may provide long-lasting control without a burn in the second year [Marty et al. 2015]) Prescribed fire may also be challenging to use in the airfield area, both because of the potential for interfering with airfield operations and because Bird/Wildlife Aircraft Strike Hazard (BASH) mowing in the airfield area reduces herbaceous fuel load, potentially reducing the burn’s effectiveness. Prescribed fire also requires cultural resources site coordination and protection. Consequently, the Beale Weed Program Manager must be ready to implement alternative treatment when prescribed fire does not appear feasible.

Herbicide application or mowing are likely to be the best alternative treatments, but they may need to be implemented earlier in the season than burning would typically take place (May to July). Glyphosate, commonly used on goatgrass, is applied in late winter to early spring while goatgrass is growing rapidly but before it flowers (Davy et al. 2008; DiTomaso et al. 2013; Beitz 2016). Goatgrass mowing occurs after flowering but before seeds fully develop, from May to very early June (Brownsey et al. 2016). Therefore, if the burn date gets cancelled, effective treatment may not be possible that year because the ‘window of susceptibility’ for the alternative methods has already closed.

Mowing controls goatgrass most effectively if plants are cut as close to the ground as possible because low-growing individuals can escape treatment (Davy et al. 2008; Beitz 2016). This requirement for successful mowing may conflict with BASH vegetation height requirements (between 7 and 14 inches) in the airfield area (DAF 2004, 11-12). An alternative treatment is broadcast herbicide application, but use of glyphosate will impact all surrounding plant species. This may conflict with BASH vegetation requirements and may not be permitted in sensitive conservation areas within the airfield. That noted, yellow starthistle (*Centaurea solstitialis*) was chemically controlled in the airfield area in 2016 so this option may also be available for goatgrass.

The Base Integrated Natural Resources Management Plan (INRMP) requires that prescribed burning and, potentially, use of an off-road vehicle for mowing or broadcast herbicide application requires coordination with the Base Cultural Resources Manager (Beale AFB 2016, 17). The INRMP states that such coordination “can take up to three months or longer if there are direct impacts and could add additional costs to projects to prepare and implement mitigation measures” (Beale AFB 2016, 17).

If burning, mowing, or herbicide application are to take place during the nesting season, nesting bird surveys are required. Consultation with the US Fish and Wildlife Service (USFWS) could also be necessary for control locations in which listed species occur or have the potential to occur. A Base-wide Environmental Assessment for weed treatment will be prepared in 2018 which should eliminate the need for individual USFWS consultations.

Maintaining spatial and attribute data on which treatments were used, when, and where, as well as monitoring data, will prove essential in subsequent treatment planning and decision-making. In addition, information on effort expended to plan, implement, and monitor goatgrass treatment will inform planning of future goatgrass (and potentially other rangeland weeds) control.

Effectiveness monitoring is necessary to confirm that the treatments are successful, especially in the large patches. Establish small permanent plots in treated areas and in similar untreated area(s). Measure cover of goatgrass in the plots (specific methods are detailed in Section 4.3 of the *Guidelines*). Comparison control plots (goatgrass-infested locations in which treatment is not applied but which are as similar as possible to the areas undergoing treatment) are necessary to differentiate between the effects of treatment compared to those changes that might appear to be the result of treatment but are actually caused by annual weather patterns or other non-management factors.

Early detection monitoring is necessary to prevent the spread of goatgrass into uninfested areas of Base. Educational signs/flyers installed at key access areas and provided to Base users should briefly describe goatgrass, preferably with photographs, and ask users (lessees, contractors, recreational users) to take a georeferenced photo of any goatgrass they observe and send the photo to the Base Natural Resources Manager. If the reported goatgrass is in a previously uninfested location, treat it as soon as possible. If the goatgrass location is found after the May mowing window, plants may have to be hand-pulled, bagged, and removed from site if they still have their seedheads. If seedheads have already dispersed, mark location for treatment the following year.

Treatment Plan

Year One

Conduct phenology surveys of barbed goatgrass patches selected for treatment every week starting in April (mowing window is only 5 weeks long so it is essential to be ready to start treatment as soon as goatgrass is vulnerable). If herbicide use is planned, start monthly phenology surveys in January. Burn large patches in Pasture Units B-1, D-4, and F-1[2], identified in Figure 2 between May and July; specific timing depends on goatgrass phenology that year. If burning is not adequately planned for by May 15, start mowing as soon as phenology allows, potentially immediately, in the large, high cover patches. Mowers <u>must be cleaned thoroughly</u> after use in infested areas to prevent spreading goatgrass seed to other areas of the Base.

Chemically treat 20% of the goatgrass-infested polygons (distributed across the site, not clustered to reduce any increase in BASH risk) in the airfield area[3] (clean mowers thoroughly following treatment). See DiTomaso et al. (2013) for recommended glyphosate application rates.

In small, low cover satellite locations within or close to Management Areas B, D, and F (see Footnote 2), hand-pull or line trim individuals or small clusters of goatgrass. This treatment occurs after flowering but before seeds fully develop, from May to very early June. Spot-treatment with herbicide in early spring could work but would require identifying goatgrass prior to the emergence of the inflorescence, which can be difficult. GPS specific locations (points and polygons) to increase efficiency of Year Two control and monitoring efforts.

Three weeks after mowing or line trimming, evaluate the treated area for goatgrass resprouts. Hand-pull or spot-treat with glyphosate any resprouts (Beitz 2016).

[2] If treating all three Management Areas, B, D, and F, in Years One through Five is not feasible, treat Management Areas B and D in Years One through Five (see Estimate of Effort section below). During Years One and Two, collect detailed data on effort required to plan, implement, and monitor goatgrass treatment. Use this information to plan for treatment of the remaining infested locations, including Management Area F.
[3] A *BASH Area Work Plan* is currently being written and will also be an appendix to the *Guidelines*. The *Goatgrass Work Plan* recommendations for the airfield area will need to comply with the *BASH Area Work Plan*.

Enter treatment spatial and attribute data (location, date, and treatment details) into Base geodatabase. Track treatments and their outcomes in the GIS data via the 50m x 50m grid and any new points/polygons from the satellite locations.

Collect detailed data on effort required to plan, implement, and monitor goatgrass treatment. Use this information to plan for treatment of the remaining infested locations.

Year Two
Conduct phenology surveys of barbed goatgrass patches selected for treatment every week starting in April. If herbicide use is planned, start monthly phenology surveys in January. Plan to burn large patches treated in Year One again; if burning is not feasible, mow. Mow or spray in airfield area again (clean mowers thoroughly).

Monitor treatment and control areas in mid-spring before Year Two treatment to evaluate success of Year One's treatment.

Continue to treat small, low-cover satellite areas within or close to Pasture Units B, D, and F (see Footnote 2), with hand-pulling or line trimming of individuals or small clusters of goatgrass.

Visit mown or line-trimmed patches three weeks after treatment to find and treat any goatgrass resprouts.

Enter treatment spatial and attribute data (location, date, and treatment details) into Base geodatabase.

Years Three through Five
Monitor treated areas in mid-spring to assess cover following the initial two years of treatment. In large patches, plan for additional treatment with herbicide or mowing if cover exceeds 10%.

Visit small satellite patches to confirm elimination of goatgrass in those locations; treat any remaining individuals with herbicide.

If necessary, enter treatment spatial and attribute data (location, date, and treatment details) into Base geodatabase. If no goatgrass is observed in a location for three years, location can be categorized as uninfested. Add the location to the Early Detection-Rapid Response (EDRR) survey list every five years to ensure populations remain eradicated.

After Year Five
In large patches, goatgrass will need to be controlled on an on-going basis, every 2-7 years after treatment (Marty et al. 2015). This will require annual monitoring to determine goatgrass cover and treatment needs.

In addition, continuing EDRR monitoring will be necessary to prevent goatgrass spread into uninfested areas of Base (see *Guidelines* and the *Early Detection-Rapid Response Work Plan*, currently being drafted).

If goatgrass control is deemed successful in targeted populations, begin Years One through Five process for all other small locations on Base not previously targeted, including in Management Areas A and C and locations not in the grazing program. Working by Management Area Lease will limit spreading of goatgrass by grazing in a particular lease/rotation system. If adequate funds are available, control of these locations can be implemented sooner. Do not add a Pasture Unit unless control of all polygons within the Unit can be conducted in a single year.

Table 3 contains the goatgrass control timeline.

Estimate of Effort

Published information on effort required to control goatgrass with each treatment method is limited. Beitz (2016) reported on goatgrass control in eastern Alameda and Contra Costa counties with line trimming and follow-up spot treatment of resprouts with glyphosate. A 1.4 acre infestation required 36 person-hours to treat, and a 13.8 acre infestation took 276 person-hours to treat, for an average of just under 21 person-hours per acre. It is not clear whether this effort estimate included their monitoring activities. See Table 2 for estimates, using this average, for Years One through Five treatments.

Table 2: Estimated effort (in hours) for mowing and manual control of barbed goatgrass in Beale AFB Management Areas B, D, and F.

Mngm Area Lease	Large Infestation (acre)	Mowing Estimated Effort (hours)	Small Infestation (acre)	Manual Control Rate (hand-pulling & chemical spot spray) (hours/acre)	Manual Control Estimated Effort (hours)	Monitoring & Reporting Estimate	Total Hours
B	57	40	15	21	315	40	395
D	41	29	3	21	63	40	132
F	143	100	~30	21	617	40	687

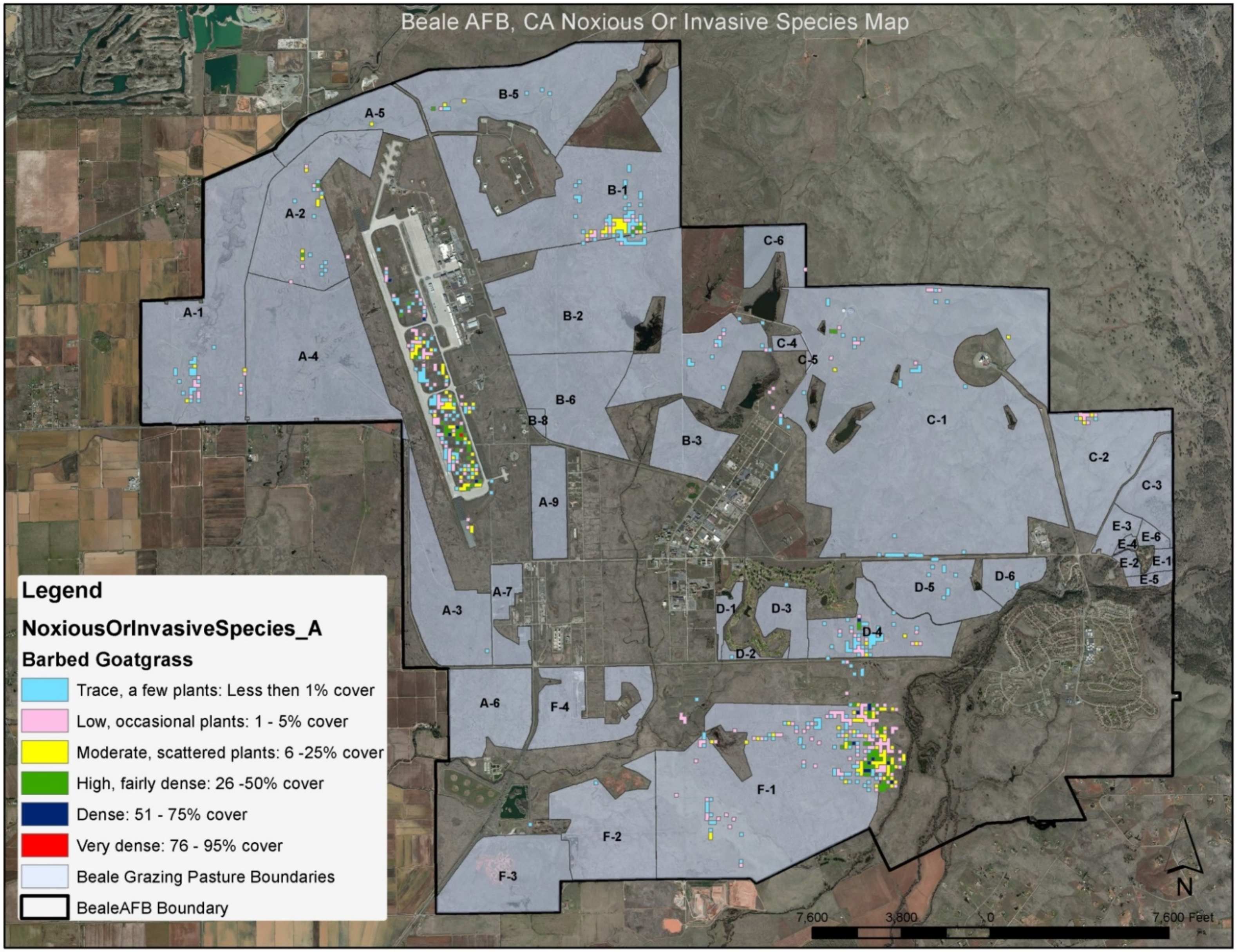

Figure 1: Location and cover class of barbed goatgrass (*Aegilops triuncialis*) on Beale AFB; map combines data from 2014 and 2016 baseline weed surveys (H.T. Harvey & Associates 2015; CEMML 2017); map produced by Behdad Sanai, Travis AFB.

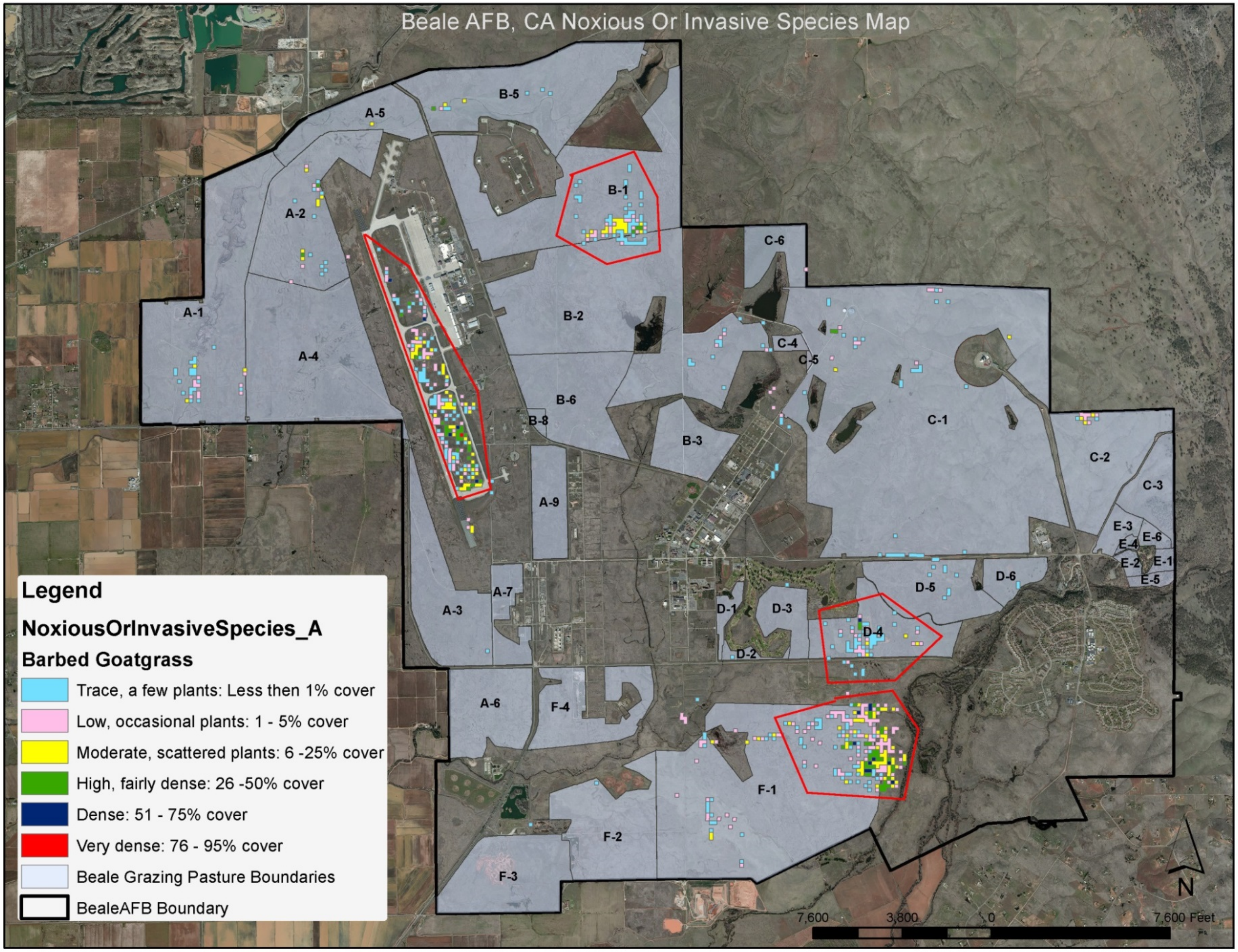

Figure 2: Location of large patches of barbed goatgrass (*Aegilops triuncialis*) on Beale AFB, delineated by red polygons.

Table 3: Beale AFB barbed goatgrass (*Aegilops triuncialis*) control timeline; (shaded cell=month(s) in which action may be necessary).

Action	Month(s) in which action may be necessary											
	August	September	October	November	December	January	February	March	April	May	June	July
YEARS ONE AND TWO												
Determine areas for treatment (or re-treatment in Year Two). Management Areas B, D, and F recommended (see Footnote 2).												
Collect detailed data on effort required to plan, implement, and monitor goatgrass treatment; use this information to plan future goatgrass control.												
Coordinate treatment plans with Base Cultural Resources Manager, as needed.												
Coordinate treatment plan for airfield area with Airfield Operations & Safety Office.												
Meet with lessees to discuss impact of goatgrass control on their operations.												
Determine likelihood that a prescribed burn will be feasible; if yes, initiate planning and permitting for burn; complete planning and permitting process for the full five years' worth of expected effort where possible												

Action	Month(s) in which action may be necessary											
	August	September	October	November	December	January	February	March	April	May	June	July
to reduce planning and permitting needs in subsequent years.												
If prescribed burning is not an option, initiate planning and permitting for other treatments, especially herbicide application; complete planning and permitting process for the full five years' worth of expected effort where possible to reduce planning and permitting needs in subsequent years.												
For all treatment methods, visit treatment sites to assess phenological stage of goatgrass – review Brownsey et al. (2016); will need to assess multiple times over the growing season.						Monthly in late winter for glyphosate application.		Mid-spring for	mowing and burning	(can be even later in the spring for burning, depending on year).		

Action	Month(s) in which action may be necessary											
	August	September	October	November	December	January	February	March	April	May	June	July
In Year One, shortly before treatment, establish permanent treatment and control plots and collect pre-treatment cover data for baseline comparison; plant identification may be difficult for herbicide treated areas because treatment is early in the season.						Specific timing	of monitoring	depends	on	treatment	method	used.
In Year Two, collect cover data in treatment and control plots from Year One.						Specific timing	of monitoring	depends	on	treatment	method used.	
In Year Two, after monitoring data have been collected, analyze data and review this year's treatment actions based on analysis.												
If using herbicide on large or small patches, apply glyphosate to goatgrass as it is rapidly growing but before it flowers (Stage V3 in Brownsey et al. [2016]).						Specific timing for	treatment depends on	goatgrass phenology.				

Action	Month(s) in which action may be necessary											
	August	**September**	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**July**
If mowing large patches, mow goatgrass, as close to the ground as possible, after goatgrass flowering but before seeds fully develop (Stages R5, R6, and R7 in Brownsey et al. [2016]). <u>Mowers must be cleaned thoroughly after use</u>.												
If line trimming small patches, trim as close to the ground as possible, after goatgrass flowering but before seeds fully develop (Stages R5, R6, and R7 in Brownsey et al. [2016]).												
Treat any goatgrass locations discovered as part of Early Detection-Rapid Response program with appropriate method for phenological stage.												
Three weeks after mowing or line trimming, revisit mown sites to evaluate and treat any goatgrass resprouts with glyphosate.												

Action	**Month(s) in which action may be necessary**											
	August	**September**	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**July**
Burn goatgrass patches while seedheads are still on the plant (Stage M10 in Brownsey et al. [2016]) but try to optimize intensity of fire.										Specific timing for	burn depends on	goatgrass phenology.
Enter treatment spatial and attribute data (location, date, and treatment details) into Base geodatabase.												
YEARS THREE, FOUR, AND FIVE												
Collect cover data in treatment and control plots from 1st year.						Specific timing	of monitoring	depends	on	treatment	method used.	
After monitoring data have been collected, analyze data and review this year's treatment actions based on analysis.												
If cover values exceed 10%, plan for treatment following year 2 template.							Specific timing for	treatment depends on	goatgrass phenology.			
Visit small satellite patches to confirm elimination of goatgrass in those locations; mow or apply glyphosate to any remaining individuals.							Specific timing for	treatment depends on	methods used and	goatgrass phenology.		

Action	Month(s) in which action may be necessary											
	August	September	October	November	December	January	February	March	April	May	June	July
Treat any goatgrass locations discovered as part of Early Detection-Rapid Response program with appropriate method for phenological stage.												
Enter any treatment spatial and attribute data into Base geodatabase; If no goatgrass is observed in a location for three years, categorize location as uninfested.												

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Behdad Sanai, CEMML, CSU, for maps and spatial data in Table 1.
Lauren Wilson, USAF, for detailed review of the Work Plan.

Appendix H: Riparian Invasive Plant Work Plan for Beale Air Force Base, California

Appendix H contains the Riparian Invasive Plant Work Plan for Beale Air Force Base, California.

Riparian Invasive Plant Work Plan for Beale Air Force Base, California

Prepared for the US Air Force by
Sarah Ratay
Center for Environmental Management of Military Lands
Colorado State University
Fort Collins, Colorado

November 2017

Purpose

The purpose of the *Riparian Invasive Plant Work Plan* (hereinafter, *Riparian Work Plan*) is to describe the operational tasks and timeline necessary to control the invasive weeds occurring in riparian habitats on Beale Air Force Base (AFB). This *Riparian Work Plan* is developed from the Beale *Updated Invasive Plant Species Management Guidelines* (hereinafter, *Guidelines*; Hopkinson et al. 2017) and is an Appendix to the *Guidelines*. Detailed species accounts and control options are available in the *Guidelines*. That information is only briefly summarized here.

Goal of Treatments

Seven species of invasive plants occurring in riparian areas on Beale AFB are targeted for eradication due to their low density and adverse effects. An additional three species are being managed at a low density, and a final species will be managed in certain areas for asset based protection.

<u>Zero density management: Eradication target species</u>

Seven species occurring in riparian areas have a goal of zero density (*Guidelines* Table 6.1, section 3.1.2). To achieve eradication status, removal of living plants needs to be followed by years of seed bank management until no germination of the target species occurs on the previously invaded site.

giant reed	*Arundo donax*	Zero density within 5 years
pokeweed	*Phytolacca americana*	Zero density within 2 years
tree-of-heaven	*Ailanthus altissima*	Zero density within 5 years
bull thistle	*Cirsium vulgare*	Zero density within 4 years
stinkwort	*Dittrichia graveolens*	Zero density within 3 years
edible fig	*Ficus carica*	Zero density within 10+ years
black locust	*Robinia pseudoacacia*	Zero density within 10+ years

<u>Containment-Level Species</u>

These species occurring in riparian habitats are to be maintained at a low cover target indefinitely (*Guidelines* Table 6.1, section 3.1.3). Their treatment has the goal of reducing their impacts on native and sensitive plant and animal species.

Klamathweed	*Hypericum perforatum*	Reduce those sites with >10% cover to < 5% cover
blessed milk thistle	*Silybum marianum*	Reduce to <10% cover
vervain	*Verbena litoralis* and/or *V. bonariensis*	Reduce to 0% cover in satellite populations and where previously treated

<u>Asset-Based Protection and Long-Term Management</u>

This species will be removed from some riparian areas to reduce impacts on sensitive species. (*Guidelines* Table 6.1, section 3.1.4)

Himalayan blackberry	*Rubus armeniacus*	Reduce to < 5% cover in targeted areas, allow little/no fruit production

Treatment Plan

Generally, herbicide treatments are more efficient and effective than other methods of removal. This document recommends the most successful methods of treatment of these species. For a comprehensive discussion of various control methods, see Appendix B of the *Guidelines.* A brief summary of treatment techniques is provided to further explain the directions in the species treatment plan. The narrative of the treatment plan is followed by a monthly work plan which further describes the timing of treatments. This document does not constitute a formal recommendation. Always read herbicide labels prior to use. Treatment recommendations are obtained from personal experience and the reference list at the end of the document.

Treatment Terminology	Description of Method
Frill and spray	Cut into the bark around the stem of a large tree, disconnecting the vascular tissue completely around the stem. Quickly apply herbicide to the cut edges. Works best in teams of two people; one cutting, one applying.
Basal bark	Apply herbicide in a continuous band around a tree trunk for at least 10 inches along the stem. Does not work well on mature stems with rough bark.
Foliar	Apply herbicide to the leaves of a plant. Works best when plant is small enough that the applicator can apply some herbicide droplets on most of the leaves of the plant. The healthier the plant the better it will conduct herbicide into its roots. Plants should be sprayed until wet but before herbicide drips from the leaves.
Pre-emergent	Apply herbicide to ground in area with young cotyledons (first leaves) of target species. Good coverage of the whole area, not just plants is necessary. Surveys for extent in the prior year may be needed to ascertain the treatment boundary.
Cut stump	Cut stem of invasive woody plant at up to a foot of height. Try to keep the cut flat to avoid crew injury. Apply herbicide to cut stem as soon as possible after cutting, within one minute. Dirt on the cut could interact with the herbicide so remove it prior to application. Apply herbicide only to the outer edge of the stem where active growth and transport is occurring for stems larger than one inch in diameter. Works best in teams of two people; one cutting, one applying. Close communication is needed if there are many stems to treat.
Satellite population	A population removed from other populations of the same invasive plant. Typically they are remote and smaller in size as they are the result of recent colonization. These populations are generally a priority to treat to stop the spread of a given invasive plant.

Year One:

Giant Reed This species will require many follow-up treatments for effective eradication. Treatment should not begin until sufficient staff time is available for treatments and follow up. First treatments should focus on satellite populations to stop those smaller occurrences from establishing significant underground material which would allow them to resprout for years after initial treatment. Larger established populations should begin treatment in subsequent years or when labor is available. Treatment options that remove the above ground biomass of the plant such as cut stump can be highly effective but are only feasible on small occurrences. Foliar application of glyphosate mixed with imazapyr in mid-summer will be the best strategy for large plants. When conducting foliar applications on large plants, applicator should climb to the center of the plant and apply outward for their safety and to ensure good coverage of the center. Ensure precise GPS coordinates are taken at the approximate center of treated plants, since resprouts will occur there and are much harder to find than the larger untreated plants. Follow up treatments should occur every three months after the first treatment.

Pokeweed This species is known from one location on base, below the Dry Creek dam on the N side. It was not previously mapped. Plants can be controlled by pulling and removing any remaining roots or cut stumping with 50% glyphosate.

Tree of Heaven This species aggressively resprouts so any treatment needs to be strategically conducted once the invasive plant program has sufficient staff time for the required follow-up treatments. There are twenty mapped populations. First treatment should occur after leaf-out is completed in spring. Large trees should be cut stumped where possible or frilled and sprayed with 40-50% glyphosate. Smaller trees and resprouts should be basal barked with Pathfinder.

Bull Thistle An annual plant which can be treated with the pre-emergent and post-emergent herbicide Milestone as it is germinating after winter rains in December through February. The herbicide will have effective control for the entire growing season. The first year's treatments may be too late for effective control with the pre-emergent. In that case, plants can be mowed as done in 2017 by H. T. Harvey & Associates. Then pre-emergent treatment will start in December for the upcoming year.

Stinkwort An annual plant in the sunflower family which can be treated with the pre-emergent and post-emergent herbicide Milestone. Milestone is effective if applied during the spring. Later season treatment should consist of hand-pulling or foliar Garlon 4 application. Flowers and seed heads should be removed from the site since they can mature on dead plants and to remove the seed from the population. Because this species is currently at a low density on base but has high potential to spread, this species should be made the highest priority.

Edible fig There are 46 mapped populations of figs on Beale AFB. This species requires intensive effort for eradication due to some aspects of its biology. Figs root along their stem, so treatment needs to occur above each instance where a branch touches the ground. This can mean dozens of application sites for large individuals. Basal bark application of Pathfinder is the best method, but for large trees it may be unfeasible. If this is the case, a foliar application of 2% glyphosate may be required. This method may require a pump and high pressure application hoses in order to achieve sufficient spray range. Repeat treatments every three months between April and September should be undertaken to control any resprouts or new seedlings.

Black Locust This tree species is best controlled by cut-stumping. For larger trees which cannot be cut down, frill and spray is recommended. Basal barking is recommended for young trees and resprouts. Fifteen populations are mapped on base.

Kalamathweed Milestone should be used from the onset of seedling germination through the actively growing pre-flowering stage. This species should be treated wherever the cover exceeds the target of 10% cover. Eleven populations exceed 5% cover.

Milk Thistle This species can be treated by Milestone as a pre/post emergent. Populations over 10% cover should be sprayed in the winter. Remote satellite populations should also be treated to slow the spread. Populations should be checked in the early spring to ensure effective control occurred.

Vervain Hand pulling of plant prior to flowering is effective. Satellite populations of this species should be treated as eradication targets to prevent establishment in new areas. Treatments in 2017 by H. T. Harvey along Reed's creek should be continued.

Year Two:

Giant Reed Continue to move from satellite populations into the older, core populations. Since this species has considerable ability to persist underground, follow up on treated populations every third month until no living plant material has been seen for a full year.

Pokeweed Follow up with same treatments to ensure no seed production occurs on site.

Tree of Heaven Begin treatment of any trees which were not treated in the first year due to staff time limitations. Follow up on resprouts from any previously treated occurrences with basal bark application of Pathfinder.

Bull Thistle Apply pre-emergent herbicide during germination in the winter and spring. Check areas in late spring to ensure effective control.

Stinkwort Continue removal and monitoring of any plants. This species is currently at a low density on base but has high potential to spread and should be made the highest priority.

Edible fig Repeat treatments every third month between April and September should be undertaken to control any resprouts or new seedlings.

Black Locust Continue treatment on untreated plants, if any. Follow up with management of respouts with basal bark applications of Pathfinder.

Kalamathweed Milestone should be used from seedling germination through actively growing pre-flowering stage. This species should be treated wherever the cover exceeds the target of 10% cover.

Milk Thistle This species can be treated by Milestone as a pre/post emergent. Populations over 10% cover should be sprayed in the winter. Remote satellite populations should also be treated to slow their spread. Populations should be checked in the early spring to ensure effective control occurred.

Vervain Check areas of previous treatment for continued presence. Hand pull if found.

Years Three through Five:

Giant Reed Continue monitoring treated populations, and initiate treatment of any new populations. Since this species has considerable ability to persist underground, follow up on treated populations every third month until no living plant material has been seen for a full year.

Pokeweed Monitor areas from previous treatments to ensure no seed production occurs on site.

Tree of Heaven Follow up on resprouts from any previously treated occurrences with basal bark application of Pathfinder.

Bull Thistle Apply pre-emergent herbicide as it is germinating in the winter and spring. Check areas in late spring to ensure effective control.

Stinkwort Continue removal and monitoring of any plants. Because this species is currently at a low density on base but has high potential to spread, this species should be made the highest priority.

Edible fig Repeat treatments every third month between April and September should be undertaken to control any resprouts or new seedlings

Black Locust Initiate treatment on untreated plants, if any. Follow up with management of respouts on previously treated plants with basal bark applications of Pathfinder.

Kalamathweed Milestone should be used from seedling germination through actively growing pre-flowering stage. This species should be treated wherever the cover exceeds the target of 10% cover.

Milk Thistle This species can be treated by Milestone as a pre/post emergent.   Populations over 10% cover should be sprayed in the winter. Remote satellite populations should also be treated to slow spread. Populations should be checked in the early spring to ensure effective control occurred.

Vervain Check areas of previous treatment for continued presence. Hand pull if found.

Yearly Work Plans
Assumed Crew Size is 2 people

<table>
<tr><th>Year 1</th><th>Goal</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>giant reed (Arundo donax)</td><td>Eradication</td><td></td><td></td><td></td><td colspan="6">4 weeks of treatment, satellite populations</td><td></td><td></td><td></td></tr>
<tr><td>common pokeweed (Phytolacca americana)</td><td>Eradication</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">1/2 week</td><td></td><td></td><td></td><td></td></tr>
<tr><td>tree of heaven (Ailanthus altissima)</td><td>Eradication</td><td></td><td></td><td colspan="7">3 weeks of cut stump and basal bark</td><td></td><td></td><td></td></tr>
<tr><td>stinkwort (Dittrichia graveolens)</td><td>Eradication</td><td></td><td></td><td colspan="2">1 week pre-emergent</td><td></td><td></td><td colspan="2">1 week hand pulling</td><td></td><td></td><td></td><td></td></tr>
<tr><td>edible fig (Ficus carica)</td><td>Eradication</td><td></td><td></td><td></td><td colspan="6">10 weeks of treatment, foliar large plants and basal bark small plants</td><td></td><td></td><td></td></tr>
<tr><td>black locust (Robinia pseudoacacia)</td><td>Eradication</td><td></td><td></td><td></td><td colspan="5">2 weeks of treatment, cut stump and basal bark</td><td></td><td></td><td></td><td></td></tr>
<tr><td>bull thistle (Cirsium vulgare)</td><td>Eradication</td><td colspan="2">1 week pre-emergent</td><td colspan="2">1/2 week, check control</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">1 week pre-emergent</td></tr>
<tr><td>blessed milk thistle (Silybum marianum)</td><td>Containment</td><td colspan="2">1 week pre-emergent</td><td colspan="2">1/2 week, check control</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">1 week pre-emergent</td></tr>
<tr><td>Klamathweed (Hypericum perforatum)</td><td>Containment</td><td></td><td></td><td colspan="3">2 weeks Milestone treatment</td><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr>
<tr><td>vervain (Verbena litoralis and/or V. bonariensis)</td><td>Containment</td><td></td><td></td><td></td><td></td><td colspan="3">2 weeks hand pulling</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Assumed Crew Size is 2 people

Year 2	**Goal**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
giant reed (*Arundo donax*)	Eradication				4 weeks of treatment, larger populations and re-treat satellites								
common pokeweed (*Phytolacca americana*)	Eradication							1/2 week					
tree of heaven (*Ailanthus altissima*)	Eradication			1 week of treatment follow-up									
stinkwort (*Dittrichia graveolens*)	Eradication			1 week pre-emergent				1 week hand pulling					
edible fig (*Ficus carica*)	Eradication				10 weeks of treatment, foliar large plants and basal bark small plants								
black locust (*Robinia pseudoacacia*)	Eradication				2 weeks of treatment, cut stump and basal bark								
bull thistle (*Cirsium vulgare*)	Eradication	1 week pre-emergent		1/2 week check control								1 week pre-emergent	
blessed milk thistle (*Silybum marianum*)	Containment	1 week pre-emergent		1/2 week check control								1 week pre-emergent	
Klamathweed (*Hypericum perforatum*)	Containment			2 weeks Milestone treatment									
vervain (*Verbena litoralis* and/or *V. bonariensis*)	Containment					2 weeks hand pulling							

Assumed Crew Size is 2 people

<table>
<tr><th>Year 3</th><th>Goal</th><th>Jan</th><th>Feb</th><th>Mar</th><th>Apr</th><th>May</th><th>Jun</th><th>Jul</th><th>Aug</th><th>Sep</th><th>Oct</th><th>Nov</th><th>Dec</th></tr>
<tr><td>giant reed (Arundo donax)</td><td>Eradication</td><td></td><td></td><td></td><td colspan="3">2 weeks of treating resprouts</td><td></td><td></td><td>1 week</td><td></td><td></td><td></td></tr>
<tr><td>common pokeweed (Phytolacca americana)</td><td>Eradication</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">1/2 week</td><td></td><td></td><td></td><td></td></tr>
<tr><td>tree of heaven (Ailanthus altissima)</td><td>Eradication</td><td></td><td></td><td colspan="7">1 week of treatment follow-up</td><td></td><td></td><td></td></tr>
<tr><td>stinkwort (Dittrichia graveolens)</td><td>Eradication</td><td></td><td></td><td colspan="2">1 week pre-emergent</td><td></td><td></td><td colspan="2">1/2 week hand pulling</td><td></td><td></td><td></td><td></td></tr>
<tr><td>edible fig (Ficus carica)</td><td>Eradication</td><td></td><td></td><td></td><td colspan="6">10 weeks of treatment, foliar large plants and basal bark small plants</td><td></td><td></td><td></td></tr>
<tr><td>black locust (Robinia pseudoacacia)</td><td>Eradication</td><td></td><td></td><td></td><td colspan="5">2 weeks of treatment, cut stump and basal bark</td><td></td><td></td><td></td><td></td></tr>
<tr><td>bull thistle (Cirsium vulgare)</td><td>Eradication</td><td colspan="2">1 week pre-emergent</td><td colspan="2">1/2 week, check control</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">1 week pre-emergent</td></tr>
<tr><td>blessed milk thistle (Silybum marianum)</td><td>Containment</td><td colspan="2">1 week pre-emergent</td><td colspan="2">1/2 week check control</td><td></td><td></td><td></td><td></td><td></td><td></td><td colspan="2">1 week pre-emergent</td></tr>
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<tr><td>vervain (Verbena litoralis and/or V. bonariensis)</td><td>Containment</td><td></td><td></td><td></td><td></td><td colspan="3">2 weeks hand pulling</td><td></td><td></td><td></td><td></td><td></td></tr>
</table>

Assumed Crew Size is 2 people

Year 4	**Goal**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
giant reed (*Arundo donax*)	Eradication				1 week			1 week			1 week		
common pokeweed (*Phytolacca americana*)	Eradication							1/2 week if needed					
tree of heaven (*Ailanthus altissima*)	Eradication			1 week of treatment follow-up, each population, if needed									
stinkwort (*Dittrichia graveolens*)	Eradication			1 week pre-emergent				1/2 week hand pulling					
edible fig (*Ficus carica*)	Eradication				5 weeks of follow up treatments								
black locust (*Robinia pseudoacacia*)	Eradication				1 week of treatment								
bull thistle (*Cirsium vulgare*)	Eradication			1/2 week, check control								1 week pre-emergent	
blessed milk thistle (*Silybum marianum*)	Containment	1 week pre-emergent		1/2 week check control								1 week pre-emergent	
Klamathweed (*Hypericum perforatum*)	Containment			2 weeks Milestone treatment									
vervain (*Verbena litoralis* and/or *V. bonariensis*)	Containment					1 week hand pulling							

Assumed Crew Size is 2 people

Year 5	**Goal**	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
giant reed (*Arundo donax*)	Eradication				1 week			1 week			1 week		
common pokeweed (*Phytolacca americana*)	Eradication							1/2 week if needed					
tree of heaven (*Ailanthus altissima*)	Eradication			1 week of treatment follow-up, each population, if needed									
stinkwort (*Dittrichia graveolens*)	Eradication			1 week pre-emergent				1/2 week hand pulling					
edible fig (*Ficus carica*)	Eradication				1 week			1 week			1 week		
black locust (*Robinia pseudoacacia*)	Eradication				1 week of treatment, if needed								
bull thistle (*Cirsium vulgare*)	Eradication			1/2 week, check control								1 week pre-emergent	
blessed milk thistle (*Silybum marianum*)	Containment	1 week pre-emergent		1/2 week check control								1 week pre-emergent	
Klamathweed (*Hypericum perforatum*)	Containment			2 weeks Milestone treatment									
vervain (*Verbena litoralis* and/or *V. bonariensis*)	Containment					1 week hand pulling, if needed							

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Personal communications

Lauren Wilson, Regional Biologist, Travis Installation Support Team, November 2017.

Tamara Gallentine, Natural and Cultural Resources Program Manager, Beale Air Force Base, November 2017.

Appendix I: Bird Air Strike Hazard Area Invasive Plant Work Plan for Beale Air Force Base, California

Appendix I contains the Bird Air Strike Hazard Area Invasive Plant Work Plan for Beale Air Force Base, California.

Bird Air Strike Hazard Area Invasive Plant Work Plan for Beale Air Force Base, California

Prepared for the US Air Force by
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November 2017

Purpose

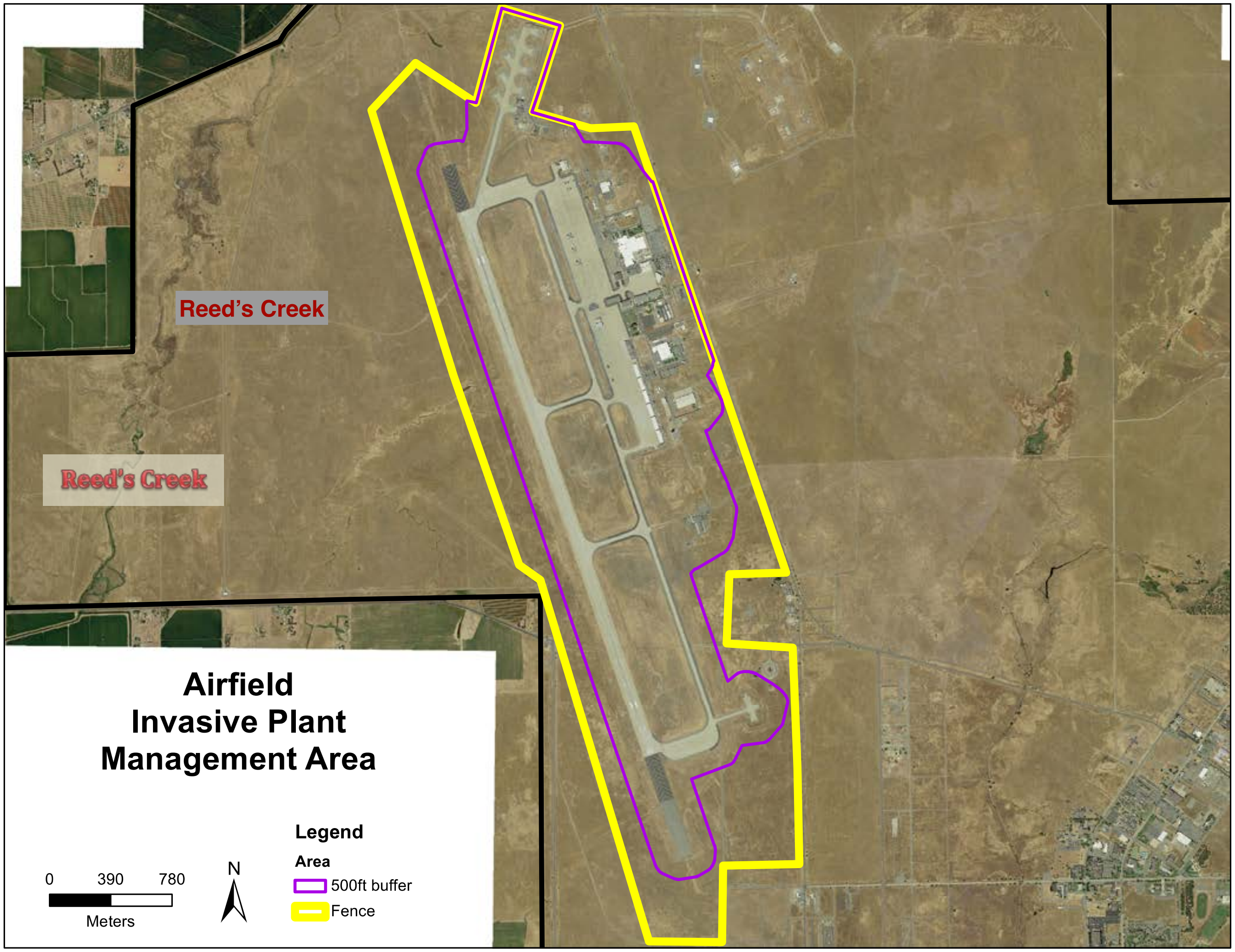
The purpose of the *Bird Air Strike Hazard Area Invasive Plant Work Plan* (hereinafter, *BASH Work Plan*) is to describe the operational tasks and timeline necessary to control the invasive weeds occurring near the airfield on Beale Air Force Base (AFB). This *BASH Work Plan* is developed from the Beale *Updated Invasive Plant Species Management Guidelines* (hereinafter, *Guidelines*; Hopkinson et al. 2017) and is an Appendix to the *Guidelines*. Detailed species accounts and control options are available in the *Guidelines*. That information is only briefly summarized here.

Goal

Manage invasive plants near the airfield to reduce bird habitat. Reduced bird populations will reduce potential bird air strike hazards.

Area

Treatment area includes the airfield core, a 500m buffer around the airfield, and the nearby riparian corridor of Reed's creek.



Target Species

To reduce Bird Air Strike Hazards, the Air Force recommends the entire airfield area to consist of a thick cover of turf grasses. These grasses are mowed to between seven and fourteen inches, as this height discourages bird species which like open soil patches as well as bird species which prefer taller grass cover (Air Force Instruction 91-202, 7.11.2.3). The general goal is to reduce botanical diversity to reduce insect density, thereby reducing bird density (Washburn 2013).

Currently on Beale Air Force Base, the airfield area is invaded by many populations of yellow star thistle. The seed of this species can serve as a food source for seed-eating birds, increasing BASH risk. Other invasives of concern which occur within or near the airfield's 500m buffer zone are listed below. These species are known to have large seeds and serve as food for various small birds that pose a BASH hazard (Beal 1907). Himalayan blackberry and bull thistle do not occur within the buffer zone but do occur in the nearby Reed's creek. Tricolored black birds have been seen using the blackberry bushes at Reed's creek then flying over the airfield, so treating blackberry in that location will reduce the bird traffic. Additionally, reducing spread of these species into the airfield area will benefit future BASH control efforts.

From (*Guidelines* Table 6.1, section 3.1.3-4)

Invasion Curve Position	Common Name	Scientific Name	Cal-IPC Rating
Long-term management: Section 3.1.3 (Containment stage)	bull thistle	*Cirsium vulgare*	Moderate
	Klamathweed	*Hypericum perforatum*	Moderate
	blessed milk thistle	*Silybum marianum*	Limited
Long-term management: Section 3.1.4 (Asset-based protection stage)	yellow starthistle	*Centaurea solstitialis*	High
	Himalayan blackberry	*Rubus armeniacus*	High

Treatment Plan

Treatment of the three thistle species (yellow starthistle, bull thistle, and blessed milk thistle) should be conducted every year after the first rains of the year as young plants are germinating (DiTomaso 2013). These species can all be treated with the highly specific herbicide Milestone, which has excellent control of both young plants as well as pre-emergent control. Weed killing soil activity remains for the entire growing season. Milestone is effective for control of thistles and other members of the sunflower (Asteraceae) family. It also can affect members of the pea family (Fabaceae) and a few other families of dicot plants. Native grasses are not affected but non-native medusahead can be suppressed at high rates of pre-emergent application (Agrosciences 2005). Due to the large area needing treatment of yellow star thistle, a boom sprayer application should be utilized to speed up herbicide application.

The few Kalamathweed populations near the airfield should also be treated with Milestone. This simplifies implementation since equipment does not need to be rinsed between applications. Kalamathweed treatment should occur in late spring/early summer when plants are actively growing but not yet flowering. Kalamathweed could be eradicated from the airfield area after a few years if complete treatment is implemented each year.

Mowing of plant material in the 500ft buffer of the airfield is standard practice and should continue. Herbicide treatments will reduce needed mowing but cannot replace it.

Reed's creek is to the west of the airfield. Treatments occurred there in 2017 to reduce blackberry cover and should be continued to reduce or eliminate fruit production. Fifteen acres were treated by H. T. Harvey. Treatment consisted of mowing, herbicide, and burning. Foliar treatment of resprouts with 2% glyphosate should continue in these areas as well as areas mowed in 2017. Future treatments should continue to ensure low/no fruit set.

Other invasive plant populations at Reed's creek include blessed milk thistle and bull thistle. These highly invasive thistles can serve as food for small birds and can spread into the airfield area from Reed's creek. These thistles should be treated along with the thistle populations in the airfield buffer every spring.

A annual treatment schedule is included below. The assumed crew size is two people. Treatment may take additional time due to accessibility coordination on the active runway. Presumably the invasive treatments can be conducted in concert with the maintenance mowing.

Fire

If feasible, treatment of yellow starthistle by prescribed fire will speed up its removal from the landscape. Burns should be followed with further herbicide treatments and native grass seeding.

Native grass seeding

In areas where vegetative ground cover is sparse, either naturally or due to weed treatments, grass seed should be applied in the early winter. A native grass species such as beardless wild rye (*Elymus triticoides*, formerly *Leymus*) would be a good choice if seed is available. This species in particular will form dense turf like grassland which should discourage bird visitation.

This document does not constitute a formal recommendation. Always read herbicide labels prior to use.

Treatment Terminology	Description of Method
Foliar	Apply herbicide to the leaves of a plant. Works best when plant is small enough that the applicator can apply some herbicide droplets on most of the leaves of the plant. The healthier the plant the better it will conduct herbicide into its roots. Plants should be sprayed until wet but before herbicide drips from the leaves.
Pre-emergent	Apply herbicide to ground in area with young cotyledons (first leaves) of target species. Good coverage of the whole area, not just plants is necessary. Surveys for extent in the prior year may be needed to ascertain the treatment boundary.

Year 1	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
yellow starthistle (*Centaurea solstitialis*)	3 weeks pre-emergent										1 week pre-emergent	
bull thistle (*Cirsium vulgare*)	1 week pre-emergent		1/2 week, check control								1 week pre-emergent	
Klamathweed (*Hypericum perforatum*)			1 week Milestone treatment									
Himalayan blackberry (*Rubus armeniacus*)							2 weeks foliar					
blessed milk thistle (*Silybum marianum*)	2 weeks pre-emergent										1 week pre-emergent	
Year 2	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
yellow starthistle (*Centaurea solstitialis*)	3 weeks pre-emergent										1 week pre-emergent	
bull thistle (*Cirsium vulgare*)	1 week pre-emergent		1/2 week, check control								1 week pre-emergent	
Klamathweed (*Hypericum perforatum*)			1 week Milestone treatment									
Himalayan blackberry (*Rubus armeniacus*)							2 weeks foliar					
blessed milk thistle (*Silybum marianum*)	2 weeks pre-emergent										1 week pre-emergent	

Year 3	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
yellow starthistle (*Centaurea solstitialis*)	3 weeks pre-emergent										1 week pre-emergent	
bull thistle (*Cirsium vulgare*)	1/2 week pre-emergent		1/2 week, check control								1/2 week pre-emergent	
Klamathweed (*Hypericum perforatum*)			1 week Milestone treatment									
Himalayan blackberry (*Rubus armeniacus*)							1 week foliar					
blessed milk thistle (*Silybum marianum*)	2 weeks pre-emergent										1 week pre-emergent	
Year 4 & Year 5	**Jan**	**Feb**	**Mar**	**Apr**	**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Nov**	**Dec**
yellow starthistle (*Centaurea solstitialis*)	2 weeks pre-emergent										1/2 week pre-emergent	
bull thistle (*Cirsium vulgare*)	1/2 week pre-emergent		1/2 week, check control								1/2 week pre-emergent	
Klamathweed (*Hypericum perforatum*)			1/2 week Milestone treatment									
Himalayan blackberry (*Rubus armeniacus*)							1 week foliar					
blessed milk thistle (*Silybum marianum*)	2 weeks pre-emergent										1/2 week pre-emergent	

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Personal communications

Lauren Wilson, Regional Biologist, Travis Installation Support Team, November 2017.

Tamara Gallentine, Natural and Cultural Resources Program Manager, Beale Air Force Base, November 2017.

Appendix J: Early Detection/Rapid Response Work Plan for Invasive Plant Species at Beale Air Force Base, CA

Appendix J contains the Early Detection/Rapid Response Work Plan for Invasive Plant Species at Beale Air Force Base, CA.

Early Detection/Rapid Response Work Plan for Invasive Plant Species at Beale Air Force Base, CA

14 Nov 2017

1 Introduction

Preventing the introduction of potentially invasive plant species on Beale Air Force Base (AFB) is the first line of defense against invasion. However, even with prevention programs in place, invasive species may still be introduced to Base lands via a number of pathways. An early detection and rapid response program (EDRR) can help minimize the impact of these species on the natural resources at Beale AFB by increasing the chances that new invaders are detected and treated before they become established over larger areas and are therefore more difficult and expensive to treat.

According to the National Invasive Species Council (2003), a successful EDRR program includes the following: "(1) potential threats are being identified in time to allow risk-mitigation measures to be taken; (2) new invasive species are being detected in time to allow efficient and environmentally sound decisions to be made; (3) responses to invasions are effective and environmentally sound and prevent the spread and permanent establishment of invasive species; (4) adequate and timely information is being provided to decision-makers, the public, and to trading partners concerned about the status of invasive species within an area; and (5) lessons learned from past efforts are being used to guide current and future efforts."

This Work Plan is designed to provide an EDRR framework to be applied at Beale AFB to assist land managers, contractors and base personnel in detection, rapid assessment and rapid response to new invasive plant species. The Plan includes a decision-making framework and guidance on action steps that should be implemented to successfully carry out EDRR to newly invading plant species.

2 EDRR Framework

An effective EDRR program requires a set of sustained and coordinated actions that ultimately lead to the eradication of a set of target invasive species. Figure 1 outlines a framework to guide decision-making and ensure timely communication and action at Beale AFB when potential new invasive species are detected.

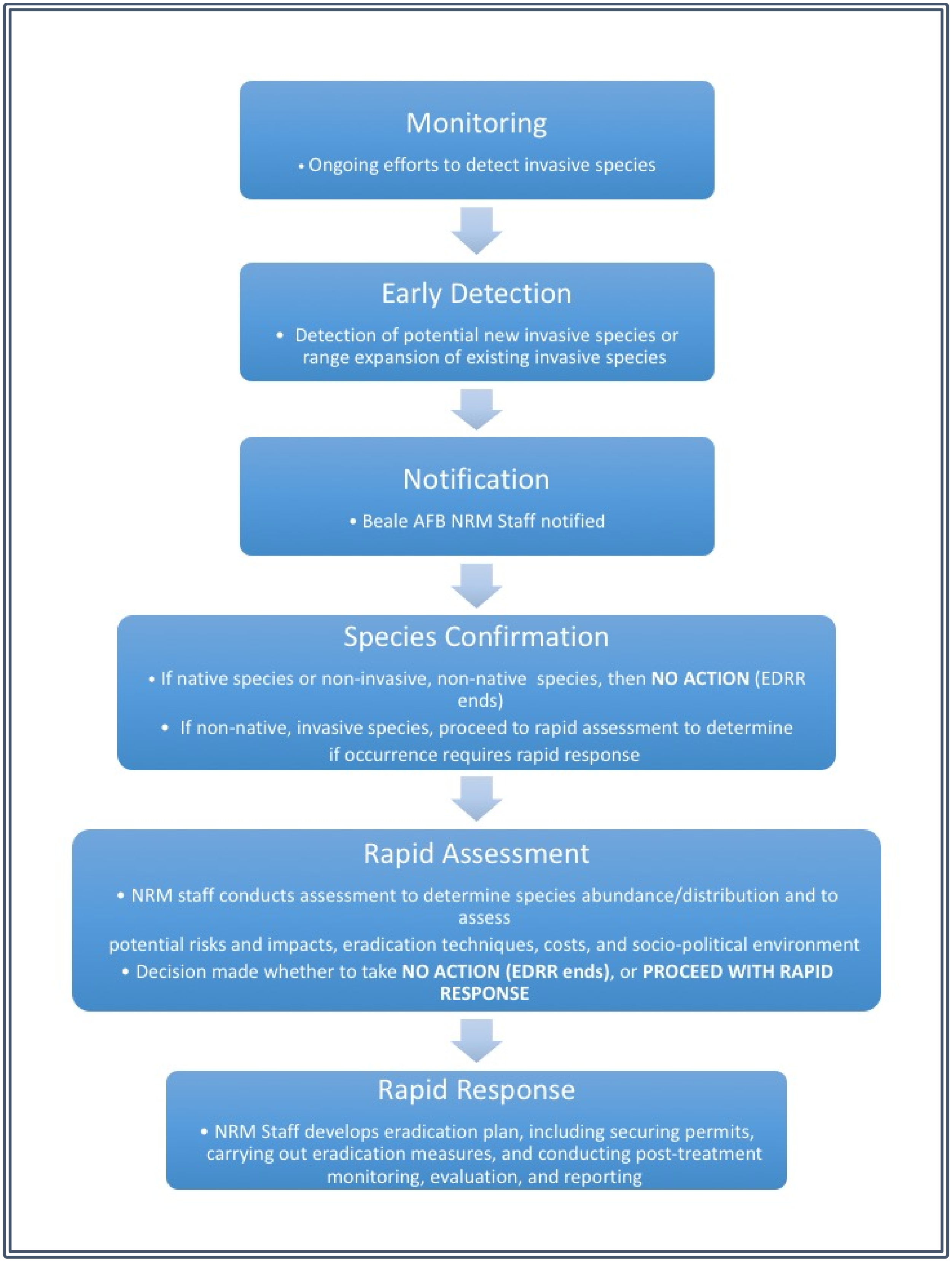

Figure 1. EDRR Decision-making Process. Adapted from USDOI 2016.

2.1 Monitoring

The 2017 Beale AFB Invasive Plant Species Management Guidelines (IPSMG; CEMML 2017) identifies eight species with potential to arrive on Beale AFB. Additionally, three species have been identified as occurring as small infestations on Beale AFB that may have potential to spread to additional areas (Table 1). These are the current priority species for the Beale AFB EDRR Program, however this list should be updated at least annually or as new invasive species are identified by Cal-IPC, USDA and other entities. This list should be provided to any personnel conducting plant or natural resource monitoring on Beale AFB to increase the probability of opportunistic detections of either target or non-target species. Other parties that may encounter these species and should be aware of the list include the grazing lessee, grounds maintenance personnel, and volunteers participating in restoration or other naturalist activities.

To assist with the identification of target early-detection species, identification cards or information sheets should be provided to the above listed groups. An initial set of identification cards were produced by Cal-IPC (Cal-IPC 2015), but additional cards should be obtained as needed. In addition to opportunistic sampling, focused invasive species surveys should occur on a regular basis as outlined in the Beale AFB IPSMG (CEMML 2017).

2.2 Early Detection, Notification and Confirmation

In order to detect new invasive species or document additional infestations of existing invasive species, the following early detection surveys should be conducted:

- The 9 CES/CEIEC Range Technicians should spot check 5 cattle pastures per year for EDRR target plants (Table 1, as updated annually), focusing on areas with heavy disturbance such as around water troughs, corrals, gates, and supplemental feeding stations.
- The annual MGT, INVASIVE SPECIES, MULTIPLE environmental quality project should include a three-day spot-check survey of locations on the base, to be rotated based on the following priorities:
    - Roads, roadsides, firebreaks, areas with recent ground disturbance – annually
    - High priority conservation areas – every 3 years
- Post-burn assessments conducted on wildfires under the POST FIRE REHAB environmental quality project shall include surveys for EDRR target plants (Table 1, as updated annually).
- All monitoring and surveys conducted under WETLANDS environmental quality programming shall include surveys for EDRR target plants (Table 1, as updated annually).

Table 1. Focal EDRR species for Beale AFB. Species in bold text are either known or are suspected to occur on Base.

Cal-IPC rating	Common and scientific names	Habitat infested	Detection Window	Areas to survey
High	spotted knapweed (*Centaurea stoebe* ssp. *micranthos*)	uplands	Perennial herb; blooms Jun-Oct	Firebreaks; roadsides; areas with recent ground disturbance
	Canada thistle (*Cirsium arvense*)	uplands, riparian	Perennial herb; blooms Jun-Sep	Firebreaks; roadsides; areas with recent ground disturbance
	artichoke thistle (*Cynara cardunculus*)	uplands	Perennial herb; blooms Apr-Jul	Firebreaks; roadsides; areas with recent ground disturbance
	perennial pepperweed (*Lepidium latifolium*)	vernal pools, wetlands, riparian	Perennial herb; blooms May-Jul	Wetlands; riparian areas; vernal pools; springs; ditches
	waterprimrose (*Ludwigia hexapetala* and/or *L. peploides* ssp. *montevidensis*)	ponds, slow-flowing water	Perennial herb; blooms Jun-Oct	Perennial wetlands/ponds; riparian areas
	purple loosestrife (*Lythrum salicaria*)	wetlands	Perennial herb; blooms Jun-Sep	Wetlands; ponds; riparian areas; springs; ditches
	Parrotfeather (*Myriophyllum* spp.)	Wetlands, riparian	Perennial herb; blooms Jul-Aug	Perennial ponds; riparian areas; springs
	smallflower tamarisk (*Tamarix parviflora*)	riparian, roadsides	Perennial tree/shrub; blooms Apr-May	Wetlands; riparian areas; springs; ditches; ponds; golf course
Moderate	**waxy mannagrass** (*Glyceria declinata*)	vernal pools, wetlands	Perennial grass; blooms May-Jun; floating leaves in wetlands are diagnostic	Wetlands; riparian areas; ponds; vernal pools; springs; ditches
	pennyroyal (*Mentha pulegium*)	vernal pools, wetlands	Perennial herb; blooms Jun-Sep	Wetlands; riparian areas; ponds; vernal pools; springs; ditches
No listing	**Indian toothcup (*Rotala indica*)**	wetlands, vernal pools	Annual herb; blooms Jun-Sep	Vernal pools; ditches; seasonal wetlands

After a new species or infestation is detected, a number of actions should occur including documentation of the infestation (see form in Appendix A), reporting of the infestation, confirmation of the identity and vouchering of the specimen. At this stage, additional data should be collected in order to perform an analysis of possible vectors and pathways that facilitated the species introduction.

The form in Appendix A provides a template for documenting a new invasive species occurrence or new infestation of an existing invasive species. The form should be made available to any groups working in areas where they may encounter invasive species. For contractors, this form, a list of target species (Table 1), and specific language shall be included in contracts as effective means of disseminating the information and increasing participation in the EDRR process. The original observer will also load information about the infestation into the CalFlora Observer smartphone application (v 1.3.1; Feb 2016) to share information with the statewide wild plant occurrence database.

As outlined in Figure 1, the Base Natural Resource Manager (or designated NRM staff) would be the focal point of contact for reporting new invasive species or new infestations of existing species. The NRM would receive the completed Early Detection Plant Species Reporting (EDPSR) form. The NRM staff would be responsible for reporting the invasive species sighting to the necessary local, state or Federal entities (e.g. USDA, Cal-IPC, USFWS, CDFW). Additionally, the NRM staff will ensure that all geospatial data is entered into the Beale AFB weed geodatabase.

The Beale AFB NRM should designate taxonomic experts (e.g. Chico State Herbarium, UC Davis Herbarium, or other local experts) to confirm the species' identity if it is uncertain before any further actions are taken. Once the identification has been confirmed, the reported sighting can be documented as either a negative or positive potential invasive species and acted upon accordingly. In some cases, a positive identification may not be possible due to the species being found at a time of year when parts necessary for a positive identification are not available. In these cases, the species should be treated as if it is a new invasive species and flagged for follow up identification. If possible, field markings should be made along with collection of accurate GPS points.

If the species is confirmed to be native then no further action is necessary because it is no longer considered an early detection of a new invasive non-native species. The EDRR process ends. If the species is confirmed to be a new occurrence of a non-native species or range extension of an existing target non-native species on Base, then the EDRR process continues on to the next step of rapid assessment.

2.3 Rapid Assessment

The rapid assessment step in the EDRR process determines the appropriate response to the new detection. This assessment will use the data collected in the field to determine the level of risk of spread as well as the risk to the ecosystem posed by the new invader. This risk analysis can include factors such as information on the potential impacts of the species; control methods; and eradication potential and feasibility. It is important to prepare preliminary risk assessments for high priority species in advance of their detection to facilitate rapid responses to invasions.

NRM staff should designate a person or team responsible for conducting the rapid assessment along with the factors to be included in the analysis well in advance of carrying out the EDRR process. This level of preparedness will ensure that a streamlined assessment leads to a rapid response. It will be important in this analysis to determine when eradication is feasible given economic, programmatic and sociopolitical constraints.

The conclusions of the rapid assessment need to be clearly communicated to the decision-making entity so resource allocation and any additional approvals can be obtained to allow for the rapid response phase. If the analysis concludes that no action is required or that eradication is infeasible, then the EDRR process ends. The process may transition to long-term monitoring or management at this point.

2.4 Rapid Response and Monitoring

Once the decision has been made to move forward with a rapid response, a number of steps must be taken to ensure that the species does not become established beyond the initial area of the sighting. Containment of the infestation may be warranted, especially if the species is in the flowering or stage or is producing fruit. This may include the installation of barriers, quarantines and access restrictions to the site. Any vectors or pathways to introduction identified during the rapid assessment phase should be carefully monitored and/or controlled during this phase to ensure further spread does not occur.

Treatment options identified during the rapid assessment phase should be implemented as quickly as possible once all permitting and environmental planning requirements are met. The Base should consider developing a programmatic process for the permitting and planning of this rapid response step in order to increase the ability to treat infestations quickly. If feasible, any actions that will initiate restoration of the site following treatment should be included as part of the treatment plan to help increase likelihood of successful eradication.

Follow-up monitoring is critical to ensure that the eradication efforts were successful. This monitoring should occur within a month following the eradication efforts to ensure successful elimination of the invader. The location of the invasion should be monitored the year following the treatment during the appropriate season and at regular intervals into the future as warranted. Additionally, if the assessment identified potential vectors and pathways of introduction for the target species, other areas on Base where these are suspected to be present should also be monitored for the target species.

3 Program Management and Reporting

3.1 Programmatic Activities

Table 2 lists the program-level activities required each year to manage an effective EDRR program at Beale AFB. Table 3 provides a timeline and sequence of activities that are required when a new species is reported using the EDRR process.

3.2 Reporting

An annual report summarizing all EDRR surveys, findings, EDPSR forms, rapid response actions, results, successes, and needed follow-up monitoring should be completed. All EDRR surveys and actions shall be tracked in a geospatial database that is maintained regularly, following the US Air Force SDSFIE 3.1x data model standards (Appendix B). Primary data layer specifications (DLS) are expected to be the "NoxiousOrInvasiveSpecies" for detected species and "NatResSurvey" for the survey area. Revisions to the EDRR process should occur on an annual basis. Documentation of these changes should be incorporated into future versions of Beale AFB IPSMG.

Table 2. Activities required to manage the EDRR Program.

Task	POC	Timeline
Review EDRR Table 1 to determine if any new species should be added	NRM	Annually; January
Send updated or existing list along with weed identification cards to: Cattle Lessees, Equestrian Club, Grounds Maintenance COR (for distribution to contract staff), contractors conducting field surveys	NRM; CONS	Annually; January or as needed
Include EDRR tasks in WETLANDS and POST FIRE REHAB SOW	NRM	Annually
Update GIS database with new weed occurrences, survey and monitoring areas	NRM; AFCEC; contractor	Annually

Table 3. EDRR process and timeline

Task	POC	Timeline
Review incoming Species Identification Forms and confirm ID	NRM	Within 48 hours of receipt
Conduct additional EDRR surveys as needed	NRM; contractor; botanical expert	Within 1 week of detection
Determine extent of infestation and identify potential vectors of introduction	NRM; contractor; botanical expert	Within 1 week of detection
Identify response action and monitoring protocol	NRM; contractor; botanical expert	Within 1 month of detection
Complete needed permits (in advance if possible)	NRM	Prior to
Conduct rapid response action	Contractor	Timing based on species
Conduct monitoring	NRM; contractor; botanical expert	Following growing season
Reporting	NRM; contractor; botanical expert	Annually following treatment

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Appendix A

Species Detection Form

Early Detection Plant Species Reporting Form (EDPSR)

Directions:

1) Fill out this form
2) Flag location with pink flagging and label flagging with EDRR and name of observer
3) Take a photo and make sure any diagnostic characteristics are visible in the photo. Ensure that geospatial information is taken with the photo if taking the photo with a smart phone (iPhone: Go to Settings, Privacy, then Location Services and make sure "Camera" says "while using") *Apps are available for smart phones that allow collection of GPS information. For example: iGIS v 8.3.10 (Oct 2017); Commander Compass Lite 3.9.5 (Nov 2017) (www.paully.com; www.happymagenta.com/compass)
4) Deliver completed form to: Natural Resources Program Manager, 9 CES/CEIER, 6425 B St., Beale AFB, CA 95903, 530-634-2738, tamara.gallentine.2@us.af.mil

General Information	
Observer's Name:	
Email:	
Phone:	
Date and time of observation:	
Species Information	
Location description (e.g. pasture name, road name):	
Species name (indicate if sample collected):	
Certainty of identity (circle one)	Extremely confident Moderately confident Not very confident
Extent of population (e.g. single plant, small patch—be as specific as possible)	
GPS coordinates (circle one)	UTM or DD
Y (Northing)	
X (Easting)	
UTM Zone	
Datum	

Appendix B

Geospatial Data Specifications

1.0 All tasks shall have at least one and likely several GIS deliverables that include all data layers used to create any and all maps within submitted deliverables. GIS deliverables shall include all new data collected throughout the course of the project. Draft GIS deliverables shall be submitted with draft reports that include their data, with final reports and GIS info submitted together.

2.0 GIS deliverables must follow Air Force geospatial data standards, an adaptation of the SDSFIE 3.1x data model, as described in the data layer specifications (DLS, Reference #3). Deliverables must comply with the latest version which may be updated annually. All metadata associated with data layers must meet the Federal Geographic Data Committee (FGDC) Content Standard for Digital Geospatial Metadata (CSDGM) revised in June 1998. Metadata must also include all content stated in the metadata section of each layer's DLS, which includes layer specific verbiage for attribute fields and definitions. Mandatory sections in the standard have some elements that are always required for all types of geospatial data sets (see References #1 and #2 on metadata).

3.0 All submitted data must use at least one of the pre-defined 50 Natural Resource DLS listed below and most likely at least two. NFE shall review the complete list before field work begins to identify which layers are needed and identify them in the Annual Work Plan. Note that the collection of "negative" data is as important as "positive" data. Survey areas are a key part of the data set even if target species are not detected. [A =area, L = line, P = point].

- **3.1.1** AgriculturalTract_A
- **3.1.2** CoastalZoneMgtArea_A
- **3.1.3** DispersedRecArea_A
- **3.1.4** EssentialFishHabitat_A
- **3.1.5** FaunaIncidentPoint_P
- **3.1.6** FireArea_A
- **3.1.7** FireBreakLine_L
- **3.1.8** FloodPlainArea_A
- **3.1.9** ForestCompartment_A
- **3.1.10** ForestMgtArea_A
- **3.1.11** ForestProductHarvest_A
- **3.1.12** ForestStand_A
- **3.1.13** FuelBreakLine_L
- **3.1.14** FuelMgtArea_A
- **3.1.15** HabitatProtectiveZone_A
- **3.1.16** HazSuppressionArea_A
- **3.1.17** HistoricRiverAlignment_L
- **3.1.18** LandCover_A
- **3.1.19** NatResRecFeature_P
- **3.1.20** NatResRestReclProj_A
- **3.1.21** NatResRestReclProj_P
- **3.1.22** NatResSurvey_A
- **3.1.23** NatResSurvey_L
- **3.1.24** NatResSurvey_P
- **3.1.25** NoxiousOrInvasiveSpecies_A
- **3.1.26** NoxiousOrInvasiveSpecies_L
- **3.1.27** NoxiousOrInvasiveSpecies_P
- **3.1.28** PrescribedBurnUnit_A
- **3.1.29** RecNatureTrail_L

3.1.30 SoilSurveyArea_A
3.1.31 SpecialMgtArea_A
3.1.32 SpecialStatusSpecies_A
3.1.33 SpecialStatusSpecies_L
3.1.34 SpecialStatusSpecies_P
3.1.35 SpeciesArea_A
3.1.36 SpeciesPoint_P
3.1.37 SpeciesSpecificHabitat_A
3.1.38 SpeciesSpecificHabitat_L
3.1.39 SpeciesSpecificHabitat_P
3.1.40 SurfaceRiparianArea_A
3.1.41 Vegetation_A
3.1.42 WaterBody_A
3.1.43 WatercourseLine_L
3.1.44 WaterFeature_A
3.1.45 Watershed_A
3.1.46 Wetland_A
3.1.47 Wetland_L
3.1.48 Wetland_P
3.1.49 WildlandUrbanInterfaceArea_A
3.1.50 WildlifeMgtArea_A

4.0 An empty, SDSFIE 3.1x compliant ArcView geodatabase (Reference #5) is available for use as is an excel data dictionary. Absolutely no changes may be made to the structure of the geodatabase. All formatting and attributes must align with the current template in order to be accepted by the AF and transferred to the official geodatabase. NFE shall discuss any concerns with the Base Geodatabase Manager and Travis ISS before work begins to find work-arounds where fields aren't available to collect needed data.

5.0 NFE shall submit a geodatabase that includes only new data rows or existing data rows that have been changed so that they may easily be added to the official geodatabase.

6.0 NFE shall populate all fields within the tables include the date the feature was originally acquired, created or generated and the full name of the person who created the feature. All data should comply with the DLS which often includes tables of available choices for each field. An excel data dictionary is also available (Reference #4).

7.0 NFE shall identify and track any issues they encounter using the DLS and submit them with the final deliverables so that the AFCEC Travis ISS may work to update the DLS standards during the next revision cycle. This shall include formatting restrictions that limited usefulness of existing fields (cover) or missing fields.

8.0 NFE shall ensure that any interrelated data layers are updated for any newly created data. For instance, if new wetlands are identified (Wetland_A) and suitability for listed branchiopods is determined during the survey, the corresponding data needs to be updated in the species layer as well (SpecialStatusSpecies_A). Even if suitability is not determined, the new wetland needs to be added to the species layer and noted as unknown suitability.

8.1 The feature classes shall be projected into the appropriate UTM Zone and WGS 84 datum.

References:

1. CSU. Jan 2016. Procedures for Creating Metadata. Air Force Environmental Geospatial Support Program.
2. AFCEC Geospatial Integration Office. Mar 2015. Feature Level Metadata Standard Operating Procedure.

3. USAF Environmental GIS Program. Jun 2017. Data Layer Specifications, All 69 Environmental Layers.
4. USAF. Aug 2015. 3.1.0.1 AF Adaptation Data Dictionary.
5. USAF. Environmental GIS Geodatabase Template 3.1 v0.2.gdb

APPENDIX C

Beale Air Force Base Grazing Management Guidelines

Grazing Management Guidelines

Beale Air Force Base, California

Prepared for the US Air Force by
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Center for Environmental Management of Military Lands
Colorado State University
Fort Collins, Colorado

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December 2016
(final revision September 2017)

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Acronyms and abbreviations used in these *Guidelines*

AFB: Air Force Base

AFCEC/CZTQ: United States Air Force Civil Engineer Center, Environmental Quality Technical Support Branch

AUE: animal unit equivalent

AUM: animal unit month

BASH: Bird/Wildlife Aircraft Strike Hazard

Cal-IPC: California Invasive Plant Council

CEMML: Center for Environmental Management of Military Lands, Colorado State University

CIMIS: California Irrigation Management Information System, California Department of Water Resources

CNLM: Center for Natural Lands Management, Temecula, CA

CRM: Base Cultural Resources Manager

DAF: United States Department of the Air Force

EA: environmental assessment

EIAP: environmental impact analysis process

ESA: United States Endangered Species Act

FY: fiscal year

GIS: geographical information system

GPS: global positioning system

INRMP: Integrated Natural Resources Management Plan

lb / lbs: pound(s) (weight)

NISC: National Invasive Species Council

NRCS: USDA Natural Resources Conservation Service pers. comm.: personal communication

pers. obs.: personal observation

RDM: residual dry matter

RMAT: Range Management Assistance Team

UC ANR: University of California Agriculture and Natural Resources

URL: uniform resource locator

USC: United States Code

USDA: United States Department of Agriculture

USDI: United States Department of the Interior

USFWS: United States Fish and Wildlife Service

YST: yellow starthistle

Acknowledgements
Many thanks to:
Professor James Bartolome for advice;
Paul Block and Travis Fry for NRCS soils data and maps;
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Felix Ratcliff for assistance with wildlife species information;
US Air Force personnel, Lauren Wilson, Chuck Carroll, Kirsten Christopherson, Gwen Vergara, Ann Bedlion, and Edward Broskey, Jr. for all their assistance in preparing these *Guidelines*.

Cover photo: Cattle grazing in a Beale AFB Management Area D pasture unit, a successful purple needlegrass restoration site, November 21, 2016.

Note: Unless stated otherwise, all maps were created with data from Beale's geodatabase.

1.0 Purpose

Beale Air Force Base (AFB) is located in Yuba County, California, 13 miles east of the city of Marysville. In common with many military installations, Beale AFB requires a substantial land base as part of its defense mission and for security and safety purposes. Over 85% of Beale's land base is undeveloped, and most of this is annual grassland. In compliance with relevant laws and regulations, Beale AFB manages the natural resources in the undeveloped area to meet conservation and other management goals (Beale AFB 2015). As part of this natural resources management, Beale operates a livestock grazing outgrant program on 60% of the unimproved land. Livestock grazing is a way to maintain sound stewardship of public lands and can help Beale AFB achieve its military mission and natural resources management goals (Beale AFB 2015, A8-42).

Air Force Instruction (AFI) 32-7064, *Integrated Natural Resources Management*, states that any Air Force installation containing significant natural resources must prepare an Integrated Natural Resources Management Plan (INRMP) as the principal tool for managing those natural resources, following Department of Defense and Air Force ecosystem management principles and guidelines. An installation's INRMP "defines natural resources management goals and objectives that are consistent with the military mission" (DAF 2016, Section 3). AFI 32-7064 permits agricultural outgrants "where feasible and compatible with the INRMP" and further states that the "overriding principles of ecosystem management . . . apply to any outgrant of AF lands for agricultural uses" (DAF 2016, Section 10.1.2). The purpose of these *Grazing Management Guidelines* (hereinafter *Guidelines*) is to help guide Beale AFB in their livestock grazing management activities so that the Base meets its INRMP natural resource management goals.

Administration of Beale's grazing program is the responsibility of the 9 Civil Engineering Squadron Environmental Element (9 CES/CEIE) and Real Property Section (9CES/CEIA). The 9 CES/CEIE (Environmental), 9 CES/CEIA (Real Property), 9 RW Legal Office, and the 9th Contracting Squadron cooperatively manage the Beale grazing program (Beale AFB 2016, 129). These *Guidelines* will be attached to the Base's INRMP (DAF 2016, 91) and implemented under the supervision of the Base Natural Resources Manager. Grazing program staff in 2017 include the Natural Resources Manager and two Civilian General Schedule employees in overhire positions paid for with grazing lease income; one position is decades old, and the second term position started in the third quarter of 2017 (Lauren Wilson, personal communication, August 2017).

Several documents on the rangeland resources and grazing program at Beale AFB proved especially useful in writing these *Guidelines*, including:

1. the 1997 Jones and Stokes report on rangeland management (Jones & Stokes 1997);
2. the 2000 report by the Range Management Assistance Team (RMAT 2000);
3. the 2015 updated Beale AFB Integrated Natural Resources Management Plan (Beale AFB 2015); and
4. recent Center for Natural Lands Management rangeland monitoring reports (CNLM 2015b; CNLM 2016).

2.0 Beale AFB grazing program: history, grazing leases and land use rules, and grazing lease income

2.1 Beale's grazing program and its history

Beale AFB covers just over 23,000 acres, of which about 20,000 acres are classified as unimproved grounds (Beale AFB 2015, 53-54). Of these unimproved grounds, 12,789 acres are currently part of Beale's grazing program, 12,632 acres grazed by cattle and 157 acres serving as horse pasture. Beale's grazing areas are divided into six Management Areas, A-F, with each Management Area subdivided into pasture units. Currently, there are 36 pasture units (Figure 2-1 and Table 2-1; Beale AFB 2015, 147).

Adjacent to Beale's eastern border is the 12,000 acre Spenceville Wildlife Area, managed by the California Department of Fish and Wildlife (Beale AFB 2015, 38-40). Beale's blue oak woodland forms a small portion of the blue oak woodland covering Spenceville. Dry Creek flows into Beale from Spenceville. Land uses around the rest of the Base include crop agriculture, orchards, livestock grazing, and rural residential properties.

Areas of what is now Beale AFB have been leased for livestock grazing since the early days of its military use, in the 1940s (Jones & Stokes 1997, 5; Beale AFB 2015, 145). A formal agricultural outgrant program dates back to at least the mid-1970s when the Base leased areas for grazing or dryland farming (Jones & Stokes 1997, 4). Perceived as an unprofitable activity on Beale, dryland farming ceased in the mid-1980s, and Beale's dryland farming areas were converted into grazing areas (Jones & Stokes 1997, 5; Beale AFB 2015, 145). In addition, the Base leased land for irrigated rice production in the Old Pheasant Farm area until the mid-1980s (RMAT 2000, 34; Bruce Reinhardt, pers. comm., July 2017). The Old Pheasant Farm area was also the site of a 1,500 acre experimental farm run by the Army; four ponds and two wells were developed and connected to provide irrigation for experimental crops (Bruce Reinhardt, pers. comm., July 2017).

A Grazing and Cropland Management Plan was prepared in 1983, governing grazing and other agricultural uses at Beale AFB from 1983 to 1989. In 1989, the plan was revised but with very few substantive changes from the 1983 plan (Beale AFB 2015, A8-42). In 2000, a Range Management Assistance Team, comprising Air Force and outside experts, reviewed Beale's grazing program and made recommendations for enhancing the program (RMAT 2000). Currently, the Beale INRMP contains an Agricultural Outleasing – Grazing Work Plan (Beale AFB 2015, 169), with extensive supporting information (Beale AFB 2015, A8-1-A8-86). In 2015, H.T. Harvey & Associates (2015a) outlined a strategy to expand the grazing program into areas of Beale that have not been grazed in recent years, to meet management goals of maintaining firebreaks, controlling invasive plants, and/or protecting and enhancing resources in these locations.

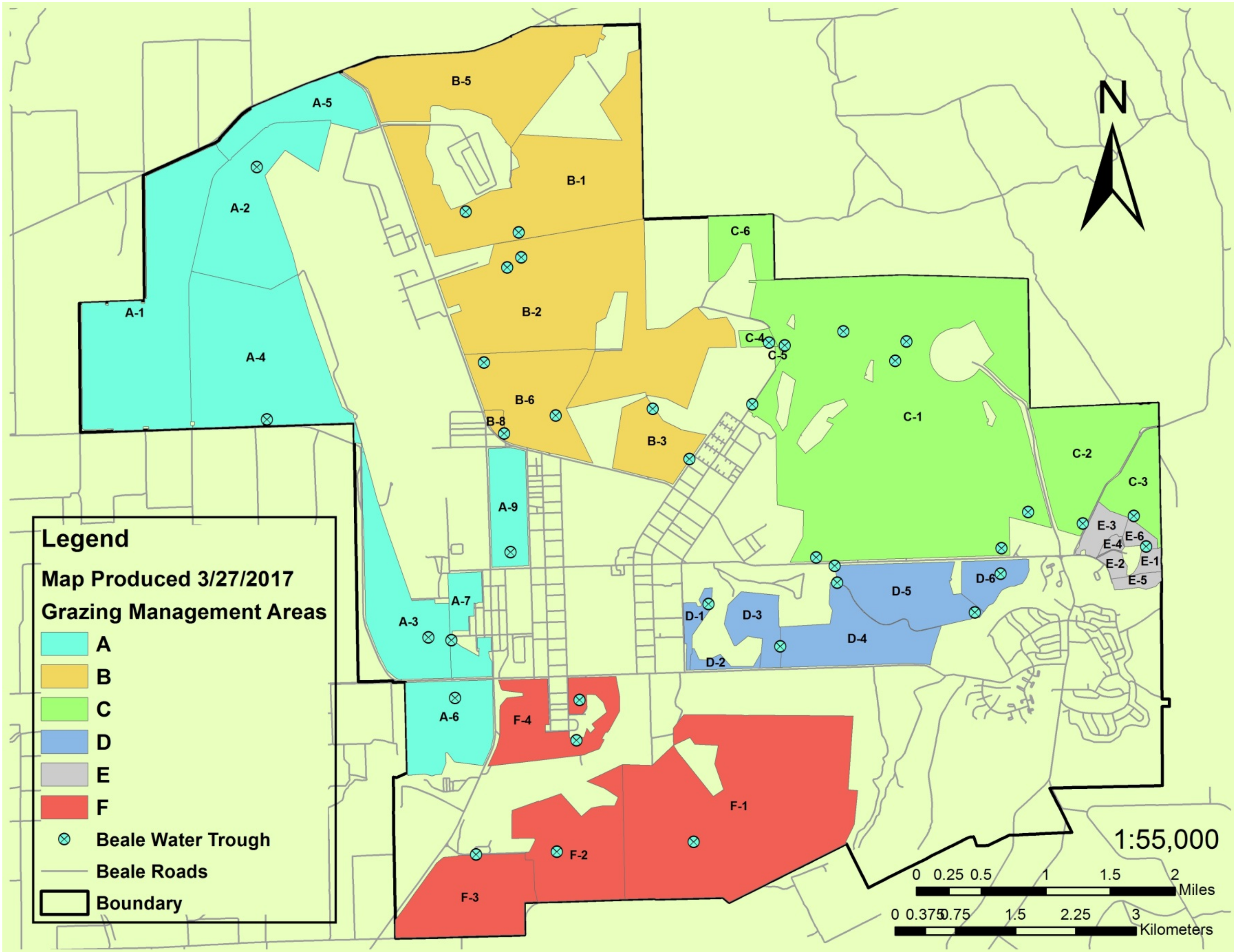

Figure 2-1: Beale AFB grazing program Management Areas and livestock pasture units; map produced by Paul Block, CEMML.

Table 2-1: Beale AFB pasture unit size (acres) and livestock type; data from Beale AFB GIS, January 2017. Note that some numbered pasture units (e.g., A-8 and B-4) are no longer part of Beale's grazing program.

Management Area	Pasture unit	Acreage	Livestock type
A	A-1	832	cattle
	A-2	471	
	A-3	359	
	A-4	746	
	A-5	207	
	A-6	284	
	A-7	114	
	A-9	167	
	Total Management Area A	**3,180**	
B	B-1	825	cattle
	B-2	1,102	
	B-3	182	
	B-5	584	
	B-6	360	
	B-8	15	
	Total Management Area B	**3,068**	
C	C-1	2,553	cattle
	C-2	375	
	C-3	147	
	C-4	26	
	C-5	4	
	C-6	131	
	Total Management Area C	**3,235**	
D	D-1	37	cattle
	D-2	23	
	D-3	111	
	D-4	281	
	D-5	259	
	D-6	90	

Management Area	Pasture unit	Acreage	Livestock type
	Total Management Area D	**800**	
E	E-1	21	horse
	E-2	21	
	E-3	55	
	E-4	11	
	E-5	24	
	E-6	26	
	Total Management Area E	**157**	
F	F-1	1,333	cattle
	F-2	387	
	F-3	360	
	F-4	269	
	Total Management Area F	**2,350**	
Beale AFB grazing program total area		**12,789**	

At the time these *Guidelines* were drafted in 2016, the Beale grazing program included 3 cattle lessees, who held the leases on 5 of the Base's Management Areas, as well as the Dry Creek Saddle Club, which held the lease for the Management Area E horse pasture units. One lessee ran an organic stocker operation and held the leases for Management Areas A and F; a second lessee ran a cow-calf operation and held the leases for Management Areas B and C; the third lessee also ran a cow-calf operation and held the lease for Management Area D (Ed Broskey, pers. comm., November 2016). These grazing leases expired at the end of the 2016/2017 grazing season. New leases will be awarded in September 2017 for the next five year lease period.

In central California, cow-calf operations maintain a mother cow herd year-round and produce calves that are typically sold after weaning in late spring. Stocker operations graze weaned calves on rangeland for several months, in central California usually during late winter and spring, before selling them or moving them elsewhere in the early summer.

For most of Beale's grazing program Management Areas, the grazing season is November 1 through May 31. Management Area E horse pasture units are used year-round. Three small Management Area C pasture units serve as temporary livestock holding areas and are used on a temporary basis as needed (Beale AFB 2015, 147, 149, A8-48).

2.2 Grazing leases and land use rules at Beale

Beale's grazing leases effectively last for five years, although more precisely, they are in effect for the first year, with four years of annual renewals thereafter. Either party to the lease can elect not to renew, but non-renewal has not occurred in recent years (Ed Broskey, pers. comm., November 2016). In compliance with AFI 32-7064, Beale's grazing leases include land use rules (DAF 2016, Section 10.2.4). The land use rules in recent Beale grazing leases (titled "Exhibit E - Operating Agreement" in a 2012/2013 Beale AFB lease [DAF 2012]) laid out the rules under which lessees operated on the Base. The 2012/2013 operating agreement stated that the lessee's use of the leased land was subordinate to and must not interfere with the military mission of Beale AFB. It then described:

1. Requirements for communication between the lessee and Beale staff, including lessee emergency contact information, and the need for weekly coordination and occasional meetings.
2. Animal Unit Month (AUM) definitions and lessee's monthly AUM reporting obligations;
3. Rules relating to Base access for lessee personnel, equipment, and livestock.
4. Responsibilities relating to maintenance of the Base's grazing infrastructure[1].
5. Regulations regarding resource management, including the grazing season (November 1 through May 31) and reasons for curtailing or extending the grazing season; the grazing capacity of the leased area in AUMs, how grazing capacity was calculated, and conditions under which that year's stocking rate might be adjusted; the minimum amount of residual dry matter that must be left "at the end of the grazing season" (800 lbs per acre; DAF 2012, Exhibit E-Operating Agreement, 30); the Beale prescribed burn program's impact on forage and how adjustments in stocking rate and rental rebate would be made as a result of prescribed burns and wildfire; limitations on supplemental feeding of livestock; and access of livestock to water and the water fee schedule.
6. Rules relating to livestock management, including management and prevention of stray livestock; uniform livestock use of leased area and minimization of sacrifice areas by managing livestock distribution with salt blocks and feed supplements; placement of salt blocks and feed supplements in relation to sensitive areas and roads; compliance with all relevant animal health laws; and disposition of dead livestock.

The 2017 leases will have revised land use rules that remove the rental rebate for prescribed burns, referred to in number 5 above. See Appendix E for the 2012/2013 land use rules and Appendix F for the 2017 land use rules. The 2017 revised land use rules still contain some potentially contradictory or non-standard provisions that the Base Natural Resources Manager should consider revising; see Appendix F for specifics.

2.3 Grazing lease income and grazing program budgets at Beale

AFI 32-7064 authorizes the use of agricultural outgrant revenue to support both agricultural program operating expenses and installation natural resources management (DAF

[1] The 2012/2013 lease's operating agreement states that the lessee is responsible for routine maintenance and repair of grazing infrastructure, a common arrangement on leased public land (DAF 2012, Exhibit E-Operating Agreement, 29). Currently, however, the Beale grazing program manager is responsible for repair and maintenance of the cattle-grazing infrastructure. See Section 4.3 for further details.

2016, Sections 10.7 and 16.3). Authorized uses of agricultural outgrant funds for agricultural program expenses include civilian pay, administrative expenses, land improvements, and vehicles and equipment (DAF 2016, Section 16.3.3.2). Annual lease income from Beale's grazing program is substantial (ranging from $212,000 to $358,000 over the period FY2014 – FY2017; Lauren Wilson, pers. comm., August 2017), provides essential funding for Beale's grazing program, and has also been used to support other natural resources management activities (RMAT 2000, 8; Beale AFB 2015, A8-84). For example, the FY2011 grazing program budget, funded by income from the grazing leases, included support for:

1. a civilian range technician overhire to implement operational component plans from the INRMP, including livestock operational tasks, such as water-hauling, and maintenance of rangeland, fish and wildlife, and outdoor recreational facilities ($78,000);
2. grazing program infrastructure installation, e.g., of water troughs and cattle guards; equipment and supplies for grazing and fish and wildlife management, including fencing materials and tools; grazing program vehicle maintenance and fuel; and professional education and training for natural resources personnel ($31,500);
3. a rangeland vegetation monitoring and infrastructure planning contract with the Center for Natural Lands Management ($25,000);
4. Base-wide wildlife surveys to inform ecosystem management planning, performed via cooperative agreements ($10,000); and
5. weed control activities and supplies ($5,000; Beale AFB 2015, A8-84).

In 2017, grazing lease income will fund the installation of solar wells to improve water distribution for livestock (ManTech 2017). In the future, lease income will likely be used to expand the grazing program into ungrazed areas of Beale, funding the necessary permitting, fencing, and water infrastructure (Lauren Wilson, pers. comm., August 2017; H.T. Harvey & Associates 2015a; ManTech 2017). Annual budgets for the Beale grazing program, including infrastructure maintenance and improvement, reflect annual spending plans for the grazing program's lease income, and are developed by the Beale Natural Resources Manager and submitted to the Air Force Subject Matter Specialist for approval.

The Beale Natural Resources Manager manages the reimbursable funds provided by the grazing leases. Use of reimbursable conservation program funds is guided by requirements in AFI 32-7064, Section 16.3. Proceeds are to be used to cover the administrative expenses of agricultural leasing and to finance natural resources management activities that implement an INRMP, including costs of normal operations or investment equipment. As noted above, authorized uses of cropland and grazing funds include civilian pay, administrative expenses, land improvements, and vehicles and equipment. Land improvements are limited to improvements that increase the productivity or value of the land for outgrant purposes. Civilian pay is limited to persons providing direct support of agricultural programs and natural resources management programs. No Environmental Quality funds should be used for the above purposes as Beale's grazing program is self-supporting with sufficient revenue to cover expected costs. The reimbursable budget process is managed by the Air Force Natural Resources Subject Matter Specialist, Mr. Kevin Porteck (AFCEC/CZTQ). Annual budgets are due to him no later than 31 July. Annual budgets are created by the Beale Natural Resources Manager and reflect projected revenue and requested reimbursements.

3.0 Goals of the Beale AFB grazing program

Beale AFB's ecosystem management goals are laid out in the Beale AFB Integrated Natural Resources Management Plan (Beale AFB 2015). The INRMP's broad goals are outlined in its Management Goals and Objectives chapter and include the following goals particularly relevant to these *Guidelines*:

1. to maintain or increase populations of special-status species and improve their habitat conditions;
2. to minimize nonpoint sources of water pollution;
3. to improve management practices and enhance habitat for wildlife species; and
4. to manage rangeland vegetation to provide high quality forage on a sustainable basis and provide a healthy ecosystem.

Building on these INRMP goals, Beale natural resources staff provided the following goals around which to develop these *Guidelines* (Table 3-1).

Table 3-1: Beale AFB grazing management goals, justification, and specific objectives. INRMP objectives from the Beale AFB Integrated Natural Resources Management Plan (Beale AFB 2015); *=goals and/or objectives that align well with existing INRMP goals or objectives but have been modified for clarity, specificity, or direct application to these *Grazing Management Guidelines*.

Goal	Justification	Objectives
1. Protect and enhance vernal pool ecosystem functions and processes.	ESA (16 USC 1531-1544) listed fauna protection (no listed flora), Clean Water Act jurisdictional water protection.	1.1 Graze vernal pool ecosystem to maintain or increase inundation periods within vernal pools to support breeding of vernal pool fairy shrimp and vernal pool tadpole shrimp, and vernal pool native plants. 1.2 Maintain residual dry matter (RDM) at recommended levels.
2. Protect and provide a conservation benefit for federal and state listed species, state species of concern, and other at-risk species including rare rangelands plants.*(Modified INRMP Goal 2)	ESA 16 USC 1533 Section 4.(a)(B)(i) requirement to provide conservation benefit for listed species to achieve exemption from critical habitat; Support of State Wildlife Action Plan and state wildlife laws; Supports conservation value of rangelands.	2.1 General: Create a grassland habitat mosaic (grazed, lightly/rotationally grazed, ungrazed) to support multiple special status species (and their prey) with varying requirements. 2.2 Monitor special-status native plant species in grazed and ungrazed plots to determine whether they benefit from a well-managed grazing program, need protection from grazing, or appear unaffected by livestock. 2.3 Conduct adaptive management study to provide site-specific information on appropriate *maximum* RDM targets for meeting wildlife habitat requirements, controlling invasive species, and minimizing fine fuel loads. Implement the following objectives: 4.1 below *(Modified INRMP Objective 2.3),

Goal	Justification	Objectives
		4.2 below *(Modified INRMP Objective 2.3), 4.3 below *(Modified INRMP Objective 2.3), 5.1 below *(Modified INRMP Objective 2.3).
3. Maintain and improve rangeland ecosystem functions and processes	Enables achievement of Goals 1, 2, and 4	3.1 Maintain RDM at recommended levels to minimize soil erosion. 3.2 Reduce cover of widespread invasive plant species. Implement Objective 2.3 above.
4. Maintain or increase populations of native rangeland plants that contribute to floral and faunal biological diversity *(Modified INRMP Objective 5.9).	Provides for the conservation and rehabilitation of natural resources and sustains the long-term ecological integrity of the resource base and the ecosystem services it provides; per Sikes Act (16 USC 670a Section 101 (a)(3)(A)(i)) and DoDI4715.03 (4.a.)	4.1 Reduce cover of widespread invasive grass medusahead (*Elymus* [*Taeniatherum*] *caput-medusae*). 4.2 Reduce cover of widespread invasive species yellow starthistle (*Centaurea solstitialis*). 4.3 Eliminate incipient populations of new invasive species by implementing a rapid response protocol per the 2017 Beale AFB Invasive Plant Species Management Guidelines and associated Work Plans. 4.4 Monitor native species richness in grazed Management Areas. 4.5 Initiate blue oak protection and enhance regeneration on and around the Saddle Club. Implement Objectives 2.2 and 2.3 above. *(Modified INRMP Project 5.9.3)
5. Manage and improve rangeland vegetation to provide high quality livestock forage on a sustainable basis to maintain benefits received from livestock grazing leases. *(Modified INRMP Goal 8)		5.1 Eliminate known populations of barbed goatgrass (*Aegilops triuncialis*) within five years, an invasive species unpalatable to livestock. 5.2 Maintain rangeland improvements (structural and nonstructural) to support grazing operations and improve the value of the lease. Implement Objective 4.1 above, as medusahead abundance reduces forage and livestock production.
6. Meet Bird/Wildlife Aircraft Strike Hazard (BASH) requirements and implement land management measures that discourage use by wildlife. (INRMP Objective 6.6)		6.1 Maintain vegetation height between 7-14 inches. 6.2 Limit forb (wildflower) abundance. 6.3 Limit patches of bare ground. 6.4 Limit edge effects. Implement Objective 4.2 above.

Goal	Justification	Objectives
7. Reduce wildland fire risk and its potential effects on Base facilities and natural resources. *(Modified INRMP Objective 6.5)	Protect mission infrastructure and human health and safety.	7.1 Reduce fine herbaceous fuels through managed livestock grazing. 7.2 Maintain wildland fire protection measures such as firebreaks, access roads for fire suppression, and use of gates for access instead of cutting fences. Implement Objective 2.3 above.
8. Ensure no adverse impacts to cultural resources and maintain cultural heritage and value of grazed California rangeland.		8.1 Staff appropriate permits (332/813/103s) when moving or placing new grazing infrastructure (e.g., fencing, water, corrals). 8.2 Consult with the Beale Cultural Resources Manager to avoid placing salt licks and other attractants in culturally sensitive areas. 8.3 Provide opportunity to livestock operators to graze on land traditionally used for grazing in the pre-Camp Beale era when land is available for this purpose and compatible with Beale's mission.
9. Ensure no net loss in the capability of Beale grazing program lands to support the military mission of the installation.	Requirement of the Sikes Act (16 USC 670a et seq.)	9.1 Maintain fencing integrity to avoid livestock in sensitive military areas. 9.2 Remove livestock carcasses from pasture units within 12 hours to reduce BASH risks. 9.3 Ensure ranching practices are flexible, and ranchers are available within 24 hours' notice if livestock needs to be moved for mission priorities.
10. Ensure compliance with applicable federal and state laws and regulations related to natural resource protection. (INRMP Goal 1)		10.1 Conduct grazing compliance surveys monthly to verify grazing lease and grazing land use regulations are properly implemented. 10.2 Comply with Grazing EA. 10.3 Comply with EIAP/Base 332/103 process. 10.4 Comply with Base Regulations.

3.1 Grazing program and mission support functions

In addition to the ways in which the Beale grazing program helps meet the goals listed in Table 3-1, Beale natural resources staff emphasize that the Beale grazing program provides the following Base mission support functions (Lauren Wilson and Ann Bedlion, pers. comm., January 2017):

1. generates revenue that supports INRMP implementation and natural resources management (Section 2.3; RMAT 2000, 8; Beale AFB 2015, A8-84);

2. maintains open land restricted from public use, providing safety and security buffers for Air Force mission activities;
3. provides opportunities for Base personnel to enjoy observing livestock and traditional ranching activities and provides a peaceful environment to support well-being of Air Force personnel and their families (see for example the Beale AFB website news article by Viglianco [2016]); and
4. allows Base to be a good neighbor and land steward by employing a land management tool (livestock grazing) that is well-established, often cost-effective and efficient, and culturally important to many people.

4.0 Condition of Beale AFB rangeland resources and grazing effects on special status species

4.1 Climate

The Beale AFB area has a typical California Mediterranean climate with cool, wet winters and hot, dry summers. Annual average precipitation is 19.88 inches; almost all of the rain falls between October and April (Table 4-1; data courtesy Beale AFB Weather Flight [SSgt Jennifer Smith, pers. comm., August 2017]). Averages can be misleading, however, as rainfall amount and pattern vary significantly from year to year (Figure 4-1), with consequent fluctuations occurring in vegetation production and species composition between years.

Beale's average annual low temperature is 50°F and its average annual high is 74°F. Summer temperatures above 100°F can last for several days (Beale AFB 2015, 54-55).

Table 4-1: Mean monthly and annual rainfall in inches for Beale AFB, 1959-2016; data courtesy Beale AFB Weather Flight (SSgt Jennifer Smith, pers. comm., August 2017).

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
4	3.5	2.9	1.5	0.08	0.2	0	0	0.3	1.2	2.5	3.7	19.88

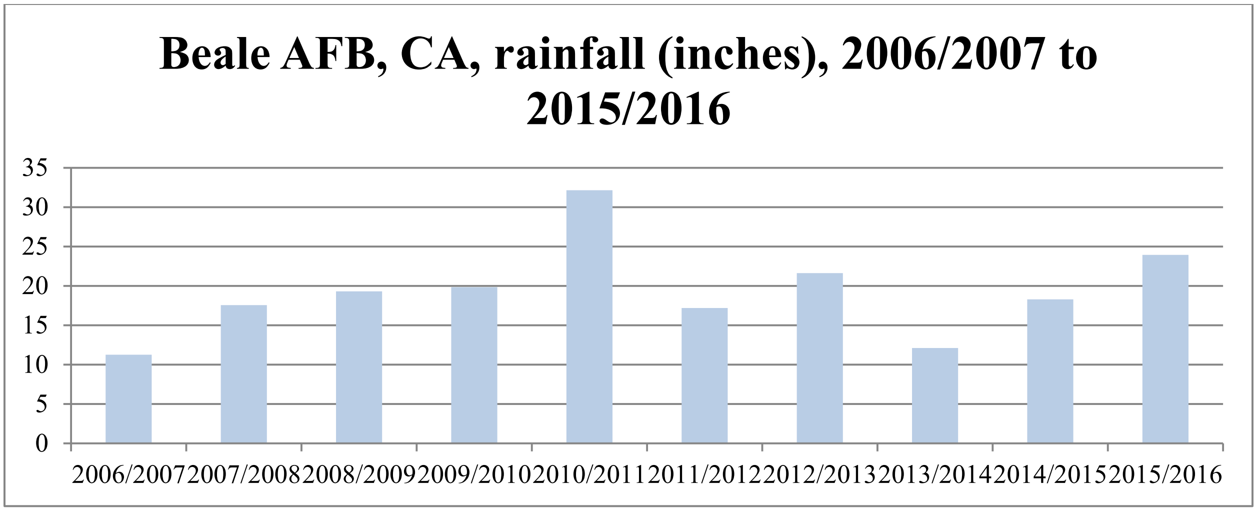

Figure 4-1: Annual (July-June) rainfall in inches for Beale AFB, California, 2006/2007 to 2015/2016; data courtesy Beale AFB Weather Flight (SSgt Jennifer Smith, pers. comm., August 2017). Data for September through December 2007 unavailable for Beale AFB so data from Browns Valley, California, substituted (UC ANR Statewide Integrated Pest Management Program, station CIMIS #84, http://ipm.ucanr.edu/WEATHER/index.html, accessed March 2017).

4.2 Land-use history

Land-use history can have significant impacts on current vegetation composition, structure, and productivity. In particular, previous cultivation is linked to the absence of native perennial bunchgrasses and native annual forbs in California grasslands (Bartolome et al. 2007a). Vernal pool areas that have been cultivated also exhibit reduced floristic quality (Lichvar et al. 2006).

The INRMP (Beale AFB 2015, 35) states that, following European settlement, the major land uses at what became Beale AFB were livestock grazing and dryland farming. Dryland farming continued at Beale until the mid-1980s (Jones & Stokes 1997, 5; Beale AFB 2015, 145). In addition, the Base leased land for irrigated rice production in the Old Pheasant Farm area until the mid-1980s (RMAT 2000, 34), and fig and olive orchards were established on Base and continue to be maintained, although not for production (Beale AFB 2015, 156). Specific information on areas that have been cultivated at Beale, if available, will prove useful in prioritizing future grassland restoration activities.

4.3 Topography, hydrology, soils, infrastructure, and improvements

Topography

Beale's western and central areas are fairly flat annual grasslands, characteristic of the Central Valley. The eastern portion of Beale features the low, rolling hills and blue oak woodlands found at the base of the Sierra Nevada foothills. Ninety-six percent of Beale's grazing pasture land is less than 10% slope (Table 4-2). Slope is an important input in determining a pasture unit's stocking rate and residual dry matter targets. Slope can also constrain feasible management activities and influence the placement of infrastructure. Figure 4-2 shows slope classes for Beale's livestock pasture units; the slope classes were selected based on University of California Agriculture and Natural Resources residual dry matter guidelines (Table 6-1; see Section 6 for further details). Beale's elevation ranges from 80-600 feet (Beale AFB 2015, 57-59).

Table 4-2: Percent slope class acreage of Beale AFB's grazing pasture land; data from Beale AFB GIS, April 2017.

Percent slope class	Acreage of percent slope class	Proportion of total acreage (%)
<10	12,078	95.6
10-20	451	3.6
21-30	99	0.8
31-40	3	0.02
>40	2	0.01

Hydrology

Three main creeks cross Beale AFB: Dry Creek including Best Slough, Hutchinson Creek, and Reeds Creek. The latter two creeks are intermittent, while, as a result of upstream water release to enhance habitat conditions in and downstream from the adjacent Spenceville Wildlife Area, Dry Creek flows throughout the year (Beale AFB 2015, 66). Dry Creek is fenced and not accessible to livestock (Beale AFB 2015, 132). Sections of Reeds Creek and the Management Area D portions of Hutchinson Creek are not fenced and are available to livestock because the pasture units do not have troughs so the creeks provide water for the cattle (Ed Broskey, pers. comm., November 2016).

Soils

The Beale AFB livestock pasture units contain 14 soil map units of soil series or soil complexes[2] and two additional map units 'Dumps, landfills' and 'Water' (Table 4-3 and Figure

[2] According to the Beale AFB INRMP, the USDA Natural Resources Conservation Service incorrectly mapped one soil map unit, 101 -- Aiken-Horseshoe complex, 2-8%, as occurring on 85 acres at Beale; the soil classified as 101 on Beale is likely 203 - Perkins loam (Beale AFB 2015, 63). These *Guidelines* follow that determination in describing Beale's soils and in calculating range production values in Section 6 and Appendix A.

4-3; NRCS 2016). Water erosion hazard for the Beale livestock pasture units' soils is for the most part rated as slight, representing more than 80% of the Base's grazing area. Three soil series on 15-30% slopes and with very slow to moderate permeability and rapid runoff are rated as having severe water erosion hazard in the *Soil Survey of Yuba County* (Lytle 1998); there are only 205 acres of these soil map units however, less than 2% of Beale's grazing area; they occur in Pasture Units C-1, C-3, and five of the six E horse pasture units (red, dark brown, and dark blue areas in Figure 4-3). In addition, the Redding-Corning complex on 3-8% slopes, of which there are 2,127 acres in Beale's grazing area, has very slow permeability and medium runoff and is rated as a moderate water erosion hazard (Lytle 1998). Maintaining recommended levels of residual dry matter should minimize rainfall-induced soil erosion; see Section 6 for further details (Bartolome et al. 2006).

All 14 soil series/complexes are described as "used mainly for" or "suitable for" rangeland/livestock grazing with few limitations (Lytle 1998). In several of the C, D, and E pasture units, Auburn-Sobrante complex, 3-8%, has the limitation that livestock grazing should be delayed until soils are firm enough to prevent compaction, and until forage species are rooted sufficiently to avoid being pulled up when trampled by livestock (319 acres; bright pink areas in Figure 4-3). The suitability for livestock grazing of Auburn-Sobrante-Rock outcrop complex, 15-30%, is limited by its tendency to produce woody vegetation that requires management (19 acres; dark blue area in Pasture Unit C-1, Figure 4-3).

Table 4-3: Soil map units within the Beale AFB pasture units, with acreage and water erosion hazard rating (Lytle 1998; NRCS 2016).

Soil series/map unit, with percent slope class	Map symbol	Acreage	Water erosion hazard
Argonaut-Auburn complex, 3-8%	102	2,154.0	slight
Argonaut-Auburn complex, 15-30%	104	86.2	severe
Auburn loam, 15-30%	108	100.5	severe
Auburn-Sobrante complex, 3-8%	110	319.0	slight
Auburn-Sobrante-Rock outcrop complex, 15-30%	118	18.7	severe
Hollenbeck clay, 0-3%	133	37.4	slight
Conejo loam, 0-2%	141	294.8	slight
Pardee gravelly loam, 3-8%	201	804.3	slight
Pardee-Ranchoseco complex, 0-3%	202	536.3	slight
Perkins loam, 0-2%	203	1,526.2[2]	slight
Redding-Corning complex, 0-3%	209	1,080.5	slight
Redding-Corning complex, 3-8%	210	2,127.1	moderate
San Joaquin loam, 0-1%	214	2,617.5	slight
San Joaquin loam, 1-3%	215	1,068.8	slight
Dumps, landfills	145	8.5	
Water	254	10.0	

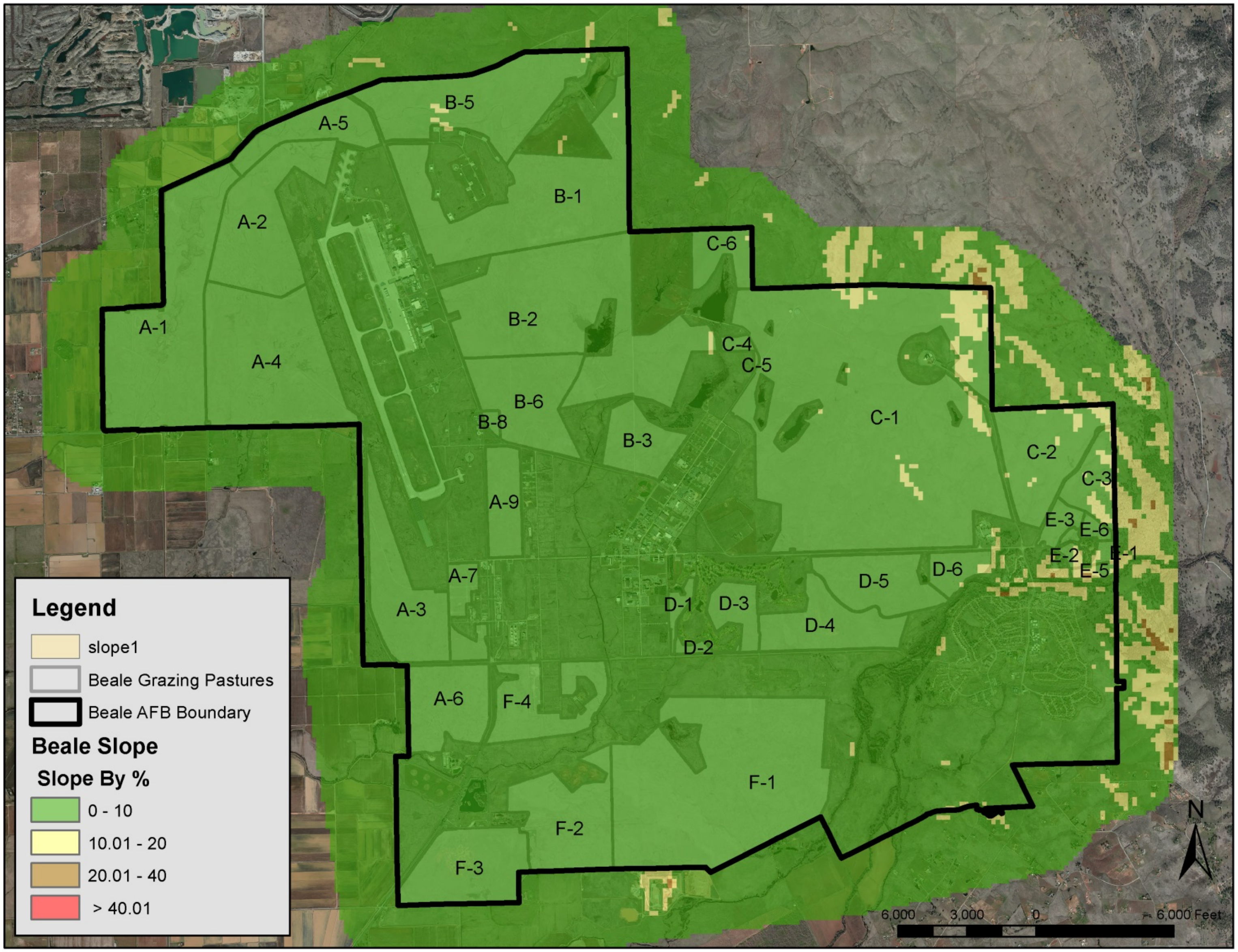

Figure 4-2: Percent slope classes for Beale AFB livestock pasture units; map produced by Behdad Sanai, Travis AFB.

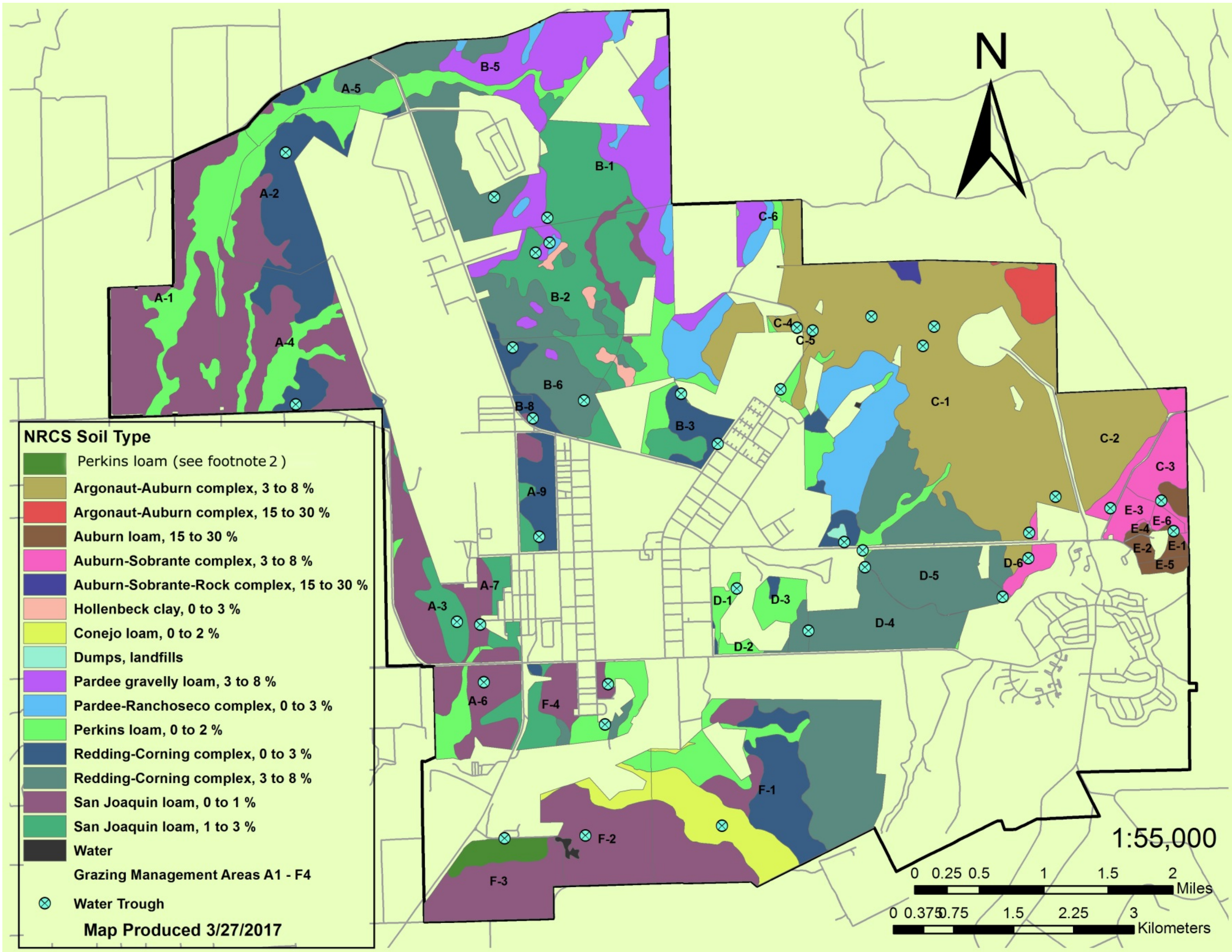

Figure 4-3: Soil series in Beale AFB livestock pasture units; soils data from NRCS (2016); map produced by Paul Block, CEMML.

Infrastructure

Beale's cattle livestock infrastructure comprises the usual fencing, gates, corrals, and water troughs (Figure 4-4; Barry et al. 2016; Nader and Drake 2006). Beale AFB is responsible for the installation and maintenance of infrastructure in the cattle lease Management Areas. No in lieu services were permitted under the leases that expired in 2016/2017 (Lauren Wilson, pers. comm., December 2016). Prior to the 1990s, lessees had been responsible for grazing infrastructure maintenance and received grazing fee credits for their work, but following some difficulties with this arrangement, the Base assumed responsibility for the grazing program infrastructure as well as for some livestock operational tasks, such as water-hauling (Ed Broskey, pers. comm., November 2016; Beale AFB 2015, A8-47). Dry Creek Saddle Club is responsible for infrastructure maintenance in the Management Area E horse pasture units (Ed Broskey, pers. comm., November 2016). The supporting information for the INRMP's Agricultural Outleasing – Grazing Work Plan includes Section A8.5, technical specifications for construction and maintenance of grazing program infrastructure, including fencing and water troughs (Beale AFB 2016, A8-53-A8-83). The USDA Natural Resources Conservation Service (NRCS) provides technical specifications for many rangeland infrastructure elements, including fences, available online (e.g., NRCS 2015a) or from the local NRCS office in Yuba City.

Not all pasture units contain troughs; some have seasonally available water in vernal pools, stockponds, or other surface waters (Figure 2-1; Table 4-4; Beale AFB 2015, 153). Not all the troughs are water line-fed or well-fed; some require water hauled to them, and others must be filled by hose. Beale AFB personnel are responsible for hauling the water to tanks/troughs or filling troughs by hose (Ed Broskey, pers. comm., November 2016). Table 4-4 provides the frequency with which these tasks must be performed for these troughs.

Table 4-4: Livestock water sources for Beale AFB pasture units and frequency with which Beale AFB personnel must haul water to trough or fill trough from hose; data from Beale AFB GIS, January 2017, and Ed Broskey, pers. comm., November 2016 and March 2017.

Pasture unit	Livestock water source	Water hauling/filling frequency
A-1	Seasonal water flow	
A-2	1 Water-Line Fed Trough; Vernal pools	
A-3	1 Water-Line Fed Trough	
A-4	1 Water-Line Fed Trough; Vernal pools	
A-5	Seasonal water flow	
A-6	1 Water-Line Fed Trough	
A-7	1 Water-Line Fed Trough	
A-9	1 Water-Line Fed Trough	
B-1	2 Water-Line Fed Troughs	
B-2	2 Water-Line Fed Troughs	
B-3	2 Water-Line Fed Troughs; 1 Hose-fed trough (1,000 gallons)	as needed

Pasture unit	Livestock water source	Water hauling/filling frequency
B-5	Seasonal water flow; 1 Hose-fed Trough (2,500 gallons)	once per month to once every two months
B-6	2 Water-Line Fed Troughs (2,000 gallons each)	
B-8	1 Trough Requires Truck Hauled Water (in corral)	once or twice per year
C-1	6 Water-Line Fed Troughs; 2 Troughs Require Truck Hauled Water (2,100 gallons in holding field; 2,000 gallons in C-1); Stockponds	holding field: as needed; C-1: once per month
C-2	1 Hose-fed Trough	
C-3	1 Hose-fed Trough	
C-4	1 Water-Line Fed Trough	
C-5	No Trough	
C-6	Seasonal water flow	
D-1	1 Water-Line Fed Trough	
D-2	Seasonal water flow	
D-3	1 Trough Requires Truck Hauled Water (2,000 gallons)	2-3 times per week
D-4	1 Trough Requires Truck Hauled Water (3,000 gallons), stockpond; Vernal pools	once every two months
D-5	1 Water-Line Fed Trough; 1 Trough Requires Truck Hauled Water (2,000 gallons); Clinic Pond	once per week
D-6	1 Water-Line Fed Trough	
E-1	1 Hose-fed Trough	
E-2	No Trough	
E-3	Seasonal water flow	
E-4	1 Hose-fed Trough	
E-5	No Trough	
E-6	2 Hose-fed Troughs	
F-1	1 Solar Well	
F-2	1 Trough Requires Truck Hauled Water (2,000 gallons); Vernal pools; Stockpond	
F-3	1 Water-Line Fed Trough (3,000-3,400 gallons); Stockpond; Seasonal water flow	every day to 2 times per week
F-4	2 Water-Line Fed Troughs	

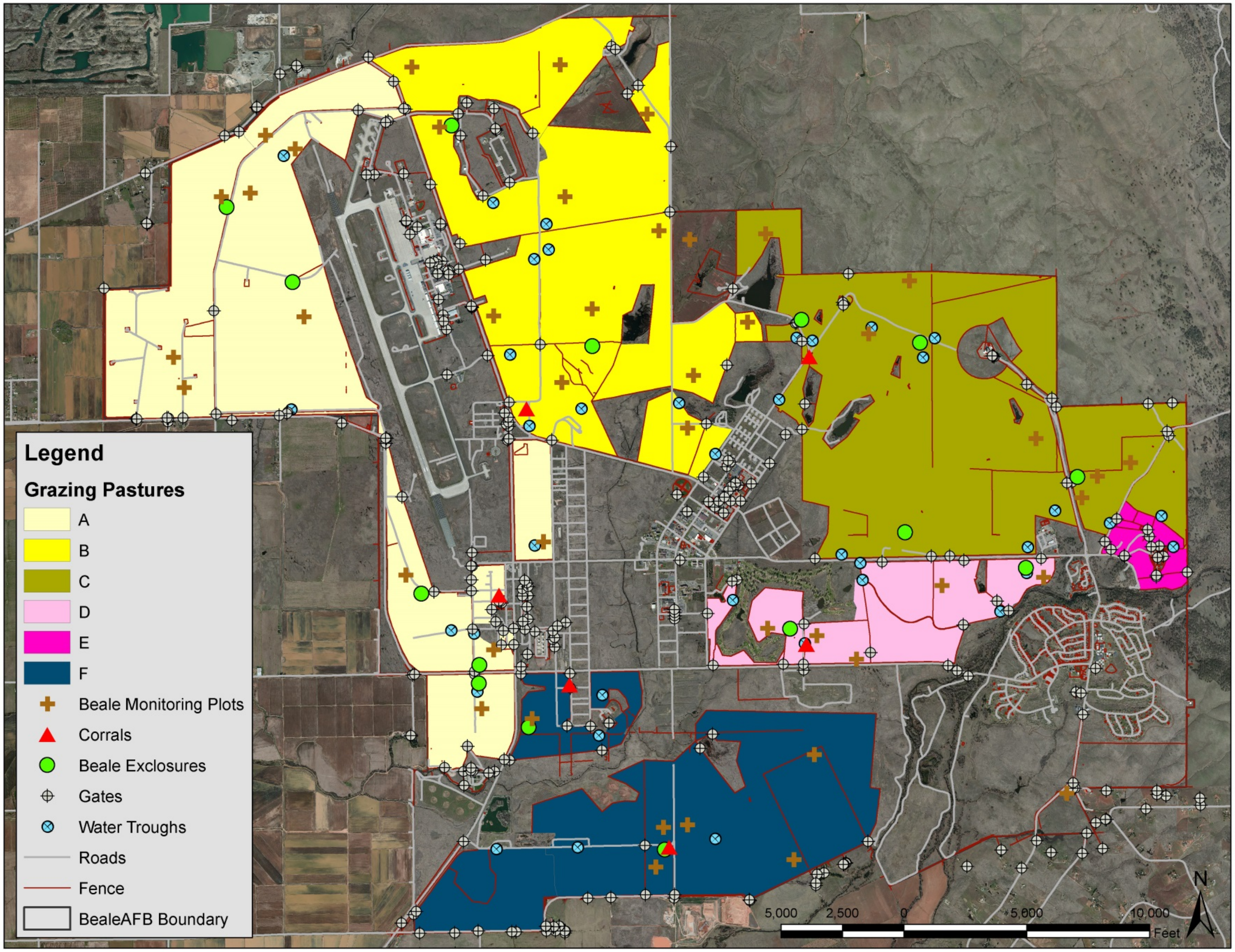

Figure 4-4: Beale AFB grazing program infrastructure; map produced by Behdad Sanai, Travis AFB.

Improvements

At least some troughs at Beale do not have wildlife escape ramps (Personal observation, November 2016; Lauren Wilson, pers. comm., February 2017; CNLM 2016, 34), a standard addition to livestock watering systems and a requirement of the Beale INRMP technical specifications for water troughs (Beale AFB 2015, A8-61-A8-65). Wildlife often drink from or bathe in livestock troughs and can drown in the troughs; this hazard can be minimized by installing small escape ramps. These escape ramps provide wildlife with access to additional water sources while minimizing drowning hazard, and also improve livestock performance by reducing water contamination (NRCS 2015b). Ramps are easy to build (e.g., NRCS 2015b), or pre-fabricated ramps can be purchased. The Center for Natural Lands Management has also recommended in its monitoring reports that Beale install escape ramps in troughs (CNLM 2015a, 32; 2016, 41). An additional consideration in trough design and management is that bats frequently use livestock troughs in arid areas and are more likely to use troughs that are larger (~6 feet in diameter), surrounded by limited vegetation, and filled with water rather than emptier (Jackrel and Matlack 2010).

Developing additional water sources would reduce labor demands on Beale grazing program staff, reduce livestock impacts on naturally occurring water sources such as creeks (see *Other special-status wildlife species* below) and vernal pools, and may enhance livestock distribution. In 2017, Beale AFB will install three solar wells, pumps, and troughs to service Pasture Units C-1, D-3, D-4, and D-5 that have previously required water-hauling (ManTech 2017). The report that recommended the optimal locations for these three wells also analyzed potential locations for future water development, both in current pasture units and in ungrazed areas of Beale that would benefit from incorporation into the grazing program but would first require installation of cattle grazing infrastructure (ManTech 2017). Appendix G provides the report's recommended solar well and trough locations.

The potential for expanding the grazing program has been evaluated by H.T. Harvey & Associates (2015a)[3]. Almost 3,200 acres, in 34 proposed units, could be incorporated into the grazing program, a 25% increase over its current size. Although 70% of the proposed units are smaller than 80 acres, 10 proposed units are larger than 100 acres, and there are opportunities to combine units to make large pastures. Most of the proposed units would require fencing, water, and other infrastructure development before they could be grazed by cattle. For those proposed units too small and isolated for feasible cattle grazing and for larger proposed units still needing cattle infrastructure installation, sheep or goat grazing may provide many of the desired management goals of maintaining firebreaks, controlling invasive plants, and protecting and enhancing resources. Sheep and goats are typically herded and fenced in with mobile, often electric, fencing so they can be spatially and temporally controlled much more easily than cattle. In addition, their water needs can often be met by a mobile water source. Appendix H provides a brief discussion of the benefits and drawbacks of using different livestock species for natural resources management.

[3] The Range Management Assistance Team noted the potential for expanding Beale's grazing program in 2000. One recommendation worth exploring further is converting the former rice field lease site near the Wheatland gate, which has fertile soils and had at the time an irrigation system, to a native grass hay field (RMAT 2000, 33-34).

Another potential use for one or more of these ungrazed units is as a 'grassland bank'. A grassland bank is a pasture that is held in reserve and only grazed intermittently as needed, such as following prescribed burning, herbicide application, wildfire, or drought. It provides a manager with the flexibility to use management tools that temporarily reduce forage in a pasture without undue impact on a grazing lessee because livestock can be moved to the grassland bank (RMAT 2000, 33). Grassland banks could also be a useful strategy in adapting to severe droughts that may occur more frequently with climate change (see Section 7.0).

According to the INRMP, Beale's grazing program infrastructure has been inconsistently inventoried, and regular planning for grazing infrastructure needs has been haphazard in the past (Beale AFB 2015, 155-156). Maintaining detailed records, including GIS shapefiles, of the Base's grazing infrastructure will improve the ability of the Natural Resources Manager to plan management actions related to the grazing program, including infrastructure maintenance and improvements. Such records will also help in coordinating with other Base departments whose activities have potential to damage or otherwise affect the grazing infrastructure. Beale should assess grazing program infrastructure needs at least annually.

The Beale grazing program GIS database should include boundary and interior fence lines (type of fence and dates of fence installation and of major maintenance are important attribute information), access roads, locations of gates, corrals, livestock water systems (troughs, wells, and pumps), cattle guards, and all other important grazing program infrastructure. Locations of salt and mineral licks and any other supplementation should be entered into the GIS database, to ensure compliance with rules regarding protection of natural and cultural resources (see Section 4.6 and Recommendation 8.6) and to assist in optimizing livestock distribution (George et al. 2007; 2008). Residual dry matter (RDM) mapping data should be entered into the GIS database, as should invasive plant observations, and spatial and attribute data on management actions such as prescribed burns and herbicide applications. If these types of spatial and attribute data are not currently in Beale's geodatabase, Beale's grazing program infrastructure should be surveyed as necessary and the data collected and entered into the geodatabase.

Spatial and attribute data for Beale's grazing program infrastructure must be kept current. If these data are out of date, information necessary for grazing program management will be inaccurate. For example, fenceline data in the Beale geodatabase were inaccurate at the time these *Guidelines* were first being drafted. If fenceline data are not up to date, pasture sizes are consequently inaccurate, and AUM calculations based on pasture size are wrong; this is a serious problem for a grazing program. Fencelines had to be re-surveyed and updated for some of Beale's pasture units, and all AUM values for these *Guidelines* recalculated. Maintenance of grazing program 'information infrastructure' should be a regular management activity in the same way that maintenance of the physical infrastructure is.

4.4 Vegetation types

Valley grassland

Valley grassland is the most common vegetation type at Beale, covering almost 19,000 acres of the Base (Beale AFB 2015, 73). The Valley grassland type, also known as California annual grassland, is found in the Central Valley, the foothills surrounding the Central Valley, including the central and southern Coast Ranges, and parts of the Transverse and Peninsula Ranges (Bartolome et al. 2007a). Non-native annual grasses and forbs have dominated this grassland type for many decades, and in most areas, native plants now make up only a very small percentage of the total cover. Despite this, numerous native species remain, generally at very low density, and can make up a significant proportion of Valley grassland species richness (number of species). In the Valley grassland generally and more specifically on Base, the majority of these native species are annual forbs (Schiffman 2007a; CNLM 2015b, 12; CNLM 2016, 12).

Primary forage species in Beale's grassland include the naturalized[4] grasses: soft chess (*Bromus hordeaceus*), Italian ryegrass (*Festuca perennis* [*Lolium multiflorum*]), and slender and common wild oats (*Avena barbata* and *A. fatua*). Brome fescue (*Festuca* [*Vulpia*] *bromoides*) and redstem filaree (*Erodium botrys*) are also common naturalized species at Beale (CNLM 2016, 17; CNLM 2015b, 16; Beale AFB 2015, 74, 153). See Section 4.5 for further details on native plants at Beale.

Based on limited evidence, it was long posited that native bunchgrasses, in particular purple needlegrass (*Stipa* [*Nassella*] *pulchra*), dominated the pre-European-settlement Valley grassland (Hamilton 1997). More recently, scientific opinion has shifted to the view that numerous native annual forb species were locally dominant, especially in the drier regions of the Central Valley, Sierran foothills, and inner Coast Ranges, and that purple needlegrass was dominant only in wetter areas (Wester 1981; Hamilton 1997; Schiffman 2007a; Minnich 2008; Evett and Bartolome 2013). Evidence to support this hypothesis comes from the writings of early European explorers and missionaries in California describing magnificent wildflower displays carpeting vast areas of the Valley and foothills (Minnich 2008), from analyses of relictual native vegetation (Schiffman 2007a), and from phytolith analyses showing very low pre-European-settlement cover of grass in most of the arid parts of the Central Valley and surrounding foothills (Evett and Bartolome 2013). Site-specific species composition, dominance relationships, cover, and many of the ecosystem processes of pre-European-settlement Valley grassland, however, are largely unknown and probably unknowable (Schiffman 2007a, b; D'Antonio et al. 2002).

The factors that caused the conversion from the "original" Valley grassland to a non-native, annual-dominated ecosystem are unknown, although several have been proposed, including intensive livestock grazing and agricultural cultivation in the 19th century, severe drought in the 1850s and 1860s, and the deliberate and accidental introductions of competitively

[4] Naturalized species are those non-native species that were once invasive but now are so wide-spread, well-established, and abundant in an ecosystem or a region that they can no longer be described as invasive, that is, as spreading into new areas (Spiegal et al. 2016).

superior non-native plant species. Unfortunately, simply ceasing the accused land-use activities does not reverse the type conversion in most cases (Harrison et al. 2003). Many studies have shown that cessation of livestock grazing or agricultural cultivation does not lead to increased native dominance, even after several decades (D'Antonio et al. 2002).

Valley grassland exhibits considerable spatial and temporal variation at many scales. Annual rainfall amount and pattern, temperatures during the growing season, variation in soil chemistry and texture, topographic variation, and land-use history, among other variables, largely determine species composition, biomass production, and dominance relationships (Eviner 2016). Management activities such as livestock grazing can achieve goals such as invasive weed control, grassland fuel reduction, or wildlife habitat enhancement (see, for example, Gennet et al. 2017), but generally do not cause spatially or temporally consistent changes in grassland community composition at the landscape level (Jackson and Bartolome 2002), although in some specialized community types such as vernal pools, grazing does appear to maintain native diversity and abundance (Marty 2015; see Section 4.5).

Blue oak woodland

Blue oak woodland or savannah is a small component of Beale's vegetation (Beale AFB 2015, 77), about 481 acres. The blue oak woodland/savannah type is found in the foothills around the Central Valley. Percent canopy cover can vary substantially. The herbaceous understory is often an extension of the Valley grassland: for the most part familiar annual grasses and forbs. Shrub species such as poison-oak (*Toxicodendron diversilobum*) also occur in this type (Allen-Diaz et al. 2007; Bartolome et al. 2007a).

The future of the blue oak woodland type in California is a cause for concern. Statewide surveys over the last few decades have noted a lack of sapling-sized blue oaks in some locations; if this shortage of saplings continues, blue oak stands may begin to thin and disappear as adult trees die but are not replaced (Allen-Diaz et al. 2007; EM-Assist 2010a). Research has shown that vertebrate grazing by wildlife and livestock reduces growth and survival of blue oaks; protection of seedlings as they move into the sapling stage may be necessary for successful maintenance of blue oak stands (Allen-Diaz et al. 2007). Cattle grazing, however, may indirectly help blue oak seedlings by reducing competition with annual grasses and forbs (Tyler et al. 2006). See Section 4.5 for further details on Beale's blue oak woodlands.

Riparian forest and scrub

The 316 acres of native riparian vegetation at Beale include several riparian forest types and riparian scrub (Beale AFB 2015, 77). Riparian forest types that occur at Beale are cottonwood-willow (*Populus fremontii* Forest Alliance, per Sawyer et al. 2009), valley oak (*Quercus lobata* Woodland Alliance, per Sawyer et al. 2009), and mixed riparian forest (Vaghti and Greco 2007). Much of the Central Valley's valley oak riparian forest has been converted to agricultural uses, and, as with blue oak, valley oak recruitment is a conservation concern (Allen-Diaz et al. 2007; Vaghti and Greco 2007). Riparian scrub at Beale is characterized by dense thickets of various willow species (*Salix* spp.; Vaghti and Greco 2007). Riparian woodland habitat is a critical wildlife resource, especially for birds, and is used by a wide variety of species (Vaghti and Greco 2007).

4.5 Sensitive biological resources and grazing effects

Native grasses and other native herbaceous plants

Stands of the common native perennial bunchgrass, purple needlegrass (*Stipa* [*Nassella*] *pulchra*), occur on Beale in several locations (Marty et al. 2005), including a cattle-grazed pasture unit (Pasture Unit D-1), in which purple needlegrass was planted in 1999 as part of a grassland restoration project (Holland and Griggs 2006). The Base's firing range also contains a population of purple needlegrass, which, although ungrazed, appears to respond well to frequent mowing at the firing range (Pers. obs., July 2015).

Purple needlegrass, the state's most intensively studied native grass, has shown varied responses to grazing: increasing in some instances, decreasing in others, or exhibiting no change (D'Antonio et al. 2002). Inconsistent responses probably reflect time- and/or site-specific factors rarely evaluated in grazing studies. Happily, site-specific information on purple needlegrass' response to grazing is available from research conducted at Beale: cattle grazing reduced the height and reproductive stem production of purple needlegrass but did not appear to affect seedling numbers the following year (Marty et al. 2005). Furthermore, grazing from January to May appeared to increase purple needlegrass seedling survival, probably by reducing competition with non-native annual plants. In ungrazed plots, seedling numbers were low. Importantly, the researchers noted that annual weather patterns had strong effects on purple needlegrass growth, reproduction, and mortality, with favorable weather patterns resulting in peak growth and reproductive stem production, irrespective of grazing status. Marty et al. (2005) concede that their study did not last long enough to elucidate the long-term effects of grazing on purple needlegrass at Beale so continued monitoring would help to inform management of the Base's purple needlegrass stands.

Several other native perennial and annual grasses are reported to occur at Beale, including California melic (*Melica californica*), big squirreltail grass (*Elymus multisetus*), spidergrass (*Aristida ternipes*), small or Pacific fescue (*Festuca* (*Vulpia*) *microstachys*), and oldfield three awn (*Aristida oligantha*; Beale AFB 2015, 74, A5-72). Research investigating grazing effects on native grasses other than purple needlegrass is very limited. A 2-year study near Mt. Hamilton in Santa Clara County found that California melic tiller production declined substantially and mortality increased with clipping, a proxy for grazing, in December; interestingly, the grass responded positively to clipping in late April after senescence (Dennis 1989). In a 3-year study in the dry Valley grassland of Carrizo Plain National Monument, the cover and number of small fescue flowers declined substantially following clipping (Kimball and Schiffman 2003). In general, research suggests that California native grass species react differently to grazing (Dennis 1989). Therefore, a grazing program that maintains a mosaic of grazing timings and intensities over the landscape level may optimize native grass biodiversity

(Huntsinger et al. 2007; D'Antonio et al. 2002); the same almost certainly also holds true for the numerous native forbs of the Valley grassland.

Five special-status native plant species, all herbaceous forbs, are known to occur at Beale (Beale AFB 2015, 78-84):

- dwarf downingia (*Downingia pusilla*) is an annual forb classified in the California Native Plant Society's Inventory of Rare and Endangered Plants as 2B.2: Plants rare, threatened, or endangered in California but more common elsewhere: Fairly threatened in California (CNPS 2016). The species blooms from March through May and is found in vernal pools and mesic grasslands. Potential threats include urbanization, development, agriculture, grazing, non-native plants, vehicles, and industrial forestry (CNPS 2016).

- hogwallow starfish (*Hesperevax caulescens*) is an annual forb classified in the California Native Plant Society's Inventory of Rare and Endangered Plants as 4.2: Plants of limited distribution: Fairly threatened in California (CNPS 2016). The species blooms from March through June and is found in vernal pools and mesic, clay grasslands. Potential threats include development, agriculture, and possibly overgrazing (CNPS 2016).

- Greene's legenere (*Legenere limosa*) is an annual forb classified in the California Native Plant Society's Inventory of Rare and Endangered Plants as 1B.1: Plants rare, threatened, or endangered in California and elsewhere: Seriously threatened in California (CNPS 2016). The species blooms from April through June and is found in vernal pools. Potential threats include grazing, road widening, non-native plants, and development (CNPS 2016).

- Tehama navarretia (*Navarretia heterandra*) an annual forb classified in the California Native Plant Society's Inventory of Rare and Endangered Plants as 4.3: Plants of limited distribution: Not very threatened in California (CNPS 2016). The species blooms from April through June and is found in vernal pools and mesic grasslands (CNPS 2016).

- stinkbells (*Fritillaria agrestis*) is a perennial bulb classified in the California Native Plant Society's Inventory of Rare and Endangered Plants as 4.2: Plants of limited distribution: Fairly threatened in California (CNPS 2016). The species blooms from March through June and is found woodland, grassland, and chaparral. Potential threats include development, grazing, vehicles, and possibly non-native plants (CNPS 2016).

These special-status plant species may be vulnerable to livestock grazing and trampling, but there is very little information describing livestock effects for these species. Some general studies have found greater native California grassland forb diversity in grazed areas than in ungrazed areas (e.g., Hayes and Holl 2003). These five forbs are small-statured, potentially creating intense competition for light with taller non-native grasses. Grazing may ameliorate this competition by reducing vegetation height. In general, cattle prefer to eat grass rather than forbs (Larson et al. 2015) and so are likely to reduce non-native grasses, with limited impact on forbs.

The first four special-status forbs are found primarily in vernal pools. Although grazing or overgrazing is listed as a potential threat for three of the four, research indicates that carefully managed livestock grazing in vernal pools tends to benefit native plant species (see Vernal pool ecosystems section below). The U.S. Fish and Wildlife Service (USFWS) in their vernal pool recovery plan observed that while more than one-third of Greene's legenere populations were in areas grazed by livestock, few of those populations were declining and cited a study that indicated that light grazing during winter and early spring did not appear to harm the species (USFWS 2005).

Land-use history and likely historic grassland composition (see Section 4.4) at Beale AFB are factors that must be considered when evaluating the potential of the grazing program to achieve goals related to native plant enhancement. Several California grassland researchers have noted that native perennial bunchgrasses, including purple needlegrass, and native annual forbs are rarely found in former crop agriculture fields (Bartolome et al. 2007a). In those Beale grazing Management Areas with a known cultivation history and a concomitant low abundance of native species, native herbaceous plant enhancement may be impractical without a significant active restoration effort. Management Areas with no cultivation history may prove more suitable for native plant restoration.

Oak recruitment

As noted above, protection of blue oak seedlings from grazing will increase the probability of recruitment of seedlings into the sapling stage. Especially when rangeland is grazed during the summer, livestock may browse on seedlings (McCreary and George 2005; McCreary 2001), although livestock grazing may also indirectly help blue oak seedlings by reducing competition with non-native annual grasses and forbs (Tyler et al. 2006). Wildlife, such as deer, feral pigs, and gophers, can also have a significant impact on oak seedlings.

Beale's blue oak woodlands for the most part occur in areas not grazed by livestock, although the Management Area E horse pasture units, grazed year-round, are in blue oak woodland. Horses do not typically browse woody vegetation, although trampling impacts may occur. In fact, the tannins in oak species are often considered toxic for livestock, including horses, (e.g., Martinson et al. undated). Horses are likely to eat surrounding annual grasses, which may reduce oak seedlings' competitive burden. Beale's primary valley oak riparian woodland along Dry Creek is not grazed by livestock (EM-Assist 2010a; Beale AFB 2015, 132); the eastern portion of cattle-grazed Pasture Unit D-6 contains scattered valley oaks (Ed Broskey, pers. comm., November 2016).

Beale AFB commissioned an oak restoration study in 2010, during which regeneration of valley and blue oaks was assessed (EM-Assist 2010a). The study's report concluded that the:

> two primary oak species on the base, blue oak and valley oak, are successfully regenerating in many areas of Beale AFB. This success is believed to be attributable to the low use these areas receive, particularly the lack of livestock grazing in most oak woodlands on the base (EM-Assist 2010a, 6).

Of the seven natural oak woodlands surveyed as part of the study, five of the sites, NCO Club, Candy Cane Park, West Dry Creek, south of Delta Drive, and Ryden Park, were actively regenerating. Two of the oak woodland sites, east of the Medical Center and Saddle Club, did not appear to be regenerating (EM-Assist 2010a). Saddle Club oak woodland is located in the Management Area E horse pasture units.

During a Beale site visit in November 2016 for these *Guidelines*, oak regeneration in the valley oak woodland east of the Medical Center (Pasture Unit D-6) and in the blue oak woodland in two Management Area E horse pasture units was informally evaluated. No valley oak seedlings or saplings in Pasture Unit D-6 were observed, and several of the mature valley oaks appeared to be dead. In the horse pasture units adjacent to Dry Creek (E-2 and E-5), four blue oak seedlings were found, all less than 1 foot in height; on the other side of the Dry Creek fence, multiple blue oak seedlings and saplings were evident[5]. No oak seedlings were observed in the horse pasture unit adjacent to the Base boundary fence (E-1).

At least seven oak (along with other species) planting projects have been implemented on Beale over the past twenty years. Three of these projects appear to have been successful, but planted oaks along Dry Creek do not appear to be thriving and are described as well browsed (EM-Assist 2010a). Given the absence of livestock grazing along Dry Creek, this suggests that wildlife may be preventing seedlings escaping the browse line into the sapling stage. The oak restoration report judges, correctly, that planting and protection of oaks in existing woodland areas is likely to have higher probability of success than restoration in non-woodland areas (EM-Assist 2010a).

Beale should continue to evaluate blue and valley oak regeneration and recruitment to ascertain the need for oak seedling protection. For example, protecting the four volunteer blue oak seedlings observed in the Dry Creek horse pasture unit may result in rapid above-ground growth of the seedlings; oak seedlings with minimal above-ground biomass often have deep and extensive root systems, allowing them to grow rapidly once protected (McCreary et al. 2011). Volunteer or planted oak seedlings should be protected from wildlife and livestock browsing using "treeshelters": individual, translucent plastic tube protectors that fit over oak seedlings and are secured with a metal fence post (McCreary 2001; McCreary et al. 2011). In addition to protection from browsing, treeshelters stimulate above-ground growth of oak seedlings by acting as a mini-greenhouse (McCreary 2001). McCreary (2001) and McCreary and George (2005) recommend the following practices:

1) use a 4-foot-tall treeshelter and leave in place for at least three years after the seedling has grown out of the top; the base of the treeshelter should be buried in the ground; the treeshelter top should have flexible wire threaded through it to prevent birds getting trapped inside the tube (see McCreary 2001 for details); this flexible wire should be removed as the oak grows out of the treeshelter; and

2) use a heavy metal fence post pounded in at least 1 foot deep and secured to the treeshelter with wire; the top of the fence post should be lower than the top of the treeshelter.

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[5] This does not necessarily indicate a grazing effect; access to greater soil moisture nearer the creek may also be a primary determinant of oak regeneration at this site.

Livestock attractants, such as salt and mineral licks and water troughs, should be placed at least ¼ mile from oak seedling protection sites (McCreary and George 2005). Treeshelters should be checked annually for maintenance needs and removed before the tree's diameter is as large as the shelter's. See McCreary (2001), available online, for detailed instructions on use of treeshelters.

Vernal pool ecosystems

Vernal pools form in small depressions that are underlain by impervious layers of clay or cemented hardpans (IER 2015). Winter rain collects in the depression and forms a pool; as spring progresses, the pool begins to dry and during the summer is typically bone-dry. Depending on the time of year, vernal pools are too wet for most upland plants or too dry for wetland plants, making survival difficult for most plant species but resulting in numerous endemic taxa: plants and animals that have evolved to tolerate the harsh and changing conditions of vernal pools (Bartolome et al. 2014). A highly specialized suite of plants has evolved that can tolerate both the aquatic and drought phases of the vernal pool cycle (Solomeshch et al. 2007). They typically germinate and begin to grow underwater, but their adult life generally occurs in much drier conditions. Endemic vernal pool tadpole and fairy shrimp species, several of which are federally listed, must also cope with desiccation for part of the year or longer.

In addition to these endemic species, vernal pools provide "safe space" for many other native plants that are largely responsible for vernal pool spring wildflower displays. The inhospitable growing conditions make it difficult for non-native grasses and forbs to flourish so native species do not have to compete with them for resources to such an extent. Unfortunately, certain non-native plant species threaten vernal pools, despite their harsh growing conditions. Although most non-native species cannot grow in a vernal pool while it is wet, they can hug the boundary of a pool as it dries, competing with native wildflowers on the edges and increasing the evapotranspiration rate for the pool water, which shortens pool inundation period. This has likely contributed to localized losses of native fauna and flora in Central Valley vernal pools (Marty 2005). Cattle grazing has been shown to protect native plant and animal biodiversity in vernal pool ecosystems in part by reducing non-native plants' competitive impacts and evapotranspiration (Marty 2015). An additional challenge facing vernal pool species is that most historic vernal pools across the state have been damaged by or lost to urban and agricultural development (Solomeshch et al. 2007), including some at Beale (Beale AFB 2015, 73).

Hydrology of vernal pool complexes is an essential consideration in their management. Depth, surface area, and duration of pool inundation affect habitat suitability and quality for many vernal pool plant and animal species (Lichvar et al. 2006; Solomeshch et al. 2007). Vernal pool hydrology is determined by annual rainfall amount and timing and by local topography, with surface and subsurface flow from the surrounding landscape filling pools (Stallings and Warren 1996; Solomeshch et al. 2007; IER 2015).

Beale contains almost 11,000 vernal pools, primarily in the western, central, and southern portions of the Base (Beale AFB 2015, 69; HDR 2016). In addition, the Base contains many constructed mitigation vernal pools (IER 2015). The Beale INRMP lists the following native plant species as dominating vernal pools on Base (Beale AFB 2015, 74):

> coyote thistle (*Eryngium* sp.), California goldfields (*Lasthenia californica*), Fremont's goldfields (*Lasthenia fremontii*), white flowered navarretia (*Navarretia leucocephala*), bractless hedge-hyssop (*Gratiola ebracteata*), vernal buttercup (*Ranunculus bonariensis* var. *trisepalus*), annual hairgrass (*Deschampsia danthonioides*), field owl's-clover (*Castilleja campestris*), Sacramento mesamint (*Pogogyne zizyphoroides*), and dwarf woolly marbles (*Psilocarphus* sp.).

Two federally listed invertebrate animal species have been found in vernal pools at Beale: vernal pool fairy shrimp (*Branchinecta lynchi*) and vernal pool tadpole shrimp (*Lepidurus packardi*). In addition, the Western spadefoot toad (*Spea hammondii*), another special status species that uses vernal pools, may have been detected on Base during recent surveys.

Vernal pool branchiopods

Vernal pools at Beale AFB contain two federally listed branchiopods: vernal pool fairy shrimp (*Branchinecta lynchi*; federally threatened) and vernal pool tadpole shrimp (*Lepidurus packardi*; federally endangered; Beale AFB 2015, 90). Livestock grazing may help maintain the necessary hydrological conditions for reproduction of these two California vernal pool branchiopods, which require several weeks to mature (USFWS 2007a and b). A Sacramento County grazing exclosure study demonstrated that, after 9 years without livestock grazing, vernal pools took up to 2 weeks longer to fill and dried 1-2 weeks earlier on average than comparison grazed pools (Marty 2015). As noted above, livestock reduce non-native cover, which in turn reduces evapotranspiration, resulting in longer vernal pool inundation periods. In addition, Marty (2015) suggests that non-native plant thatch build-up in ungrazed pools increases soil organic matter and consequently soil water-holding capacity; as a result, the surrounding soil holds more water in an ungrazed vernal pool, and less is retained in the vernal pool itself, reducing inundation period. In its most recent 5-year reviews for both vernal pool fairy and tadpole shrimp, the USFWS states that cessation of grazing is a threat to the species, while noting that overgrazing that modifies vernal pools by increasing sedimentation and nutrient inputs is also likely to be a threat; livestock trampling may also crush shrimp cysts (USFWS 2007a and b).

Western spadefoot toad

The Western spadefoot toad (*Spea hammondii*), a California Species of Special Concern and currently under review for federal listing (USFWS 2015a), may occur in Beale AFB vernal pools: the species may have been detected on Base during 2012 and 2016 surveys (Beale AFB 2015, 91; Beale AFB 2016, 60). As with the vernal pool branchiopods, livestock grazing may help maintain the necessary pool inundation period for completion of the toad's metamorphosis, estimated to average 58 days (Morey 1998; USFWS 2005, II-227-II-228; Marty 2005). In addition, longer inundation periods are thought to improve juvenile survivorship and fitness by permitting longer larval development and fat accumulation (Morey 1998; USFWS 2005, II-228).

Western spadefoot toads prefer areas of open vegetation and short grass (USFWS 2005, II-230-II-231). The increased levels of both live biomass and thatch produced by non-native grasses may degrade habitat values for the toad and interfere with movement, including dispersal by toadlets. Livestock grazing generally reduces vegetation height and removes biomass so may reduce this impact on the toad. Dispersing toadlets may seek refuge under, among other habitat elements, cow pies (USFWS 2005, II-228). Livestock may cause negative impacts while using vernal pool areas by trampling toad egg clusters and juvenile and adult toads (USFWS 2005, II-233).

Other special-status wildlife species

The Beale INRMP lists 32 other special-status wildlife species that are known to occur on Base (Beale AFB 2015, 88-113). Table 4-5 summarizes possible grazing effects on these species.

An obvious commonality running through Table 4-5 is that, although clear-cut, high-quality research evidence is usually pretty skimpy, livestock grazing in riparian areas appears likely to be negative for many of the special-status species. As noted above, Dry Creek is not available to livestock and so negative impacts of livestock grazing are likely to be minimal in this riparian zone. Parts of Reeds Creek and the Management Area D portions of Hutchinson Creek, however, are used by livestock as no other water source is available, and so special-status species may be experiencing negative impacts of grazing in those locations. During a Beale site visit in November 2016, evidence of cattle in Reeds Creek creekbed in Pasture Unit A-1 was observed. Bank slump erosion was occurring, although whether the slumping was caused by cattle use was not clear; woody riparian vegetation was also sparse in the area. Beale AFB should evaluate grazing impacts in these two riparian zones[6]. Potential actions to reduce livestock impacts include installing troughs in those pasture units without them to reduce reliance on creek water and placing livestock attractants so as to draw livestock away from the riparian zone. Excluding livestock with fencing along the riparian corridor is also an option, although an expensive one and with drawbacks of its own, including disturbing the riparian zone during fence installation, impeding wildlife access to drinking water and to the riparian zone in general, and potentially encouraging, in the absence of grazing, riparian weeds.

[6] The 2000 Range Management Assistance Team report similarly recommended that Beale should monitor livestock impacts on the unfenced riparian corridors in the Beale pasture units (RMAT 2000, 26-27).

Table 4-5: Possible grazing effects on special-status wildlife species known to occur at Beale AFB (Beale AFB 2015, 88-113).

Species	Special status (Beale AFB 2015; CDFW 2016)	Habitat/ occurrence (Beale AFB 2015)	Potential effects of livestock grazing and associated impacts	Grazing impact assessment
Birds				
Accipiter cooperii (Cooper's hawk)	State Taxa to Watch	Oak woodlands, riparian woodlands, and second growth coniferous forests for nesting; uses dense stands with moderate crown depths for nesting; often nests near water; uses snags and dead branches for resting and perching; woodlands and edges of other habitats for foraging	Livestock impacts to riparian areas could affect nests; in Arizona, nesting success was lower in heavily grazed areas than in lightly grazed areas (Stephens and Anderson 2002).	Grazing possibly negative.
Accipiter striatus (sharp-shinned hawk)	State Taxa to Watch	Breeds primarily in lower elevation conifer forests and oak, pinon-juniper, aspen, and riparian woodlands; nests in single-tiered dense pole and small tree stands; feeds in open stands; often nests near water	Grazing effects on this species unknown (Stephens and Anderson 2002).	Grazing effects unknown.
Agelaius tricolor (tricolored blackbird)	Federal Bird of Conservation Concern and currently under review for federal listing (USFWS 2015b); State Candidate for Listing	Breeds in freshwater marshes and blackberry thickets; cattail and tule marshes, blackberry thickets, mustard and thistle stands for nesting; grasslands, agricultural fields, irrigated pastures, and wetlands for foraging; known to forage up to 5 miles from nesting colony	Generally breeds in freshwater marshes and agricultural fields; grazing vegetation to < 15 cm can improve foraging habitat (TBWG 2009); livestock grazing can eliminate breeding colonies located in mustard stands (Meese 2016).	Heavy grazing in mustard-dominated breeding areas likely negative; grazing probably beneficial in foraging areas.
Aquila chrysaetos (golden eagle)	Federal Bald and Golden Eagle Protection Act; State Taxa to Watch and Fully Protected	Grasslands and savannas for foraging; oak woodlands and cliffs for nesting	Moderate grazing improves habitat for primary prey species; livestock also source of carrion (ECCC HCP 2006a).	Grazing beneficial if not excessive.

Species	**Special status (Beale AFB 2015; CDFW 2016)**	**Habitat/ occurrence (Beale AFB 2015)**	**Potential effects of livestock grazing and associated impacts**	**Grazing impact assessment**
Asio flammeus (short-eared owl)	State Species of Special Concern	Use fresh and saltwater marshes, lowland meadows, and irrigated alfalfa fields; need dense tules or tall grass for nesting and daytime roosts	Livestock grazing may reduce prey availability; ground nests are vulnerable to livestock trampling (Johnson and Horn 2008; Shuford and Gardali 2008).	Grazing likely negative.
Athene cunicularia hypugea (western burrowing owl)	Federal Bird of Conservation Concern; State Species of Special Concern	Breeds and forages in annual grasslands and agricultural fields; open, dry, and nearly level grassland or prairie habitat; nests in fossorial mammal burrows and man-made burrows	Burrowing owls often require short grass for foraging; burrowing owl often associated with grazed areas; livestock grazing may enhance burrowing owl foraging and nesting habitat (Kantrud and Kologiski 1982; Lantz et al. 2004); short grass may be correlated with presence of ground squirrels in whose burrows owls nest (Wilson 2015); burrowing owl nests lined with livestock manure may have higher success rate (Dechant et al. 2002a).	Grazing beneficial if not excessive.
Buteo regalis (ferruginous hawk)	Federal Bird of Conservation Concern; State Taxa to Watch	Open grassland with perch sites	Grazing reduces plant cover, making prey more visible (Dechant et al. 2002b); in Central Valley, ferruginous hawk at higher densities in grazed compared to ungrazed grasslands (Pandolfino et al. 2011).	Grazing beneficial if not excessive.
Buteo swainsoni (Swainson's hawk)	Federal Bird of Conservation Concern; State Threatened	Riparian habitats and isolated trees for nesting; grasslands and agricultural fields for foraging	Nests strongly associated with riparian vegetation; grasslands provide foraging habitat only: grazing may increase visibility of prey by reducing cover (Woodbridge 1998); in Central Valley, Swainson's hawk strongly associated with grazed grasslands (Swolgaard et al. 2008).	Grazing beneficial if not excessive.

Species	Special status (Beale AFB 2015; CDFW 2016)	Habitat/ occurrence (Beale AFB 2015)	Potential effects of livestock grazing and associated impacts	Grazing impact assessment
Circus cyaneus (northern harrier)	State Species of Special Concern	Nests in dense grasslands and wetlands; forages in wetlands, grasslands, and agricultural fields	Overgrazing can reduce prey base of small mammals; ground nests are highly vulnerable to livestock trampling (Shuford and Gardali 2008); in Central Valley, northern harrier more abundant in ungrazed compared to grazed grasslands (Pandolfino et al. 2011).	Grazing probably negative, especially during nesting season.
Dendroica petechia (yellow warbler)	State Species of Special Concern	Riparian (including willow and cottonwood) forests and scrub habitats for nesting and foraging; breeds in riparian woodlands, montane chaparral, conifer forests with substantial brush; and desert woodlands	In OR and AZ, removal of heavy cattle grazing in riparian willow shrub habitat significantly increased yellow warbler numbers (Taylor and Littlefield 1986; Krueper et al. 2003).	Heavy grazing in riparian habitat negative.
Elanus caeruleus (white-tailed kite)	Federal Species of Concern; State Fully Protected	Open savannas, grasslands, and wetlands for foraging; trees and large shrubs in riparian and oak woodland areas for nesting	Livestock grazing may reduce prey availability (Johnson and Horn 2008); in Central Valley, white-tailed kite is more abundant in ungrazed compared to grazed grasslands (Pandolfino et al. 2011).	Grazing probably negative.
Falco mexicanus (prairie falcon)	Federal Bird of Conservation Concern; State Taxa to Watch	Nests on cliff ledges and escarpments; forages in open country, including grasslands	Prairie falcons at higher densities in grazed compared to ungrazed grasslands (Pandolfino et al. 2011; Foss 2016).	Grazing probably beneficial if not excessive.
Falco peregrinus anatum (American peregrine falcon)	Federally Delisted and Bird of Conservation Concern; State Delisted and Fully Protected	Protected ledges of high cliffs, usually adjacent to marshes, lakes, or rivers, for nesting; open habitats for foraging; in winter forages in grasslands and wetlands	Heavy livestock grazing of grasslands and riparian vegetation could potentially reduce abundance of avian prey (USFWS 1999).	Grazing probably not significant.

Species	Special status (Beale AFB 2015; CDFW 2016)	Habitat/ occurrence (Beale AFB 2015)	Potential effects of livestock grazing and associated impacts	Grazing impact assessment
Grus canadensis tabida (greater sandhill crane)	State Threatened and Fully Protected	Summers in open terrain near shallow lakes or freshwater marshes; winters in plains and valleys near bodies of fresh water and agricultural fields	Heavy livestock use of wetlands can disrupt nesting and, by reducing vegetative cover, make nests more visible to predators (USFS 1999; Ivey and Dugger 2008); however, in OR, no effects of grazing on nest success were found (Ivey and Dugger 2008).	Grazing in wetlands possibly negative during nesting season.
Haliaeetus leucocephalus (bald eagle)	Federally Delisted but protected under Federal Bald and Golden Eagle Protection Act; State Endangered and Fully Protected	Large lakes or streams with large trees for nesting; lakes, reservoirs, and streams with perching trees for foraging	Overgrazing in riparian areas may degrade bald eagle habitat (USFWS 2012a); in Central Valley, bald eagle equally abundant in grazed compared to ungrazed grasslands (Pandolfino et al. 2011).	Grazing probably not significant.
Icteria virens (yellow-breasted chat)	State Species of Special Concern	Nests in dense, multilayered riparian forests with perennial or nearly perennial water	In AZ, removal of cattle grazing in riparian habitat significantly increased yellow-breasted chat numbers (Krueper et al. 2003).	Heavy grazing in riparian habitat negative.
Lanius ludovicianus (loggerhead shrike)	Federal Bird of Conservation Concern; State Species of Special Concern	Grasslands and agricultural areas. Prefers open habitats with scattered shrubs, trees, posts, fences, utility lines, or other perches	Studies in western US found no grazing impact or slightly positive grazing effect (CalPIF 2005).	Grazing possibly beneficial if not excessive.

Species	Special status (Beale AFB 2015; CDFW 2016)	Habitat/ occurrence (Beale AFB 2015)	Potential effects of livestock grazing and associated impacts	Grazing impact assessment
Laterallus jamaicensis coturniculus (California black rail)	Federal Bird of Conservation Concern; State Threatened and Fully Protected	Tidal salt marshes associated with heavy growth of pickleweed; also occurs in brackish marshes or freshwater marshes at low elevations	In a study conducted primarily at Spenceville Wildlife Area, marsh habitat that received water primarily from irrigation inputs and had light to moderate winter/spring grazing had the highest levels of California black rail occupancy, possibly due to increased summer vegetative cover from summer inputs of water; marsh habitat that received water primarily from natural springs or streams and that was winter/spring-grazed had the lowest levels of occupancy (Richmond et al. 2012).	Grazing in wetlands that receive water primarily from natural springs or streams probably negative; grazing in wetlands that receive water primarily from irrigation inputs possibly beneficial.
Pandion haliaetus (osprey)	State Taxa to Watch	Rivers, lakes, and reservoirs with perching trees for foraging; large trees within 1 mile of aquatic habitats (lakes and streams) for nesting	Grazing impacts on water quality could affect fish, osprey's primary prey (Zwartjes et al. 2005).	Grazing possibly negative, if it degrades water quality for fish habitat.
Pelecanus erythrorhynchos (American white pelican)	State Species of Special Concern	Found in fresh or saltwater bodies of various depths	No effects noted (Shuford and Gardali 2008).	Grazing effects unknown but probably not significant.
Plegadis chihi (white-faced ibis)	Federal and State Species of Special Concern	Prefers freshwater marshes with tules, cattails, and rushes, but may nest in trees and forage in flooded agricultural fields	White-faced ibis breeding colony abandoned in UT marsh following intensive overgrazing by cattle (Weller et al. 1958).	Heavy grazing in wetlands probably negative during nesting season.
Fish				
Oncorhynchus mykiss (Central Valley steelhead)	Federally Threatened	Perennial and intermittent streams	Land use activities, including livestock grazing, have affected habitat by changing streambank and channel morphology, increasing water temperatures, and impairing water quality (McEwan and Jackson 1996).	Heavy grazing in riparian areas negative; grazing is not likely to affect species because habitat on Base is found only in and adjacent to ungrazed Dry Creek area (Beale

Species	Special status (Beale AFB 2015; CDFW 2016)	Habitat/ occurrence (Beale AFB 2015)	Potential effects of livestock grazing and associated impacts	Grazing impact assessment
				AFB 2015, 155).
Oncorhynchus tshawytscha (fall-run chinook salmon)	Federal and State Species of Special Concern	Perennial and intermittent streams	Grazing may alter habitat but is considered low level threat (CDFW undated).	Heavy grazing in riparian areas negative; grazing is not likely to affect species because habitat on Base is found only in and adjacent to ungrazed Dry Creek area (Beale AFB 2015, 155).
Insect				
Desmocerus californicus dimorphus (Valley elderberry longhorn beetle)	Federally Threatened	Riparian and oak savannas habitats with elderberry (*Sambucus* spp.)	Cattle can consume new growth of host plant, reducing habitat availability but probably not crushing beetle young (USFWS 1984; Barr 1991; USFS 1999); grazing is not considered a widespread threat (USFS 1999; USFWS 2012b).	Grazing probably not significant; grazing is not likely to affect species because habitat on Base is found only in and adjacent to ungrazed Dry Creek area (Beale AFB 2015, 155).
Mammals				
Antrozous pallidus (pallid bat)	State Species of Special Concern	Open, dry habitats with rocky areas for roosting; roosts in undisturbed areas, such as abandoned buildings and caves	Grazing may reduce vegetative “clutter”, increasing prey availability but may also reduce prey abundance (Gervais 2016; Rainho et al. 2010); grazing should be used to maintain vegetation heterogeneity and structure (Gervais 2016); grazing can reduce regeneration of oak woodland, pallid bat roosting habitat (USFS 1999).	Grazing probably beneficial if not excessive.
Bassariscus astutus (ringtail)	State Fully Protected	Prefers riparian forests, chaparral, brushland, oak woodlands, and rocky hillsides	No information found.	Grazing effects unknown.

Species	Special status (Beale AFB 2015; CDFW 2016)	Habitat/ occurrence (Beale AFB 2015)	Potential effects of livestock grazing and associated impacts	Grazing impact assessment
Corynorhinus townsendii (Townsend's big-eared bat)	Federal and State Species of Special Concern; State candidate (endangered)	Found in a variety of habitats; roosts in caves, tunnels, mines, crevices, and buildings; usually near water; data from Vandenberg AFB indicate that grassland habitat used frequently by species in some years (CEMML 2014, 18, 21-22)	In a Marin County, CA, study, species found to forage in heavily vegetated stream corridors and to avoid open, grazed grasslands; no evidence to determine whether this was a preference for forested areas or avoidance of grazed areas (Fellers and Pierson 2002; ECCC HCP 2006b); grazing effects on riparian overstory vegetation and sediment transport into streams may reduce habitat values (Gruver and Keinath 2006).	Heavy grazing in riparian areas probably negative; grazing in upland grasslands possibly negative.
Lasiurus blossevillii (western red bat)	State Species of Special Concern	Known to roost in cottonwoods or willows but is commonly detected in a variety of habitats	Overgrazing in riparian areas, especially willow-dominated, may degrade foraging and roosting habitat (USFS 1999).	Heavy grazing in riparian areas probably negative.
Myotis ciliolabrum (western small-footed myotis)	Federal Species of Special Concern	Found in a variety of habitats where it roosts singly or in small groups in cliff and rock crevices, buildings, concrete overpasses, caves, and mines	Grazing effects on this species unknown; livestock could trample ground roosts; grazing could improve habitat by reducing vegetation height (Schmidt 2003a).	Grazing effects unknown.
Myotis volans (long-legged myotis)	Federal Species of Special Concern	Uses abandoned buildings, cracks in the ground, cliff crevices, exfoliating tree bark, and hollows within snags as summer day roosts; caves and mine tunnels as hibernacula	Grazing effects on this species unknown (Schmidt 2003b).	Grazing effects unknown.
Reptiles				
Actinemys marmorata marmorata (northwestern pond turtle)	Federal and State Species of Special Concern	Ponds, marshes, and streams for foraging and cover; adjacent grasslands and savannas for nesting	Livestock may trample eggs and small juveniles; grazing may degrade aquatic habitat (USFS 1999; Hayes et al. 1999); pond turtles in coastal California use grazed grasslands for nesting and as terrestrial refuge (Rathbun et al. 2002).	Heavy grazing in riparian areas probably negative.

Species	Special status (Beale AFB 2015; CDFW 2016)	Habitat/ occurrence (Beale AFB 2015)	Potential effects of livestock grazing and associated impacts	Grazing impact assessment
Thamnophis gigas (giant garter snake)	Federally Threatened; State Threatened	Marshes, water conveyance channels, and adjacent uplands	Grazing can degrade upland refugia; trampling can damage aquatic and terrestrial vegetation needed for cover and thermoregulation; well-managed sheep or goat grazing can maintain habitat (USFWS 2012c).	Heavy cattle grazing in riparian areas probably negative; managed sheep or goat grazing possibly beneficial.

The species- and habitat-specific grazing effects information in this section provides evidence that livestock grazing, when well managed, can prove of specific conservation benefit in many instances. In general, livestock grazing lowers vegetation height, removes plant biomass, and reduces competitive impacts, especially of non-native grasses; many native grassland wildlife and plant species prefer those habitat conditions. Care should be paid to minimize livestock impacts during vulnerable life history events for species of concern (e.g., nesting, dispersal of young, germination, seed fall, seedling to sapling recruitment in oaks) and vulnerable periods for habitats or landscapes (e.g., saturated soil, soil immediately post-fire). Riparian zones often bear the brunt of significant cattle use, causing negative impacts on vegetation and wildlife; cattle use of some creeks on Base may require management attention.

4.6 Cultural resources

Cultural resources can be affected by the activities of livestock, including trampling and rubbing/scratching behavior. At sites in which cultural resources are located, potential impacts of livestock activity on the cultural resources should be assessed and management actions to minimize or eliminate grazing impacts implemented.

The Beale INRMP states that 90% of Beale has been surveyed for cultural resources, and 127 prehistoric and historic era archeological sites have been found (Beale AFB 2015, 30). The Beale Cultural Resources Manager and the Beale Integrated Cultural Resources Management Plan are the sources for further information about the Base's cultural resources. Some natural resource management activities require coordination with the Beale Cultural Resources Manager before being implemented, including grazing-related activities such as:

- construction or removal of livestock fences, ponds, troughs, or livestock water pipelines running cross country,
- placement of salt licks for livestock, and
- off-road vehicle travel (Beale AFB 2015, 30).

Other rangeland-related activities requiring coordination with the Cultural Resources Manager include:

- prescribed burning, including firebreak construction,

- restoration projects such as vernal pool restoration, tree or native grass planting, and
- wildlife habitat improvement projects.

Furthermore, the Beale INRMP specifically states that:

> Cultural resources at Beale AFB may be adversely affected by livestock, particularly where cattle congregate and trample vegetation and compress the soil. Management practices prescribed by the Cultural Resources Manager will be implemented as part of the grazing program (Beale AFB 2015, 156).

If livestock are likely to congregate in a location (for example, because water or shade are available), fencing the site to exclude livestock is a reliable method of protecting cultural resources from livestock impacts. If a cultural resource site is not located in an area of concentrated livestock activity, livestock use of the area can often be managed so as to prevent damage to the cultural resource. Best management practices can be implemented, such as locating livestock-holding areas (e.g., corrals) and livestock water sources and placing mineral supplements or supplemental feed away from cultural resource sites. For such practices to be successful, communication between Beale's Natural Resources Manager, Cultural Resources Manager, and the Base grazing lessees is essential.

Livestock grazing can help reduce the adverse impacts of wildfire on cultural resources by lowering vegetative fuel loads to minimize wildfire risk. Invasive weeds and the dense thatch they often produce may also negatively impact cultural resource values, and livestock grazing can significantly reduce weeds and associated thatch.

5.0 Invasive plants at Beale AFB

Controlling invasive plants has proven to be one of the greatest challenges facing California rangeland managers and restoration practitioners (Stromberg et al. 2007). Beale has an invasive species management plan (EM-Assist 2010b), based on a weed survey in 2010 and on an earlier weed survey and plan (EDAW 2004). The principal rangeland weeds identified in the 2004 and 2010 plans were medusahead (*Elymus* [*Taeniatherum*] *caput-medusae*) and yellow starthistle (*Centaurea solstitialis*), both described as "extensive throughout the base" in the 2010 plan, and barbed goatgrass (*Aegilops triuncialis*) in the Dry Creek area of the base (EM-Assist 2010b, 3; EDAW 2004). More recently, the California Invasive Plant Council undertook a review of invasive species management at Beale and made recommendations for enhancing the Base's program (Cal-IPC 2015b). Building on a partial weed survey conducted in 2014 (H.T. Harvey & Associates 2015b), the Center for Environmental Management of Military Lands (CEMML) completed an invasive weed survey of the remainder of the Base in 2016 (CEMML 2017). In addition, several monitoring and weed treatment reports provide further information on weed populations and control efforts at Beale (CNLM 2015a, 2015b, 2016; HDR 2016). A detailed weed management strategy is beyond the scope of these *Guidelines*; general recommendations and brief overviews of common management methods for the three primary rangeland weed species of concern at Beale are provided below. Beale has contracted with CEMML to produce updated Invasive Plant Species Management Guidelines and associated work plans, addressing the 2014 and 2016 invasive weed survey data and incorporating the 2015 California Invasive Plant Council report recommendations; the Invasive Plant Species Management Guidelines and work plans will be completed in fall 2017.

Preventing new infestations is generally acknowledged as the most cost-effective method of managing invasive species (Lodge et al. 2006; NISC 2016), and the Beale Invasive Plant Species Management Guidelines should describe best management practices that reduce the likelihood that invasive plants are introduced onto Base. The 2004 weed plan lists a handful of best management practices, some of which should help prevent new introductions (EDAW 2004). A California Invasive Plant Council publication provides a comprehensive description of best management practices for preventing introductions of invasive plants (Cal-IPC 2012); its recommendations should be incorporated into the updated Beale Invasive Plant Species Management Guidelines. A weed management plan should also include a well-designed monitoring component that evaluates treatment effectiveness and assesses any unintended consequences, such as increased erosion or impact on non-target species. Neither the 2004 nor the 2010 weed management plan includes detailed monitoring protocols; they simply recommend implementing a monitoring program to assess effectiveness of treatments (EDAW 2004; EM-Assist 2010b). A recent yellow starthistle control report includes a useful, Beale-specific 'lessons learned' section that should be referred to in planning weed control activities on Base (HDR 2016, 33-34).

Invasive plant management tools available to rangeland managers include livestock grazing; however, a single weed management tool typically does not result in successful control (DiTomaso et al. 2007). To increase the likelihood of successful long-term control, weed management experts recommend combining several weed management methods, tailored to situation-specific goals, constraints, and opportunities (DiTomaso et al. 2007; NISC 2016).

Using livestock to control invasive plants often requires prescription grazing, which is the application of specified livestock grazing actions to accomplish specific vegetation management goals. Grazing intensity, animal distribution, and grazing period are often rather different from standard, light to moderate intensity grazing, and livestock performance may be significantly reduced. Consequently, finding a lessee willing to implement a grazing prescription can prove difficult and may require reduced grazing fees or even payment to the livestock operator. Furthermore, intensive grazing, sometimes necessary for successful weed control, can have undesirable consequences: concentrated hoof impacts and greatly reduced vegetative cover (i.e., reduced residual dry matter) could result in increased soil erosion, and greater area of bare ground may allow other weed species to establish and thrive. In addition, intensive grazing may significantly impact desirable species in the weed-infested area.

Those caveats noted, prescription grazing can work well in controlling some weed species (DiTomaso et al. 2007). An essential planning factor is that prescription grazing has to be timed to the target species' phenology. Grazing must occur when weeds are most vulnerable to defoliation; poorly timed grazing can actually benefit target species (Huntsinger et al. 2007). Timing prescription grazing to avoid vulnerable periods for *desirable* plants like native bunchgrasses may also be necessary. Another consideration is the effect of prescription grazing on stocking rate. Forage consumed as part of a grazing prescription should be considered when making stocking rate decisions, although Animal Unit Months in weed-infested areas may differ from standard calculations (see Section 6 and Appendix A). A weed management plan and associated work plans should address these important issues.

When developing a weed management work plan for an area that is grazed, if herbicide use is being contemplated, it is important to account for the fact that some herbicides have restrictions for use in rangelands, and treated areas may have to be excluded from livestock grazing for weeks or even an entire season, depending on the herbicide (DiTomaso et al. 2013, 510-511; Hulting 2016; Prather 2017). For example, Clethodim, recommended for goatgrass control, is not registered for use on land grazed by livestock unless grazing is excluded for 1-2 years (Beitz 2016). Although this trade-off may be well worth making in order to control a weed population, the restriction on livestock use should be planned for, in consultation with the grazing lessee.

Herbicide use on rangeland weeds can also result in loss of organic certification for livestock that graze in the treated area (Beale AFB 2012, 7) so lessees with organic livestock operations should be consulted before herbicides are used in their lease areas. Some organic certification-compatible herbicides are available, but information about their efficacy in range systems is generally limited. Available organic herbicides damage a plant upon contact but are not conveyed through the plant's vascular system so typically do not kill large or perennial plants; control of small, annual plants may be achievable. Available organic herbicides are also non-selective so will damage non-target plants if contact occurs (Cal-IPC 2015a, 9-10; Kyser 2015).

Prescribed burning for weed control is likely to reduce forage production by as much as half in the first year or two following the fire and should be planned for in consultation with the grazing lessee (RMAT 2000; Becchetti et al. 2011). Current Beale grazing leases require that lessees submit a grazing plan to the Base; these lessee grazing plans should include prescribed burn contingency plans (contingency planning for forage loss due to wildfire should also be included in lessee plans). If prescribed burning becomes a more frequently used management tool at Beale, development of a 'grassland bank' site may limit the impact of burning (and other treatments such as herbicides that require livestock exclusion for a long period) on grazing lessees (RMAT 2000, 33). A grassland bank is a pasture that is held in reserve and grazed intermittently as needed (see Section 4.3 Improvements for further details).

Finally, Beale should develop an early detection-rapid response program to find and eradicate incipient infestations of new invasive species or satellite populations of resident invasives, as recommended in the recent California Invasive Plant Council report to Beale (Cal-IPC 2015b, 5, 9). Invasive species experts consider such programs to be key for successful, long-term invasives control, in part because they allow for the possibility of immediate eradication at the stage when an invasive is at low numbers and occupies a small area (DiTomaso et al. 2007; NISC 2016). An early detection-rapid response program may also reduce invasive control costs over the long-term (Lodge et al. 2006). The National Invasive Species Council, of which the Department of Defense is a founding member, recently released a management plan that emphasizes early detection and rapid response as an essential strategy for reducing the adverse impacts of invasive species and lays out the action plan for implementing a national early detection-rapid response program over the next two years (NISC 2016).

Early detection-rapid response programs often rely upon reports from users of an area (e.g., lessees or recreational users; Lodge et al. 2006). Educational signs around corrals and at gates should briefly describe potential invasives, preferably with photographs, and ask users to take a georeferenced photo of any of those invasives they observe and send it to the Beale Natural Resources Manager[7]. Act upon user reports as soon as possible. Note that the Base Pest Management Plan does not allow lessees to apply pesticides themselves (Beale AFB 2012, 7).

5.1 Medusahead

The annual grass medusahead (*Elymus* (*Taeniatherum*) *caput-medusae*; Poaceae family) is a noxious rangeland weed, increasing across California and the western U.S. (DiTomaso and Healy 2007). Medusahead and yellow starthistle are the two most common invasives in the Valley grassland (DiTomaso et al. 2007). Medusahead can form dense stands and persistent thatch layers that displace native species and reduce wildlife habitat and forage values (DiTomaso et al. 2013). Preliminary results from a study at the UC Sierra Foothill Research and Extension Center indicate that abundant medusahead causes significant loss of cattle productivity and, therefore, livestock market value (James et al. 2016). In addition, medusahead awns can injure grazing animals, and its thatch layer can increase fuel for wildfire (DiTomaso and Healy 2007). Kyser et al. (2014) is a useful general manual on medusahead control. According to the recent Beale weed surveys, medusahead is ubiquitous across the Base, generally at moderate to high cover (H.T. Harvey & Associates 2015b; CEMML 2017). Dr. Jeremy James, a University of California medusahead control expert, stated that Beale has the worst medusahead infestation of any site he has seen in California (Pers. comm. with Lauren Wilson, 2015, 2017).

In a recent meta-analysis of 22 medusahead control studies, herbicide with subsequent reseeding proved the most effective treatment method, and glyphosate the most effective herbicide (James et al. 2015). James et al. (2015) suggested that burning may be similarly effective but could not locate a sufficient quantity of long-term studies to test this hypothesis. In the Central Valley, two consecutive annual burns when medusahead has begun to head out but before it has dropped seed can nearly eliminate a medusahead infestation (DiTomaso et al. 2013). In the meta-analysis, sheep and cattle grazing appeared to be moderately effective, but the control effect was strongly dependent on grazing timing and intensity, which can be difficult to implement (James et al. 2015; Davy et al. 2015; Brownsey et al. 2016). Although livestock typically avoid medusahead as it matures, DiTomaso et al. (2007) reported that high intensity grazing by sheep in April and May can reduce medusahead cover significantly. A recent University of California Agriculture and Natural Resources publication provides clear descriptions of the susceptible growth stages and the approximate timing for grazing to control medusahead successfully; a very short, 2 to 3 week period, typically from early April to May is the optimal period to achieve control of medusahead with livestock grazing (Brownsey et al. 2016). Where feasible, mowing can also be an effective method of control, if timed to coincide

[7] The California Invasive Plant Council has already produced a series of identification cards for invasive species either on Base or with the potential to be on Base that could be used for this purpose (Cal-IPC 2015b).

with medusahead's vulnerable growth stage, an approximately 5 week period, typically lasting from late April to early June (Brownsey et al. 2016).

5.2 Yellow starthistle

Yellow starthistle (*Centaurea solstitialis*; Asteraceae family) is one of the worst rangeland weeds in California, occupying over 3 million hectares of California grasslands and continuing to spread (Bossard and Randall 2007). Beale AFB has a significant infestation of yellow starthistle that reduces habitat values for many species, reduces forage for both wildlife and livestock, and increases Bird/Wildlife Aircraft Strike Hazard (BASH) risk by attracting certain seed-eating bird species (DiTomaso et al. 2006; RMAT 2000, 20; HDR 2016, 6). Research conducted at Beale has shown, however, that yellow starthistle appears to provide adequate habitat for grassland rodents, an important prey base for many other species (Christopherson and Morrison 2004). Yellow starthistle often forms monocultures, displacing native species, and as a deep-rooted summer annual, can deplete soil moisture and alter a site's hydrology (Gerlach 2004). Yellow starthistle infestation also lowers recreational and other human use values (DiTomaso et al. 2006). Several methods of control, including prescribed burning, livestock grazing, herbicide application, and biological control by insects, can help control, if not eliminate, yellow starthistle (DiTomaso et al. 2007). Because horses occur on Base, it is important to note that yellow starthistle is toxic to horses. DiTomaso et al. (2006) is a useful general reference on control of yellow starthistle. According to the recent Beale weed surveys, yellow starthistle is widespread across the Base, often at fairly low cover, although impenetrably dense in some locations (H.T. Harvey & Associates 2015b; CEMML 2017).

Grazing prescriptions must be carefully designed because grazing yellow starthistle at the wrong phenological stage can actually benefit the plant. Cattle grazing in late winter or early spring can favor yellow starthistle because cattle will primarily eat grasses, leaving the low-growing yellow starthistle rosettes unshaded; the increased sunlight levels stimulate their growth (Huntsinger et al. 2007). Bossard et al. (2000) report that intensive grazing by sheep, goats, or cattle before yellow starthistle's spiny stage but after bolting, which generally occurs in late spring/early summer, can reduce biomass and seed production. A recent study found that prescribed cattle grazing from January through May failed to reduce yellow starthistle cover, probably because the grazing season did not extend into summer when yellow starthistle is most vulnerable to grazing (Davy et al. 2015). Especially in years with significant late spring rainfall, Davy et al. (2015) recommend that cattle grazing should, if possible, continue into the summer to maintain control of yellow starthistle. The cattle-grazing season at Beale ends on May 31; extending the cattle-grazing season or grazing sheep or goats in the summer months may improve yellow starthistle control on Base. Cattle and sheep will no longer graze on yellow starthistle once spines are present and can, in fact, be injured by the spines so grazing by these livestock species should stop at this phenological stage. Goats will continue to eat yellow starthistle even with spines present.

Beale staff have indicated an interest in using prescribed goat grazing to control yellow starthistle and to create fire breaks, among other vegetation control activities (Charles Carroll, pers. comm., February 2016). Goat grazing has proved successful in controlling yellow starthistle experimentally (Thomsen et al. 1993; Goehring et al. 2010) and in management situations (DiTomaso et al. 2006). Unlike cattle or sheep, goats will eat yellow starthistle in the spiny stage and so can be deployed later in the season; goats can also be corralled within small areas by electric fencing and watered with a mobile water source. As a result, a mixed goat and cattle or sheep strategy may afford greater control than cattle or sheep alone. On the downside, goat rental can be expensive (goat herd owners are typically paid to graze their animals), goats are vulnerable to predators, and their impact on non-target plant species may be undesirable (DiTomaso et al. 2006). Furthermore, because they are often fenced into small areas and will eat a wide variety of plants, goats can remove most of the plant cover in an area; unless carefully managed, they may increase erosion on slopes or creek banks. Such considerations should be addressed in integrated weed control and prescribed grazing work plans and monitored for if goat grazing is implemented.

Other control methods such as burning and herbicide application can provide good control. DiTomaso et al. (2007) describe a successful long-term control program using a prescribed burn in the first year, followed by a second-year clopyralid treatment. Bossard et al. (2000) recommend burning after native species have dispersed their seeds but before yellow starthistle produces viable seed in the summer months. DiTomaso et al. (2013) provide detailed recommendations about herbicide use for yellow starthistle control.

5.3 Barbed goatgrass

Barbed goatgrass (*Aegilops triuncialis*; Poaceae family) is an invasive annual grass spreading rapidly in California's rangelands. It forms monocultural stands that reduce species diversity, habitat values, and forage for livestock and wildlife (Davy et al. 2008). Like medusahead, it forms a thatch layer that is slow to decompose and can inhibit germination of other plants. Its awns can injure livestock. According to the recent Beale weed surveys, barbed goatgrass is found in fairly discrete patches, although at least two of them are large (H.T. Harvey & Associates 2015b; CEMML 2017). If Beale grazing areas become dominated by barbed goatgrass, leasing the infested areas for livestock grazing will no longer be feasible. Because goatgrass is such a noxious and invasive weed and currently does not appear to be as widespread across Beale as medusahead or yellow starthistle, an early detection-rapid response program focused on goatgrass should be an effective weed control technique, helping to contain, if not eradicate, the infestation.

Control of goatgrass is typically achieved with prescribed fire or with herbicides because this annual grass species is mostly unpalatable to livestock (Davy et al. 2008). Brownsey et al. (2016) describe the growth stages during which goatgrass is likely to be vulnerable to grazing but do not currently recommend grazing as a control method. A goatgrass seed is often twinned with a smaller seed that is inhibited from germinating by its larger sibling seed. This second, smaller seed tends to germinate the year after its larger twin. Consequently, several studies have recommended that multiple burns, ideally two consecutive annual burns, are needed for effective control of goatgrass because a single burn is unlikely to kill the smaller seeds remaining in the soil that then germinate the following season (DiTomaso et al. 2001, Hopkinson et al. 1999). A recent report by Marty et al. (2015), however, suggests that in years with high biomass production and therefore high fuel loading, a prescribed fire will likely burn hot enough to kill most of the seeds and achieve control for several years after the burn. Therefore, in highly productive years, goatgrass burns are a priority. Ideally, the initial burn would be followed by a second burn the following year to maximize control results; however, a consecutive burn is more important following a burn in a low productivity year when control is likely to be limited.

Goatgrass seedheads remain on the plant later into the summer than seedheads of most other annual grassland species. Therefore, an appropriately timed burn can kill goatgrass seeds aboveground but not affect more desirable forage and/or native species seeds that have already shattered and entered the soil. Marty et al. (2015) burned in June and saw not only reduced goatgrass germination and cover for 6-7 years but also an increase in native species richness in the first year. DiTomaso et al. (2001) note that goatgrass phenology varies "dramatically depending on seasonal climatic conditions" so burns may work best from May to July, depending on goatgrass phenology in the burn year.

Herbicide application can also successfully control goatgrass. A study in Lake County found that application of fluazifop in early May resulted in excellent control of goatgrass (Aigner and Woerly 2011). In addition, carefully timed mowing can reduce goatgrass seed production. Mowing must occur after flowering but before seeds fully develop (Aigner and Woerly 2011; DiTomaso et al. 2013; Brownsey et al. 2016). Goatgrass recovers from early mowing, and mowing late in the season can spread goatgrass seeds (DiTomaso et al. 2013). A recent University of California Agriculture and Natural Resources publication provides clear descriptions of the susceptible growth stages and the approximate timing for mowing to control goatgrass successfully; a five week period typically from May to early June affords the greatest likelihood of successful control (Brownsey et al. 2016).

6.0 Grazing capacity assessment and stocking rates for Beale AFB

A primary purpose of grazing management plans or guidelines is to determine the number of grazing animals that the area under evaluation can support on a sustainable basis, that is, without long-term adverse impacts to the natural resource base (e.g., soil, vegetation). Range managers call this number "grazing capacity". Grazing capacity has been defined more formally as the maximum number of animals in a defined area that will produce a target level of production without ecosystem deterioration over a defined period, usually a long time (Heady and Child 1994), although it is probably more useful to conceptualize grazing capacity as a range of values constrained by climatic characteristics of the area rather than as a single 'maximum number' (for example, see range of values, varying based on rainfall, in Table 6-2). After grazing capacity has been determined, an initial stocking rate can then be decided upon based on the grazing capacity estimates; stocking rate is the *actual* number of animals in a defined area during a single grazing season (Heady and Child 1994). Both grazing capacity and stocking rates are typically reported in a standard unit of measurement, the Animal Unit Month (AUM; see Appendix A for further explanation).

The concept of a single, sustainable stocking rate, set for multiple years, has been questioned for dry rangelands in general (Heitschmidt and Stuth 1991) and is regarded as of little value for Mediterranean annual-type range like the Valley grassland (George et al. 2001). Although long-term vegetation production averages can be determined, average values have limited practical use under the extreme fluctuations in production caused by California's highly variable annual weather patterns (see Section 4.1 Climate). Therefore, grazing capacity estimates provide a range of data points for setting annual stocking rates and provide a general guide around which stocking rates can be adjusted. Stocking rates themselves, however, must be adjustable in response to variations in forage production and the timing of actual use.

It is important to realize that setting a stocking rate in California requires retrospective rather than prospective consideration. Annual forage production in California cannot be reliably predicted until February or later, by which time it is generally too late for a livestock operator to reduce herd size; livestock decisions for the following spring are typically made in the fall of the previous year. This is an inescapable fact of range management in California.

A solution to the difficulty lies in setting stocking rates for the coming grazing season based on fall residual dry matter (RDM) remaining from the previous grazing season. Based on many years of research in California rangelands, fall RDM at levels appropriate for a site has been shown to protect soil from the erosive force of rain and wind and to limit nutrient losses from the soil (Bartolome et al. 2006). Furthermore, in rangeland areas with more than 15 inches of annual rainfall, such as Beale AFB, appropriate fall RDM levels also maximize rangeland biomass production and can influence plant species composition in some instances (Bartolome et al. 2006; Bartolome et al. 2007b; Amatangelo et al. 2008).

When fall RDM meets the minimum targets, then the stocking rate suggested by the grazing capacity estimate is appropriate for the following year's grazing season. If fall RDM has fallen below the minimum targets, as can happen, for example, in a drought year because of the difficulty of predicting forage production before the start of the grazing season, the stocking rate for the following year's grazing season may need to be reduced (see Section 8.3). The reduced stocking rate is likely to ensure that fall RDM minimum targets are achieved for that grazing season. In other words, livestock use to below fall RDM minimums may occasionally occur but only within a single season, which is unlikely to result in long-term damage to the range resource. Of course, in extreme drought years when forage production fails, the grazing season may have to be curtailed (see Section 7). Stocking rate decisions are generally considered the most important of all grazing management decisions (Holechek et al. 2011) and should therefore be supervised by an experienced range manager.

6.1 Method used for determining grazing capacity

Production of available forage to support livestock varies based on an array of interacting environmental factors including weather, substrate, accessibility, and vegetation composition. In determining grazing capacity for the grazing Management Areas at Beale, these *Guidelines* used the Ecological Site method, which is based on vegetation production estimates for different soil types developed by the USDA Natural Resources Conservation Service (NRCS). This soil type-based method provides average above-ground vegetation production values for all soil types but does not account for the actual vegetation communities found at any particular site.

The NRCS has developed an extensive landscape classification system, the Ecological Site Information System, based on soil type, slope, and vegetation (see http://esis.sc.egov.usda.gov/ for further details). The NRCS Web Soil Survey and soil data access websites (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm and http://sdmdataaccess.nrcs.usda.gov/, accessed October 2016) provide Ecological Site vegetation production estimates for soil map units at 3 levels of annual rainfall (favorable, average, and unfavorable years[8]); these production estimates are total annual, above-ground biomass production (all vegetation, whether or not it is palatable to livestock) in pounds/acre and are based upon an extensive vegetation sampling program conducted by the NRCS and its cooperators.

Starting with these NRCS production estimates for each soil map unit within each of Beale's livestock pasture units, the University of California Agriculture and Natural Resources (UC ANR) recommended fall RDM minimum allowance for the slope class of that soil map unit (Table 6-1) and a summer biomass decomposition loss estimate were then subtracted to determine an estimate of available forage per acre.

Table 6-1: Fall residual dry matter targets for annual grassland recommended by University of California Agriculture and Natural Resources (Bartolome et al. 2006).

0-10 % slope	10-20 % slope	20-40 % slope	>40 % slope
500 lbs/acre	600 lbs/acre	700 lbs/acre	800 lbs/acre

Within each pasture unit, every soil map unit's available-forage-per-acre value was multiplied by the soil map unit's total acreage to determine total available forage for that soil map unit[9]. All these available forage values were added together to determine each pasture unit's total available forage at 3 levels of rainfall. Total available forage for each pasture unit was then converted into Animal Unit Months for each pasture unit. Table 6-2 presents estimated grazing capacity in AUMs for each pasture unit, for each Management Area, and for the entire Base grazing program area. Please see Appendix A for vegetation production tables and full details on the grazing capacity calculations.

[8] The NRCS does not elaborate on these categories of annual production, other than to state that in favorable years, "the amount and distribution of precipitation and the temperatures make growing conditions substantially better than average," while in dry years, "growing conditions are well below average, generally because of low available soil moisture" (https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx, accessed March 2017). Lytle (1998) states much the same thing and provides no further details.

[9] Road acreage was subtracted from soil map unit total acreage in keeping with previous Beale AUM calculations (DAF 2012, Exhibit E-Operating Agreement, 29-30); 'Water' (254) and 'Dumps, landfills' (145) acreage were also removed; see Section 4.3 Soils.

Table 6-2: Estimated grazing capacity in Animal Unit Months (AUM) for favorable, average, and unfavorable rainfall years in Beale AFB pasture units, Management Areas, and the entire Base grazing program area.

Management Area	Pasture unit	AUM		
		Favorable	Average	Unfavorable
A	A-1	1,711	1,119	327
	A-2	918	615	170
	A-3	603	392	107
	A-4	1,418	935	263
	A-5	492	327	98
	A-6	551	360	103
	A-7	187	122	33
	A-9	288	194	51
	Totals for A	**6,168**	**4,064**	**1,152**
B	B-1	1,572	978	242
	B-2	2,124	1,333	338
	B-3	355	237	66
	B-5	1,252	764	189
	B-6	610	410	108
	B-8	25	17	4
	Totals for B	**5,937**	**3,740**	**948**
C	C-1	5,377	3,041	650
	C-2	850	465	107
	C-3	337	184	40
	C-4	59	33	8
	C-5	8	4	1
	C-6	286	164	35
	Totals for C	**6,916**	**3,891**	**841**
D	D-1	101	67	21
	D-2	60	40	12
	D-3	270	179	54
	D-4	466	317	79
	D-5	432	294	74
	D-6	193	113	28
	Totals for D	**1,522**	**1,010**	**268**
E	E-1	43	21	1
	E-2	42	20	0
	E-3	127	71	17
	E-4	21	10	1
	E-5	50	23	0

	E-6	59	32	7
	Totals for E	**343**	**177**	**27**
F	F-1	2,763	1,913	652
	F-2	722	486	162
	F-3	697	454	130
	F-4	551	362	106
	Totals for F	**4,732**	**3,216**	**1,049**
Beale AFB grazing program totals		**25,619**	**16,097**	**4,285**

Based on the NRCS vegetation production estimates for the soil types found in the Beale grazing program Management Areas, total grazing capacity is estimated to be 25,619 AUMs in a wet year, 16,097 AUMs in an average rainfall year, and 4,285 AUMs in a dry year. Dry year AUMs are estimated at just over 25% of normal year AUMs, reflecting the significant decline in production in dry years and the fact that fall RDM targets and summer decomposition loss values remain constant whatever the weather and, therefore, reduce AUMs to a proportionally greater extent in less productive years. It is worth considering, however, that in 2014, one of the recent severe drought years, overall Beale biomass levels in June averaged 1,363 pounds per acre[10], suggesting that even in drought periods, unused forage capacity remains in at least some of Beale's pasture units[11] (CNLM 2015a). In favorable years, 60% more AUMs are available than in a normal year.

AUMs allowed for in the 2012/2013 grazing leases were substantially lower than estimated AUMs presented in Table 6-2 (Table 6-3). Although pasture unit and Management Area acreage has changed between 2012 and 2017, AUMs can be compared as AUMs/acre (or Acres/AUM) for each Management Area. A partial explanation for the lower AUM/acre values in 2012 is the RDM values used in each instance: 800 lbs/acre of June biomass for the 2012/2013 leases compared to the generally lower UC ANR fall RDM targets in Table 6-1 used in these *Guidelines*' grazing capacity calculations. In addition, the current NRCS vegetative production values for many of the soil types ('Rangeland Productivity' under the Soil Reports subtab of the Soil Data Explorer tab, NRCS Web Soil Survey) are higher than the production values reported in the *Soil Survey of Yuba County* (Lytle 1998). The 2012/2013 leases may have used these lower production values from Lytle (1998) or related publications. Finally, as detailed in Appendix A, these *Guidelines*' grazing capacity calculations incorporated production on minor components of each soil mapping unit; previous grazing capacity calculations may have used production on major components only (see for example, the county soil survey's presentation of range production values [Lytle 1998, Table 10]).

[10] Accounting for summer biomass decomposition loss of 7% per month (see Appendix A), approximately 1,060 pounds per acre of RDM would still remain by early October.

[11] This assumes that UC ANR recommended fall RDM targets (Table 6-1) are adopted by Beale. If Beale selects higher fall RDM targets, there may not be unused forage capacity in drought years.

Table 6-3: Beale AFB grazing Management Area AUM/acre and Acre/AUM estimates from these *Grazing Management Guidelines* compared to AUM/acre and Acre/AUM values in the 2012/2013 grazing leases; values from these *Guidelines* are the average year AUMs (see Table 6-2); data for 2012/2013 grazing leases from Lauren Wilson (pers. comm., January 2017).

Grazing Management Guidelines					**2012/2013 Grazing Leases**				
Mngmnt Area	**AUMs**	**Acres**	**AUM/acre**	**Acre/AUM**	**Mngmnt Area**	**AUMs**	**Acres**	**AUM/acre**	**Acre/AUM**
A	4,064	3,162	1.29	0.78	**A**	1,855	3,156	0.59	1.70
B	3,740	3,048	1.23	0.82	**B**	1,633	3,028	0.54	1.85
C	3,891	3,212	1.21	0.83	**C**	1,800	3,207	0.56	1.78
D	1,010	801	1.26	0.79	**D**	487	798	0.61	1.64
E	177	155	1.14	0.87	**E**	No data			
F	3,216	2,332	1.38	0.73	**F**	1,094	2,258	0.48	2.06
Total	16,097	12,709	1.27	0.79	**Total**	6,869	12,447	0.55	1.81

California range managers commonly define the grazing capacity of a site as the estimated AUMs available in an average rainfall year, although, as noted above, the range of possible production values is probably a better way to conceptualize grazing capacity. This average year grazing capacity value for the site is then often used as the initial stocking rate. If conservation goals are paramount, the initial stocking rate can be set more conservatively. Thereafter, the stocking rate for the following season should be adjusted based on results of fall RDM monitoring from the previous year.

7.0 Contingencies for low forage years

As described in Section 6.0, a key to controlling over-stocking is to build in a fall RDM-based rolling stocking rate that allows for variations due to weather-induced differences but prevents successive years of over-use. In extreme drought years, however, when forage production fails, the Natural Resources Manager may decide that the grazing season has to be curtailed to protect Beale's rangeland resources; provision should be made for such emergency cessation of grazing in Base grazing leases.

With the advent of climate change, extreme drought years and multiyear droughts may become more frequent in California (Polley et al. 2013; Chaplin-Kramer and George 2013), which will significantly affect livestock grazing management. AFI 32-7064 directs installations to plan for climate change impacts on ecosystems and to implement management approaches that will enhance ecosystem resilience to climate change (DAF 2016, Section 3.8.3). Deliberately planning for major drought events in cooperation with grazing lessees is highly recommended. The Beale grazing leases from 2012-2017 required that lessees submit a grazing plan to the Base;

these lessee grazing plans should include extreme drought contingency plans. Typical drought contingencies that grazing operators implement include moving livestock to other pastures nearby or to regions unaffected by drought, reducing overall herd size, early weaning, and supplemental feeding (McDougald et al. 2001). Beale AFB should consider a grassland bank as a useful strategy to mitigate the impacts of extreme droughts (see Section 4.3).

8.0 Grazing management recommendations for Beale AFB

8.1 In Beale AFB grazing leases, include:

- specific allowed stocking rates but allow for adjustments based on fall residual dry matter (RDM) and other evaluations,
- monthly livestock reporting requirements,
- fall RDM targets,
- animal management specifications, and
- contingencies for low forage years.

Lessee grazing plans, submitted as a requirement of Beale grazing leases, should include drought, wildfire, and prescribed burn contingency plans. Consider the use of a grassland bank during droughts and following invasive species control treatments or wildfire (see Sections 4.3 and 5.0).

8.2 For the initial grazing season following implementation of these *Grazing Management Guidelines*, establish the Beale stocking rate at 16,097 AUMs (see Table 6-2 for pasture unit-specific AUMs). The potential cattle grazing season in Management Areas A, B, C, D, and F extends from November 1 through May 31, with the exception of overnight Holding Fields C4 and C5 that are for temporary use and Pasture Unit C6, which is potentially available from February 1 through April 30 depending on presence of surface water. The horse grazing season in Management Area E pasture units is year-round.

8.3 Map RDM in each pasture unit every fall, prior to the onset of germinating rains (generally undertaken in early October; see Section 9.1 and Appendix B). Fall RDM mapping data should be maintained in the GIS database. Table 6-1 provides UC ANR recommended minimum fall RDM guidelines based on slope. The vast majority of Beale's pasture units are less than 10% slope (Table 4-2) on which a minimum fall RDM target of 500 pounds per acre is recommended. Some pasture units have steeper areas, with a recommended minimum RDM targets of 600 pounds per acre (10-20% slope) or 700 pounds per acre (20-40% slope).

If minimum fall RDM targets are not achieved for that season over a significant area of a pasture unit, the Base Natural Resources Manager may need to adjust the stocking rate for the following year and/or shorten the season for those pasture units that did not meet fall RDM targets. Put the lessee(s) on notice in October that fall RDM targets have not been met, that fall RDM targets cannot be missed in a second consecutive year, and that, after a field assessment in the following February, stocking rate and/or grazing season may need to be curtailed for that year to ensure that fall RDM targets are met. Stocking rate decisions should be supervised by an experienced range manager and based on assessment of forage production in February.

8.4 In years when rainfall is running significantly below average, re-evaluate forage production projections, animal numbers, and levels of utilization in mid-February. Following the February evaluation, modify livestock use if necessary, either by reducing animal numbers or curtailing the grazing season. Lessees should be informed and participate in fall RDM evaluations and in any February evaluations. In cooperation with grazing lessees, plan for major drought events (see Section 7.0).

8.5 Require lessees to report monthly AUMs and animal numbers and then confirm these reports with occasional compliance monitoring (see Section 9.1).

8.6 Restrict supplemental feeding of livestock to mineral and limited protein supplements. Salt and mineral licks and other supplements should be placed no less than ¼ mile away from any vernal pools, riparian areas, wetlands, oak seedling protection sites, or other sensitive natural resources, unless there are specific management reasons for placing them nearer, as determined by the Beale Natural Resources Manager. The Beale INRMP explicitly states that placement of salt licks requires coordination with the Base Cultural Resources Manager. In addition, placement of livestock attractants provides an opportunity to manage livestock distribution to encourage more uniform distribution of livestock grazing (George et al. 2007; 2008); RDM mapping will prove useful in determining where attractants should be located (see Section 9.1). Locations of supplements should be maintained in the GIS database.

8.7 Maintain up-to-date, accurate, and detailed records, including GIS shapefiles, of the Base's grazing infrastructure to improve planning for management actions related to the grazing program, including infrastructure maintenance (see Section 4.3). Collect and incorporate into grazing program database missing information such as fence type and dates of infrastructure installation and of major infrastructure maintenance. Assess grazing program infrastructure needs at least annually. Coordinate with the Base Cultural Resources Manager before construction or removal of livestock fences, ponds, troughs, or livestock water pipelines running cross country.

8.8 Beale AFB has experienced BASH problems when cattle die while giving birth, the carcasses attracting vultures and other scavenging birds and wildlife to the airfield area. Even the afterbirth from successful deliveries can be a hazard, affecting flight safety and scheduling (Charles Carroll, pers. comm., Feb. 2016). Require lessees to move cattle that are soon to give birth out of pasture units near the airfield or implement other approved methods for minimizing BASH hazard (DAF 2016, Section 15.2.5). Livestock carcasses should be immediately reported to the Beale Natural Resources Manager and removed as instructed.

8.9 Evaluate livestock grazing impacts, especially regarding bank erosion and special-status wildlife that use riparian habitat, in the grazed sections of Reeds Creek and the Management Area D portions of Hutchinson Creek (see Section 4.5). Additional riparian zone grazing management may be necessary to protect these resources.

8.10 Update the Beale Invasive Plant Species Management Guidelines, addressing the 2014 and 2016 invasive weed survey data, and create associated work plans. Guidelines should describe best management practices that reduce the likelihood that invasive plants are introduced onto Base and should also include a well-designed monitoring component that evaluates treatment effectiveness and assesses any unintended consequences, such as increased erosion or impact on non-target species.

8.11 Develop an early detection-rapid response program to find and eradicate incipient infestations of new invasive species or satellite populations of resident invasives (see Section 5.0 and Beale early detection-rapid response work plan, currently being drafted). Preventing further spread of barbed goatgrass into uninfested areas of the Base should be an initial goal.

8.12 Collect information on specific areas that have been cultivated for crops and orchards on Base. Enter this information in the GIS database. Cultivation information will prove useful in prioritizing future grassland restoration activities (see Section 4.2).

8.13 From March through July (or as long as livestock are present), monitor spring cover in Beale's black rail breeding marsh habitat and reduce grazing in those areas if spring vegetation cover falls below 60% of normal levels (see Section 9.1). Richmond et al. (2012) recommend minimizing grazing impacts to black rails in non-irrigated marshes by excluding livestock or limiting livestock use with alternative water sources.

8.14 Implement an adaptive management process when the optimal management activity to achieve a particular management goal is not obvious. The adaptive management process entails setting clear goals, implementing management activities, monitoring management and control areas, analyzing monitoring data to determine if management activities have achieved the goals, and then using the monitoring data to decide on next management steps (see Section 9.3). Design effectiveness monitoring protocols, including those for analysis and reporting, to meet the needs of the adaptive management process.

8.15 Install wildlife escape ramps in those livestock troughs that do not already have them to comply with the technical specifications for water troughs in the Beale INRMP (Beale AFB 2015, A8-61-A8-65; see Section 4.3).

8.16 Evaluate blue oak and valley oak recruitment into the sapling stage, especially in Management Area E horse pastures and in Pasture Unit D-6, to ascertain the need for oak seedling protection (see Section 4.5).

8.17 Develop a plan for expanding the Beale grazing program into areas of the Base not currently grazed in order to meet natural resource management goals in those areas. Consider grazing goats and sheep in the expansion areas. Assess the value of creating a grassland bank within the expansion areas (see Section 4.3 Improvements).

Table 8.1 links these grazing management recommendations to the Beale AFB grazing program goals and objectives listed in Section 3.

Table 8-1: Recommended grazing management actions linked to Beale AFB grazing program goals and objectives from Table 3-1.

Goal	Objectives	Recommended actions
1. Protect and enhance vernal pool ecosystem functions and processes.	1.1 Graze vernal pool ecosystem to maintain or increase inundation periods within vernal pools to support breeding of vernal pool fairy shrimp and vernal pool tadpole shrimp, and vernal pool native plants. 1.2 Maintain residual dry matter (RDM) at recommended levels.	8.1) detailed lease provisions; 8.2) recommended AUMs and grazing season; 8.3) fall RDM mapping and actions if fall RDM targets missed; 8.4) drought year planning and re-evaluations in February; 8.6) place livestock attractants to protect natural and cultural resources and enhance livestock distribution; 8.10) update Beale weed management plan; 8.11) implement early detection-rapid response program to eradicate new invasive plants; 8.14) use adaptive management process to improve management effectiveness; 8.17) expand the grazing program to meet natural resource management goals.
2. Protect and provide a conservation benefit for federal and state listed species, state species of concern, and other at-risk species including rare rangelands plants.*(Modified INRMP Goal 2)	2.1 General: Create a grassland habitat mosaic (grazed, lightly/rotationally grazed, ungrazed) to support multiple special status species (and their prey) with varying requirements. 2.2 Monitor special-status native plant species in grazed and ungrazed plots to determine whether they benefit from a well-managed grazing program, need protection from grazing, or appear unaffected by livestock. 2.3 Conduct adaptive management study to provide site-specific information on appropriate *maximum* RDM targets for meeting wildlife habitat requirements,	8.1) detailed lease provisions; 8.2) recommended AUMs and grazing season; 8.3) fall RDM mapping and actions if fall RDM targets missed; 8.4) drought year planning and re-evaluations in February; 8.6) place livestock attractants to protect natural and cultural resources and enhance livestock distribution; 8.9) evaluate livestock impacts on riparian zone; 8.10) update Beale weed management plan; 8.11) implement early detection-rapid response

Goal	Objectives	Recommended actions
	controlling invasive species, and minimizing fine fuel loads. Implement the following objectives: 4.1 below *(Modified INRMP Objective 2.3), 4.2 below *(Modified INRMP Objective 2.3), 4.3 below *(Modified INRMP Objective 2.3), 5.1 below *(Modified INRMP Objective 2.3).	program to eradicate new invasive plants; 8.13) monitor spring cover of black rail breeding habitat; 8.14) use adaptive management process to improve management effectiveness; 8.15) install wildlife escape ramps in livestock troughs; 8.16) evaluate need for blue and valley oak seedling protection; 8.17) expand the grazing program to meet natural resource management goals.
3. Maintain and improve rangeland ecosystem functions and processes	3.1 Maintain residual dry matter (RDM) at recommended levels to minimize soil erosion. 3.2 Reduce cover of widespread invasive plant species. Implement Objective 2.3 above.	8.1) detailed lease provisions; 8.2) recommended AUMs and grazing season; 8.3) fall RDM mapping and actions if fall RDM targets missed; 8.4) drought year planning and re-evaluations in February; 8.6) place livestock attractants to protect natural and cultural resources and enhance livestock distribution; 8.9) evaluate livestock impacts on riparian zone; 8.10) update Beale weed management plan; 8.11) implement early detection-rapid response program to eradicate new invasive plants; 8.14) use adaptive management process to improve management effectiveness; 8.16) evaluate need for blue and valley oak seedling protection; 8.17) expand the grazing program to meet natural resource management goals.

Goal	Objectives	Recommended actions
4. Maintain or increase populations of native rangeland plants that contribute to floral and faunal biological diversity *(Modified INRMP Objective 5.9).	4.1 Reduce cover of widespread invasive species medusahead. 4.2 Reduce cover of widespread invasive species yellow starthistle. 4.3 Eliminate incipient populations of new invasive species by implementing a rapid response protocol per the Invasive Species Management Plan and new Work Plans. 4.4 Monitor native species richness in grazed Management Areas. 4.5 Initiate blue oak protection and enhance regeneration on and around the Saddle Club. Implement Objectives 2.2 and 2.3 above. *(Modified INRMP Project 5.9.3)	8.1) detailed lease provisions; 8.2) recommended AUMs and grazing season; 8.3) fall RDM mapping and actions if fall RDM targets missed; 8.4) drought year planning and re-evaluations in February; 8.6) place livestock attractants to protect natural and cultural resources and enhance livestock distribution; 8.10) update Beale weed management plan; 8.11) implement early detection-rapid response program to eradicate new invasive plants; 8.12) determine historic cultivation patterns for restoration planning; 8.14) use adaptive management process to improve management effectiveness; 8.16) evaluate need for blue and valley oak seedling protection; 8.17) expand the grazing program to meet natural resource management goals.
5. Manage and improve rangeland vegetation to provide high quality livestock forage on a sustainable basis to maintain benefits received from livestock grazing leases. *(Modified INRMP Goal 8)	5.1 Eliminate known populations of barbed goatgrass within five years, an invasive species unpalatable to livestock. 5.2 Maintain rangeland improvements (structural and nonstructural) to support grazing operations and improve the value of the lease. Implement Objective 4.1 above, as medusahead abundance reduces forage and livestock production.	8.1) detailed lease provisions; 8.2) recommended AUMs and grazing season; 8.3) fall RDM mapping and actions if fall RDM targets missed; 8.4) drought year planning and re-evaluations in February; 8.6) place livestock attractants to protect natural and cultural resources and enhance livestock distribution; 8.10) update Beale weed management plan;

Goal	Objectives	Recommended actions
		8.11) implement early detection-rapid response program to eradicate new invasive plants; 8.14) use adaptive management process to improve management effectiveness; 8.15) install wildlife escape ramps in livestock troughs; 8.17) expand the grazing program to meet natural resource management goals.
6. Meet Bird/Wildlife Aircraft Strike Hazard (BASH) requirements and implement land management measures that discourage use by wildlife. (INRMP Objective 6.6)	6.1 Maintain vegetation height between 7-14 inches. 6.2 Limit forb (wildflower) abundance. 6.3 Limit patches of bare ground. 6.4 Limit edge effects. Implement Objective 4.2 above.	8.1) detailed lease provisions; 8.2) recommended AUMs and grazing season; 8.3) fall RDM mapping and actions if fall RDM targets missed; 8.4) drought year planning and re-evaluations in February; 8.6) place livestock attractants to protect natural and cultural resources and enhance livestock distribution; 8.8) require lessees to move cattle about to give birth away from airfield and remove livestock carcasses promptly; 8.10) update Beale weed management plan; 8.11) implement early detection-rapid response program to eradicate new invasive plants; 8.14) use adaptive management process to improve management effectiveness.
7. Reduce wildland fire risk and its potential effects on Base facilities and natural resources. *(Modified INRMP Objective 6.5)	7.1 Reduce fine herbaceous fuels through managed livestock grazing. 7.2 Maintain wildland fire protection measures such as firebreaks, access roads for fire suppression, and use of gates for access instead of cutting fences.	8.1) detailed lease provisions; 8.2) recommended AUMs and grazing season; 8.3) fall RDM mapping and actions if fall RDM targets missed; 8.6) place livestock attractants

Goal	Objectives	Recommended actions
	Implement Objective 2.3 above.	to protect natural and cultural resources and enhance livestock distribution; 8.7) maintain detailed records of grazing infrastructure and assess annually; 8.17) expand the grazing program to meet natural resource management goals.
8. Ensure no adverse impacts to cultural resources and maintain cultural heritage and value of grazed California rangeland.	8.1 Staff appropriate permits (332/813/103s) when moving or placing new grazing infrastructure (e.g., fencing, water, corrals). 8.2 Consult with the Beale Cultural Resources Manager to avoid placing salt licks and other attractants in culturally sensitive areas. 8.3 Provide opportunity to livestock operators to graze on land traditionally used for grazing in the pre-Camp Beale era when land is available for this purpose and compatible with Beale's mission.	8.1) detailed lease provisions; 8.4) drought year planning and re-evaluations in February; 8.6) place livestock attractants to protect natural and cultural resources and enhance livestock distribution; 8.7) maintain detailed records of grazing infrastructure and assess annually; 8.17) expand the grazing program to meet natural resource management goals.
9. Ensure no net loss in the capability of Beale grazing program lands to support the military mission of the installation.	9.1 Maintain fencing integrity to avoid livestock in sensitive military areas. 9.2 Remove livestock carcasses from pasture units within 12 hours to reduce BASH risks. 9.3 Ensure ranching practices are flexible, and ranchers are available within 24 hours' notice if livestock needs to be moved for mission priorities.	8.1) detailed lease provisions; 8.7) maintain detailed records of grazing infrastructure and assess annually; 8.8) require lessees to move cattle about to give birth away from airfield and remove livestock carcasses promptly; 8.17) expand the grazing program to meet natural resource management goals.
10. Ensure compliance with applicable federal and state laws and regulations related to natural resource protection. (INRMP Goal 1)	10.1 Conduct grazing compliance surveys monthly to verify grazing lease and grazing land use regulations are properly implemented. 10.2 Comply with Grazing EA. 10.3 Comply with EIAP/Base 332/103 process. 10.4 Comply with Base Regulations.	8.1) detailed lease provisions; 8.5) monthly AUM reports from lessee and periodic compliance checks; 8.9) evaluate livestock impacts on riparian zone; 8.15) install wildlife escape ramps in livestock troughs.

9.0 Monitoring and adaptive management at Beale AFB

Grazing monitoring accomplishes two objectives: 1) compliance monitoring determines if an action complies with expectations or regulations; and 2) effectiveness monitoring determines if management actions are achieving the desired results (Bush 2006). The data from a properly designed monitoring program provide guidance both for compliance and effectiveness and are used to improve management practices (a continuous process called adaptive management). A good monitoring program efficiently produces at minimum cost the information required to accomplish stated goals. See Appendix B for detailed discussion of recommended monitoring methods.

Since 2003, Beale has had a range monitoring program to measure biomass remaining at the end of the grazing season and to "assess changes in plant community composition, grassland productivity, and invasive exotic plant distributions on grazed lands" (CNLM 2015a, 2015b, 2016). The Beale monitoring program is based on annual sampling at permanent plots following a standard protocol. Attributes sampled include: cover of native plants, exotic grasses, exotic forbs, three invasive species, bare ground, and litter; in addition, biomass is sampled in June once cattle have been removed from the pasture units (CNLM 2015a, 2015b, 2016). Appendix D provides an evaluation of the Beale monitoring program and recommendations for changes.

In general, the Natural Resources Manager should discuss monitoring methods and results with the Base grazing lessees because a lessee's familiarity with and insights about the grazing areas and the livestock operations may provide useful guidance in the implementation of effective monitoring methods and the interpretation of monitoring results and consequent feasible management actions.

9.1 Compliance monitoring, including RDM monitoring

Compliance monitoring requires information about the number of animals, timing of grazing, distribution of grazing, and the intensity of grazing:

1. Number of animals: Livestock can be counted as they are brought on to the property. The counts should be supervised by Beale range staff, and thus bringing animals on Base requires prior notification by a lessee. These counts can be supplemented by monthly reports from each lessee.
2. The presence of animals (timing and distribution of grazing) on a property can be documented by regular surveys by range staff. Again, this information can also be provided by monthly reports from lessees.
3. The distribution and intensity of grazing can be adequately monitored through assessment of residual dry matter (RDM) remaining in the fall. Fall RDM monitoring is considered the most commonly used and important compliance monitoring method on grazed California rangelands (Bush 2006).

Guidelines for minimum fall RDM targets have been developed by University of California researchers that apply to most of the state's grasslands and savannahs (Bartolome et al. 2006; see Section 6 and Table 6-1). As described in Section 6.0, fall RDM limits rainfall-induced soil erosion and soil nutrient losses and, in areas with more than 15 inches of annual rainfall such as Beale AFB, also maximizes biomass production and can influence plant species composition in some instances (Bartolome et al. 2007b; Amatangelo et al. 2008). UC ANR researchers recommend conducting RDM monitoring in the early fall before the onset of germinating rains (typically undertaken in late September to early October) to ensure that accurate year- and site-specific information is collected because fall starts the period during which RDM protects soil and influences production for the following grazing season (Bartolome et al. 2006).

Beale's current biomass compliance monitoring takes place in June (CNLM 2015a,b, 2016). When biomass monitoring occurs at the end of the spring grazing season like this, RDM remaining in the fall must be estimated with significant uncertainties. While biomass loss over the summer months can be broadly estimated, decomposition rates vary from site to site and from year to year (Frost et al. 2005); furthermore, grazing by wild ungulates, small mammals, and other wildlife is not accounted for. Given the importance of knowing how much RDM remains in the fall, Beale should measure RDM in late September/early October.

There are legitimate reasons for measuring herbaceous biomass at other times of the year, although these measurements should be referred to as biomass sampling or similar terms rather than as RDM monitoring. For example, measuring biomass during the spring and/or immediately after the grazing season can inform decisions about extending the grazing season in high production years and can help assess whether lessees are likely to be in compliance with fall RDM targets (currently, Beale grazing leases set a biomass target for the end of the grazing season, May 31 [DAF 2012, Exhibit E-Operating Agreement, 30]). Lower cost methods such as ocular estimates of biomass may also provide the necessary information to make these decisions. Importantly, any such biomass measurements should not supplant annual RDM monitoring in the fall.

Traditionally, the standard method for monitoring fall RDM requires the establishment of several permanent monitoring locations in a grazed site. In each location, RDM is determined in early fall before the onset of germinating rains (typically late September to early October) by any of a variety of methods including (Bartolome et al. 2006; Bush 2006; Guenther and Hayes 2008):

- clipping biomass in several small plots and weighing the clipped biomass;
- visual estimation of RDM in comparison to photo guides; or
- the comparative yield method that combines clipping a small number of plots and visually estimating RDM based on those clipped plots.

A more recent innovation is the RDM mapping technique, developed and implemented in California, which allows for a clearer picture of the spatial distribution of RDM.

RDM mapping is easy to learn and often requires less time to complete than the traditional permanent plot-based method, while still producing robust information. Sites with too little or too much fall RDM can be quickly identified, and solutions based on manipulating livestock distribution may also be more easily developed. RDM mapping requires developing fall RDM classes (e.g., 0-600 pounds per acre, 600-1,000 pounds per acre, etc.) and, with a paper map or GPS unit in-hand, mapping RDM classes in the fall based on visual estimation of fairly large areas (up to several acres). The minimum mapping unit should be on the order of a quarter acre so sacrifice areas immediately around troughs or salt licks are not typically mapped. Visual estimates are calibrated during the mapping process by clipping and weighing RDM from small, representative plots. Annual time-series of fall RDM class maps can then be evaluated for areas requiring management attention.

Fall RDM mapping is the RDM monitoring technique that Beale should adopt. It is cost-effective and will provide spatially explicit information at a level of detail appropriate for management decision-making. The Range Management Assistance Team similarly recommended that Beale implement this technique in their 2000 report (RMAT 2000, 10). The traditional plot-based techniques described above are also suitable fall RDM monitoring methods. For pasture units that have low and highly spatially variable fall RDM levels, a more intensive, plot-based method may be necessary to provide the appropriate level of accuracy. Plot-based sampling may also be appropriate if a pasture unit falls below its fall RDM target over multiple years, or if a dispute with a lessee arises over compliance. Bartolome et al. (2006), Bush (2006), and Guenther and Hayes (2008) provide useful information on implementing a fall RDM monitoring program; the first two are available online. See also Appendix B.

Once the annual fall RDM data are collected and analyzed, the Natural Resources Manager should review the RDM results with the grazing lessees and the point of contact for the Dry Creek Saddle Club. Discussions regarding the year's RDM levels in relation to Beale's fall RDM targets should inform planning for the coming grazing season for all participants.

The minimum fall RDM targets recommended by UC ANR researchers are general guidelines, and, as Bartolome et al. (2006) state in their publication, managers may need to develop site-specific fall RDM targets for multiple reasons, such as unusual site conditions, management goals that focus on listed species' habitat requirements, weed control, or herbaceous fuel load reduction. Consequently, these *Guidelines*' recommendation of a minimum fall RDM target of 500 pounds per acre may need to be adjusted as fall RDM monitoring data are collected, and as the Natural Resources Manager evaluates whether management goals are being achieved at this level of fall RDM[12].

9.2 Effectiveness monitoring for management actions

Effectiveness monitoring is usually more complex and expensive than compliance monitoring and requires longer-term data collection. Effectiveness monitoring is important even

[12] As noted in Section 2, recent Beale leases require 800 lbs per acre as the minimum amount of biomass remaining "at the end of the grazing season" (DAF 2012, Exhibit E-Operating Agreement, 30). This biomass target probably comes from a recommendation in the 2000 Range Management Assistance Team report (RMAT 2000, 9-12). Prior to the 800 lbs per acre minimum biomass target, Beale required 600 lbs per acre minimum RDM, based on UC ANR guidelines from the 1980s (RMAT 2000, 11). Confusingly, the Beale INRMP contains both targets (Beale AFB 2015, 150, A8-49).

in those relatively rare instances when robust research information points clearly to a specific management action. This is because California rangelands vary a great deal from place to place and from year to year (see Sections 4.4 and 4.5). Even if research indicates a management action will result in a particular outcome, in different locations and in different years, outcomes may not turn out as expected. Unexpected outcomes are even more likely when research does not provide clear management recommendations. Consequently, site-specific effectiveness monitoring is necessary as part of an adaptive management approach (see Section 9.3) to generate the information necessary to manage a specific location effectively.

Effectiveness monitoring is tied to specific grazing management goals (Table 3-1), measures specific variables identified within objectives (Table 3-1), and answers the question “am I meeting my stated grazing management goal?” For instance, Goal 1 in Table 3-1 is to “Protect and enhance vernal pool ecosystem functions and processes.” Objective 1.1 explains how to achieve this goal: “Graze vernal pool ecosystem to maintain or increase inundation periods within vernal pools to support breeding of vernal pool fairy shrimp and vernal pool tadpole shrimp, and vernal pool native plants.” Therefore, the effectiveness monitoring protocol would include measuring the inundation period of vernal pools within a grazed area (and within an ungrazed, control area; see below). In this case, inundation period is an important process related to vernal pool ecosystems and is being used as a proxy for increased breeding or persistence of federally listed branchiopods (Marty 2005, 2015). Direct measurement of listed branchiopod populations (density and/or presence/absence) is another option, though in some cases more expensive and time-consuming and potentially harder to detect with confidence.

The general approach to effectiveness monitoring is to establish permanent plot locations and measure critical response variables over a period sufficient to determine whether management actions are having the desired effect. Plots can be located in areas representative of general vegetation types or in areas of special concern such as purple needlegrass stands, sites with grazing-affected listed species, or sites undergoing invasive species treatment. Establishing comparison control plots (locations in which management is not applied but which are as similar as possible to the areas under management) is necessary to differentiate between the effects of management activities such as prescribed grazing or fire as compared to those changes that might appear to be the result of management but are actually caused by annual weather patterns or other non-management factors (see Section 9.3 for further explanation). Appendix B describes in more detail monitoring methods that could be implemented at Beale.

Though not necessarily related to the grazing program[13], Beale could expand its monitoring program to assess California black rail (*Laterallus jamaicensis coturniculus*) habitat during the breeding season, March through July. Based on their research at Spenceville Wildlife Area, Richmond et al. (2012) state that fall RDM monitoring in California black rail marsh habitat does not adequately characterize spring marsh vegetation cover, critical for black rail

[13] Although potential California black rail habitat exists on Beale, and black rails were detected on Base between 2002 and 2009, surveys have not detected the bird since 2009. Nathan Van Schmidt, a black rail researcher from UC Berkeley, stated that, “Generally Beale does not have many Black Rails on it due to many of the pond fringe wetlands having very intense seasonal cycles of flooding and drying” (pers. comm. to Lauren Wilson, February 2017). In addition, known potential black rail habitat on Beale is fenced, and no grazing is permitted in black rail habitat on Base (Ann Bedlion, pers. comm., May 2017).

breeding success. They recommend monitoring black rail marsh habitat cover in the spring to ensure that marsh cover does not fall below 60% of normal levels. Maps in Appendix C show Beale's known potential black rail habitat and modeled occupancy probability estimates for habitat on Beale.

9.3 Adaptive management approach

In general, an important reason for monitoring in complex and dynamic ecosystems such as Valley grassland and vernal pools is the essential role monitoring plays in adaptive management. Adaptive management of natural resources is the continuous process of developing a response dataset that is adequate for testing the effectiveness of management actions, then analyzing that dataset, and using the analysis to refine specific management goals and actions (Reever-Morghan et al. 2006). An adaptive management process can be a powerful tool for creating data-based feedback that improves management outcomes and long-term ecosystem conditions

The crux of adaptive management is to monitor both areas under management and comparison control areas. A control area is a location in which management is not applied but that is as similar as possible to the managed area; the control area is monitored using the same methods employed in the managed area. Control plots allow the manager to compare what happens in the managed area with what happens in the control area, which helps to distinguish between those changes that really are the result of management and those changes caused by some other factor, for example, annual rainfall. This comparison assists the manager in deciding whether all the time and money spent on a particular management action is actually achieving the desired results.

Generally, a quasi-experimental design is desirable, with multiple treatment and control monitoring plots (replication), as well as randomized location of plots and randomized assignment of treatment(s) to plots if feasible. Even if a rigorous design is not feasible, a simple treatment (management action) and control (no management action) design can provide information robust enough to guide management choices. It is essential to remember when planning an adaptive management process that staff time must be scheduled to analyze the monitoring data that has been collected and, importantly, the resulting analysis must be fed back into the management decision-making process. If the analysis suggests that a management action is not achieving its goals, then a new management approach should be considered and implemented, and evaluated, in turn, for effectiveness.

An adaptive management process can be fairly easy to implement as, in many ways, it follows regular management protocols. An example might be the control of the invasive species yellow starthistle (YST). First, the managers must understand the extent of the YST infestation (e.g., conduct a baseline survey). Then, managers must develop YST management goals and objectives, evaluate the feasible YST treatment options, and develop a monitoring program that will cost-effectively determine whether the implemented treatment activities are achieving the management goals. Generally, incorporating input from other stakeholders (e.g., livestock lessees and other departments with responsibilities for the property) during the goal-setting process will improve the likelihood of success. After this planning process has finished, the selected YST treatment activities (e.g., prescription goat grazing and/or herbicide application, etc.) should be implemented followed by monitoring of both the treated YST areas and some YST-infested control areas that have not been treated[14] but are otherwise as similar as possible to the treated areas. Comparing monitoring data from the treatment and control areas should give managers information about whether the treatment has worked effectively (for example, if the goat-grazed areas have 10% YST cover the next year while the control areas have 60% YST cover, that suggests that the goat grazing has reduced the YST infestation). Managers should discuss the monitoring analysis and, based on how well the treatment activities have achieved management goals, decide whether to continue those treatments or try a different YST treatment method. The cycle of monitoring, analysis, and management discussion of treatment effectiveness and future activities should continue until management goals are fully achieved. In some instances, management goals may need to be altered based on monitoring information; for example, permanent eradication of YST may not be an achievable goal and so a new goal of long-term reduction to low levels of YST may need to be substituted for the original goal.

In general, effectiveness monitoring protocols, including analysis and reporting components, should be designed to meet the needs of the adaptive management process. Monitoring reports should explicitly address the question of whether management activities have achieved management goals. If goals have not been met, the report should recommend changes to management activities that the monitoring analysis suggests could improve the effectiveness of those activities.

As noted in Section 4.5, little is known about grazing effects on Beale's special-status plant species. Monitoring the five special-status native plant species in grazed and ungrazed plots should help determine whether these species benefit from a well-managed grazing program, need protection from grazing, or appear unaffected by livestock (Objective 2.2 in Table 3-1). Even for a well-studied species such as purple needlegrass, additional site-specific information should prove useful for achieving management goals or for determining whether management goals are suitable. For example, monitoring purple needlegrass in grazed and ungrazed plots over multiple years with different weather patterns may help confirm whether livestock grazing plays a significant role in the grass' abundance, or whether ample rainfall or some other factor outside management control is of overriding importance. Note, however, that monitoring purple needlegrass is a lower priority than monitoring the special-status species, as Marty et al. (2005) have already conducted research on this question at Beale (see Section 4.5). Appendix B provides details on some monitoring methods that could be used to answer such questions.

Another possible adaptive management project at Beale might involve investigating *maximum* fall RDM levels. Although fall RDM monitoring samples are typically compared to a minimum target to minimize soil erosion and optimize forage production (see Sections 6 and 9.1), a maximum fall RDM target may also be important for certain management goals. Maximum fall RDM targets may be useful in meeting wildlife habitat requirements (e.g., those of burrowing owl [*Athene cunicularia* ssp. *hypugaea*]), controlling invasive species, or minimizing fine fuel loads. Currently, maximum fall RDM targets have not been developed by

[14] Note that in some circumstances, untreated areas of invasive species can serve as a source for re-infestation of treated areas. Care should be taken when siting the control plots.

researchers, although a few agencies and researchers have recommended specific maximum RDM targets based on expert opinion[15]. Determining whether maximum fall RDM targets might be useful will require site- and/or species-specific evaluation. Conducting modest adaptive management experiments at Beale may provide some useful site-specific information on appropriate maximum fall RDM targets (Objective 2.3 in Table 3-1), which can then feed back into management activities.

Table 9-1 suggests priorities for adaptive management projects based on whether relevant research recommends management actions to achieve objectives from Table 3-1 (see first paragraph of Section 9.2 for a general caveat to the assessments in Table 9-1).

Table 9-1: Potential adaptive management project priorities for the Beale AFB grazing program, based on assessment of relevant research recommending management actions to achieve selected objectives from Table 3-1.

Goal	Objectives	Status of research pertaining to objective
1. Protect and enhance vernal pool ecosystem functions and processes.	1.1 Graze vernal pool ecosystem to maintain or increase inundation periods within vernal pools to support breeding of vernal pool fairy shrimp and vernal pool tadpole shrimp, and vernal pool native plants. 1.2 Maintain residual dry matter (RDM) at recommended levels.	1.1 Adequate experimental evidence to proceed with management (Marty 2005, 2015). 1.2 Adequate experimental evidence to proceed with management (Bartolome et al. 2006, 2007b).
2. Protect and provide a conservation benefit for federal and state listed species, state species of concern, and other at-risk species including rare rangelands plants.*(Modified INRMP Goal 2)	2.1 General: Create a grassland habitat mosaic (grazed, lightly/rotationally grazed, ungrazed) to support multiple special status species (and their prey) with varying requirements. 2.2 Monitor special-status native plant species in grazed and ungrazed plots to determine whether they benefit from a well-managed grazing program, need protection from grazing, or appear unaffected by livestock. 2.3 Conduct adaptive management	2.1 Limited supporting evidence, especially in California; adaptive management experiment is appropriate. 2.2 Limited supporting evidence for most species; adaptive management experiment is appropriate. 2.3 Limited supporting evidence for most species; adaptive management experiment is appropriate.

[15] For example: the Contra Costa Water District established an RDM "upper limit" of 1,500-2,000 lbs/acre for San Joaquin kit fox (*Vulpes macrotis mutica*) habitat (CCWD 2008, 30-31); Barry et al. (2011, 28) suggested 500 lbs/acre as a maximum RDM target for kit fox; Constable et al. (2009, 41-42) recommended that based on "observations in the southern portion of the kit fox range, RDM levels lower than 1,000 lbs/ac and probably closer to 500 lbs/ac would result in favorable habitat conditions" for both kit fox and kangaroo rats (*Dipodomys* spp.); and Germano et al. (2012) addressed the impact of excessive biomass (defined in their study as herbaceous biomass greater than 500 lbs/acre by April 1) on several special status animals in the southern San Joaquin Valley, although they did not explicitly recommend a maximum RDM target.

Goal	Objectives	Status of research pertaining to objective
	study to provide site-specific information on appropriate *maximum* RDM targets for meeting wildlife habitat requirements, controlling invasive species, and minimizing fine fuel loads. Implement the following objectives: 4.1 below *(Modified INRMP Objective 2.3), 4.2 below *(Modified INRMP Objective 2.3), 4.3 below *(Modified INRMP Objective 2.3), 5.1 below *(Modified INRMP Objective 2.3).	
3. Maintain and improve rangeland ecosystem functions and processes	3.1 Maintain RDM at recommended levels to minimize soil erosion. 3.2 Reduce cover of widespread invasive plant species. Implement Objective 2.3 above.	3.1 Adequate experimental evidence to proceed with management (Bartolome et al. 2006, 2007b). 3.2 Adequate experimental evidence to proceed with management (see Section 5.0).
4. Maintain or increase populations of native rangeland plants that contribute to floral and faunal biological diversity *(Modified INRMP Objective 5.9).	4.1 Reduce cover of widespread invasive grass medusahead (*Elymus* [*Taeniatherum*] *caput-medusae*). 4.2 Reduce cover of widespread invasive species yellow starthistle (*Centaurea solstitialis*). 4.3 Eliminate incipient populations of new invasive species by implementing a rapid response protocol per the 2017 Beale AFB Invasive Plant Species Management Guidelines and associated Work Plans. 4.4 Monitor native species richness in grazed Management Areas. 4.5 Initiate blue oak protection and enhance regeneration on and around the Saddle Club. Implement Objectives 2.2 and 2.3	4.1 Adequate experimental evidence to proceed with management (see Section 5.0), but adaptive management experiment to assess efficacy of treatment may be appropriate. 4.2 Adequate experimental evidence to proceed with management (see Section 5.0), but adaptive management experiment to assess efficacy of treatment may be appropriate. 4.3 Adequate evidence to support this objective (see Section 5.0). 4.4 Adequate evidence to proceed with monitoring. 4.5 Adequate experimental

Goal	Objectives	Status of research pertaining to objective
	above. *(Modified INRMP Project 5.9.3)	evidence to proceed with management (see Section 4.5 Blue oak woodlands).
5. Manage and improve rangeland vegetation to provide high quality livestock forage on a sustainable basis to maintain benefits received from livestock grazing leases. *(Modified INRMP Goal 8)	5.1 Eliminate known populations of barbed goatgrass (*Aegilops triuncialis*) within five years, an invasive species unpalatable to livestock. 5.2 Maintain rangeland improvements (structural and nonstructural) to support grazing operations and improve the value of the lease. Implement Objective 4.1 above, as medusahead abundance reduces forage and livestock production.	5.1 Adequate experimental evidence to proceed with management (see Section 5.0), but adaptive management experiment to assess efficacy of treatment may be appropriate. 5.2 General consensus supports this objective.
6. Meet Bird/Wildlife Aircraft Strike Hazard (BASH) requirements and implement land management measures that discourage use by wildlife. (INRMP Objective 6.6)	6.1 Maintain vegetation height between 7-14 inches. 6.2 Limit forb (wildflower) abundance. 6.3 Limit patches of bare ground. 6.4 Limit edge effects. Implement Objective 4.2 above.	6. All objectives required by AF Pamphlet 91-212 (DAF 2004).
7. Reduce wildland fire risk and its potential effects on Base facilities and natural resources. *(Modified INRMP Objective 6.5)	7.1 Reduce fine herbaceous fuels through managed livestock grazing. 7.2 Maintain wildland fire protection measures such as firebreaks, access roads for fire suppression, and use of gates for access instead of cutting fences. Implement Objective 2.3 above.	7.1 General consensus supports this objective; experimental evidence for California is limited.

10.0 Recommended actions timeline for Beale AFB grazing program

Table 10-1 is a timeline for grazing program actions recommended in these *Guidelines*. The timeline recommends the months in which the action should be undertaken, but these are broad ranges; in some instances, actions must be taken during a specific window of opportunity, related to plant phenology, annual weather, or other factors, that changes from year to year. Table 10-1 should be improved and updated as Beale range personnel determine necessary.

Table 10-1: Recommended actions timeline for Beale AFB grazing program; (shaded cell=month(s) in which action should be undertaken.

Action	Month(s) in which action should be undertaken											
	August	September	October	November	December	January	February	March	April	May	June	July
Map RDM in pasture units.												
Enter RDM data into GIS and analyze.												
Put lessee(s) on notice if RDM targets not met.												
Determine stocking rates for coming season.												
Review annual lessee grazing plans.												
Meet with lessees and Saddle Club to discuss fall RDM results and coming grazing season.												
November 1 - start of grazing season.												
Count animal numbers as livestock are brought on Base.												
Instruct lessees to move cattle that are soon to give birth to pasture units away from airfield.												
Review monthly AUM reports from lessees.												
Conduct occasional compliance monitoring to confirm monthly AUM reports												

Action	Month(s) in which action should be undertaken											
	August	**September**	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**July**
Maintain GIS records of livestock salt licks and supplement locations; coordinate their placement with CRM.												
Monitor condition of infrastructure, undertake necessary maintenance, and maintain GIS records of infrastructure maintenance; coordinate with CRM as necessary.												
Evaluate and minimize livestock impacts during life history events for species of concern (e.g., nesting, dispersal of young, native plant germination, native plant seed fall).				Appropriate	dates will	vary by	species and	by year.				
Haul water to troughs as necessary.												
Remove livestock carcasses as necessary.												
Determine opening date for Pasture Unit C-6.												
In cooperation with lessees, assess year's forage production in early spring.												

Action	Month(s) in which action should be undertaken											
	August	**September**	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**July**
If production is low, decide whether to reduce stocking rate for the season or curtail grazing season; if production is high, consider extending grazing season (potentially with sheep or goats).												
Evaluate livestock impacts on grazed areas of Reed and Hutchinson creeks.												
Monitor black rail marsh habitat cover.												
Determine year's medusahead phenology; graze cattle to control medusahead during its most vulnerable period.									Specific period will vary	from year to year.		
Determine year's medusahead phenology; mow medusahead during its most vulnerable period.									Specific period	will vary from	year to year.	
Determine year's yellow starthistle phenology; graze cattle to control yellow starthistle.									Specific period will vary	from year to year.		
In years with significant late spring rainfall, consider extending the grazing season to control yellow starthistle (potentially with goats).									Specific period	will vary	from	year to year.
May 31 - end of regular grazing season.												

Action	Month(s) in which action should be undertaken											
	August	**September**	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**July**
Determine year's goatgrass phenology; mow goatgrass during its most vulnerable period.										Specific period will vary	from year to year.	
Prepare annual budget submissions for Reimbursable Conservation Program funding by **31 July** each year for the upcoming fiscal year. Budgets must identify projected revenue and requested reimbursements (AFI 32-7064 Section 16.3.5.1).												
In years with high biomass production, consider a prescribed burn to control goatgrass (determine year's goatgrass phenology)										Specific period	will vary from	year to year.
Check oak treeshelters for maintenance needs.												
In cooperation with lessees, assess infrastructure needs, weed control needs.												
Implement effectiveness or project-specific monitoring as necessary (see Appendix D). Should begin as management actions are planned. Refer to Goals, Objectives, Projects, and Recommended Actions in Tables 3-1 and 8-1.	Effectiveness monitoring is project-specific and should occur based on the response variable(s) being monitored.											

Action	Month(s) in which action should be undertaken											
	August	**September**	**October**	**November**	**December**	**January**	**February**	**March**	**April**	**May**	**June**	**July**
Analyze effectiveness or project-specific monitoring data and review management actions based on analysis (see Section 9.3).	Project-specific timeline.											
Install wildlife escape ramps in all livestock water troughs (see Section 4.3 Improvements).	One time action, as soon as possible.											
Conduct the baseline survey of infrastructure for the Geodatabase (see Section 4.3 Improvements).	One time action, as soon as possible.											
Collect information on specific areas that have been cultivated for crops and orchards. Enter data into Geodatabase (see Section 4.2).	One time action.											
Evaluate blue oak and valley oak recruitment into the sapling stage, especially in Management Area E horse pastures and in Pasture Unit D-6, to ascertain the need for oak seedling protection (see Section 4.5).	Initial baseline survey; thereafter, monitor as needed to assess management effectiveness.											

11.0 References

URLs correct as of June 2016.

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Appendix A: Vegetation production estimates and Animal Unit Month calculations

A1. Calculating Animal Unit Month values for Beale AFB pasture units

As described briefly in the main text of the *Grazing Management Guidelines* (hereinafter *Guidelines*), to determine grazing capacity on the 36 pasture units in Beale's six management areas, the Ecological Site method was used, which is based on rangeland vegetative production estimates for the various soil types provided by the USDA Natural Resources Conservation Service (NRCS). This soil type method provides average above-ground rangeland vegetation production values for each soil type but does not account for the actual vegetation communities found at any particular site.

The NRCS has developed an extensive landscape classification system, the Ecological Site Information System, based on soil type, slope, and vegetation (see https://esis.sc.egov.usda.gov/Default.aspx for further details). The NRCS Web Soil Survey and soil data access websites (http://websoilsurvey.nrcs.usda.gov/app/HomePage.htm and http://sdmdataaccess.nrcs.usda.gov/, accessed October 2016 and August 2017) provide Ecological Site rangeland vegetative production estimates for the 36 pasture units' soil map units at 3 levels of annual rainfall (favorable, normal, and unfavorable years); these production estimates are total annual, above-ground biomass production (all vegetation, whether or not it is palatable to livestock) in pounds per acre and are based upon an extensive vegetation sampling program by the NRCS and its cooperators.

Several of the 14 soil map units in Beale's pasture units (Table A-1) comprise more than one major soil type (e.g., Argonaut-Auburn complex), and all the soil map units also contain at least 1 minor soil component. Each of these different major and minor soil components, although occurring within a single soil map unit, produces differing amounts of total annual, above-ground biomass. For each soil map unit, the NRCS offers an average vegetation production value weighted by percent occurrence of the major soil components, but these weighted averages do not incorporate production values for the minor components, which make up as much as 25% of the map unit but more typically 20%. The NRCS weighted average production values, therefore, may underestimate production significantly. To address this underestimate, weighted average production values that include the minor components were generated for these *Guidelines* (Table A-2). Drawing both from the NRCS website data and from Lytle (1998) to determine minor soil components and their percentages of the soil mapping units, these *Guidelines* selected Lytle's more detailed description when the two sources conflicted. Rangeland vegetative production values for each soil type (rather than averaged values for the soil map unit) came from the NRCS Web Soil Survey ('Rangeland Productivity' under the Soil Reports subtab of the Soil Data Explorer tab). Generally, production values were not directly provided for minor components. In such instances, these *Guidelines* conservatively estimated production values as follows: For most of the soil map units, one or more of the minor soils was a major soil component or other named soil type but described as shallower, rockier, or more disturbed than the regular soil series. It was assumed that in such cases, vegetation production was likely to be lower and so production was reduced for that component by an arbitrary 25%. If a named minor soil was described as deeper than its regular soil, the production value of the regular soil series was assigned unchanged. In three instances, no production data were available from the NRCS. For those three cases, production values were assigned to the soil series/complex as follows:

1. 'Rock outcrop', a component of several map units, was assigned a production value of 0.
2. Horst soil, a minor component of soil map unit 141, is suitable for irrigated crops; consequently, it was assigned the production values of Perkins, a productive major soil in the same map unit.
3. Soil map unit 215 contains an unnamed soil type that is shallower than the major soil component; it was conservatively assigned the production values of 'San Joaquin, but shallower', the least productive soil component in the map unit.

Following the determination of each soil component's production values, production values were then weighted by the percent occurrence of each soil component in the soil map unit and summed to generate a total soil map unit rangeland vegetative production estimate for each level of annual rainfall: favorable, normal, and unfavorable (Table A-2).

Table A-1: Soil map units within the Beale AFB pasture units, not including Dumps, landfills map unit (Lytle 1998; NRCS 2016).

Soil series/map unit, with percent slope class	Map symbol
Argonaut-Auburn complex, 3-8%	102
Argonaut-Auburn complex, 15-30%	104
Auburn loam, 15-30%	108
Auburn-Sobrante complex, 3-8%	110
Auburn-Sobrante-Rock outcrop complex, 15-30%	118
Hollenbeck clay, 0-3%	133
Conejo loam, 0-2%	141
Pardee gravelly loam, 3-8%	201
Pardee-Ranchoseco complex, 0-3%	202
Perkins loam, 0-2%	203
Redding-Corning complex, 0-3%	209
Redding-Corning complex, 3-8%	210
San Joaquin loam, 0-1%	214
San Joaquin loam, 1-3%	215

Table A-2: Total annual, above-ground rangeland vegetative production (pounds per acre) at 3 levels of annual rainfall for major and minor components of the soil map units of Beale AFB pasture units. *=component's production values are 75% of regular soil series' values. Data from Lytle (1998) and USDA Natural Resources Conservation Service Web Soil Survey and soil data access websites (websoilsurvey.nrcs.usda.gov/app/HomePage.htm and sdmdataaccess.nrcs.usda.gov/, accessed October 2016 and August 2017).

Soil map unit symbol	Component name	Fraction of each component in map unit	Unweighted annual range production (lbs/acre)			Annual range production, weighted by percent occurrence in soil map unit (lbs/acre)		
			Favorable	Normal	Unfavorable	Favorable	Normal	Unfavorable
102	Argonaut, loam	0.4	3,000	2,000	1,000	1,200	800	400
102	Auburn, loam	0.4	3,200	2,000	1,000	1,280	800	400
102	Rock outcrop	0.05	0	0	0	0	0	0
102	Sobrante (assuming loam)	0.05	3,500	2,400	1,200	175	120	60
102	Argonaut, but deeper	0.05	3,000	2,000	1,000	150	100	50
102	Auburn, but clay loam subsoil*	0.05	2,400	1,500	750	120	75	38
102	**Soil map unit weighted totals**					**2,925**	**1,895**	**948**
104	Argonaut, loam	0.4	3,000	2,000	1,000	1,200	800	400
104	Auburn, loam	0.4	3,200	2,000	1,000	1,280	800	400
104	Rock outcrop	0.05	0	0	0	0	0	0
104	Sobrante (assuming loam)	0.05	3,500	2,400	1,200	175	120	60
104	Argonaut, but deeper	0.05	3,000	2,000	1,000	150	100	50
104	Auburn, but clay loam subsoil*	0.05	2,400	1,500	750	120	75	38
104	**Soil map unit weighted totals**					**2,925**	**1,895**	**948**
108	Auburn, loam	0.8	3,200	2,000	1,000	2,560	1,600	800
108	Rock outcrop	0.05	0	0	0	0	0	0
108	Sobrante (assuming loam)	0.05	3,500	2,400	1,200	175	120	60
108	Argonaut	0.05	3,000	2,000	1,000	150	100	50
108	Auburn, but clay loam subsoil*	0.05	2,400	1,500	750	120	75	38
108	**Soil map unit weighted totals**					**3,005**	**1,895**	**948**

Soil map unit symbol	Component name	Fraction of each component in map unit	Unweighted annual range production (lbs/acre)			Annual range production, weighted by percent occurrence in soil map unit (lbs/acre)		
			Favorable	Normal	Unfavorable	Favorable	Normal	Unfavorable
110	Auburn, loam	0.4	3,200	2,000	1,000	1,280	800	400
110	Sobrante, loam	0.4	3,500	2,400	1,200	1,400	960	480
110	Rock outcrop	0.05	0	0	0	0	0	0
110	Argonaut	0.05	3,000	2,000	1,000	150	100	50
110	Timbuctoo	0.05	1,500	1,000	500	75	50	25
110	Auburn, but shallower*	0.025	2,400	1,500	750	60	38	19
110	Auburn, but clay loam subsoil*	0.012	2,400	1,500	750	29	18	9
110	Sobrante, but clay loam subsoil*	0.013	2,625	1,800	900	34	23	12
110	**Soil map unit weighted totals**					**3,028**	**1,989**	**994**
118	Auburn, gravelly loam	0.35	3,000	2,000	1,000	1,050	700	350
118	Sobrante, gravelly loam	0.3	2,500	2,000	1,500	750	600	450
118	Rock outcrop	0.15	0	0	0	0	0	0
118	Argonaut	0.05	3,000	2,000	1,000	150	100	50
118	Timbuctoo	0.05	1,500	1,000	500	75	50	25
118	Auburn, but shallower*	0.05	2,250	1,500	750	113	75	38
118	Sobrante, but shallower*	0.05	1,875	1,500	1,125	94	75	56
118	**Soil map unit weighted totals**					**2,231**	**1,600**	**969**
133	Hallenbeck, clay	0.85	3,500	2,500	1,500	2,975	2,125	1,275
133	Redding	0.05	2,500	2,000	1,000	125	100	50
133	San Joaquin	0.05	2,400	1,800	1,000	120	90	50
133	Hallenbeck, but deeper	0.05	3,500	2,500	1,000	175	125	50
133	**Soil map unit weighted totals**					**3,395**	**2,440**	**1,425**

Soil map unit symbol	Component name	Fraction of each component in map unit	Unweighted annual range production (lbs/acre)			Annual range production, weighted by percent occurrence in soil map unit (lbs/acre)		
			Favorable	Normal	Unfavorable	Favorable	Normal	Unfavorable
141	Conejo, loam	0.85	4,000	3,200	2,000	3,400	2,720	1,700
141	Perkins	0.05	3,500	2,500	1,200	175	125	60
141	Horst [irrigated crop soil; assigned Perkins production values]	0.05	3,500	2,500	1,200	175	125	60
141	Canejo, but shallower*	0.05	3,000	2,400	1,500	150	120	75
141	**Soil map unit weighted totals**					**3,900**	**3,090**	**1,895**
201	Pardee, gravelly loam	0.9	3,000	2,000	1,000	2,700	1,800	900
201	Ranchoseco	0.05	2,000	1,500	500	100	75	25
201	Pardee, but deeper	0.05	3,000	2,000	1,000	150	100	50
201	**Soil map unit weighted totals**					**2,950**	**1,975**	**975**
202	Pardee, gravelly loam	0.5	3,000	2,000	1,000	1,500	1,000	500
202	Ranchoseco, very cobbly loam	0.35	2,000	1,500	500	700	525	175
202	Rock outcrop	0.05	0	0	0	0	0	0
202	Pardee, but rockier*	0.05	2,250	1,500	750	113	75	38
202	Ranchoseco, but shallower*	0.05	1,500	1,125	375	75	56	19
202	**Soil map unit weighted totals**					**2,388**	**1,656**	**731**
203	Perkins	0.85	3,500	2,500	1,200	2,975	2,125	1,020
203	Conejo	0.1	4,000	3,200	2,000	400	320	200
203	Perkins, but shallower*	0.05	2,625	1,875	900	131	94	45
203	**Soil map unit weighted totals**					**3,506**	**2,539**	**1,265**

Soil map unit symbol	Component name	Fraction of each component in map unit	Unweighted annual range production (lbs/acre)			Annual range production, weighted by percent occurrence in soil map unit (lbs/acre)		
			Favorable	Normal	Unfavorable	Favorable	Normal	Unfavorable
209	Redding, gravelly loam	0.4	2,500	2,000	1,000	1,000	800	400
209	Corning, gravelly loam	0.35	2,400	1,800	1,000	840	630	350
209	Perkins	0.05	3,500	2,500	1,200	175	125	60
209	San Joaquin	0.05	2,400	1,800	1,000	120	90	50
209	Redding, but rockier*	0.05	1,875	1,500	750	94	75	38
209	Corning, but rockier*	0.05	1,800	1,350	750	90	68	38
209	Redding, but shallower*	0.05	1,875	1,500	750	94	75	38
209	**Soil map unit weighted totals**					**2,413**	**1,863**	**973**
210	Corning, gravelly loam	0.35	2,400	1,800	1,000	840	630	350
210	Redding, gravelly loam	0.35	2,500	2,000	1,000	875	700	350
210	San Joaquin	0.1	2,400	1,800	1,000	240	180	100
210	Redding, but rockier*	0.1	1,875	1,500	750	188	150	75
210	Corning, but rockier*	0.1	1,800	1,350	750	180	135	75
210	**Soil map unit weighted totals**					**2,323**	**1,795**	**950**
214	San Joaquin, loam	0.8	2,400	1,800	1,000	1,920	1,440	800
214	Perkins, but disturbed*	0.05	2,625	1,875	900	131	94	45
214	Redding, but disturbed*	0.05	1,875	1,500	750	94	75	38
214	San Joaquin, but shallower or deeper*	0.05	1,800	1,350	750	90	68	38
214	San Joaquin, but shallower or deeper*	0.05	1,800	1,350	750	90	68	38
214	**Soil map unit weighted totals**					**2,325**	**1,744**	**958**

Soil map unit symbol	Component name	Fraction of each component in map unit	Unweighted annual range production (lbs/acre)			Annual range production, weighted by percent occurrence in soil map unit (lbs/acre)		
			Favorable	Normal	Unfavorable	Favorable	Normal	Unfavorable
215	San Joaquin, loam	0.8	2,400	1,800	1,000	1,920	1,440	800
215	Perkins	0.05	3,500	2,500	1,200	175	125	60
215	Redding	0.05	2,500	2,000	1,000	125	100	50
215	unnamed, shallow [assigned ‘San Joaquin, but shallower or deeper’ production values]	0.05	1,800	1,350	750	90	68	38
215	San Joaquin, but shallower or deeper*	0.05	1,800	1,350	750	90	68	38
215					**Soil map unit weighted totals**	**2,400**	**1,800**	**985**

From these three production estimates for each soil map unit, the University of California Agriculture and Natural Resources recommended fall RDM minimum target for the slope class of the soil map unit (Table A-3) was subtracted to account for a basic RDM allowance. Note that because slope classes for the RDM targets only partially overlap those for the soil map units, these estimates use the *higher* RDM target for each soil map unit slope class, to ensure adequate RDM levels (compare Tables A-3 and A-4).

Table A-3: Fall residual dry matter targets for annual grassland recommended by University of California Agriculture and Natural Resources (Bartolome et al. 2006).

0-10 % slope	10-20 % slope	20-40 % slope	>40 % slope
500 lbs/acre	600 lbs/acre	700 lbs/acre	800 lbs/acre

Table A-4: Fall residual dry matter (RDM) target employed for each NRCS soil map unit slope class in Beale AFB pasture units.

Soil map unit slope class description	RDM target used in analysis
0 to 1 percent slopes	500 lbs/acre
0 to 2 percent slopes	500 lbs/acre
0 to 3 percent slopes	500 lbs/acre
1 to 3 percent slopes	500 lbs/acre
3 to 8 percent slopes	500 lbs/acre
15 to 30 percent slopes	700 lbs/acre

A summer biomass loss estimate was also subtracted to determine available forage per acre. Decomposition of biomass in California over the summer months prior to sampling of fall RDM in early October has been estimated to average about 7% per month (Frost et al. 2005; Bartolome et al. 2006). For the majority of cattle pasture units in Management areas A, B, C, and D, cattle are removed by May 31 (Beale AFB 2015, 147-149) so four months' (June through September) biomass decomposition is accounted for. The Beale horse pasture units in Management area E are grazed year-round, which may affect biomass decomposition rates, but how and to what extent is not known; the Beale Natural Resources Manager may wish to adjust for this unknown as data from fall RDM sampling of the horse pasture units accumulate. For soil map units with a 500 pounds/acre fall RDM target, the summer loss estimate was 169 pounds per acre, and for the soil map unit with a 700 pounds per acre fall RDM target, the estimate was 236 pounds per acre. Table A-5 summarizes each soil map unit's three production values, fall RDM target, and summer biomass loss estimate.

Table A-5: Total annual, above-ground rangeland vegetative production (pounds per acre) at 3 levels of annual rainfall, fall RDM target, and summer biomass loss estimate for soil map units of Beale AFB pasture units; *=soil map unit slope classes overlap two RDM slope classes so soil map unit conservatively assigned the higher fall RDM target (see Tables A-3 and A-4).

Soil map unit symbol	Soil map unit name	Annual range production (lbs/acre)			Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)
		Favorable	Normal	Unfavorable		
102	Argonaut-Auburn complex, 3-8%	2,925	1,895	948	500	169
104	Argonaut-Auburn complex, 15-30%	2,925	1,895	948	700*	236
108	Auburn loam, 15-30%	3,005	1,895	948	700*	236
110	Auburn-Sobrante complex, 3-8%	3,028	1,989	994	500	169
118	Auburn-Sobrante-Rock outcrop complex, 15-30%	2,231	1,600	969	700*	236
133	Hollenbeck clay, 0-3%	3,395	2,440	1,425	500	169
141	Conejo loam, 0-2%	3,900	3,090	1,895	500	169
201	Pardee gravelly loam, 3-8%	2,950	1,975	975	500	169
202	Pardee-Ranchoseco complex, 0-3%	2,388	1,656	731	500	169
203	Perkins loam, 0-2%	3,506	2,539	1,265	500	169
209	Redding-Corning complex, 0-3%	2,413	1,863	973	500	169
210	Redding-Corning complex, 3-8%	2,323	1,795	950	500	169
214	San Joaquin loam, 0-1%	2,325	1,744	958	500	169
215	San Joaquin loam, 1-3%	2,400	1,800	985	500	169

For each of Beale's pasture units, every soil map unit's available-forage-per-acre value was multiplied by the soil map unit's total acreage to determine total available forage for that soil map unit. As part of this calculation and at the request of the Beale Natural Resources Manager, road acreage[1] was removed from the acreage of any soil map unit in which it occurred (Ann Bedlion, pers. comm., May 2017); this is consistent with the 2012/2013 Beale AFB leases, in force until June 2017, which stated that stocking rates were calculated with road acreage removed (DAF 2012, Provision 5.2; see Appendix E, E5-E6). Approximately 62 acres of roads were removed from the 12,789 acre grazing area (10 acres of 'Water' [254] and 8.5 acres of 'Dumps, landfills' [145] were also removed from the grazing capacity calculations). Available

[1] The Base Geodatabase contains roads only as one-dimensional line features. To estimate road acreage, road lines were buffered to 10 feet on either side for a total width of 20 feet, the average road width of Beale's pasture unit roads (Ann Bedlion, pers. comm., May 2017). The acreage of these road polygons was then subtracted from the acreage of the surrounding soil map unit.

forage values were added together to determine each pasture unit's total available forage. Total available forage was then converted into Animal Unit Months (AUM) for each pasture unit at 3 levels of rainfall (Table A-6, located at the end of this Appendix).

Animal Unit Month (AUM)

An Animal Unit Month (AUM) is the standard measurement unit used for describing grazing capacity and stocking rates (Heady and Child 1994; Bush 2006). An AUM is defined as the amount of forage required by 1 Animal Unit for 1 month (SRM 1998). An Animal Unit is defined as 1 mature, 1,000 lb cow, which by definition eats 1,000 lbs of California annual range forage per month. Other kinds and classes of grazing animals (including wildlife) are calculated as a percentage of an Animal Unit; for example, a horse is 1.25 of an Animal Unit. Reported Animal Unit Equivalents (AUE) for different classes of cattle and for different livestock and wildlife species can vary somewhat, but the following AUEs are commonly used in California (Heady and Child 1994, 159; Bush 2006, 9) and nationwide (SRM RAMC 2017, 18):

- 0.2 AUM: one mature sheep, grazing for one month;
- 0.6 AUM: one yearling bovine, grazing for one month; one weaned calf less than 1 year old (stocker), grazing for one month;
- 1.0 AUM: one mature cow with or without unweaned calf not more than six months old, grazing for one month;
- 1.25 AUM: one mature horse, grazing for one month; and
- 1.25-1.5 AUM: one bovine bull more than 2 years old, grazing for one month.

A2. Beale's long-term vegetative production dataset

In 1984, the NRCS began measuring forage production in the Beale grazing pastures (RMAT 2000, 10). Since then, rangeland biomass production has been sampled in up to 17 grazing exclosures on Base by a number of collaborators (for map of exclosure locations, see Figure D-1 in Appendix D), although production data have not been collected every year (Beale AFB 2016, A8-1; CNLM 2016). In the mid-2000s, the Center for Natural Lands Management (CNLM) was hired by Beale AFB to conduct rangeland monitoring, including sampling biomass production.

The current methodology is to clip and weigh the herbaceous biomass within 5 randomly-located, 1 square foot samples within each of the grazing exclosures; biomass sampling typically occurs in June; not every exclosure has been sampled every year (CNLM 2016, Appendix A). Table A-7 presents annual average production values for each grazing exclosure from 1993-2016; exclosures presumably occur on a single soil component of the reported soil map unit, but which soil component is not known. Annual average production values range widely, from 380 lbs per acre in exclosure C4 in 2009 to 8,767 lbs per acre in exclosure A41 in 2005; both of these values are outside the range of production values provided by the NRCS Web Soil Survey for soil series found at Beale (Table A-2, unweighted annual range production values).

Even within a single year, the set of 5 samples that are collected within each exclosure can vary significantly. Table A-8 provides the 5 sample weights for each exclosure sampled in 2015 and 2016. Coefficients of variation are fairly high for several of the exclosures. Within a year, production values from different exclosures but in the same soil map unit differ, sometimes by hundreds of lbs per acre (compare annual averages within the same soil map unit in Table A-8). When comparing exclosure production values (Table A-7 and A-8) to the NRCS Web Soil Survey-derived production values (Table A-5) within a single year, some exclosure production values appear to correspond with normal year NRCS values, while other exclosure values are more similar to dry or wet year values, making it uncertain how to categorize years.

Table A-7: Annual average production values in lbs per acre for 17 Beale AFB grazing exclosures, 1993-2016; Excl=exclosure number (letter and first digit correspond to pasture unit [e.g., B31 is in Pasture Unit B-3]), SMU sym=soil map unit symbol; comp=compromised exclosure, no data taken; data courtesy of the Center for Natural Lands Management (Catherine Little, pers. comm. with Lauren Wilson, June 2017).

Excl	Soil map unit name	SMU sym	1993*	1994*	1995*	1996*	1997*	1998*	1999*	2000*	2005	2006	2007	2008	2009	2010	2011	2013	2014	2015	2016
A1	Perkins loam, 0-2%	203																		2,060	2,880
A31	San Joaquin loam, 0-1%	214	1,036	825	1,357	1,167	824	1,340	843	1,020	1,500	1,000	2,640	1,600	870	1,667	1,213	500	1,250	1,660	2,420
A41	Redding-Corning complex, 0-3%	209	861	933	1,874	1,403	839	2,425	955	1,092	8,767	2,633	2,610	1,800	3,670	3,500	3,030			2,880	4,470
A61	San Joaquin loam, 0-1%	214	1,758	1,627	2,051	1,771	917	2,322	1,246	1,293	4,633	700	1,980	950	857	2,863	1,697	700	1,250	1,330	1,700
A7	San Joaquin loam, 0-1%	214	1,166	883	1,301	1,332	639	2,048	850	1,002	5,133	2,000	2,430	600	810	2,150	1,717	900	1,600	1,770	1,940
B1W	Redding-Corning complex, 3-8%	210									1,800	1,567	1,950	1,200	1,247	1,830				1,410	2,610
B31			1,669	1,299	2,569	2,733	1,620	2,030	1,580	1,389	5,200	2,433	1,530	1,750	1,380	2,180	2,140	1,300			
B6	Redding-Corning complex, 3-8%	210																		1,110	2,810
C1-1	Argonaut-Auburn complex, 3-8%	102																		1,060	2,050
C1-3	Redding-Corning complex, 3-8%	210																		1,780	1,610
C2	Argonaut-Auburn complex, 3-8%	102	2,190	1,889	3,335	2,106	987	2,152	1,923	1,437	2,333	1,100	3,390	1,100	1,457	2,520	1,283			2,220	1,730
C4 (C1W)	Argonaut-Auburn complex, 3-8%	102	2,673	1,102	1,649	2,040	1,107	1,932	2,124	1,087	2,833	933	1,410	750	380	1,243	643	900		1,420	1,790
D11			1,344	1,101	1,958	1,418	748	1,447	612	632	3,000	967	2,310	1,700	1,017	1,793	2,127				
D31	Perkins loam, 0-2%	203	1,279	963	1,923	1,543	661	1,885	1,019	733	2,967	967	2,610	900	1,087	2,983	1,770	1,400	1,200	1,560	1,490
D6	Perkins loam, 0-2%	203																		1,490	2,610
F1	San Joaquin loam, 0-1%																			comp	comp
F41	San Joaquin loam,1-3%	215	1,249	1,553	1,515	1,585	687	2,594	1,513	1,132	3,800	1,800	1,830	1,900	977	1,550	1,387			570	740

Table A-8: Production values in lbs per acre for 5 samples for each of the Beale AFB grazing exclosures sampled in 2015 and 2016; Excl=exclosure number (letter and first digit correspond to pasture unit [e.g., B1 is in Pasture Unit B-1]), SMU sym=soil map unit symbol; aver=average, stdev=standard deviation, C of V=coefficient of variation; production data from CNLM (2015, 2016).

Excl	Soil map unit name	SMU sym	2015 exclosure production samples					2015 aver	2015 stdev	2015 C of V	2016 exclosure production samples					2016 aver	2016 stdev	2016 C of V
			1	2	3	4	5				1	2	3	4	5			
C2	Argonaut-Auburn complex, 3-8%	102	2,000	3,300	1,800	2,100	1,900	2,220	614	28%	1,450	1,350	2,300	1,450	2,100	1,730	437	25%
D6	Argonaut-Auburn complex, 3-8%	102	1,150	1,500	1,450	1,650	1,700	1,490	216	15%	1,650	2,000	2,500	2,400	4,500	2,610	1,109	43%
C4	Argonaut-Auburn complex, 3-8%	102	1,800	1,500	1,300	1,250	1,250	1,420	236	17%	1,150	1,900	1,800	1,950	2,150	1,790	380	21%
C1-1	Argonaut-Auburn complex, 3-8%	102	1,050	1,400	1,500	800	550	1,060	399	38%	1,900	1,950	1,900	2,400	2,100	2,050	212	10%
A1	Perkins loam, 0-2%	203	2,300	1,500	1,900	2,800	1,800	2,060	503	24%	2,150	3,450	3,100	2,800	2,900	2,880	478	17%
D3	Perkins loam, 0-2%	203	1,350	1,300	1,400	1,700	2,050	1,560	315	20%	1,350	2,150	1,450	1,350	1,150	1,490	385	26%
A4	Redding-Corning complex, 0-3%	209	3,000	3,400	2,250	3,550	2,200	2,880	631	22%	4,900	5,400	2,500	5,500	4,050	4,470	1,242	28%
C1-3	Redding-Corning complex, 3-8%	210	1,850	1,100	1,600	2,900	1,450	1,780	682	38%	1,800	1,600	1,550	1,200	1,900	1,610	270	17%
B1	Redding-Corning complex, 3-8%	201	1,900	1,200	1,150	1,450	1,350	1,410	299	21%	2,500	2,550	2,850	2,800	2,350	2,610	210	8%
A7	San Joaquin loam, 0-1%	214	1,300	1,600	1,650	2,200	2,100	1,770	373	21%	1,100	1,600	1,900	1,350	3,750	1,940	1,054	54%
A3	San Joaquin loam, 0-1%	214	1,100	1,550	1,850	2,150	1,650	1,660	388	23%	2,350	2,000	2,550	1,500	3,700	2,420	819	34%
A6	San Joaquin loam, 0-1%	214	1,050	1,450	1,100	1,350	1,700	1,330	266	20%	1,600	1,750	1,850	1,200	2,100	1,700	334	20%
B6	San Joaquin loam, 1-3%	215	1,100	900	1,550	1,000	1,000	1,110	256	23%	2,700	2,600	2,550	2,300	3,900	2,810	627	22%
F4	San Joaquin loam, 1-3%	215	850	650	700	300	350	570	236	41%	900	650	700	750	700	740	96	13%

Finally, there are anomalies in the production data that cloud analysis. For example, in 2016, exclosure D-3 had much lower production inside the exclosure (1,490 lbs per acre) than biomass that was sampled nearby outside the exclosure and presumably grazed (2,480 lbs per acre; CNLM 2016, 30). Similarly, in 2015, the average production value inside exclosure F4 was 570 lbs per acre but 850 lbs per acre outside the exclosure (CNLM 2015, 27). Also, in 2015, biomass was sampled in small exclosures near eight of the established larger exclosures (CNLM 2015, 26-27). Production values in the small exclosures were much higher than in the associated larger exclosures, for unknown reasons (Table A-9; CNLM 2015, 26-27). This raises concerns about how representative the exclosures are of the soil map unit and of the pasture unit.

Table A-9: Annual average production values in lbs per acre for 8 paired large and small Beale AFB grazing exclosures, 2015; Excl=exclosure number (letter and first digit correspond to pasture unit [e.g., B6 is in Pasture Unit B-6]), SMU sym=soil map unit symbol; comp=compromised exclosure, no data taken; data from CNLM (2015).

Excl	Soil map unit name	SMU sym	Inside large exclosure	Inside small exclosure	% difference
A1	Perkins loam, 0-2%	203	2,060	4,200	104
A3	San Joaquin loam, 0-1%	214	1,660	2,200	33
A7	San Joaquin loam, 0-1%	214	1,770	2,450	38
B6	San Joaquin loam, 1-3%	215	1,110	2,080	87
C1-3	Redding-Corning complex, 3-8%	210	1,780	3,350	88
C2	Argonaut-Auburn complex, 3-8%	102	2,220	2,600	17
D3	Perkins loam, 0-2%	203	1,560	2,600	67
D6	Argonaut-Auburn complex, 3-8%	102	1,490	2,025	36

Uncertainty about methodological differences between NRCS soil series production sampling, NRCS Beale production sampling in the 1990s, and CNLM Beale production sampling in the 2000s, as well as the significant intra-annual variation and apparent anomalies in reported Beale production values, make it unclear how to relate production values provided by the NRCS Web Soil Survey for soil series found at Beale to the production data collected on Base. Whether the production samples collected in the exclosures, presumably on a single component of the soil mapping unit, are adequately representative of the overall soil mapping unit and the pasture unit itself is unknown. Clearly, however, the production data are site-specific to Beale's pasture units and so should help inform grazing capacity calculations and stocking rate decisions.

The Beale exclosure production dataset can be incorporated into decision-making as a guide to adjusting stocking rates in pasture units, if their AUM values and RDM data do not appear to be consistent with these *Guidelines*' grazing capacity calculations (Table A-6, located at the end of this Appendix). Table A-10 displays the ranked production values for each exclosure. For those exclosures with a long-term dataset, the range of values offers some guidance to potential production in that location, if NRCS Web Soil Survey-based grazing capacity calculations do not appear to correspond to pasture unit-scale AUM and RDM monitoring in the future.

Table A-10: Ranked annual average production values in lbs per acre for 16 Beale AFB grazing exclosures over the years 1993-2016; data courtesy of the Center for Natural Lands Management (Catherine Little, pers. comm. with Lauren Wilson, June 2017).

Exclosures, soil map unit name, and soil map unit symbol															
C4 (C1W)	C21	C1-1	D31	A1	D6	A41	B1W	B6	C1-3	A31	A61	A71	F41	B31	D11
Argonaut-Auburn complex, 3-8%	Argonaut-Auburn complex, 3-8%	Argonaut-Auburn complex, 3-8%	Perkins loam, 0-2%	Perkins loam, 0-2%	Perkins loam, 0-2%	Redding-Corning complex, 0-3%	Redding-Corning complex, 3-8%	Redding-Corning complex, 3-8%	Redding-Corning complex, 3-8%	San Joaquin loam, 0-1%	San Joaquin loam, 0-1%	San Joaquin loam, 0-1%	San Joaquin loam, 1-3%		
102	102	102	203	203	203	209	210	210	210	214	214	214	215		
2,833	3,390	2,050	2,983	2,880	2,610	8,767	2,610	2,810	1,780	2,640	4,633	5,133	3,800	5,200	3,000
2,673	3,335	1,060	2,967	2,060	1,490	4,470	1,950	1,110	1,610	2,420	2,863	2,430	2,594	2,733	2,310
2,124	2,520		2,610			3,670	1,830			1,667	2,322	2,150	1,900	2,569	2,127
2,040	2,333		1,923			3,500	1,800			1,660	2,051	2,048	1,830	2,433	1,958
1,932	2,220		1,885			3,030	1,567			1,600	1,980	2,000	1,800	2,180	1,793
1,790	2,190		1,770			2,880	1,410			1,500	1,771	1,940	1,585	2,140	1,700
1,649	2,152		1,560			2,633	1,247			1,357	1,758	1,770	1,553	2,030	1,447
1,420	2,106		1,543			2,610	1,200			1,340	1,700	1,717	1,550	1,750	1,418
1,410	1,923		1,490			2,425				1,250	1,697	1,600	1,515	1,669	1,344
1,243	1,889		1,400			1,874				1,213	1,627	1,332	1,513	1,620	1,101
1,107	1,730		1,279			1,800				1,167	1,330	1,301	1,387	1,580	1,017
1,102	1,457		1,200			1,403				1,036	1,293	1,166	1,249	1,530	967
1,087	1,437		1,087			1,092				1,020	1,250	1,002	1,132	1,389	748
933	1,283		1,019			955				1,000	1,246	900	977	1,380	632
900	1,100		967			933				870	950	883	740	1,300	612
750	1,100		963			861				843	917	850	687	1,299	
643	987		900			839				825	857	810	570		
380			733							824	700	639			
			661							500	700	600			

A3. References

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Personal communications

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Catherine Little, Regional Preserve Manager - Northern and Central California, Center for Natural Lands Management, personal communication with Lauren Wilson, June 2017.

Table A-6: Beale AFB pasture unit Animal Unit Months for 3 levels of annual rainfall, with soil map units, annual range production values, fall RDM target, and summer biomass loss estimate.

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
Favorable year								
A-1	203	282.07	3,506	500	169	2,837	800,303	800
A-1	214	550.09	2,325	500	169	1,656	910,949	911
		832.16					**PASTURE UNIT TOTAL:**	**1,711**
Normal year								
A-1	203	282.07	2,539	500	169	1,870	527,400	527
A-1	214	550.09	1,744	500	169	1,075	591,209	591
		832.16					**PASTURE UNIT TOTAL:**	**1,119**
Unfavorable year								
A-1	203	282.07	1,265	500	169	596	168,114	168
A-1	214	550.09	958	500	169	289	158,701	159
		832.16					**PASTURE UNIT TOTAL:**	**327**
Favorable year								
A-2	203	96.94	3,506	500	169	2,837	275,043	275
A-2	209	267.80	2,413	500	169	1,744	466,906	467
A-2	214	106.53	2,325	500	169	1,656	176,418	176
		471.27					**PASTURE UNIT TOTAL:**	**918**
Normal year								
A-2	203	96.94	2,539	500	169	1,870	181,254	181
A-2	209	267.80	1,863	500	169	1,194	319,617	320
A-2	214	106.53	1,744	500	169	1,075	114,496	114
		471.27					**PASTURE UNIT TOTAL:**	**615**

Rainfall year type and pasture unit name	**Soil map unit symbol**	**Size of soil map unit and total pasture unit (acres)**	**Soil map unit annual range production for applicable rainfall level (lbs/acre)**	**Minimum fall RDM target (lbs/acre)**	**Summer biomass loss (lbs/acre)**	**Available forage (lbs/acre)**	**Total forage (lbs)**	**Animal Unit Month**
Unfavorable year								
A-2	203	96.94	1,265	500	169	596	57,776	58
A-2	209	267.80	973	500	169	304	81,277	81
A-2	214	106.53	958	500	169	289	30,735	31
		471.27					**PASTURE UNIT TOTAL:**	**170**
Favorable year								
A-3	203	7.79	3,506	500	169	2,837	22,102	22
A-3	214	253.14	2,325	500	169	1,656	419,197	419
A-3	215	93.37	2,400	500	169	1,731	161,621	162
		354.30					**PASTURE UNIT TOTAL:**	**603**
Normal year								
A-3	203	7.79	2,539	500	169	1,870	14,565	15
A-3	214	253.14	1,744	500	169	1,075	272,061	272
A-3	215	93.37	1,800	500	169	1,131	105,600	106
		354.30					**PASTURE UNIT TOTAL:**	**392**
Unfavorable year								
A-3	203	7.79	1,265	500	169	596	4,643	5
A-3	214	253.14	958	500	169	289	73,030	73
A-3	215	93.37	985	500	169	316	29,504	30
		354.30					**PASTURE UNIT TOTAL:**	**107**
Favorable year								
A-4	203	153.33	3,506	500	169	2,837	435,026	435
A-4	209	171.50	2,413	500	169	1,744	299,005	299

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
A-4	214	412.99	2,325	500	169	1,656	683,908	684
		737.81					**PASTURE UNIT TOTAL:**	**1,418**
Normal year								
A-4	203	153.33	2,539	500	169	1,870	286,683	287
A-4	209	171.50	1,863	500	169	1,194	204,682	205
A-4	214	412.99	1,744	500	169	1,075	443,859	444
		737.81					**PASTURE UNIT TOTAL:**	**935**
Unfavorable year								
A-4	203	153.33	1,265	500	169	596	91,383	91
A-4	209	171.50	973	500	169	304	52,049	52
A-4	214	412.99	958	500	169	289	119,147	119
		737.81					**PASTURE UNIT TOTAL:**	**263**
Favorable year								
A-5	203	124.51	3,506	500	169	2,837	353,266	353
A-5	209	23.88	2,413	500	169	1,744	41,635	42
A-5	210	55.54	2,323	500	169	1,654	91,835	92
A-5	214	3.06	2,325	500	169	1,656	5,067	5
		206.99					**PASTURE UNIT TOTAL:**	**492**
Normal year								
A-5	203	124.51	2,539	500	169	1,870	232,803	233
A-5	209	23.88	1,863	500	169	1,194	28,501	29
A-5	210	55.54	1,795	500	169	1,126	62,538	63
A-5	214	3.06	1,744	500	169	1,075	3,289	3
		206.99					**PASTURE UNIT TOTAL:**	**327**

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
Unfavorable year								
A-5	203	124.51	1,265	500	169	596	74,208	74
A-5	209	23.88	973	500	169	304	7,248	7
A-5	210	55.54	950	500	169	281	15,607	16
A-5	214	3.06	958	500	169	289	883	1
		206.99					**PASTURE UNIT TOTAL:**	**98**
Favorable year								
A-6	203	67.02	3,506	500	169	2,837	190,152	190
A-6	214	187.82	2,325	500	169	1,656	311,030	311
A-6	215	28.92	2,400	500	169	1,731	50,061	50
		283.76					**PASTURE UNIT TOTAL:**	**551**
Normal year								
A-6	203	67.02	2,539	500	169	1,870	125,311	125
A-6	214	187.82	1,744	500	169	1,075	201,860	202
A-6	215	28.92	1,800	500	169	1,131	32,709	33
		283.76					**PASTURE UNIT TOTAL:**	**360**
Unfavorable year								
A-6	203	67.02	1,265	500	169	596	39,944	40
A-6	214	187.82	958	500	169	289	54,186	54
A-6	215	28.92	985	500	169	316	9,139	9
		283.76					**PASTURE UNIT TOTAL:**	**103**
Favorable year								
A-7	203	1.71	3,506	500	169	2,837	4,839	5

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
A-7	214	53.80	2,325	500	169	1,656	89,088	89
A-7	215	53.54	2,400	500	169	1,731	92,676	93
		109.04					**PASTURE UNIT TOTAL:**	**187**
Normal year								
A-7	203	1.71	2,539	500	169	1,870	3,189	3
A-7	214	53.80	1,744	500	169	1,075	57,818	58
A-7	215	53.54	1,800	500	169	1,131	60,553	61
		109.04					**PASTURE UNIT TOTAL:**	**122**
Unfavorable year								
A-7	203	1.71	1,265	500	169	596	1,017	1
A-7	214	53.80	958	500	169	289	15,520	16
A-7	215	53.54	985	500	169	316	16,918	17
		109.04					**PASTURE UNIT TOTAL:**	**33**
Favorable year								
A-9	209	116.06	2,413	500	169	1,744	202,351	202
A-9	214	22.07	2,325	500	169	1,656	36,548	37
A-9	215	28.49	2,400	500	169	1,731	49,316	49
		166.62					**PASTURE UNIT TOTAL:**	**288**
Normal year								
A-9	209	116.06	1,863	500	169	1,194	138,518	139
A-9	214	22.07	1,744	500	169	1,075	23,720	24
A-9	215	28.49	1,800	500	169	1,131	32,222	32
		166.62					**PASTURE UNIT TOTAL:**	**194**

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
Unfavorable year								
A-9	209	116.06	973	500	169	304	35,224	35
A-9	214	22.07	958	500	169	289	6,367	6
A-9	215	28.49	985	500	169	316	9,003	9
		166.62					**PASTURE UNIT TOTAL:**	**51**
Favorable year								
B-1	201	299.86	2,950	500	169	2,281	683,991	684
B-1	202	28.32	2,388	500	169	1,719	48,668	49
B-1	210	220.64	2,323	500	169	1,654	364,828	365
B-1	214	5.00	2,325	500	169	1,656	8,282	8
B-1	215	269.25	2,400	500	169	1,731	466,079	466
		823.08					**PASTURE UNIT TOTAL:**	**1,572**
Normal year								
B-1	201	299.86	1,975	500	169	1,306	391,623	392
B-1	202	28.32	1,656	500	169	987	27,959	28
B-1	210	220.64	1,795	500	169	1,126	248,441	248
B-1	214	5.00	1,744	500	169	1,075	5,375	5
B-1	215	269.25	1,800	500	169	1,131	304,526	305
		823.08					**PASTURE UNIT TOTAL:**	**978**
Unfavorable year								
B-1	201	299.86	975	500	169	306	91,759	92
B-1	202	28.32	731	500	169	62	1,763	2
B-1	210	220.64	950	500	169	281	62,000	62
B-1	214	5.00	958	500	169	289	1,443	1
B-1	215	269.25	985	500	169	316	85,084	85

Rainfall year type and pasture unit name	**Soil map unit symbol**	**Size of soil map unit and total pasture unit (acres)**	**Soil map unit annual range production for applicable rainfall level (lbs/acre)**	**Minimum fall RDM target (lbs/acre)**	**Summer biomass loss (lbs/acre)**	**Available forage (lbs/acre)**	**Total forage (lbs)**	**Animal Unit Month**
		823.08					**PASTURE UNIT TOTAL:**	**242**
Favorable year								
B-2	102	80.66	2,925	500	169	2,256	181,969	182
B-2	133	29.62	3,395	500	169	2,726	80,753	81
B-2	201	142.75	2,950	500	169	2,281	325,604	326
B-2	202	129.79	2,388	500	169	1,719	223,038	223
B-2	203	87.91	3,506	500	169	2,837	249,418	249
B-2	209	4.98	2,413	500	169	1,744	8,683	9
B-2	210	179.79	2,323	500	169	1,654	297,286	297
B-2	214	55.20	2,325	500	169	1,656	91,411	91
B-2	215	384.38	2,400	500	169	1,731	665,357	665
		1,095.07					**PASTURE UNIT TOTAL:**	**2,124**
Normal year								
B-2	102	80.66	1,895	500	169	1,226	98,889	99
B-2	133	29.62	2,440	500	169	1,771	52,463	52
B-2	201	142.75	1,975	500	169	1,306	186,427	186
B-2	202	129.79	1,656	500	169	987	128,132	128
B-2	203	87.91	2,539	500	169	1,870	164,367	164
B-2	209	4.98	1,863	500	169	1,194	5,944	6
B-2	210	179.79	1,795	500	169	1,126	202,445	202
B-2	214	55.20	1,744	500	169	1,075	59,326	59
B-2	215	384.38	1,800	500	169	1,131	434,731	435
		1,095.07					**PASTURE UNIT TOTAL:**	**1,333**
Unfavorable year								
B-2	102	80.66	948	500	169	279	22,504	23

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
B-2	133	29.62	1,425	500	169	756	22,395	22
B-2	201	142.75	975	500	169	306	43,680	44
B-2	202	129.79	731	500	169	62	8,079	8
B-2	203	87.91	1,265	500	169	596	52,393	52
B-2	209	4.98	973	500	169	304	1,511	2
B-2	210	179.79	950	500	169	281	50,521	51
B-2	214	55.20	958	500	169	289	15,925	16
B-2	215	384.38	985	500	169	316	121,463	121
		1,095.07					**PASTURE UNIT TOTAL:**	**338**
Favorable year								
B-3	203	37.20	3,506	500	169	2,837	105,545	106
B-3	209	92.03	2,413	500	169	1,744	160,454	160
B-3	215	51.35	2,400	500	169	1,731	88,892	89
		180.58					**PASTURE UNIT TOTAL:**	**355**
Normal year								
B-3	203	37.20	2,539	500	169	1,870	69,554	70
B-3	209	92.03	1,863	500	169	1,194	109,838	110
B-3	215	51.35	1,800	500	169	1,131	58,080	58
		180.58					**PASTURE UNIT TOTAL:**	**237**
Unfavorable year								
B-3	203	37.20	1,265	500	169	596	22,171	22
B-3	209	92.03	973	500	169	304	27,931	28
B-3	215	51.35	985	500	169	316	16,227	16
		180.58					**PASTURE UNIT TOTAL:**	**66**

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
Favorable year								
B-5	201	307.76	2,950	500	169	2,281	701,993	702
B-5	202	34.98	2,388	500	169	1,719	60,106	60
B-5	203	82.51	3,506	500	169	2,837	234,099	234
B-5	210	140.42	2,323	500	169	1,654	232,183	232
B-5	215	13.64	2,400	500	169	1,731	23,618	24
		579.31					**PASTURE UNIT TOTAL:**	**1,252**
Normal year								
B-5	201	307.76	1,975	500	169	1,306	401,930	402
B-5	202	34.98	1,656	500	169	987	34,530	35
B-5	203	82.51	2,539	500	169	1,870	154,271	154
B-5	210	140.42	1,795	500	169	1,126	158,112	158
B-5	215	13.64	1,800	500	169	1,131	15,432	15
		579.31					**PASTURE UNIT TOTAL:**	**764**
Unfavorable year								
B-5	201	307.76	975	500	169	306	94,173	94
B-5	202	34.98	731	500	169	62	2,177	2
B-5	203	82.51	1,265	500	169	596	49,175	49
B-5	210	140.42	950	500	169	281	39,458	39
B-5	215	13.64	985	500	169	316	4,312	4
		579.31					**PASTURE UNIT TOTAL:**	**189**
Favorable year								
B-6	133	7.71	3,395	500	169	2,726	21,017	21
B-6	201	4.15	2,950	500	169	2,281	9,466	9
B-6	203	0.05	3,506	500	169	2,837	142	0

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
B-6	209	58.42	2,413	500	169	1,744	101,850	102
B-6	210	205.71	2,323	500	169	1,654	340,144	340
B-6	214	0.09	2,325	500	169	1,656	149	0
B-6	215	79.42	2,400	500	169	1,731	137,473	137
		355.55					**PASTURE UNIT TOTAL:**	**610**
Normal year								
B-6	133	7.71	2,440	500	169	1,771	13,654	14
B-6	201	4.15	1,975	500	169	1,306	5,420	5
B-6	203	0.05	2,539	500	169	1,870	93	0
B-6	209	58.42	1,863	500	169	1,194	69,721	70
B-6	210	205.71	1,795	500	169	1,126	231,631	232
B-6	214	0.09	1,744	500	169	1,075	97	0
B-6	215	79.42	1,800	500	169	1,131	89,822	90
		355.55					**PASTURE UNIT TOTAL:**	**410**
Unfavorable year								
B-6	133	7.71	1,425	500	169	756	5,829	6
B-6	201	4.15	975	500	169	306	1,270	1
B-6	203	0.05	1,265	500	169	596	30	0
B-6	209	58.42	973	500	169	304	17,730	18
B-6	210	205.71	950	500	169	281	57,805	58
B-6	214	0.09	958	500	169	289	26	0
B-6	215	79.42	985	500	169	316	25,096	25
		355.55					**PASTURE UNIT TOTAL:**	**108**
Favorable year								
B-8	209	11.61	2,413	500	169	1,744	20,236	20

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
B-8	214	2.63	2,325	500	169	1,656	4,360	4
		14.24					**PASTURE UNIT TOTAL:**	**25**
Normal year								
B-8	209	11.61	1,863	500	169	1,194	13,853	14
B-8	214	2.63	1,744	500	169	1,075	2,830	3
		14.24					**PASTURE UNIT TOTAL:**	**17**
Unfavorable year								
B-8	209	11.61	973	500	169	304	3,523	4
B-8	214	2.63	958	500	169	289	760	1
		14.24					**PASTURE UNIT TOTAL:**	**4**
Favorable year								
C-1	102	1,665.50	2,925	500	169	2,256	3,757,359	3,757
C-1	104	86.17	2,925	700	236	1,989	171,392	171
C-1	110	6.10	3,028	500	169	2,359	14,390	14
C-1	118	18.66	2,231	700	236	1,295	24,165	24
C-1	202	309.92	2,388	500	169	1,719	532,752	533
C-1	203	112.05	3,506	500	169	2,837	317,874	318
C-1	209	53.89	2,413	500	169	1,744	93,982	94
C-1	210	281.13	2,323	500	169	1,654	464,994	465
		2,533.41					**PASTURE UNIT TOTAL:**	**5,377**
Normal year								
C-1	102	1,665.50	1,895	500	169	1,226	2,041,898	2,042
C-1	104	86.17	1,895	700	236	959	82,637	83
C-1	110	6.10	1,989	500	169	1,320	8,052	8

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
C-1	118	18.66	1,600	700	236	664	12,390	12
C-1	202	309.92	1,656	500	169	987	305,891	306
C-1	203	112.05	2,539	500	169	1,870	209,525	210
C-1	209	53.89	1,863	500	169	1,194	64,343	64
C-1	210	281.13	1,795	500	169	1,126	316,556	317
		2,533.41					**PASTURE UNIT TOTAL:**	**3,041**
Unfavorable year								
C-1	102	1,665.50	948	500	169	279	464,673	465
C-1	104	86.17	948	700	236	12	1,034	1
C-1	110	6.10	994	500	169	325	1,983	2
C-1	118	18.66	969	700	236	33	616	1
C-1	202	309.92	731	500	169	62	19,215	19
C-1	203	112.05	1,265	500	169	596	66,779	67
C-1	209	53.89	973	500	169	304	16,382	16
C-1	210	281.13	950	500	169	281	78,998	79
		2,533.41					**PASTURE UNIT TOTAL:**	**650**
Favorable year								
C-2	102	308.49	2,925	500	169	2,256	695,951	696
C-2	110	65.40	3,028	500	169	2,359	154,279	154
		373.89					**PASTURE UNIT TOTAL:**	**850**
Normal year								
C-2	102	308.49	1,895	500	169	1,226	378,207	378
C-2	110	65.40	1,989	500	169	1,320	86,328	86
		373.89					**PASTURE UNIT TOTAL:**	**465**

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
Unfavorable year								
C-2	102	308.49	948	500	169	279	86,068	86
C-2	110	65.40	994	500	169	325	21,255	21
		373.89					**PASTURE UNIT TOTAL:**	**107**
Favorable year								
C-3	108	24.18	3,005	700	236	2,069	50,028	50
C-3	110	121.57	3,028	500	169	2,359	286,785	287
		145.75					**PASTURE UNIT TOTAL:**	**337**
Normal year								
C-3	108	24.18	1,895	700	236	959	23,189	23
C-3	110	121.57	1,989	500	169	1,320	160,473	160
		145.75					**PASTURE UNIT TOTAL:**	**184**
Unfavorable year								
C-3	108	24.18	948	700	236	12	290	0
C-3	110	121.57	994	500	169	325	39,510	40
		145.75					**PASTURE UNIT TOTAL:**	**40**
Favorable year								
C-4	102	22.67	2,925	500	169	2,256	51,144	51
C-4	203	2.62	3,506	500	169	2,837	7,434	7
		25.29					**PASTURE UNIT TOTAL:**	**59**
Normal year								
C-4	102	22.67	1,895	500	169	1,226	27,793	28
C-4	203	2.62	2,539	500	169	1,870	4,899	5

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
		25.29					**PASTURE UNIT TOTAL:**	**33**
Unfavorable year								
C-4	102	22.67	948	500	169	279	6,325	6
C-4	203	2.62	1,265	500	169	596	1,562	2
		25.29					**PASTURE UNIT TOTAL:**	**8**
Favorable year								
C-5	102	3.66	2,925	500	169	2,256	8,257	8
		3.66					**PASTURE UNIT TOTAL:**	**8**
Normal year								
C-5	102	3.66	1,895	500	169	1,226	4,487	4
		3.66					**PASTURE UNIT TOTAL:**	**4**
Unfavorable year								
C-5	102	3.66	948	500	169	279	1,021	1
		3.66					**PASTURE UNIT TOTAL:**	**1**
Favorable year								
C-6	102	45.79	2,925	500	169	2,256	103,292	103
C-6	201	41.03	2,950	500	169	2,281	93,596	94
C-6	202	29.78	2,388	500	169	1,719	51,175	51
C-6	203	13.25	3,506	500	169	2,837	37,594	38
		129.85					**PASTURE UNIT TOTAL:**	**286**
Normal year								
C-6	102	45.79	1,895	500	169	1,226	56,133	56

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
C-6	201	41.03	1,975	500	169	1,306	53,589	54
C-6	202	29.78	1,656	500	169	987	29,399	29
C-6	203	13.25	2,539	500	169	1,870	24,774	25
		129.85					**PASTURE UNIT TOTAL:**	**164**
Unfavorable year								
C-6	102	45.79	948	500	169	279	12,774	13
C-6	201	41.03	975	500	169	306	12,556	13
C-6	202	29.78	731	500	169	62	1,854	2
C-6	203	13.25	1,265	500	169	596	7,897	8
		129.85					**PASTURE UNIT TOTAL:**	**35**
Favorable year								
D-1	203	34.35	3,506	500	169	2,837	97,460	97
D-1	209	2.27	2,413	500	169	1,744	3,958	4
		36.62					**PASTURE UNIT TOTAL:**	**101**
Normal year								
D-1	203	34.35	2,539	500	169	1,870	64,226	64
D-1	209	2.27	1,863	500	169	1,194	2,709	3
		36.62					**PASTURE UNIT TOTAL:**	**67**
Unfavorable year								
D-1	203	34.35	1,265	500	169	596	20,473	20
D-1	209	2.27	973	500	169	304	689	1
		36.62					**PASTURE UNIT TOTAL:**	**21**
Favorable year								

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
D-2	203	19.02	3,506	500	169	2,837	53,964	54
D-2	210	3.59	2,323	500	169	1,654	5,936	6
		22.61					**PASTURE UNIT TOTAL:**	**60**
Normal year								
D-2	203	19.02	2,539	500	169	1,870	35,563	36
D-2	210	3.59	1,795	500	169	1,126	4,042	4
		22.61					**PASTURE UNIT TOTAL:**	**40**
Unfavorable year								
D-2	203	19.02	1,265	500	169	596	11,336	11
D-2	210	3.59	950	500	169	281	1,009	1
		22.61					**PASTURE UNIT TOTAL:**	**12**
Favorable year								
D-3	203	72.61	3,506	500	169	2,837	206,013	206
D-3	209	7.79	2,413	500	169	1,744	13,582	14
D-3	210	30.27	2,323	500	169	1,654	50,051	50
		110.67					**PASTURE UNIT TOTAL:**	**270**
Normal year								
D-3	203	72.61	2,539	500	169	1,870	135,763	136
D-3	209	7.79	1,863	500	169	1,194	9,297	9
D-3	210	30.27	1,795	500	169	1,126	34,084	34
		110.67					**PASTURE UNIT TOTAL:**	**179**
Unfavorable year								
D-3	203	72.61	1,265	500	169	596	43,276	43

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
D-3	209	7.79	973	500	169	304	2,364	2
D-3	210	30.27	950	500	169	281	8,506	9
		110.67					**PASTURE UNIT TOTAL:**	**54**
Favorable year								
D-4	203	0.97	3,506	500	169	2,837	2,752	3
D-4	210	280.23	2,323	500	169	1,654	463,360	463
		281.20					**PASTURE UNIT TOTAL:**	**466**
Normal year								
D-4	203	0.97	2,539	500	169	1,870	1,814	2
D-4	210	280.23	1,795	500	169	1,126	315,539	316
		281.20					**PASTURE UNIT TOTAL:**	**317**
Unfavorable year								
D-4	203	0.97	1,265	500	169	596	578	1
D-4	210	280.23	950	500	169	281	78,745	79
		281.20					**PASTURE UNIT TOTAL:**	**79**
Favorable year								
D-5	110	1.13	3,028	500	169	2,359	2,666	3
D-5	141	0.11	3,900	500	169	3,231	355	0
D-5	203	2.01	3,506	500	169	2,837	5,703	6
D-5	210	256.23	2,323	500	169	1,654	423,676	424
		259.48					**PASTURE UNIT TOTAL:**	**432**
Normal year								
D-5	110	1.13	1989	500	169	1,320	1,492	1

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
D-5	141	0.11	3,090	500	169	2,421	266	0
D-5	203	2.01	2,539	500	169	1,870	3,758	4
D-5	210	256.23	1,795	500	169	1,126	288,515	289
		259.48					**PASTURE UNIT TOTAL:**	**294**
Unfavorable year								
D-5	110	1.13	994	500	169	325	367	0
D-5	141	0.11	1,895	500	169	1,226	135	0
D-5	203	2.01	1,265	500	169	596	1,198	1
D-5	210	256.23	950	500	169	281	72,001	72
		259.48					**PASTURE UNIT TOTAL:**	**74**
Favorable year								
D-6	102	19.41	2,925	500	169	2,256	43,789	44
D-6	110	43.99	3,028	500	169	2,359	103,772	104
D-6	141	0.55	3,900	500	169	3,231	1,777	2
D-6	210	26.37	2,323	500	169	1,654	43,603	44
		90.32					**PASTURE UNIT TOTAL:**	**193**
Normal year								
D-6	102	19.41	1,895	500	169	1,226	23,797	24
D-6	110	43.99	1989	500	169	1,320	58,067	58
D-6	141	0.55	3,090	500	169	2,421	1,332	1
D-6	210	26.37	1,795	500	169	1,126	29,693	30
		90.32					**PASTURE UNIT TOTAL:**	**113**
Unfavorable year								
D-6	102	19.41	948	500	169	279	5,415	5

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
D-6	110	43.99	994	500	169	325	14,297	14
D-6	141	0.55	1,895	500	169	1,226	674	1
D-6	210	26.37	950	500	169	281	7,410	7
		90.32					**PASTURE UNIT TOTAL:**	**28**
Favorable year								
E-1	108	18.76	3,005	700	236	2,069	38,814	39
E-1	110	1.92	3,028	500	169	2,359	4,529	5
		20.68					**PASTURE UNIT TOTAL:**	**43**
Normal year								
E-1	108	18.76	1,895	700	236	959	17,991	18
E-1	110	1.92	1,989	500	169	1,320	2,534	3
		20.68					**PASTURE UNIT TOTAL:**	**21**
Unfavorable year								
E-1	108	18.76	948	700	236	12	225	0
E-1	110	1.92	994	500	169	325	624	1
		20.68					**PASTURE UNIT TOTAL:**	**1**
Favorable year								
E-2	108	20.34	3,005	700	236	2,069	42,083	42
		20.34					**PASTURE UNIT TOTAL:**	**42**
Normal year								
E-2	108	20.34	1,895	700	236	959	19,506	20
		20.34					**PASTURE UNIT TOTAL:**	**20**

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
Unfavorable year								
E-2	108	20.34	948	700	236	12	244	0
		20.34					**PASTURE UNIT TOTAL:**	**0**
Favorable year								
E-3	108	0.80	3,005	700	236	2,069	1,662	2
E-3	110	53.10	3,028	500	169	2,359	125,271	125
		53.91					**PASTURE UNIT TOTAL:**	**127**
Normal year								
E-3	108	0.80	1,895	700	236	959	770	1
E-3	110	53.10	1,989	500	169	1,320	70,096	70
		53.91					**PASTURE UNIT TOTAL:**	**71**
Unfavorable year								
E-3	108	0.80	948	700	236	12	10	0
E-3	110	53.10	994	500	169	325	17,259	17
		53.91					**PASTURE UNIT TOTAL:**	**17**
Favorable year								
E-4	108	7.41	3,005	700	236	2,069	15,336	15
E-4	110	2.49	3,028	500	169	2,359	5,863	6
		9.90					**PASTURE UNIT TOTAL:**	**21**
Normal year								
E-4	108	7.41	1,895	700	236	959	7,108	7
E-4	110	2.49	1,989	500	169	1,320	3,281	3
		9.90					**PASTURE UNIT TOTAL:**	**10**

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
Unfavorable year								
E-4	108	7.41	948	700	236	12	89	0
E-4	110	2.49	994	500	169	325	808	1
		9.90					**PASTURE UNIT TOTAL:**	**1**
Favorable year								
E-5	108	24.32	3,005	700	236	2,069	50,324	50
		24.32					**PASTURE UNIT TOTAL:**	**50**
Normal year								
E-5	108	24.32	1,895	700	236	959	23,326	23
		24.32					**PASTURE UNIT TOTAL:**	**23**
Unfavorable year								
E-5	108	24.32	948	700	236	12	292	0
		24.32					**PASTURE UNIT TOTAL:**	**0**
Favorable year								
E-6	108	4.23	3,005	700	236	2,069	8,743	9
E-6	110	21.27	3,028	500	169	2,359	50,187	50
		25.50					**PASTURE UNIT TOTAL:**	**59**
Normal year								
E-6	108	4.23	1,895	700	236	959	4,052	4
E-6	110	21.27	1,989	500	169	1,320	28,083	28
		25.50					**PASTURE UNIT TOTAL:**	**32**

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
Unfavorable year								
E-6	108	4.23	948	700	236	12	51	0
E-6	110	21.27	994	500	169	325	6,914	7
		25.50					**PASTURE UNIT TOTAL:**	**7**
Favorable year								
F-1	141	240.28	3,900	500	169	3,231	776,338	776
F-1	203	136.07	3,506	500	169	2,837	386,067	386
F-1	209	259.07	2,413	500	169	1,744	451,689	452
F-1	210	417.91	2,323	500	169	1,654	691,014	691
F-1	214	276.61	2,325	500	169	1,656	458,062	458
		1,329.94					**PASTURE UNIT TOTAL:**	**2,763**
Normal year								
F-1	141	240.28	3,090	500	169	2,421	581,713	582
F-1	203	136.07	2,539	500	169	1,870	254,419	254
F-1	209	259.07	1,863	500	169	1,194	309,200	309
F-1	210	417.91	1,795	500	169	1,126	470,567	471
F-1	214	276.61	1,744	500	169	1,075	297,284	297
		1,329.94					**PASTURE UNIT TOTAL:**	**1,913**
Unfavorable year								
F-1	141	240.28	1,895	500	169	1,226	294,581	295
F-1	203	136.07	1,265	500	169	596	81,098	81
F-1	209	259.07	973	500	169	304	78,628	79
F-1	210	417.91	950	500	169	281	117,433	117
F-1	214	276.61	958	500	169	289	79,801	80
		1,329.94					**PASTURE UNIT TOTAL:**	**652**

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
Favorable year								
F-2	141	52.50	3,900	500	169	3,231	169,628	170
F-2	203	14.17	3,506	500	169	2,837	40,204	40
F-2	214	309.04	2,325	500	169	1,656	511,765	512
		375.71					**PASTURE UNIT TOTAL:**	**722**
Normal year								
F-2	141	52.50	3,090	500	169	2,421	127,103	127
F-2	203	14.17	2,539	500	169	1,870	26,494	26
F-2	214	309.04	1,744	500	169	1,075	332,138	332
		375.71					**PASTURE UNIT TOTAL:**	**486**
Unfavorable year								
F-2	141	52.50	1,895	500	169	1,226	64,365	64
F-2	203	14.17	1,265	500	169	596	8,445	8
F-2	214	309.04	958	500	169	289	89,157	89
		375.71					**PASTURE UNIT TOTAL:**	**162**
Favorable year								
F-3	203 [101]	84.61	3,506	500	169	2,837	240,060	240
F-3	214	275.64	2,325	500	169	1,656	456,460	456
		360.25					**PASTURE UNIT TOTAL:**	**697**
Normal year								
F-3	203 [101]	84.61	2,539	500	169	1,870	158,200	158
F-3	214	275.64	1,744	500	169	1,075	296,244	296
		360.25					**PASTURE UNIT TOTAL:**	**454**

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
Unfavorable year								
F-3	203 [101]	84.61	1,265	500	169	596	50,428	50
F-3	214	275.64	958	500	169	289	79,522	80
		360.25					**PASTURE UNIT TOTAL:**	**130**
Favorable year								
F-4	141	0.37	3,900	500	169	3,231	1,195	1
F-4	203	89.27	3,506	500	169	2,837	253,267	253
F-4	209	5.41	2,413	500	169	1,744	9,432	9
F-4	210	23.30	2,323	500	169	1,654	38,530	39
F-4	214	86.95	2,325	500	169	1,656	143,991	144
F-4	215	60.45	2,400	500	169	1,731	104,639	105
		265.75					**PASTURE UNIT TOTAL:**	**551**
Normal year								
F-4	141	0.37	3,090	500	169	2,421	896	1
F-4	203	89.27	2,539	500	169	1,870	166,903	167
F-4	209	5.41	1,863	500	169	1,194	6,457	6
F-4	210	23.30	1,795	500	169	1,126	26,238	26
F-4	214	86.95	1,744	500	169	1,075	93,451	93
F-4	215	60.45	1,800	500	169	1,131	68,369	68
		265.75					**PASTURE UNIT TOTAL:**	**362**
Unfavorable year								
F-4	141	0.37	1,895	500	169	1,226	454	0
F-4	203	89.27	1,265	500	169	596	53,202	53
F-4	209	5.41	973	500	169	304	1,642	2

Rainfall year type and pasture unit name	Soil map unit symbol	Size of soil map unit and total pasture unit (acres)	Soil map unit annual range production for applicable rainfall level (lbs/acre)	Minimum fall RDM target (lbs/acre)	Summer biomass loss (lbs/acre)	Available forage (lbs/acre)	Total forage (lbs)	Animal Unit Month
F-4	210	23.30	950	500	169	281	6,548	7
F-4	214	86.95	958	500	169	289	25,085	25
F-4	215	60.45	985	500	169	316	19,102	19
		265.75					**PASTURE UNIT TOTAL:**	**106**

Appendix B: Recommended vegetation monitoring methods

B1. Introduction

Appendix B describes the following vegetation monitoring methods that Beale AFB may consider using to monitor the Beale grazing pasture units:

- Photo points,
- Frequency plots,
- Residual dry matter (RDM) monitoring and mapping,
- Vegetation production plots,
- Relevé plots, and
- Line-point transects.

This Appendix refers to several publications, most available online, that provide greater detail on the implementation of these monitoring methods.

Estimating time required to complete a plot using the various methods is inexact because plots vary in complexity and personnel vary in expertise. Note that the estimated times provided do not include travel time to plot nor time spent establishing a new plot or re-locating a pre-existing plot. Based on experience with UC Berkeley field crews, a frequency plot of the design described below takes two crew members (one person sampling the quadrats, the other recording the data) about 20 minutes to complete. RDM monitoring and mapping time depends too greatly on the topography, size, RDM variability, vehicular accessibility, etc. of an individual site to generalize with confidence, but in good conditions, an experienced crew of two can cover several hundred acres in a day. A $100m^2$ relevé plot takes one experienced field crew member, if armed with a local species list, about 30-60 minutes to complete. A 50-100 point line-point transect takes two crew members (one person reading the transect, the other recording the data) 30-60 minutes to complete.

B2. Recommended vegetation monitoring methods

Table B-1 lists the recommended vegetation monitoring methods, broadly ranked from least to most expensive, the kind of information that the method provides, and the goals that each method is best suited to meet. By matching goals with appropriate methods, a suitable monitoring methodology can be developed.

Table B-1: Recommended rangeland vegetation monitoring methods.

Sampling method	Data generated	Typical goals
Permanent photo points	Visual evidence of large changes in biomass and species composition	Independent check on plant changes indicated by quantitative data; changes in abundance for some invasive species; public presentations
Frequency plots	Presence/absence of species of interest	Broad changes in species abundance, estimates of species richness
Residual dry matter (RDM) sampling	Dry weight of above ground biomass	Monitoring distribution and intensity of grazing; compliance with minimum RDM standards
Cover: relevé plot	Small-scale cover, including rare species; species richness, including rare species;	Presence of rare plants; localized changes in species composition, richness, and abundance
Cover: line-point transects	Cover of dominant species especially; species richness	Changes in species composition, abundance; estimates of species richness; functional group analysis; effect of management

Photo points

Permanent (i.e., at a GPS-ed location with a fixed azimuth and a fixed field of view) photo points retaken every year can be an inexpensive but broadly effective method of monitoring for large changes in vegetation, e.g., cover of invasive plants, coyote brush invasion. They can also serve as useful indexes of annual herbaceous production and of residual dry matter (RDM).

Frequency plots

Beale AFB is likely to find frequency monitoring a time-effective method of monitoring broad changes in abundance of native or invasive species of interest, following some management action (e.g., for native species, cattle grazing to reduce competition with non-native grasses; for invasive plants, control with herbicides or goat grazing). The frequency plot method is "useful for monitoring vegetation changes over time at the same locations or for comparisons of different locations" (Despain et al. 1991) and can provide this information at relatively low cost. Despain et al. (1991, 7) define frequency as:

> the number of times a plant species is present within a given number of sample quadrats of uniform size placed repeatedly across a stand of vegetation . . . It is generally expressed as a percentage of total placements and reflects the probability of encountering a particular species at any location within the stand.

Average frequency values can be followed from year to year and provide an index of a species' density and dispersion (Despain et al. 1991).

Although frequency plot specifics can vary based on monitoring needs, a frequency plot may, for example, comprise a 10 meter transect with 20 quadrats arranged on alternating sides of the transect. Within each quadrat, the field crew determines whether any individual of the species under consideration is rooted within the quadrat. The resulting metric is the species' frequency of occurrence in the 20 quadrats of the plot (for example, if yellow starthistle occurred in 15 of 20 quadrats along a transect, its frequency for that plot is 0.75).

Quadrat size has a significant effect on frequency values (Despain et al. 1991) and so must be carefully selected. Frequency sampling works best when a species' frequency values fall between 20% and 80% (Despain et al. 1991) so quadrat size must be selected to provide values that fall within that range. Typically, larger-sized quadrats will include sparsely distributed species but will result in almost 100% frequencies for common species, reducing one's ability to detect change in common species; smaller quadrats solve this problem but can miss sparsely distributed species (Despain et al. 1991). Because frequency varies based on species size, abundance, and distribution in the plot area, it is necessary to determine in the field which quadrat size is most suitable. A recommended technique is initially to employ nested quadrats of 5x5 cm, 10x10 cm, 25x25 cm, and 50x50 cm and then determine which quadrat size is most appropriate for the situation.

Frequency plots should be randomly located within the management and control areas, and the azimuth of the frequency transect should be randomly selected (even if the range of acceptable azimuths is constrained to keep the transect within the area of interest). Permanently mark the beginning of the frequency transect (either with a stake or rebar[B1] or take a sub-meter GPS reading) and record the azimuth of the transect, then take two photographs of each frequency plot, the first from the start of the frequency transect to the end of the transect and the second in the reverse direction.

RDM monitoring and mapping

The distribution and intensity of grazing can be monitored through assessment of residual dry matter (RDM). Traditionally, the standard method for monitoring RDM requires the establishment of several permanent monitoring locations in a grazed site. In each location, RDM is determined in early fall, before the onset of germinating rain, through the use of photo guides or the comparative yield method. See Bartolome et al. 2006, Bush 2006, and Guenther and Hayes 2008 for descriptions of RDM monitoring techniques.

[B1] If a stake or a rebar is used, care must be taken in vernal pool areas not to damage pool claypan or other natural resources.

Within the last decade, the RDM mapping technique has been developed and implemented in California, an innovation that allows for a clearer picture of the spatial distribution of RDM (Harris et al. 2002; Guenther and Hayes 2008). RDM mapping is easy to learn and often requires less time to complete than the traditional permanent plot-based method, while still producing robust information. Sites with too little or too much RDM can be quickly identified, and solutions based on manipulating animal distribution may also be more easily developed. Annual time-series of RDM maps can be assessed for areas requiring management attention. In the Bay Area county of Contra Costa, the Contra Costa Water District has successfully implemented RDM mapping at Los Vaqueros Reservoir and may be willing to share advice and recommendations for implementing an RDM mapping program.

RDM mapping requires developing a few, broad RDM classes (e.g., 0-500 lbs/acre, 500-1000 lbs/acre, >1000 lbs/acre etc.) based on management goals and RDM targets, and then mapping these RDM classes in the fall based on visual estimation of fairly large areas (up to several acres), with either a paper map or GPS in-hand. The minimum mapping unit should be on the order of a quarter acre (~1,000 m^2) so sacrifice areas immediately around troughs or salt licks are not typically mapped. Visual estimates are calibrated during the mapping process by clipping and weighing RDM from small, representative plots (e.g., a 25cm x 25cm quadrat). Photographs are taken of large representative areas of RDM classes and of the calibration plots prior to clipping.

There may be areas in which RDM levels are fairly low and also highly spatially variable over short distances. Accurately describing RDM levels in these areas will likely require a more intensive, plot-based method. A transect with sampling quadrats on alternating sides, similar to the frequency plot described above, should work well. Measurement of bare ground may also be necessary. Ocular estimates of bare ground within each quadrat should be recorded, and large areas of bare ground within the area mapped.

Vegetation production plots

Beale AFB already has a 10+ year dataset of vegetation production for its grazing pasture units (CNLM 2016). However, if further direct measurement of vegetative production is desired or becomes necessary, sampling biomass from ungrazed plots at peak standing biomass is the usual technique. This is typically accomplished by clipping biomass within a small quadrat (e.g., 1x1 foot or 0.25x0.25 meter square-frame) at peak standing biomass (at the end of rapid spring growth) in an ungrazed plot, then oven or air drying it, weighing it, and converting the biomass weight/quadrat size to lbs/acre (Bush 2006; Becchetti et al. 2016). Because production on California annual grasslands is highly variable, both in space and time (Bartolome et al. 2007), several plots should be placed within each pasture unit to capture different production capabilities (generally based on soil type and topography; see Figures 4-2 and 4-3 in the main plan) and sampled over a series of years that encompasses the range of annual rainfall amount and pattern, to the extent possible (Bush 2006).

In pasture units that are grazed, exclosure plots can be difficult to protect from livestock. A reliable design for protective wire cages is the "Kosco cage", made out of four 48-inch, heavy-gauge, woven wire panels that should be cut 3 feet long at the base and 18 inches long at the top (so the cage is essentially 1 meter square at the base). The four panels are wired together to form a pyramidal shape, open at the top. The cage is then anchored to the ground via one 12-18 inch wooden stake per panel, pounded into the ground, with a nail hammered in near the top of the stake that is bent and then turned down to hook over the bottom wires of the center of each panel.

Exclosure cages typically strike cattle as perfect scratching posts and so are often knocked over in the course of a grazing season. The Kosco cage design tends not to be very appealing to scratch against because the cages flex and are angled in at the top so cattle typically leave them alone. Over many years, the UC Berkeley Range Lab has only had a few toppled over, although the cages certainly get a bit bashed up.

Relevé plots

To establish baseline data on native species richness and abundance in native species-rich sites or to monitor native species richness in native species-rich sites with rare plant populations, for example in vernal pools, Beale could establish permanent relevé plots (e.g., a 5m x 20m rectangular plot, which gives a100m^2 plot). Relevé plots should be sited within a single, continuous vegetation type. The field crew visually estimates cover of all species occurring in the relevé. The relevé plot method is useful for generating data on rare species, both species numbers and coarse estimates of species' abundances, is time- and labor-efficient, and is likely to provide data robust enough for adaptive management needs, although the ocular estimates of cover are not generally adequate for research. As a technique used by the California Native Plant Society for classifying vegetation, it could also allow for comparisons between data from Beale monitoring and alliances in the *Manual of California Vegetation* (Sawyer et al. 2009).

The relevé plot method provides data on a site's species richness and abundance including uncommon species, while the line-point transect method, described below, delivers reliable cover values for the site's dominant species. The UC Berkeley Range Lab has developed a hybrid relevé/line-point transect technique, designed to collect species composition and abundance information in adequate detail at reasonable cost. The technique involves establishing: 1) a permanent 100m^2 relevé plot to provide data on plant diversity and capture rare plant species, and 2) four 25-meter, 50-point line-point transects radiating from the corners of the relevé plot to provide data on dominant species cover. The relevé is a 5m by 20m rectangular plot; all species within the relevé are listed with an ocular estimation of cover for each species. Along the line-point transects, field crew record the first species hit every half meter. Again, relevé plots should be sited within a single, continuous vegetation type; if including line-point transects in the plot, be sure the transects also fall within the single, continuous vegetation type. Take photographs of the relevé plot and the line point transects (in both directions along each transect).

After baseline species information is established for species-rich areas, different monitoring methods, such as frequency plots and line-point transects, can be used for following effects of management actions on specific species of interest.

Line-point transects

Line-point transects work well to monitor changes in cover of a dominant species, including native or invasive plants in areas where they are abundant. Line-point transects would also be useful for monitoring cover of native forbs in areas that have abundant cover of multiple forb species. This method is generally more time-consuming than frequency plots but results in more precise estimates of abundance. A point "hit" can be recorded either for all plants intercepted at each point or for only the first plant intercepted (or bare ground, rock, etc. if no plant is intercepted). Much California rangeland research has used the first hit method as it is more precise and more efficient; the first hit method does result in a slight bias towards taller species (James Bartolome, pers. comm., 2017; CNLM 2016, 6). If the monitoring is focused on short-statured species (e.g., native forbs) in a grassland dominated by tall grasses, recording all plants for each point may be the appropriate method; otherwise, recording the first plant intercepted is recommended.

For monitoring purposes, a potential design could be a 25m transect with points taken every 50cm for 50 points total or a 50m transect with points taken every 50cm for 100 points total, depending on the size of the area of interest and the degree of precision desired (increasing the number of points within a given area increases precision of cover estimates). Typically, line-point transects would be sited within a single, continuous vegetation type. Transects should be randomly located within the area of interest, and the azimuth of the transect should be randomly selected (even if the range of acceptable azimuths is constrained). Permanently mark the beginning of the transect (either with a stake or rebar[B1] or take a sub-meter GPS reading), record the azimuth of the transect, and take photographs of the line-point transects in both directions along each transect.

B3. Determining adequate sample size

A basic question that should be addressed in developing an adaptive management monitoring program is how many samples or plots are necessary to test management hypotheses (in other words, is the management activity affecting the attribute of interest in the way and to the extent that the manager wants). The answer depends on two sets of factors:
1) manager-determined factors:

a) the maximum acceptable probability of committing a Type I error (rejecting a true null hypothesis, commonly set at $\alpha = 0.05$ for scientific research but often 0.1 or larger for monitoring), and

b) the maximum acceptable probability of committing a Type II error (accepting a false null hypothesis, commonly set at $\beta = 0.2$);

and 2) underlying ecological characteristics of the population, community, or ecosystem being managed:

a) the size of the difference between means for the groups (managed, control) being compared (smaller differences require more samples), and

b) the size of the variance (larger variance requires more samples) (Crawley 2002, 131).

Power analysis uses these manager-determined factors and ecosystem characteristics to calculate the sample size necessary to test hypotheses or to calculate the power of a study given a pre-set sample size. Power is the probability that a study will correctly reject the hypothesis of no difference between groups (the null hypothesis) when the hypothesis genuinely is false (Crawley 2002, 131). Examples of null hypotheses might be that there is no difference in native forb species richness or in cover[2] of yellow starthistle between grazed and ungrazed sites.

In determining necessary sample size, 0.8 is a commonly set level of power (power is 1 – the maximum acceptable probability of committing a Type II error; Crawley 2002, 131). Power analyses are useful because they can show whether adding a few extra monitoring plots would increase power to sufficient levels (e.g., 0.8). Conversely, power analyses can show that, given underlying ecosystem means and variation, an infeasibly large number of plots would be necessary to reach the desired level of power.

It is important to note that a power analysis requires data on ecosystem or species means and variance so a pilot round of management activity and monitoring is necessary before determining final sample size. A potential useful, pre-existing source of such data is the Beale rangeland monitoring program (CNLM 2016); although means and variances from the last 10 years of monitoring data may not provide a completely accurate picture for a particular study or monitoring project, they are likely a good starting point.

Finally, interannual fluctuations in averages and level of variability mean that the results of a power analysis are guidelines only. For example, in a very dry year, species richness could fall to such low numbers in management and control groups that a 0.8 power level is not attained even with the sample sizes suggested by the power analysis, especially if the pilot data are limited, as they are likely to be.

B4. References

URLs correct as of June 2016.

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[2] Note that because cover is not necessarily statistically normally distributed, a power analysis may provide inaccurate results (Crawley 2002, 134-36).

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Vol II:
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Appendix C: California black rail habitat on Beale Air Force Base

Appendix C contains maps of 1) survey activity, 2002-2016, for California black rail (*Laterallus jamaicensis coturniculus*) presence in known potential habitat at Beale Air Force Base (Figure C-1), and 2) modeled average occupancy probability for potential black rail habitat at Beale (Figure C-2), along with a summary table of survey activity and modeled occupancy (Table C-1). Data for the maps and table are courtesy of Nathan Van Schmidt, a black rail researcher at UC Berkeley.

Potential California black rail habitat exists on Beale, and black rails were detected on Base between 2002 and 2009; surveys have not detected the bird since 2009 (Nathan Van Schmidt, pers. comm. to Lauren Wilson, February 2017). Known potential black rail habitat on Beale is fenced, and no grazing is permitted in the habitat on Base (Ann Bedlion, pers. comm., May 2017).

Nathan Van Schmidt (pers. comm. to Lauren Wilson, February 2017) noted regarding these data that:

1) Most sites on Beale have fairly low black rail occupancy because intense seasonal fluctuations in water levels tend to flood out black rails in the winter and then are too low-water in the summer.

2) Occupancy probability was modeled as a function of both site habitat covariates and actual survey data. Beale's sites are fairly unusual within the study area because of Beale's high degree of seasonality; as a result, modeled probability estimates for unsurveyed sites are likely somewhat high. Consequently, unsurveyed sites tend to have higher occupancy than surveyed sites.

3) Data for the wetlands along the creek on the far west side of Beale are uncertain. One site has been surveyed but not comprehensively so lack of detections there is ambiguous. The other site has not been surveyed so it has very high modeled occupancy; however, occupancy may be overestimated given that the site is unlike others in our study (very large creeks in wide-open, flat areas with managed water). Nevertheless, from my visits there, in years where the wetland is doing well, I would not be surprised to see Black Rails there.

Table C-1: Survey activity, 2002-2016, for California black rail (*Laterallus jamaicensis coturniculus*) presence in known potential habitat locations at Beale AFB and modeled average occupancy probabilities for each location; note that there was never more than 1 black rail detection per site per year; data courtesy of Nathan Van Schmidt, UC Berkeley.

Habitat polygon name	Geomorphology	Years surveyed	Number of years of black rail detection	Years detected	Average modeled occupancy probability
E-1159	Fluvial	Never	NA	NA	0.060
E-1159a	Fluvial	Never	NA	NA	0.042
E-1333	Fringe	Never	NA	NA	0.015
E-1336	Fluvial	Never	NA	NA	0.127
E-1337	Fluvial	Never	NA	NA	0.048
E-1338	Fluvial	Never	NA	NA	0.040
E-1339	Fluvial	Never	NA	NA	0.040
E-1340	Slope	Never	NA	NA	0.163
E-1342	Fringe	Never	NA	NA	0.956
E-442	Slope	Never	NA	NA	0.174
E-456	Fluvial	Never	NA	NA	0.041
E-457	Slope	Never	NA	NA	0.142
E-469	Slope	Never	NA	NA	0.185
E-470	Slope	Never	NA	NA	0.144
E-471	Slope	Never	NA	NA	0.142
E-521	Fringe	Never	NA	NA	0.063
E-536	Fluvial	Never	NA	NA	0.060
E-301	Fluvial	Never	NA	NA	0.099
E-1159b	Fluvial	Never	NA	NA	0.146
E-340	Fluvial	Never	NA	NA	0.093
E-385	Ditch	Never	NA	NA	0.022
E-489	Fringe	Never	NA	NA	0.033
E-440	Ditch	Never	NA	NA	0.100

Habitat polygon name	Geomorphology	Years surveyed	Number of years of black rail detection	Years detected	Average modeled occupancy probability
141	Fringe	2002-2016	6	2002-2004, 2006, 2008-2009	0.486
310-06	Fringe	2006-2016	2	2007, 2008	0.165
56	Fluvial	2002-2016	1	2002	0.072
Y-16	Slope	2002-2016	0		0.001
211	Fringe	2002-2016	0		0.000
212	Fringe	2006-2016	0		0.027
213	Fringe	2002-2016	0		0.000
215	Fluvial	2002, 2005-2016	0		0.004
216	Slope	2002, 2005-2016	0		0.024
248-04	Fringe	2004-2016	0		0.012
28	Fluvial	2002-2016	0		0.004
363-13	Fringe	2013-2016	0		0.034
364-14	Fringe	2014-2016	0		0.209

Personal communications

Ann Bedlion, Natural Resources Manager, Beale AFB, May 2017.

Nathan Van Schmidt, Doctoral student, University of California, Berkeley, personal communication with Lauren Wilson, February 2017.

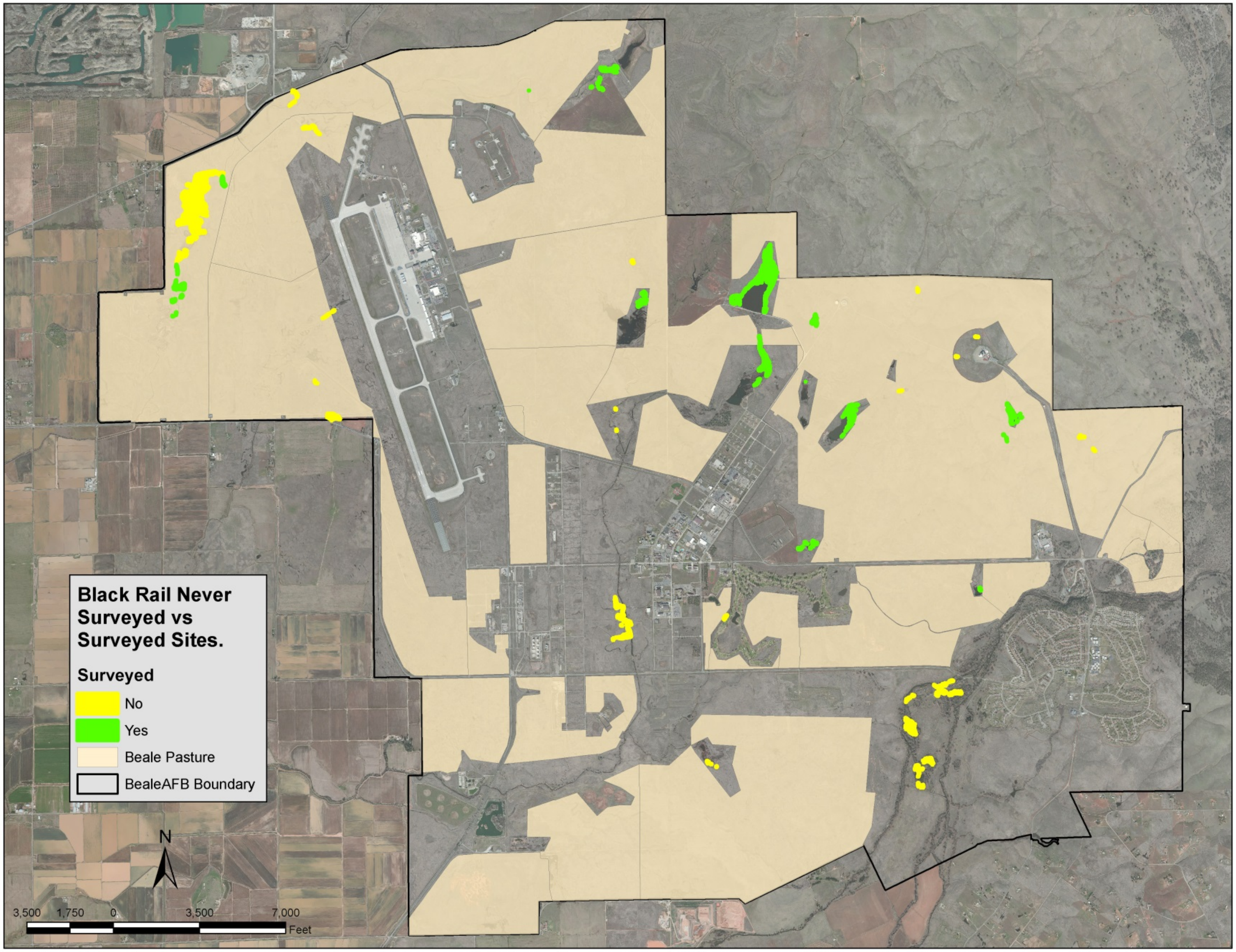

Figure C-1: Survey activity for California black rail (*Laterallus jamaicensis coturniculus*) presence in known potential habitat at Beale AFB, 2002-2016; data courtesy of Nathan Van Schmidt, UC Berkeley; map produced by Behdad Sanai, Travis AFB.

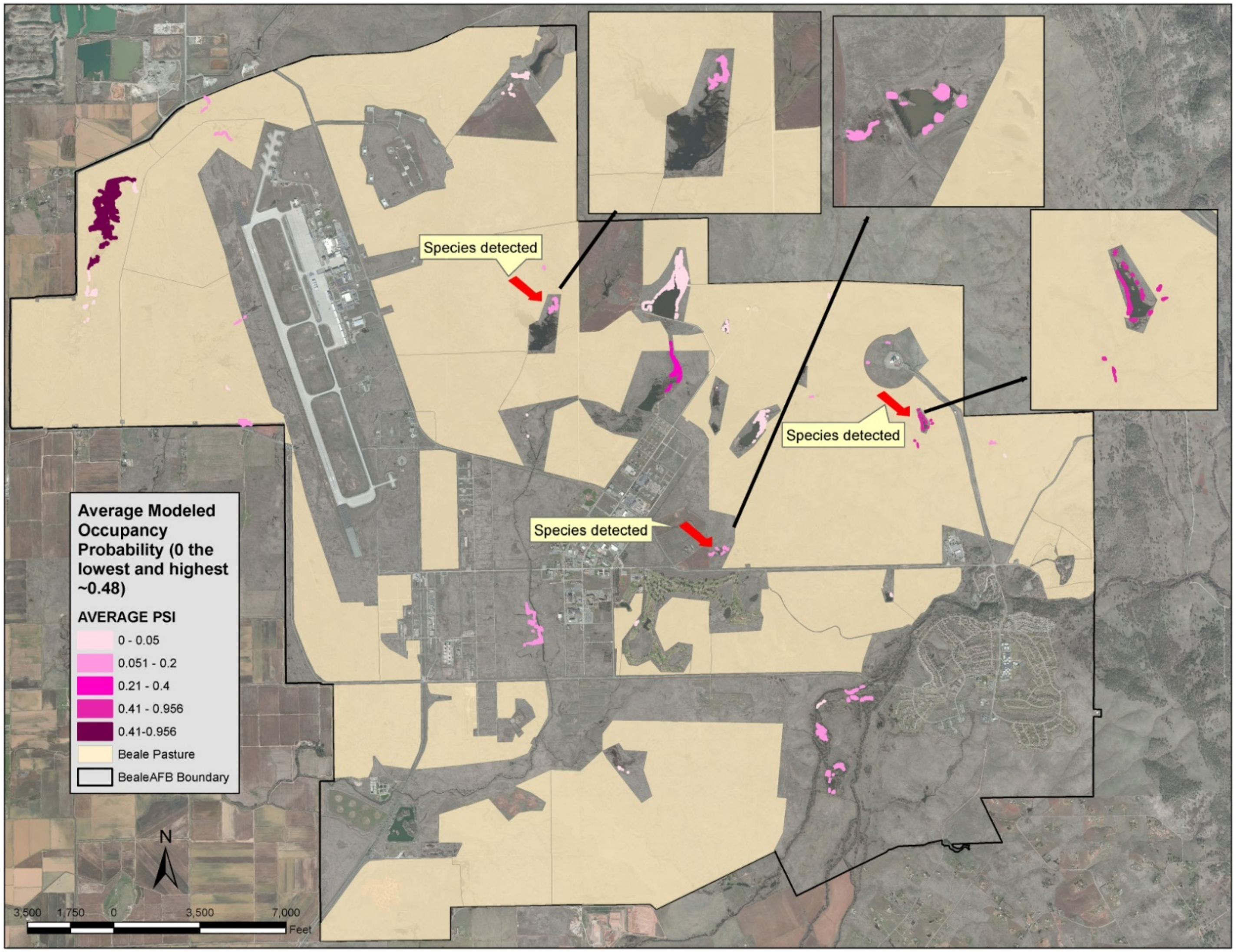

Figure C-2: Average modeled occupancy probability (ψ; *psi*) for potential California black rail (*Laterallus jamaicensis coturniculus*) habitat at Beale AFB; locations in which black rail were actually detected during 2002-20016 are noted with red arrows; black arrows point to insets of these locations enlarged; data courtesy of Nathan Van Schmidt, UC Berkeley; map produced by Behdad Sanai, Travis AFB.

Appendix D: Evaluation of and recommendations for Beale Air Force Base's range monitoring program

Appendix D contains:
1) an evaluation of and recommendations for the Beale Air Force Base range monitoring program by Peter Hopkinson, Center for Environmental Management of Military Lands, Colorado State University, completed June 2017; and
2) a map of the permanent range monitoring plots and grazing exclosures at Beale (CNLM 2016, 5).

Evaluation of and recommendations for Beale AFB's range monitoring program

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Center for Environmental Management of Military Lands
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March 2017, revised June 2017

Introduction

Beale Air Force Base has had its current range monitoring program in place since 2003[1], designed to "assess changes in plant community composition, grassland productivity, and invasive exotic plant distributions on grazed land on the Base" (CNLM 2015a, 4). Reportedly, the monitoring tasks were selected based on recommendations in the 2000 Range Management Assistance Team report (CNLM 2015a,b, 2016) but seemingly only loosely[2] (RMAT 2000, 8-12). The monitoring program follows the methodology developed by Matt Wacker in his 2004 monitoring plan (Wacker 2004). Monitoring appears not to have been conducted every year since 2003, due to financial constraints, but has occurred in most years, although sometimes only on a small subset of the monitoring plots (CNLM 2015a,b, 2016). The Center for Natural Lands Management has conducted Beale's range monitoring since 2006.

The Beale monitoring methodology assesses:

1. cover of native plants,
2. cover of non-native naturalized grasses,
3. cover of non-native naturalized forbs,
4. cover of three invasive species, medusahead (*Elymus* (*Taeniatherum*) *caput-medusae*), yellow starthistle (*Centaurea solstitialis*), and barbed goatgrass (*Aegilops triuncialis*),
5. cover of bare ground,
6. cover of litter,
7. end-of-grazing-season residual dry matter (RDM),
8. biomass production, and

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[1] Prior to 2003, rangeland monitoring was conducted by the USDA Natural Resources Conservation Service (NRCS) and the Yuba County Resource Conservation District, starting in 1995; forage production has been measured since 1984 by the NRCS (RMAT 2000, 10). In 2001, a cooperative agreement with the U.S. Forest Service in Nevada City was signed, and the Forest Service conducted rangeland monitoring on Base. A year or two later, following delays due to Forest Service staff turnover, Beale contracted with EDAW and then subsequently with the Center for Natural Lands Management to conduct rangeland monitoring on Base (Beale AFB 2016, A8-1; CNLM 2016).

[2] For example, the 2000 Range Management Assistance Team report does not recommend with much enthusiasm collecting species composition data except when monitoring invasive species (RMAT 2000, 12, 18-19). The report recommends RDM *mapping* in the fall "just before the start of the rainy season", in addition to biomass sampling of grazed and ungrazed plots at the end of the grazing season (RMAT 2000, 8-12, 15). Sampling bare ground and litter is not mentioned in the report.

9. general grazing lease compliance (CNLM 2016).

The number of plots on which monitoring occurs varies from year to year, based on available funding and other constraints. As of 2016, the monitoring program had 43 permanent vegetation plots, 15 grazing-exclosure biomass-production sites, and 9 permanent RDM-calibration plots (data from which are used to assess RDM at the 43 vegetation plots). Vegetation monitoring takes place in March or April; biomass production and RDM monitoring occurs in June. Grazing lease compliance is evaluated during the vegetation and RDM monitoring (CNLM 2016).

The monitoring data collected since 2003 provide a useful baseline dataset for Beale's managers to understand their rangeland resource and how it varies over time, especially in relation to annual weather patterns (e.g., Table 2a in CNLM 2016). The current monitoring program is not designed to differentiate between livestock grazing effects and weather effects (see e.g., CNLM 2016, 18), which limits the value of the data for management decision-making. The grazing exclosure plots are only used to collect production biomass data and do not serve as control (ungrazed) plots to compare to the 43 grazed plots. See Section 9 and Appendix B of the Beale Grazing Management Guidelines for a discussion of use and implementation of control plots.

The biomass production data should prove valuable for verifying grazing capacity estimates for Beale's pastures and is being analyzed for the Beale Grazing Management Guidelines. The invasive species cover data could be used to target weed control activities. As described in recent CNLM monitoring reports (CNLM 2015a,b, 2016), the reported fluctuations in cover of native, non-native, and even invasive plants, bare ground, and litter are for the most part driven by annual weather and generally conform to patterns that a California range manager would expect. Consequently, adequate baseline data have been collected at this point, and the Beale monitoring program should focus on compliance monitoring, in particular annual fall RDM mapping, and implement effectiveness monitoring methods only when management goals and actions require monitoring feedback. Wacker (2004) makes a point of stating that his methodology is "not intended to be static but rather to develop a framework within which annual monitoring results can be used to further develop and refine the management of the grazing program. As additional data [are] collected, specific tasks outlined in this document may be revised considerably or dropped altogether" (2004, [3]).

RDM monitoring and other compliance monitoring

Fall RDM monitoring is considered the most common and important compliance monitoring method on grazed California rangelands and should be undertaken every year in some fashion (Bush 2006). RDM limits rainfall-induced soil erosion and soil nutrient losses and, in areas with more than 15 inches of annual rainfall such as Beale AFB, also maximizes biomass production and can influence plant species composition in some instances (Bartolome et al. 2007; Amatangelo et al. 2008). CNLM (2016, 40) suggests that if Beale's grazing program faces budgetary constraints, rangeland monitoring could be undertaken every other year or specific monitoring tasks alternated between years. In the case of RDM monitoring however, Beale should monitor RDM <u>every fall</u>, as this information forms the basis for stocking rate decisions the following grazing season, confirms lessee compliance with the current year's stocking rates, and provides evidence that Beale's rangeland resources are being managed sustainably.

Beale's current RDM monitoring method is a variant of the comparative yield method, a standard range sampling technique. It is, however, a fairly intensive sampling scheme that produces data at a greater level of detail than is demanded by current management goals, both in terms of the intensity of sampling within plots and of the categorization of the RDM data. To optimize the efficiency of monitoring, data collection should link directly to management goals. The current method creates 5 categories of RDM that change from year to year based on the low and high RDM values sampled at nine permanent RDM-calibration plots every year (CNLM 2016). Because the primary RDM management goal is whether RDM meets the minimum target of 800 lbs/acre (DAF 2012, Exhibit E-Operating Agreement, 30), the simplest RDM monitoring scheme would have only 2 categories of RDM, viz., "meets target" and "falls below target". Managers could then use this information to focus on those areas that failed to meet the minimum target.

Additional RDM categories for some or all locations would prove useful to Beale managers, for example, targets related to wildlife habitat requirements or grassland fuels reduction. Specific management goals related to habitat needs or fuels reduction should be developed, after which the RDM monitoring methodology could be updated. In particular, Beale natural resources staff have expressed concern that too much RDM often remains at the end of the grazing season, which can degrade habitat values for wildlife species of concern, increase wildfire risk, encourage those invasive species such as medusahead that thrive in high thatch environments, and increase Bird/Wildlife Aircraft Strike Hazard (BASH) risk. A <u>maximum</u> RDM target may help Beale managers achieve their goals related to these concerns and should be developed (note that maximum RDM targets have not yet been developed by researchers; see the Beale Grazing Management Guidelines for further discussion of this topic). RDM monitoring categories could then be changed to: 1) below minimum target; 2) between minimum and maximum targets (that is, meets management goals); and 3) above maximum target. In contrast to the current RDM monitoring method (see e.g., CNLM 2016, 22), fall RDM mapping, using these three categories, would provide sufficient RDM information in a spatially explicit format, allowing managers to implement actions to increase or reduce RDM in the locations where they are necessary.

RDM mapping is easy to learn and often requires less time to complete than the traditional permanent plot-based method, while still producing robust information. Sites with too little or too much RDM can be quickly identified, and solutions based on manipulating livestock distribution may also be more easily developed. RDM mapping requires developing RDM classes (e.g., 0-600 pounds per acre, 600-1,000 pounds per acre, etc.) and, with a paper map or GPS unit in-hand, mapping RDM classes in the fall based on visual estimation of fairly large areas (up to several acres). The minimum mapping unit should be on the order of a quarter acre so sacrifice areas immediately around troughs or salt licks are not typically mapped. Visual estimates are calibrated during the mapping process by clipping and weighing RDM from small, representative plots. Annual time-series of RDM class maps can then be evaluated for areas requiring management attention.

University of California Agriculture and Natural Resources (UC ANR) researchers recommend conducting RDM monitoring in the early fall before the onset of germinating rains (typically undertaken in late September to early October) to ensure that accurate year- and site-specific information is collected because fall starts the period during which RDM protects soil and influences production for the following grazing season (Bartolome et al. 2006). Beale's current RDM monitoring takes place in June. When RDM monitoring occurs at the end of the grazing season like this, RDM remaining in the fall must be estimated with significant uncertainties. While RDM loss over the summer months can be broadly estimated, decomposition rates vary from site to site and from year to year (Frost et al. 2005); furthermore, grazing by wild ungulates, small mammals, and other wildlife is not accounted for. Given the importance of knowing how much RDM remains in the fall, Beale should measure RDM in late September/early October.

There are legitimate reasons for measuring herbaceous biomass at other times of the year, although these measurements should be referred to as biomass sampling or similar terms rather than as RDM monitoring. For example, measuring biomass during the spring and immediately after the grazing season can inform decisions about extending the grazing season in high production years and making sure lessees are in compliance with RDM targets (currently, Beale grazing leases set the RDM target at the end of the grazing season (DAF 2012, Exhibit E-Operating Agreement, 30)), although ocular estimates of biomass and other methods may also provide the necessary information to make these decisions. Importantly, these biomass measurements should not supplant annual RDM monitoring in the fall.

Fall RDM mapping is the RDM monitoring technique that Beale should adopt. It is cost-effective and will provide spatially explicit information at a level of detail appropriate for management decision-making. For pastures that have low and highly spatially variable RDM levels, a more intensive, plot-based method may be necessary to provide the appropriate level of accuracy. Plot-based sampling may also be appropriate if a pasture falls below its RDM target over multiple years, or if a dispute with a lessee arises over compliance. Bartolome et al. (2006), Bush (2006), and Guenther and Hayes (2008), the first two available online, provide useful information on implementing an RDM monitoring program. See also Section 9.1 and Appendix B of the Beale Grazing Management Guidelines.

Once the annual fall RDM data are collected and analyzed, the Beale Natural Resources Manager should review the RDM results with the grazing lessees and the point of contact for the Dry Creek Saddle Club. Discussions regarding the year's RDM levels in relation to Beale's RDM targets should inform planning for the coming grazing season for all participants.

The minimum fall RDM targets recommended by UC ANR researchers are general guidelines, and, as Bartolome et al. (2006) state in their publication, managers may need to develop site-specific RDM targets for multiple reasons, such as unusual site conditions, management goals that focus on listed species' habitat requirements, weed control, or herbaceous fuel load reduction. Consequently, the UC ANR guidelines' recommendations may need to be adjusted as RDM monitoring data are collected, and as the Natural Resources Manager evaluates whether management goals are being achieved at this level of RDM.

Monitoring of general grazing lease compliance (e.g., condition of fences and water troughs) is potentially useful but may be duplicating effort expended by the Beale grazing program manager, who works in the grazing pastures with some frequency. In addition, lease compliance evaluation as part of the range monitoring program only occurs for a short period during the course of the grazing season, which limits its value.

Currently, Beale grazing program infrastructure maintenance is the responsibility of the Base rather than the lessees (Beale AFB 2016, 133) so evaluation of fences and water troughs does not fall under the heading of lease compliance by lessees. Beale's Integrated Natural Resources Management Plan states that the grazing program's infrastructure has been inconsistently inventoried, and regular planning for grazing infrastructure needs has been haphazard in the past (Beale AFB 2016, 137). Standardizing the collection of infrastructure maintenance information by the Beale Grazing Program Manager will improve regular maintenance scheduling as well as annual planning for infrastructure improvements.

Other general grazing lease compliance monitoring such as counting livestock as they are brought on to the property, reviewing monthly livestock reports from the lessees, and observing the timing and distribution of livestock grazing over the course of the grazing season (Bush 2006) are typically undertaken by staff range managers as part of their normal management activities.

Effectiveness and project-specific monitoring

Monitoring data on, for example, cover of native bunchgrasses or of invasive species, may be essential to assess the effectiveness of management activities that target bunchgrasses or invasives, but there is limited value in collecting these data unless management activities are being implemented that affect these species. As noted above, the Beale monitoring program has generated a large baseline dataset so the general impacts of current livestock management on range resources at Beale are already described (CNLM 2016, 35-36). If new management activities are implemented, for example, goat grazing to reduce yellow starthistle cover or increasing cattle stocking rates to increase native annual forb abundance, then the effects of those activities should be monitored to determine whether they are effective. This kind of goal-driven monitoring is an integral component of adaptive management and should prove more useful and potentially less expensive than the current monitoring program, which collects data regardless of management activities and whether or not it is of much use for management decision-making. Table 1 lists general monitoring goals and recommended monitoring methods. Section 9 and Appendix B of the Beale Grazing Management Guidelines contain more detailed descriptions of the monitoring methods and recommendations about what type of goals each method is best suited to meet.

As an example, the Beale Natural Resource Manager might want to evaluate the impacts of a new multi-pasture, short duration-high intensity grazing system implemented by a lessee. Because grazing impacts are being evaluated, ungrazed control areas would need to be monitored as well as the new grazing system pastures; this allows changes caused by annual weather and other factors to be distinguished from changes caused by the new grazing system. In addition, the Natural Resource Manager would need to implement the grazing system monitoring program for 3-5 years to be fairly confident that any longer-term changes caused by the grazing system are observed. Fall RDM mapping would provide important information about the basic issue of protecting soil and maintaining vegetation productivity. If RDM is very low with significant bare ground, more intensive, plot-based RDM monitoring would be appropriate, again with ungrazed control plots. Transects with sampling quadrats on alternating sides would work well for measuring low, patchy RDM. Ocular estimates of bare ground within each quadrat could also be recorded, and large areas of bare ground within the pasture mapped if need be. The potential for changes in plant species composition may also be a concern, for example, a loss of native plants or an increase in invasive species. Monitoring vegetation cover in grazed areas and ungrazed control areas using line-point transects would provide the data necessary for evaluating species composition changes. The line-point transect data would also provide information on changes in the amount of bare ground. The number of plots necessary to generate sufficient information for informed decisions depends on the specifics of the site, year, and other factors and has to be determined on a project-by-project basis (see Appendix B of the Beale Grazing Management Guidelines for further details).

Table 1: Recommended rangeland vegetation monitoring methods.

Monitoring goals	Sampling method	Data generated
Independent check on plant changes indicated by quantitative data; changes in abundance for some invasive species; public presentations	Permanent photo points	Visual evidence of large changes in biomass and species composition
Broad changes in species abundance, estimates of species richness	Frequency plots	Presence/absence of species of interest
Monitoring distribution and intensity of grazing; compliance with minimum RDM standards	Residual dry matter (RDM) sampling	Dry weight of above ground biomass
Presence of rare plants; localized changes in species composition, richness, and abundance	Cover: relevé plot	Small-scale cover, including rare species; species richness, including rare species;

Monitoring goals	Sampling method	Data generated
Changes in species composition, abundance; estimates of species richness; functional group analysis; effect of management	Cover: line-point transects	Cover of dominant species especially; species richness

Monitoring the expansion of invasive species into new areas and increases in abundance can be informative, even if weed management activities are not being implemented. The current frequency occurrence analysis of invasives within the 43 vegetation plots can provide some basic information about spread of invasives, including newly occurring species, within the monitored area (CNLM 2016, 20-21) but is unlikely to be the most efficient method of undertaking this kind of surveillance monitoring.

Early detection-rapid response programs can help find and eradicate incipient infestations of new invasive species or satellite populations of resident invasives. Such programs need to be continuously running because livestock grazing, military mission activities, and other land use activities have the potential to introduce new invasive species on an on-going basis. Early detection-rapid response programs are key for successful invasives management, in part because they allow for the possibility of immediate eradication at the stage when the invasive is present at low numbers and occupies a small area; they may also reduce long-term invasive control costs. Beale is currently working with the Center for Environmental Management of Military Lands, Colorado State University, to develop an early detection-rapid response work plan suited to Beale's needs and available resources.

As noted in the Beale Grazing Management Guidelines and though not necessarily related to the grazing program, Beale could expand its monitoring program to assess California black rail (*Laterallus jamaicensis coturniculus*) habitat[3]. Based on their research at Spenceville Wildlife Area, Richmond et al. (2012) state that fall RDM monitoring in California black rail marsh habitat does not adequately characterize spring marsh vegetation cover, critical for black rail breeding success. They recommend monitoring black rail marsh habitat cover in the spring to ensure that marsh cover does not fall below 60% of normal levels.

[3] Although potential California black rail habitat exists on Beale, and black rails were detected on Base between 2002 and 2009, surveys have not detected the bird since 2009 (Nathan Van Schmidt, pers. comm. to Lauren Wilson, February 2017). In addition, known potential black rail habitat on Beale is fenced, and no grazing is permitted in the habitat on Base (Ann Bedlion, pers. comm., May 2017).

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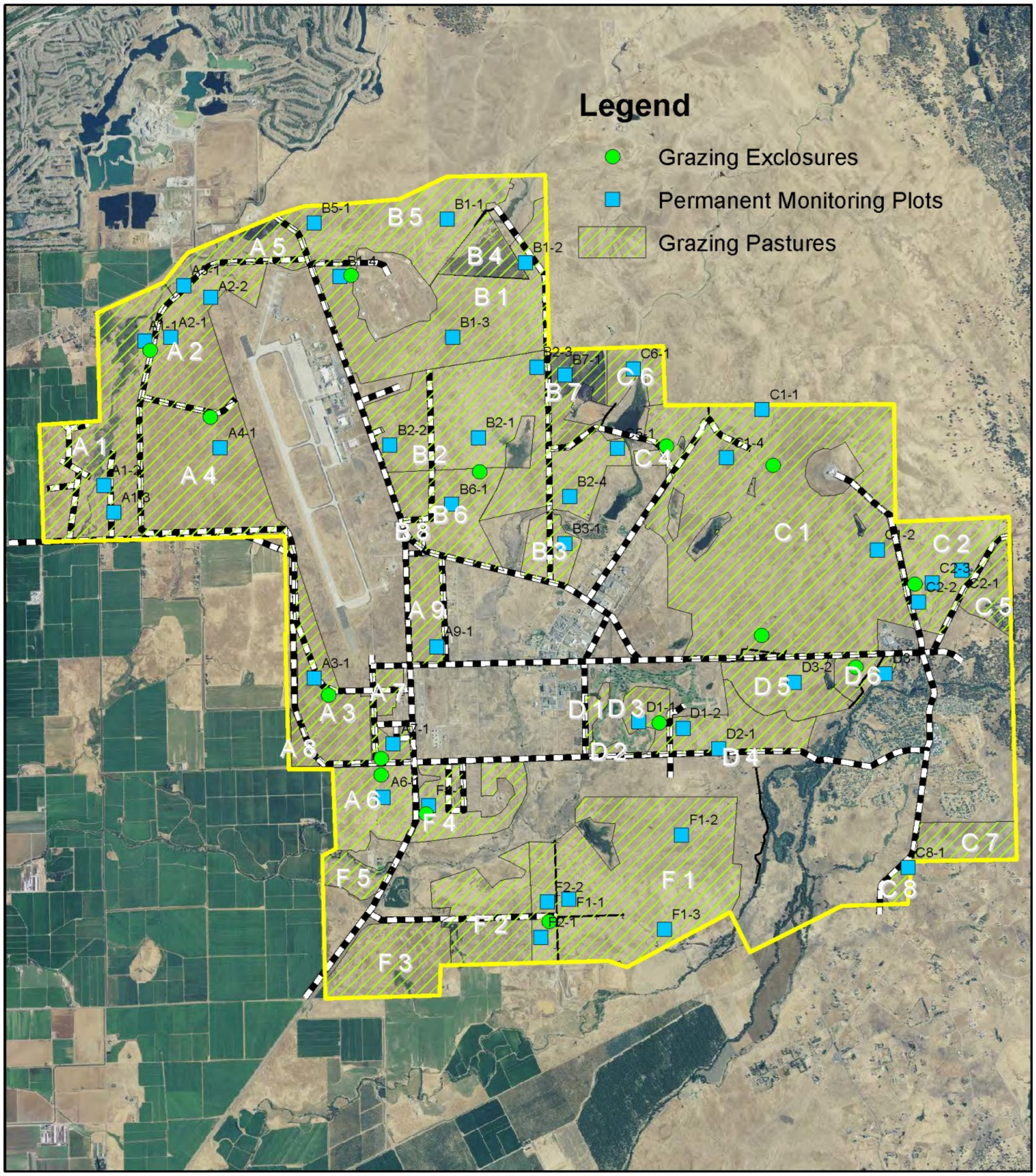

Figure 1. Beale Air Force Base Grassland Vegetation Monitoring

Map production: Sept. 26, 2015 by Cathy, CNLM Preserve Manager
Data source(s): Aerial photograph from CaSIL NAIP 2012 remote sensing.
Boundary and roads from Eric Olson (CNLM Preserve Manager).

Center for Natural Lands Management

Figure D-1: Permanent range monitoring plots and grazing exclosures at Beale AFB; map courtesy of Center for Natural Lands Management (CNLM 2016, 5).

Appendix E: 2012/2013 Beale Air Force Base grazing land use rules

Appendix E contains the land use rules, entitled Exhibit E – Operating Agreement, from the 2012/2013 grazing lease for Beale Air Force Base Management Area A. The land use rules for the 2017 Beale grazing leases have been updated and can be found in Appendix F.

Exhibit E – Operating Agreement

OPERATING AGREEMENT FOR GRAZING LEASE ON BEALE AIR FORCE BASE

Provision 1. Overview
1.1 The Leased Premises are subject to multiple uses, and the Lessee's use of the Leased Premises is subordinate to and must not interefere with the military mission of Beale AFB. Additionally, it is the expressed intent of the Air Force to maintain the Leased Premises in accordance with proper range management practices. The protection of the soil and its vegetative cover from deterioration by erosion, overgrazing, wildfire, noxious weed infestation, or other causes is considered part of proper range management. The Lessee's use of the land must comply with Beale AFB land use, conservation, preservation, and environmental concerns. The purpose of this Operating Agreement is to give effect to the provisions of the Lease and to ensure the Lessee uses the Leased Premises in a manner consistent with the Beale Air Force Base land use and range management practices.

Provision 2. Supervision
2.1 The Lessee's use and occupation of the Leased Premises shall be subject to the general supervision and approval of the 9th Civil Engineer Squadron Commander (9 CES/CC), or his or her representatives, and to such rules and regulations regarding the ingress, egress, safety, sanitation and security as may be prescribed by 9 CES/CC from time to time, provided that such rules and regulations do not unnecessarily interfere with the Lessee's use of the Leased Premises.

2.1.1 The lessee shall furnish all equipment, labor and supplies and shall pay all expenses necessary and incident to compliance with these regulations. The maintenance, protection and restoration required of the lessee constitute a portion of the compensation for use of the leased land. FAILURE TO ACCOMPLISH THE MAINTENANCE, PROTECTION, AND RESTORATION AS HEREIN SPECIFIED WILL BE REGARDED AS A DELINQUENCY THE SAME AS FAILURE TO PAY CASH RENTAL.

2.2 The Lessee shall closely coordinate grazing operations with 9 CES/CC, including, but not limited to, the following:

2.2.1 The Lessee shall provide 9 CES/CC with the current emergency telephone numbers where the Lessee may be contacted at any time twenty-four (24) hours per day, seven (7) days per week.

2.2.2 The Lessee shall provide 9 CES/CC with a list of all ranch hands or other persons expected to require access to Beale Air Force Base in support of the Lessee's operations prior to the beginning of each grazing season. This list may be modified as necessary, but the Lessee must comply with the Provision 3, Access to Beale Air Force Base, before any individual may be given access to Beale Air Force Base.

2.2.3 The Lessee shall contact 9 CES/CC at least once per week to maintain adequate coordination between military uses and the Lessee's operations once livestock are present on the Leased Premises.

2.2.4 The Lessee shall attend occasional meetings, which may be called for the purpose of discussing the Lessee's operation, when requested to do so by 9 CES/CC.

2.2.5 All mature cattle will be marked with a distinctive, permanent brand or ear tag, visible from at least 50 feet, and subject to the approval of the Natural Resources Manager. The Lessee shall provide to 9 CES/CC a list of all brands registered to the Lesee prior to the start of the Lease. The Air Force may confiscate livestock found on the Leased Premises that possess brands that are not on this list.

2.3 The Lessee shall provide 9 CES/CC with sufficient information to verify the numbers and weights of livestock brought onto and removed from the Leased Premises. Therefore, the Lessee shall:

2.3.1 Notify 9 CES/CC at least two (2) working days prior to placing livestock on or removing livestock from the Leased Premises. Transportation of livestock onto Beale AFB without the consent of 9 CES/CC is prohibited.

2.3.2 Make available for inspection upon the request of 9 CES/CC pertinent documents including, but not limited to, weight certificates, health certificates, brand inspection reports, and shipping documents.

2.3.3 Submit by the tenth (10th) day of each month a report that lists the number of AUMs grazed during the previous month.

2.3.3.1 9 CES/CC will provide the Lessee with the format for the report and specify the method for computing AUMs.

2.3.3.2 Animal Unit Month (AUM) is a unit of measurement based on a 1,000-pound dry cow grazing for 30 days. It is further defined as:

2.3.3.2.1. 0.65 AUM is one weaned bovine weighing under 600 pounds at the time of entry to the leased premises that has grazed for one month.

2.3.3.2.2. 1.0 AUM is one mature bovine weighing more than 1,000 pounds at the time of entry to the leased premises that has grazed for one month.

2.3.3.2.3. 1.3 AUM is a mature bull or one cow with suckling calf less than six months of age at the time of entry to the leased premises that has grazed for one month.

2.3.3.3 If there is a dispute about AUM categories assigned to specific cattle on the report, weight certificates for livestock placed on the Leased Premises will be requested. In the absence of weight certificates, each bovine will be considered as one animal unit. The Lessee shall ensure properly completed weight certificates accompany all arriving livestock shipments. The Lessee shall make these certificates available for inspection by the 9 CES/CC at the time of livestock delivery to the Leased Premises.

2.3.3.4 This report shall be completed in duplicate and mailed to: Natural Resources Manager, 9 CES/CEAN, 6601 B Street, Beale AFB CA 95903-1708.

2.3.4 In addition to the monthly AUM report, 9 CES/CC may require supplemental information regarding AUM usage by pasture. The format for such a report shall be supplied by 9 CES/CC. The Lessee shall submit such information as required to 9 CES/CC.

2.3.5 Failure of the Lessee to comply with the reporting requirements outlined in this Condition shall constitute justification for 9 CES/CC to order all livestock to be gathered, counted, weighed, and assigned an animal unit classification based on the result of the weighing. The Lessee shall be liable for all costs associated with such action, and the Lessee shall have no claim of any character on account thereof against the government or any officer, agent, or employee thereof.

2.3.6 To ensure compliance with the Lease and Operating Agreement and to document Lessee performance, an inspection checklist will be reviewed by 9 CES/CC with the Lessee 4 times throughout the grazing season.

Provision 3. Access to Beale Air Force Base

3.1 The Lessee shall obtain installation entry passes from the 9th Security Forces Squadron for all personnel who require access to Beale AFB as part of the Lessee's operations.

3.1.1 For all personnel requiring a pass, the Lessee shall submit a list of full names (first, middle, and last), dates of birth, home addresses, home or business phone numbers, and drivers' license numbers and states of issue. This list shall also include the name, address, and grazing pasture(s) of the Lessee.

3.1.2 The 9th Security Forces Squadron shall perform a background check for all individuals requesting a pass. The Lessee shall ensure that no person on the access list is an illegal alien. Individuals who have criminal convictions, outstanding warrants, or are determined to be a security risk or detrimental to the good order and discipline at Beale Air Force Base may, solely at the discretion of the Air Force, be denied access to Beale Air Force Base.

3.2 All installation entry passes shall be issued for daytime use only. Access to Beale Air Force Base during non-daytime hours shall be limited to emergencies only. All base access must be through a manned base entry control point (e.g. Main Gate, Wheatland Gate, Vassar Lake Gate, Grass Valley Gate, or Doolittle Gate), or the Lessee must be escorted by an Air Force representative onto the base property. Vehicles with equipment or large enclosures must enter through the Wheatland Gate and undergo inspection.

3.3 The Lessee shall ensure that all installation entry passes are returned to the Air Force before any employee leaves the Lessee's employ or the expiration of the term of the Lease, whichever is earlier.

3.4 The Lessee shall only use the Wheatland Gate/Commercial Vehicle Search Area when transporting cattle or equipment. 9 CES/CC shall designate the route of ingress and egress for livestock through the base to the Leased Premises. Loading and unloading of animals, in areas other than the government corrals, must be approved by 9 CES/CC.

3.5 There are two (2) areas that can only be accessed from the outside of the base: North Beale Road A Pastures and Grass Valley Gate Pasture C-2. These routes are approved for loading and unloading cattle. However, the Lessee must be escorted to these areas by a designated Air Force representative. Under no circumstances will the Lessee be given a key to these gates. Cattle trucks must be inspected at the Wheatland Gate prior to unloading cattle in these locations.

3.6 The Lessee shall carry a cell phone at all times while on the installation to allow the SFCC to contact them for emergency purposes.

3.7 If heightened security concerns arise, the Wing Commander (9 RW/CC) or designated representative may require the movement of cattle to a separate pasture or removal of cattle from the base. The Lessee shall commence cattle movement within four (4) hours of notification.

3.8 The Lessee shall receive an antiterrorism/force protection briefing from the Security Forces prior to the start of the Lease.

Provision 4. Maintenance of Property

4.1 The Lessee, at the Lessee's own expense, shall:

4.1.1 Perform monthly routine maintenance and repair to maintain all fences, corrals, cattle guards, and gates in livestock-tight condition.

4.1.2 Repair any facilities damaged by the Lessee, his employees, his livestock, or acts of God.

4.1.3 Perform emergency repairs, as determined by the 9 CES/CC, within forty-eight (48) hours after notification.

4.1.4 Ensure that all water troughs are in good working order before the grazing season including repairing leaky float devices. Leaking water lines shall be repaired by the 9 CES/CC.

4.1.5 Clean troughs at least once every two (2) years.

4.2 All materials used in maintaining Air Force facilities shall be at least the same type and quality as those used in original construction and shall remain as Air Force property after the expiration of the Lease. 9 CES/CC may order the Lessee to replace material that does not meet these specifications at the Lessee's expense.

4.3 9 CES/CC shall repair facilities damaged by military and fire fighting activities unless the Lessee caused the damage or the fire.

4.4 The Lessee shall ensure proper clean-up of all areas used by his personnel and will dispose of refuse and debris generated as a result of various lease activities conducted on the leased property.

4.5 The Lessee shall obtain written approval from the 9 CES/CC before using any pesticides on the Leased Premises. As used herein, the term "pesticides" includes herbicides, insecticides, fungicides and rodenticides but does not include products commonly known as medicines. All pesticides must be applied in accordance with the manufacturer's instructions by a certified applicator. All chemicals, pesticides or medicines used on the leasehold will be disposed of according to label instructions. The lessee will be held financially accountable for improper disposal of chemicals or containers that contaminate either the soil or ground water.

Provision 5. Resource Management

5.1 The term of the grazing season shall generally be seven (7) months as described in Annex 1. However:

5.1.1 9 CES/CC may curtail the grazing season when, in his opinion, accessible forage has been utilized to the extent where further grazing would be detrimental to the land or vegetative resources.

5.1.2 9 CES/CC may extend the grazing season when, in his opinion, sufficient forage exists to sustain additional grazing and the Lessee has submitted a written request to 9 CES/CC requesting an extension to the grazing season.

5.2 The nominal grazing capacity (total number of AUM) of the Leased Premises is described in Annex 1. The acreage was calculated using a computer mapping system (ArcView 3.1, ArcMAP 9.0 and ArcMAP 10) and excludes roads, buildings, and old building foundations within the pastures. The availability of forage and the general condition of the range shall determine the grazing capacity for each grazing season. The Air Force seeks to ensure that a minimum quantity of residual dry matter (mulch) in the amount of approximately 800 lbs. per acre remain on all pastures at end of grazing season.

5.2.1 Contingencies before or during the grazing season may increase or decrease the grazing capacity of the Leased Premises. Thus, 9 CES/CC may modify the grazing capacity as follows:

5.2.1.1 9 CES/CC may reduce the nominal grazing capacity of the Leased Premises prior to the start of the grazing season. 9 CES/CC will notify the Lessee of this reduction in writing at least thirty (30) days in advance of the Term Beginning Date for that grazing season.

5.2.1.2 9 CES/CC may reduce the grazing capacity by requiring the Lessee to refrain from using part of the Leased Premises in accordance with Condition 7, Easements, Rights-Of-Way, and Reserved Rights.

5.2.1.3 9 CES/CC may reduce the grazing capacity through controlled burns of the pastureland.

5.2.1.3.1 To improve range conditions, the Beale Air Force Base Prescribed Burn Management Plan sets forth goals to burn approximately 1,500-2,000 acres of pastureland per year. Forage production in these burned areas will be reduced following the burn. To compensate the Lessee, a fifty (50) percent reduction in AUMs for the burn area will be applied to the first grazing season following the burn and a thirty-three (33) percent reduction for the second growing season. There will be no adjustments to the grazing capacity in the third or later grazing seasons following the burn.

5.2.1.3.2 Wildfires are not part of the Beale AFB controlled burn plan and are not governed by this Provision. However, while there will be no rental rebate in the event of a wildfire, the number of cows able to graze on that land the following year must be reduced by fifty (50) percent to prevent overgrazing.

5.2.1.3.3 9 CES/CC shall provide Lessee with a minimum of forty-eight (48) hours advance notice for all such burns when livestock are present in the lease area.

5.2.1.4 The Lessee may make a written request to increase the grazing capacity of the Leased Premises. 9 CES/CC may, at his or her discretion, approve this request provided adequate forage is available.

5.2.2 When the grazing capacity of the Leased Premises is increased or decreased, the rent owed by the Lessee to the Air Force shall be the product of the difference between the nominal grazing capacity and the actual grazing capacity and the AUM rate.

5.3 The forage that exists on the Leased Premises shall be the major source of food for the livestock. The Lessee shall not feed the livestock with supplemental tabs, grains, hay, silage, or other similar feeds when this material constitutes a major portion of the livestock's total daily feed requirement. The Lessee may feed the livestock with protein, salt, minerals, and trace additives, whether singly or in combination, to supplement the animals' daily food requirements only. Short-term emergency feeding may be permitted, in lieu of hardship of temporary removal of the animals, only with prior written permission of the 9 CES/CC.

5.4 If the Lessee so desires, the Air Force will provide water for the Lessee's livestock in accordance with the terms of the Lease. The following conditions shall apply:

5.4.1 The Air Force has no means of metering the water used by the Lessee in each of the parcels. Thus, the Lessee shall pay following annual flat fees for water usage in each of the parcels:

Parcel	Amount
Parcel A	185.50

5.4.2 The Air Force shall provide the following number of troughs in the following pastures. The Air Force shall not be responsible for providing additional troughs.

A-1	A-2	A-3	A-4	A-5	A-6	A-7	A-9
0	1	1	1	0	1	1	1

5.4.3 Reservoirs that have been fenced to enhance the wildlife habitat and recreational qualities of the sites may not be used by cattle.

Provision 6. Livestock Management

6.1 The Lessee shall move cattle onto and off of the base during business hours, Monday-Friday, 7 a.m. – 5 p.m., unless special arrangements have been made through the 9 CES/CC.

6.2 The Lessee shall ensure that his livestock are confined to the Leased Premises at all times. If the Lessee's livestock stray from the Leased Premises:

6.2.1 The Lessee shall collect the strays and return them to the Leased Premises as soon as possible, but no later than four (4) hours after receiving notice of the strays by the Air Force.

6.2.2 The Lessee shall determine how the strays exited from the Leased Premises and take immediate action to correct the deficiency.

6.2.3 The lessee shall move individual animals at the request of the Natural Resources Manager or Natural Resources Technician, within 48 hours, if animals cause problems such as fence damage or repeated escapes.

6.3 The Lessee shall not use any of the structures existing on the land. These enclosures are used by the Air Force for various purposes including weather and wildlife monitoring, bivouacs, etc.

6.3.1 The Lessee shall remove any livestock that stray into these structures within four (4) hours of notification by the Air Force.

6.3.2 The Lessee shall take immediate action to prevent livestock from entering into the structures again and repair any fences around these structures completely within fourteen (14) days of the incident.

6.4 The Lessee shall ensure that the livestock are distributed over the Leased Premises to ensure a uniform use of the Leased Premises, minimize sacrifice areas, reduce the overall fire hazard, and enhance the overall land use. To accomplish this, unless otherwise directed in writing by the 9 CES/CC, the Lessee shall adhere to the following practices:

6.4.1 When forage on any portion of the Leased Premises has been reduced to the minimum level, the Lessee shall move and restrict livestock to areas containing adequate forage.

6.4.2 The Lessee shall distribute and move salt blocks and feed supplements to promote optimum distribution of livestock.

6.4.3 The Lessee shall move salt blocks and feed supplements monthly throughout the Leased Premises to limit sacrifice areas.

6.4.4 The Lessee shall not place salt blocks or feed supplements within 250 feet of any watering sources, wetland, vernal pool, archeological site, or wildlife nesting site unless approved by 9 CES/CC. To avoid conflicts, the Lessee shall request approval from 9 CES/CC of proposed supplement locations.

6.4.5 The Lessee shall not place salt blocks or feed supplements within one-quarter (1/4) mile of any paved road unless approved by the 9 CES/CC.

6.5 Upon the request of 9 CES/CC, the Lessee shall furnish written evidence that the Lessee is in compliance with all federal, state, and local animal health laws and regulations with respect to livestock grazing in the Leased Premises. 9 CES/CC reserves the right to impose quarantine, immunization, or other health requirements deemed necessary to prevent or control diseases.

6.6 The Lessee shall comply with all instructions issued by 9 CES/CC concerning the disposition of dead livestock.

6.6.1 If not otherwise instructed, dead livestock that present no hazard to health and do not constitute a nuisance may be left to decompose naturally, except that carcasses shall be immediately removed a distance of 250 feet from (a) any areas adjacent to or near a water source when contamination of the water source may result from natural decomposition of the carcasses, (b) areas adjacent to or near paved road where the animal can be seen, and (c) any area within a flight safety wildlife exclusion zone.

6.6.2 The Lessee shall respond to the 9 CES/CC request to move dead livestock within forty-eight (48) hours of 9 CES/CC's notification.

6.7 The Lessee shall comply with all instructions issued by the 9 CES/CC concerning the movement of or emergency response to injured or diseased livestock within four (4) hours of receiving the notification. At the discretion of 9 CES/CC, the Lessee shall move the injured or diseased livestock to a different location within the Leased Premises or remove them completely from the Leased Premises.

Larry R. Harris

LARRY R. HARRIS, Lt Col, USAF
Commander, 9th Civil Engineer Squadron

11 Dec 2012
Date

Chris Donati

CHRIS DONATI
Executive Officer, Donati Ranches

13 Dec. 2012
Date

Appendix F: 2017 Beale Air Force Base grazing land use rules

Appendix F contains the revised grazing land use rules (known as the Operating Agreement) for Beale AFB, drafted in 2017. These grazing land use rules are likely to be appended to the 2017 cattle grazing leases (see *Beale Grazing Management Guidelines*, Section 2).

The 2017 revised land use rules still contain some potentially contradictory or non-standard provisions from the previous version of the land use rules (see Appendix E), described below. The Base Natural Resources Manager should consider updating the land use rules.

1. Section 2.3.3.2: The Animal Unit Month (AUM) definition is non-standard, as are the Animal Unit Equivalent values. An AUM is the standard measurement unit used for describing grazing capacity and stocking rates (Heady and Child 1994; Bush 2006). An AUM is defined as the amount of forage required by 1 Animal Unit for 1 month (SRM 1998). An Animal Unit is defined as 1 mature, 1,000 lb cow, which by definition eats 1,000 lbs of California annual range forage per month. Other kinds and classes of grazing animals (including wildlife) are calculated as a percentage of an Animal Unit; for example, a horse is 1.25 of an Animal Unit. Reported Animal Unit Equivalents (AUE) for different classes of cattle and for different livestock and wildlife species can vary somewhat, but the following AUEs are commonly used in California (Heady and Child 1994, 159; Bush 2006, 9) and nationwide (SRM RAMC 2017, 18):

   - 0.2 AUM: one mature sheep, grazing for one month;
   - 0.6 AUM: one yearling bovine, grazing for one month; one weaned calf less than 1 year old (stocker), grazing for one month;
   - 1.0 AUM: one mature cow with or without unweaned calf not more than six months old, grazing for one month;
   - 1.25 AUM: one mature horse, grazing for one month; and
   - 1.25-1.5 AUM: one bovine bull more than 2 years old, grazing for one month.

2. Section 4.1.1 and 4.1.3: Are lessees allowed to undertake minor fence and water trough repairs? Air Force personnel indicated that since the 1990s, Beale AFB grazing program staff have been responsible for the maintenance of infrastructure in the cattle lease Management Areas and that no in lieu services were permitted (Lauren Wilson, pers. comm., December 2016; Ed Broskey, pers. comm., November 2016).

3. Section 4.5: Beale's *Installation Pest Management Plan* does not allow lessees to apply any pesticides (see Beale AFB 2017, section 5.7).

4. Section 5.2 and following sections: The terms 'authorized stocking rate' or 'maximum allowed AUMs' are more appropriate here than the term 'grazing capacity'. See Section 6 of the *Guidelines* for an explanation.

5. Section 5.2: 800 lbs per acre of biomass remaining at the end of the grazing season (May 31), with a summer decomposition rate of 7% per month, results in approximately 600 lbs per acre at the end of September/beginning of October, the time when residual dry matter (RDM) is typically measured. Is 600 lbs per acre the fall RDM target that Beale wants? The *Guidelines'* AUM estimates were calculated using the University of California Agriculture and Natural Resources (UC ANR) recommended fall RDM minimum targets (500 lbs per acre for most of Beale's cattle-grazing pasture units) so they are not consistent with this provision of land use rules (see sections 6.1 and 9.1 of the *Guidelines*). The UC ANR fall RDM targets are widely accepted and used across the state.

   Regardless of the actual RDM targets Beale chooses, the land use rules should designate **fall** RDM targets. If desired, the Beale grazing land use rules could also include 'suggested' end of season residual biomass values, approximately 670 lbs per acre, if 500 lbs per acre fall RDM is the desired target (assuming 7% decomposition per month over the summer).

References

Beale AFB (Air Force Base). 2017. Installation pest management plan for Beale AFB, California. 5-year revision for 2017. Draft. Beale AFB, CA.

Bush, L. 2006. Grazing handbook: a guide for resource managers in coastal California. Santa Rosa, CA: Sotoyome Resource Conservation District. Available at: http://www.sonomarcd.org/documents/Grazing-Handbook.pdf.

Heady, H.F. and R.D. Child. 1994. Rangeland ecology and management. Boulder, CO: Westview Press.

SRM (Society for Range Management). 1998. Glossary of term used in range management. Denver, CO: SRM.

SRM RAMC (Society for Range Management Rangeland Assessment and Monitoring Committee). 2017. Does size matter? Animal Units and Animal Unit Months. Rangelands 39: 17-19.

Personal communications

Edward Broskey, Jr., Grazing Program Manager, Beale AFB, November 2016 and March 2017.

Lauren Wilson, Regional Biologist, Travis Installation Support Team, multiple occasions, 2016-2017.

Exhibit F – Operating Agreement

OPERATING AGREEMENT
FOR GRAZING LEASE
ON BEALE AFB

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2.2 The Lessee shall closely coordinate grazing operations with 9 CES/CC representative, including, but not limited to, the following:

2.2.1 The Lessee shall provide 9 CES/CC representative with current emergency telephone numbers where the Lessee may be contacted at any time twenty-four (24) hours per day, seven (7) days per week.

2.2.2 The Lessee shall provide 9 CES/CC representative with a list of all ranch hands or other persons expected to require access to Beale AFB in support of the Lessee's operations prior to the beginning of each grazing season. This list may be modified as necessary, but the Lessee must comply with the Provision 3, Access to Beale AFB, before any individual may be given access to Beale AFB.

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2.3.2 Make available for inspection upon the request of 9 CES/CC representative pertinent documents including, but not limited to, weight certificates, health certificates, brand inspection reports, and shipping documents.

2.3.3 Submit by the tenth (10th) day of each month a report that lists the number of AUMs grazed during the previous month.

2.3.3.1 9 CES/CC representative will provide the Lessee with the format for the report and specify the method for computing Animal Unit Month (AUM).

2.3.3.2 AUM is a unit of measurement based on a 1,000-pound dry cow grazing for 30 days. It is further defined as:

2.3.3.2.1. 1.3 AUM is a mature bull, pregnant cow, or one cow with suckling calf less than six months of age at the time of entry to the leased premises that has grazed for one month.

` 2.3.3.3. If there is a dispute about AUM categories assigned to specific cattle on the report, weight certificates for livestock placed on the Leased Premises will be requested. In the absence of weight certificates, each bovine will be considered as one animal unit. The Lessee shall ensure properly completed weight certificates accompany all arriving livestock shipments. The Lessee shall make these certificates available for inspection by the 9 CES/CC representative at the time of livestock delivery to the Leased Premises.

2.3.3.4 This report shall be completed in duplicate and mailed to: Grazing Program Manager, 9 CES/CEIEC, 6601 B Street, Beale AFB CA 95903-1708.

2.3.4 In addition to the monthly AUM report, 9 CES/CC representative may require supplemental information regarding AUM usage by pasture. The format for such a report shall be supplied by 9 CES/CC representative. The Lessee shall submit such information as required to 9 CES/CC representative.

2.3.5 Failure of the Lessee to comply with the reporting requirements outlined in this Condition shall constitute justification for 9 CES/CC to order all livestock to be gathered, counted, weighed, and assigned an animal unit classification based on the result of the weighing. The Lessee shall be liable for all costs associated with such action, and the Lessee shall have no claim of any character on account thereof against the government or any officer, agent, or employee thereof.

2.3.6 To ensure compliance with the Lease and Operating Agreement and to document Lessee performance, an inspection checklist may be reviewed by 9 CES/CC representative with the Lessee up to four times throughout the grazing season with additional documentation recorded and filed as necessary.

Provision 3. Access to Beale AFB

3.1 The Lessee shall obtain installation entry passes from the 9th Security Forces Squadron for all personnel who require access to Beale AFB as part of the Lessee's operations. Enacted in 2005 the REAL ID Act established minimum security standards for state-issued driver's licenses and identification cards and prohibits federal agencies form accepting for official purposes licenses and identification cards from states that do not meet these standards. Beale AFB cannot accept licenses from the following states for visitor access unless it is an Enhanced Driver's License: Kentucky, Maine, Minnesota, Missouri, Montana, Pennsylvania, and Washington. Minnesota and Washington States are issuing Enhanced Driver's License approved for installation access.

ACCEPTABLE FORMS OF IDENTIFICATION:

- Unexpired US Passport of passport card
- Driver's License/State photo ID
- ID card issued by federal, state or local government agencies, with all required REAL ID Act information, which should contain a photo, name, date of birth, gender, height, eye color and address.
- Personal Identification Verification (PIV) card, issued by Federal Government
- Veterans Health ID card, issued by U.S. Department of Veteran's Affairs
- Certificate of Naturalization/Certificate of Citizenship (Form N-550)
- Permanent Resident Card/Alien Registration Receipts card (Form I-551)
- Native American Tribal document with photograph
- An employee authorization document that contains a photograph (Form I-766)
- U.S. Coast Guard merchant mariner cards/credentials
- Foreign Government issued passport
- U.S. Military ID (Including retirees and dependents)

3.1.1 For all personnel requiring a pass, the Lessee shall submit a list of full names (first, middle, and last), dates of birth, home addresses, home or business phone numbers, and drivers' license numbers and states of issue. This list shall also include the name, address, and grazing pasture(s) of the Lessee.

3.1.2 The 9th Security Forces Squadron shall perform a background check for all individuals requesting a pass. The Lessee shall ensure that no person on the access list is an illegal alien or felon. Individuals who have criminal convictions, outstanding warrants, or are determined to be a security risk or detrimental to the good order and discipline at Beale AFB may, solely at the discretion of the Air Force, be denied access to Beale AFB.

3.2 All installation entry passes shall be issued for daytime use only. Access to Beale AFB during non-daytime hours shall be limited to emergencies only. All base access must be through a manned base entry control point (e.g. Schneider Gate, Wheatland Gate, Vassar Lake Gate, Grass Valley Gate, or Doolittle Gate), or the Lessee must be escorted by an Air Force representative onto the base property. Vehicles with equipment or large enclosures must enter through the Inspection Gate and undergo inspection.

3.3 The Lessee shall ensure that all installation entry passes are returned to the Air Force before any employee leaves the Lessee's employ or the expiration of the term of the Lease, whichever is earlier.

3.4 The Lessee shall only use the Inspection Gate/Commercial Vehicle Search Area when transporting cattle or equipment. 9 CES/CC representative shall designate the route of ingress and egress for livestock through the base to the Leased Premises. Loading and unloading of animals, in areas other than the government corrals, must be approved by 9 CES/CC representative.

3.5 There is one (1) area that can be accessed from the outside of the base: Grass Valley Gate Pasture C-2. This route is approved for loading and unloading cattle. However, the Lessee must be escorted to that area by a designated Air Force representative. Under no circumstances will the Lessee be given a key to the gate. Cattle trucks must be inspected at the Inspection Gate prior to unloading cattle in these locations.

3.6 The Lessee shall carry a cell phone at all times while on the installation to allow the Security Forces Command Center (SFCC) to contact them for emergency purposes.

3.7 If heightened security concerns arise, the 9th Reconnaissance Wing Commander or designated representative may require the movement of cattle to a separate pasture or removal of cattle from the base. The Lessee shall commence cattle movement within four (4) hours of notification.

3.8 The Lessee shall receive an antiterrorism/force protection briefing from the Security Forces prior to the start of the Lease.

Provision 4. Maintenance of Property

4.1 The Lessee, at the Lessee’s own expense, shall:

4.1.1 Perform minor fence repair as needed and report routine maintenance and repair needs for fences, corrals, cattle guards, troughs and gates in livestock-tight condition.

4.1.2 Repair any facilities damaged by the Lessee, his employees, and or livestock.

4.1.3 Ensure that all water troughs are in good working order before the grazing season including repairing leaky float devices. Leaking water lines shall be repaired by the 9 CES/CC representative.

4.2 All materials used in maintaining Air Force facilities shall be at least the same type and quality as those used in original construction and shall remain as Air Force property after the expiration of the Lease. 9 CES/CC representative may order the Lessee to replace material that does not meet these specifications at the Lessee’s expense.

4.3 9 CES/CC representative shall repair facilities damaged by military and firefighting activities unless the Lessee caused the damage or the fire.

4.4 The Lessee shall ensure proper clean-up of all areas used by his personnel and will dispose of refuse and debris generated as a result of various lease activities conducted on the leased property.

4.5 The Lessee shall obtain written approval from the 9 CES/CC representative before using any pesticides on the Leased Premises. As used herein, the term "pesticides" includes herbicides, insecticides, fungicides and rodenticides but does not include products commonly known as medicines. All pesticides must be applied in accordance with the manufacturer's instructions by a certified applicator. All chemicals, pesticides or medicines used on the leasehold will be disposed of according to label instructions. The Lessee will be held financially accountable for improper disposal of chemicals or containers that contaminate either the soil or ground water.

Provision 5. Resource Management

5.1 The term of the grazing season shall generally be seven (7) months as described in Annex 1. However:

5.1.1 9 CES/CC may curtail the grazing season when, in his opinion, accessible forage has been utilized to the extent where further grazing would be detrimental to the land or vegetative resources.

5.1.2 9 CES/CC may extend the grazing season when, in his opinion, sufficient forage exists to sustain additional grazing and the Lessee has submitted a written request to 9 CES/CC requesting an extension to the grazing season.

5.2 The nominal grazing capacity (total number of AUM) of the Leased Premises is described in Annex 1. The acreage was calculated using a computer mapping system (ESRI GIS Software) and excludes roads, buildings, and old building foundations within the pastures. The availability of forage and the general condition of the range shall determine the grazing capacity for each grazing season. The Air Force seeks to ensure that a minimum quantity of residual dry matter (mulch) in the amount of approximately 800 lbs. per acre remain on all pastures at end of grazing season.

5.2.1 Contingencies before or during the grazing season may increase or decrease the grazing capacity of the Leased Premises. Thus, 9 CES/CC representative may modify the grazing capacity as follows:

5.2.1.1 9 CES/CC representative may reduce the nominal grazing capacity of the Leased Premises prior to the start of the grazing season. 9 CES/CC representative will notify the Lessee of this reduction in writing at least thirty (30) calendar days in advance of the Term Beginning Date for that grazing season.

5.2.1.2 9 CES/CC may reduce the grazing capacity by requiring the Lessee to refrain from using part of the Leased Premises in accordance with Condition 7, Easements, Rights-Of-Way, and Reserved Rights.

5.2.1.3 9 CES/CC may reduce the grazing capacity through controlled burns of the pastureland.

5.2.1.3.1 To improve range conditions, the Beale AFB Prescribed Burn Management Plan sets forth goals to burn approximately 1,500-2,000 acres of pastureland per year. Forage production in these burned areas will be reduced following the burn. Up to fifty (50) percent reduction in AUMs for the burn area will be applied to the first grazing season following the burn, based on the growth rate of the burned area... There will be no adjustments to the grazing capacity in the second or later grazing seasons following the burn.

5.2.1.3.2 Wildfires are not part of the Beale AFB controlled burn plan and are not governed by this Provision. However, while there will be no rental rebate in the event of a wildfire, the number of cows able to graze on that land the following year will be reduced by up to fifty (50) percent, based on the growth rate of the burned area.

5.2.1.3.3 9 CES/CC shall provide Lessee with a minimum of forty-eight (48) hours advance notice for all such burns when livestock are present in the lease area.

5.2.1.4 The Lessee may make a written request to increase the grazing capacity of the Leased Premises. 9 CES/CC representative may, at his or her discretion, approve this request provided adequate forage is available.

5.2.2 When the grazing capacity of the Leased Premises is increased or decreased, the rent owed by the Lessee to the Air Force shall be calculated according to the adjusted AUM number multiplied by the negotiated AUM rate.

5.3 The forage that exists on the Leased Premises shall be the major source of food for the livestock. The Lessee shall not feed the livestock with supplemental tabs, grains, hay, silage, or other similar feeds when this material constitutes a major portion of the livestock's total daily feed requirement. The Lessee may feed the livestock with protein, salt, minerals, and trace additives, whether singly or in combination, to supplement the animals' daily food requirements only. Short-term emergency feeding may be permitted, in lieu of hardship of temporary removal of the animals, only with prior written permission of the 9 CES/CC representative.

5.3.1 The Lessee shall use hay or other materials that are certified weed free for feeding of horses or livestock.

5.4 The Air Force (AF) will provide water for the Lessee's livestock in accordance with the terms of the Lease. The following conditions shall apply:

5.4.1 A Utility Sales Agreement AF Form 3553, will be made a part of the Lease Agreement. The AF will meter the water used by the Lessee in each of the parcels. Thus, the Lessee will be sent monthly utility billings for water usage in each of the parcels with watering troughs; and troughs serviced by tank filling will be billed each time the tanks are filled, at a rate of $3.13 per 1000 gallons.

5.4.2 The Air Force shall provide the following number of troughs in the following pastures. The Air Force shall not be responsible for providing additional troughs unless at the discretion of 9 CES/CC representative.

A-2	A-3	A-4	A-6	A-7	A-9	B-1	B-2	B-3	B-6	C-1	C-2	C-3	C-4	D-1	D-3	D-4	F-1	F-4
1	1	1	1	1	1	2	2	1	3	7	1	1	1	1	2	1	1	2

5.4.3 Reservoirs that have been fenced to enhance the wildlife habitat and recreational qualities of the sites may not be used by cattle.

Provision 6. Livestock Management

6.1 The Lessee shall move cattle onto and off of the base during business hours, Monday-Friday, 6 a.m. – 4 p.m., unless special arrangements have been made through the 9 CES/CC representative.

6.2 The Lessee shall ensure that his livestock are confined to the Leased Premises at all times. If the Lessee's livestock stray from the Leased Premises:

6.2.1 The Lessee shall collect the strays and return them to the Leased Premises as soon as possible, but no later than four (4) hours after receiving notice of the strays by the Air Force.

6.2.2 The Lessee shall determine how the strays exited from the Leased Premises and take immediate action to correct the deficiency in coordination with the Grazing Manager.

6.2.3 The Lessee shall move individual animals at the request of the 9 CES/CC representative, within 48 hours, if animals cause problems such as fence damage or repeated escapes.

6.3 The Lessee shall not use any of the structures existing on the land with the exception of corrals. These structures are used by the Air Force for various purposes including weather and wildlife monitoring, bivouacs, etc.

6.3.1 The Lessee shall remove any livestock that stray into these structures within four (4) hours of notification by the Air Force.

6.3.2 The Lessee shall take immediate action to prevent livestock from entering into the structures again and repair any fences around these structures completely within two (2) calendar days of the incident.

6.4 The Lessee shall ensure that the livestock are distributed over the Leased Premises to ensure a uniform use of the Leased Premises, minimize sacrifice areas, reduce the overall fire hazard, and enhance the overall land use. To accomplish this, unless otherwise directed in writing by the 9 CES/CC representative, the Lessee shall adhere to the following practices:

6.4.1 When forage on any portion of the Leased Premises has been reduced to the minimum level, the Lessee shall move and restrict livestock to areas containing adequate forage.

6.4.2 The Lessee shall distribute and move salt blocks and feed supplements to promote optimum distribution of livestock.

6.4.3 The Lessee shall move salt blocks and feed supplements monthly throughout the Leased Premises to limit sacrifice areas.

6.4.4 The Lessee shall not place salt blocks or feed supplements within 250 feet of any watering sources, wetland, vernal pool, archeological site, or wildlife nesting site unless approved by 9 CES/CC representative. To avoid conflicts, the Lessee shall request approval from 9 CES/CC representative of proposed supplement locations.

6.4.5 The Lessee shall not place salt blocks or feed supplements within one-quarter (1/4) mile of any paved road unless approved by the 9 CES/CC representative.

6.5 Upon the request of 9 CES/CC representative, the Lessee shall furnish written evidence that the Lessee is in compliance with all federal, state, and local animal health laws and regulations with respect to livestock grazing in the Leased Premises. 9 CES/CC representative reserves the right to impose quarantine, immunization, removal, or other health requirements deemed necessary to prevent or control diseases.

6.6 The Lessee shall comply with all instructions issued by 9 CES/CC representative concerning the disposition of dead livestock.

6.6.1 If not otherwise instructed, dead livestock that present no hazard to health and do not constitute a nuisance may be left to decompose naturally, except that carcasses shall be immediately removed a distance of 250 feet from (a) any areas adjacent to or near a water source when contamination of the water source may result from natural decomposition of the carcasses, (b) areas adjacent to or near paved road where the animal can be seen, and (c) any area within a flight safety wildlife exclusion zone.

6.6.2 The Lessee shall respond to the 9 CES/CC representative request to move dead livestock within twenty-four (24) hours of 9 CES/CC representative notification.

6.7 The Lessee shall comply with all instructions issued by the 9 CES/CC representative concerning the movement of or emergency response to injured or diseased livestock within four (4) hours of receiving the notification. At the discretion of 9 CES/CC representative, the Lessee shall move the injured or diseased livestock to a different location within the Leased Premises or remove them completely from the Leased Premises.

_____________________________ _____________

FREDRICK S. BERRIAN, Lt Col, USAF Date
Commander, 9th Civil Engineer Squadron

_____________________________ _____________

NAME Date
TITLE
COMPANY NAME

Appendix G: Potential solar well and trough locations

Appendix G provides lists and maps of potential solar well and water trough locations, both in current Beale Air Force Base Pasture Units and in ungrazed areas of Beale that would benefit from incorporation into the grazing program but would first require installation of grazing infrastructure (ManTech 2017). In current Pasture Units, developing additional water sources would reduce labor demands on Beale grazing program staff, reduce livestock impacts on naturally occurring water sources such as creeks and vernal pools, and may enhance livestock distribution. Developing water sources in ungrazed areas of Beale would allow the incorporation of these areas into the grazing program for the purposes of maintaining firebreaks, controlling invasive plants, and protecting and enhancing resources (H.T. Harvey & Associates 2015). See Section 4.3 of the *Grazing Management Guidelines* for further details.

The lists and maps come from a report by ManTech SRS Technologies, Inc. ManTech (2017, 3, 12) analyzed potential locations based on minimization of range technician labor, impacts to natural resources, effects on cattle distribution (including slope of potential location), and the logistics of well and trough installation and maintenance. Table G-1 and Figure G-1 show the four potential well and trough locations in current Pasture Units. Table G-2 and Figure G-2 show the thirty-eight potential well and trough locations in ungrazed units of Beale.

References

H.T. Harvey & Associates. 2015. [Strategy for expanding Beale's grazing program into ungrazed areas]. Letter from Matt Wacker to Charles Carroll, dated July 15, 2015.

ManTech SRS Technologies, Inc. (ManTech). 2017. Cattle distribution plan at Beale Air Force Base, California. Prepared for Department of the Navy, Naval Facilities Engineering Command Southwest and U.S. Air Force, 9 CES/CEIEC. Lompoc, CA: ManTech.

Table G-1: Potential well and trough locations in current Beale AFB pasture units; table from ManTech (2017).

Grazing Area	Notional ID	General Location	Current Condition	Benefit
B-5	RT4	North end, near fire break on a high spot (39.171896, -121.41574)	Only seasonal water in south end	Would encourage more even grazing patterns; reduce pressure on seasonal wetlands
F-1	RT1	East end (39.085063, -121.373219)	Only one trough on west end and seasonal water throughout	Heavy star thistle infestation, would potentially help reduce population
C-2	RT3	North end (39.12968, -121.328227)	Only one trough on south end	Would encourage more even grazing patterns and draw cattle to steeper slopes
C-1	RT2	South central/southeast (39.126083, -121.354585)	Many troughs and seasonal water throughout, but none within this region	Would encourage more even grazing patterns and draw cattle to steeper slopes

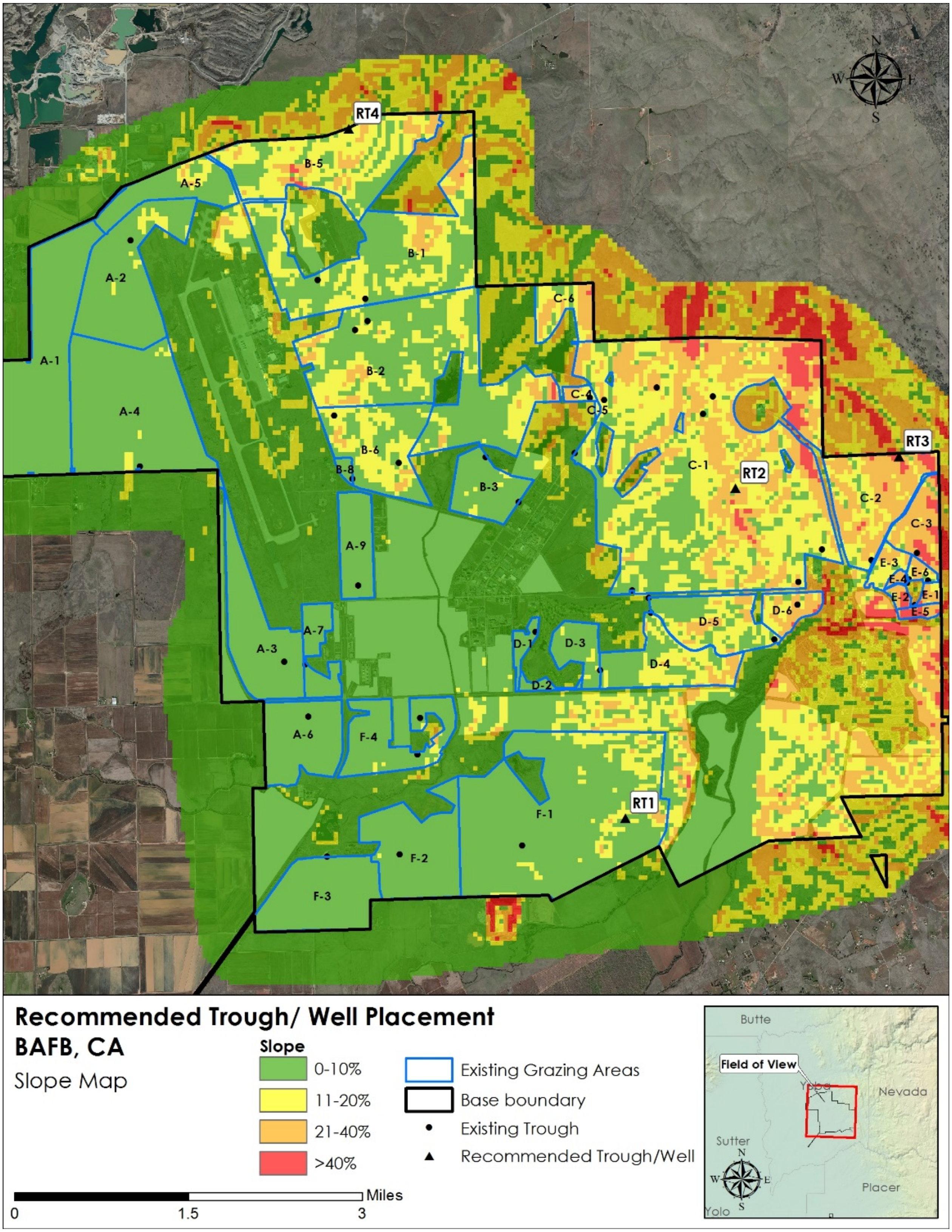

Figure G-1: Potential well and trough locations (RT1 to RT4; black triangles) in current Beale AFB pasture units (blue boundaries); WGS 1984 UTM Zone 10N; map from ManTech (2017).

Table G-2: Potential well and trough locations in ungrazed units of Beale AFB; table from ManTech (2017).

ID	Note	Latitude	Longitude
RT5	200 feet from waterline	39.15745562290	-121.43349348200
RT6	Access via firebreak	39.15892763640	-121.42324422200
RT7	Would require well install	39.10472808590	-121.43593697100
RT9	148 feet from waterline	39.08210568860	-121.42652446000
RT10	Would require well install	39.08663186930	-121.42532083200
RT8	81 feet from waterline	39.12525428250	-121.43713513700
RT 11	Direct tie into waterline	39.11038704870	-121.41866674300
RT12	Would require well install	39.10103025050	-121.41522233000
RT13	Direct tie into waterline	39.10467517880	-121.41637900000
RT14	Direct tie into waterline	39.11283867570	-121.40597265900
RT15	Direct tie into waterline	39.10130842500	-121.40766064100
RT16	Direct tie into waterline	39.10912325190	-121.41621682700
RT17	Direct tie into waterline	39.11294135800	-121.40128037600
RT18	60 feet from waterline	39.10116386660	-121.39790850400
RT19	Direct tie into waterline	39.10411183350	-121.39530031200
RT20	Direct tie into waterline	39.10483298800	-121.39472815500
RT21	Direct tie into waterline	39.12187340170	-121.40809376900
RT22	Direct tie into waterline	39.11355013140	-121.40789241500
RT23	80 feet from waterline	39.12211858560	-121.39515347200
RT24	Direct tie into waterline	39.11783217500	-121.39871048700
RT25	Direct tie into waterline	39.13035714300	-121.38490937000
RT26	Direct tie into waterline	39.11508339920	-121.38380845200
RT27	Direct tie into waterline	39.10041276960	-121.41023670000
RT28	Would require well install	39.09892242240	-121.37696729600
RT29	Would require well install	39.10082619600	-121.36305039000
RT30	20 feet from waterline	39.09795338300	-121.35877039400
RT31	Would require well install	39.09568919510	-121.36310910900
RT32	Would require well install	39.08317405930	-121.35829377300
RT33	Direct tie into waterline	39.09567682470	-121.34577377000
RT34	Would require well install	39.08314876580	-121.34440997200
RT35	Would require well install	39.08568188430	-121.34109982300
RT36	Would require well install	39.09574076480	-121.33552496000
RT37	Direct tie into waterline	39.09698774060	-121.32259525400
RT38	would require well install	39.09203572870	-121.32245206800
RT39	25 feet from waterline	39.10155573160	-121.34610580800
RT40	Would require well install	39.10014856120	-121.35028305000
RT41	Direct tie into waterline	39.11448894100	-121.33415392900
RT42	Direct tie into waterline	39.11078379540	-121.33168633100

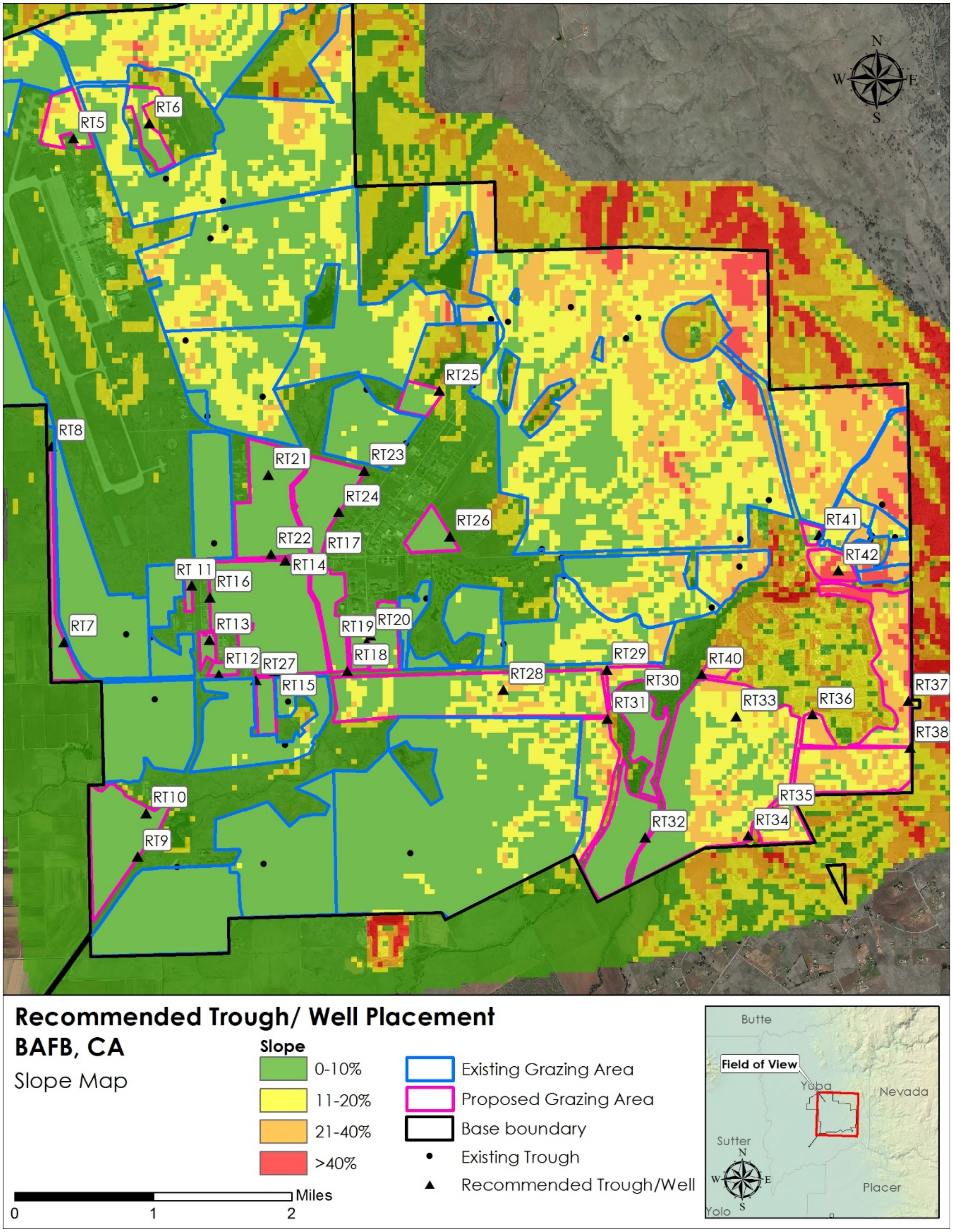

Figure G-2: Potential well and trough locations (RT5 to RT42; black triangles) in ungrazed units of Beale AFB (pink boundaries); WGS 1984 UTM Zone 10N; map from ManTech (2017).

Appendix H: Using different livestock species for natural resources management: **livestock considerations for expansion of the Beale AFB grazing program**

The potential for an expansion of the Beale Air Force Base grazing program has been evaluated by H.T. Harvey & Associates (2015). Almost 3,200 acres, in thirty-four proposed units, could be incorporated into the grazing program. Seventy percent of the proposed units are smaller than 80 acres, and most of the proposed units would require fencing, water, and other infrastructure development before they could be grazed by cattle. For those proposed units too small and isolated for feasible cattle grazing and for larger proposed units awaiting infrastructure installation, sheep or goat grazing may provide many of the desired management goals of maintaining firebreaks, controlling invasive plants, and protecting and enhancing resources.

Deciding what species of livestock to employ in any particular area is based on considerations of:

- the rangeland vegetation each species eats in relation to management goals and forage availability,
- the site's topography,
- the site's existing infrastructure, and
- revenue needs.

Cattle prefer to eat grass rather than forbs or shrubs; sheep eat both grass and forbs and can eat shrubs; goats eat shrubs, forbs, grass, and have a wide tolerance for plants that are toxic or too thorny/spiny for other ungulates; horses primarily eat grass and can crop vegetation very close to the ground (Larson et al. 2015). Although not a major consideration for the western half of Beale with its generally flat topography, the eastern part of the Base has some steeper slopes, including in and around the Base family housing area (Figure 4.2 in the *Grazing Management Guidelines*; Beale AFB 2016, 30, 48). Livestock species use the landscape differently, with sheep and goats generally able to use steeper terrain than cattle. Stockers (young, weaned cows) may be more willing to scale slopes than adult cows, especially cows that are pregnant and/or lactating (George et al. 2007). Sheep and goats are typically herded and fenced in with mobile, often electric, fencing so they can be spatially and temporally controlled much more easily than cattle and horses. In addition, their water needs can often be met by mobile water sources. Sheep and goat operators are likely to be concerned about predators, including domestic dogs from any nearby houses. Sheep and goats typically require a herder onsite with them at all times, and herding dogs may also be a necessary component of a sheep operation. Cattle and horses as heavier animals can have an impact on soil stability and creek banks; large numbers of smaller ungulates can also cause soil erosion. Cattle, in particular, are attracted to riparian zones, which can result in undesirable impacts to creek banks, riparian vegetation and wildlife habitat, and water quality. Sheep can be kept away from riparian areas with herding and mobile fencing, and goats tend to avoid water. Bedding locations for sheep can also be a concern and generally should be moved every few days to avoid damage to rangeland resources. Finally, cattle and sheep operators typically pay for the use of grazing land, whereas goat herd owners frequently charge land managers for employing their goats to control vegetation.

In the large proposed units at Beale that already have suitable fencing and water infrastructure, cattle are likely to be the best choice. A cattle lease generates revenue, cattle do not require constant supervision by a herder, and cattle can be managed to help Beale achieve several natural resource management goals: reduction in grassland fuel loads; control of non-native, naturalized annual grasses that compete with native forbs and can reduce habitat values for wildlife; and control of some invasive rangeland weeds such as medusahead (*Elymus caput-medusae*) and yellow starthistle (*Centaurea solstitialis*). In Beale's vernal pool systems, cattle are likely to be the appropriate choice, if cattle grazing infrastructure is feasible to install. Cattle grazing has been shown in several studies to maintain native vernal pool plant and animal populations, in part by controlling non-native annual grasses, which reduces the competitive burden on native plants and reduces evapotranspiration of vernal pool water (Marty 2005; Marty 2015).

Horse grazing may provide conservation benefits similar to those provided by cattle, but there is only anecdotal evidence to support this hypothesis. Horses tend to crop vegetation shorter than cattle, which could result in undesirable impacts to soil and vegetation, but the wildlife habitat value of very short vegetation can be positive depending on the wildlife species (e.g., Barry et al. 2015). There is also limited research suggesting horses may cause greater soil compaction than other livestock (Larson et al. 2015). Properly managed grazing should minimize this impact.

However, for many of the units proposed for grazing, lack of fencing and water and, in many cases, the small size of the area make sheep or goats the preferable choice. The cost of fencing and water supply suitable for cattle use could probably not be justified solely by the revenue generated by these small pastures, at least in the short-term; sheep operations typically provide their own mobile infrastructure and would likely generate revenue; goats operators also provide their own fencing and water but generally charge for their prescribed grazing services. Sheep can control herbaceous fuel loads and some invasive species well; as noted below, their impact on vernal pool forbs would need to be monitored. Goats can control herbaceous and small woody vegetative fuel and some invasive species well; their impact on vernal pool ecosystems is not well-studied. For the proposed units near Base housing, care would need to be taken in protecting sheep and goats from domestic dogs and in selecting an operator with staff who could interact positively with residents.

If native forbs are known to be abundant on any of the proposed units, sheep preference for forbs may present a problem that would need to be evaluated by the Base Natural Resources Manager. Monitoring would be important to determine the potential for negative impacts of sheep grazing on forb populations.

Some of the invasive plant species found on Base, including in the proposed units, have the potential to be controlled with livestock, including sheep and goats. Because sheep and goats are corralled within small areas by electric fencing and watered with a mobile water source, their grazing impact can be focused on areas with heavy weed infestations. For example, DiTomaso et al. (2007) reported that high intensity grazing by sheep in April and May can reduce medusahead cover significantly. Goat grazing has proved successful in controlling yellow starthistle (DiTomaso et al. 2006). Unlike cattle or sheep, goats will eat yellow starthistle in the spiny stage and so can be deployed later in the season to control the species (see Section 5.2 in *Grazing Management Guidelines*). In Base riparian zones, coarse riparian vegetation and some invasive species could be controlled by goat grazing. Goats are commonly used to control woody and coarse vegetation on steep banks of creeks and other steep sites.

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URLs correct as of August 2017.

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APPENDIX D

Beale Air Force Base Wildland Fire Management Plan

2018

Beale Air Force Base

WILDLAND FIRE MANAGEMENT PLAN

CHLOETA

Prepared by

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Cover Photo: A Wheatland Calif., firefighter ignites a fire at the M-60 range on Beale Air Force Base, Calif., June 27, 2013. The Beale fire department combined forces with local fire departments to conduct a prescribed fire. (U.S. Air Force photo by Airman 1st Class Bobby Cummings/Released; http://www.beale.af.mil/News/Article-Display/Article/280010/team-beale-fights-fire-with-fire/)

TIER 1 Wildland Fire Management Plan

Installation: Beale Air Force Base

Effective Date: ______________________

Approved By:

Signature: ______________________ **Date:** ______________________
LARRY R. BROADWELL, Col.
Installation Commander

Signature: ______________________ **Date:** ______________________
[NATURAL RESOURCES/ENVIRONMENTAL]

Signature: ______________________ **Date:** ______________________
MICAH SHULER, GS-13
Program Manager, Air Force Wildland Fire Branch
AFCEC/CZOF

This Wildland Fire Management Plan has been prepared in accordance with regulations, standards and procedures of Section E3.8 of the Department of Defense Instruction 6055.06, *DoD Fire and Emergency Services Certification Program*, 21 December 2006 and Section 13 of the Air Force Instruction 32-7064, *Integrated Natural Resources Management*, 22 Nov 2016.

The signature above indicates approval of the Plan for Implementation.

The completion of this plan alone does not satisfy the requirements of a Prescribed Fire Plan.

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Executive Summary

The Wildland Fire Management Program on the lands of the 9th Reconnaissance Wing (9 RW) at Beale Air Force Base (BAFB) near Marysville, California is driven by a need to manage natural resources, including habitat for several Threatened and Endangered (T&E) species, minimization of Bird/Wildlife Aircraft Strike Hazards (BASH) on the runways, and minimization of the effects of wildfire on installation values to protect. Prescribed fire is a cost-effective tool that can be used to meet these needs. The existing prescribed fire program can be enhanced by introducing prescribed fire to more areas of the installation. These efforts will improve floral and faunal diversity, improve rangeland habitat quality, control certain invasive species, and reduce hazardous fuels that could currently intensify wildfires. Non-fire fuels treatments as well as preparedness and readiness actions are also important for minimizing the effects of wildfire and are recommended as part of this Wildland Fire Management Plan (WFMP). BAFB will implement this WFMP to carry out the natural resources management goals outlined in the BAFB Integrated Natural Resources Management Plan (INRMP) and to comply with all applicable laws and regulations and to fulfill the recommendations established by Chapter 13 of Air Force Instruction 32-7064, *Integrated Natural Resources Management*, 22 November 2016 (AFI 32-7064).

BAFB will implement improvements to its land and firefighting resources that will enhance the response and capabilities of firefighters. Chief among these is formally establishing Fire and Emergency Services (FES) as the primary initial attack responders, along with working to increase the operational qualifications of FES personnel. Focusing on preparedness and readiness actions are also major purposes of this WFMP. This plan establishes a Wildland Fire Program Coordinator (WFPC) to oversee the planning and implementation of wildland fire projects. Additional proponents of this plan include the FES Fire Chief (FC), Natural Resources Manager (NRM) Air Force Wildland Fire Branch (AFCEC/CZOF), and the Wildland Support Module (WSM) to be established at BAFB.

This plan will be reviewed annually to ensure the latest information is consistently incorporated into Air Force (AF) wildfire prevention and suppression procedures. An ad hoc review committee will be convened by the WFPC and will consider fire activity, and prevention and response effectiveness. They will conduct an audit of fire occurrences and expenses and recommend what, if any, changes are necessary to improve the wildland fire management program. In addition, this plan is a living document and may be changed as necessary to account for the constantly evolving requirements placed on the Wildland Fire Management Program.

Chapter 1. Introduction

The intent of this chapter is to introduce the reader, who may or may not be associated with the AF, or local installation, to scope, purpose and area covered by this WFMP.

A wildland fire is defined as any non-structure fire that occurs in vegetation or natural fuels including:

- **Wildfires** – Unplanned fires including natural fires (e.g. lightning), munitions-caused fires, unauthorized human-caused fires, escaped prescribed fire projects, etc.
- **Prescribed Fires** – Any fire purposely ignited by natural resource managers to meet specific land management objectives.

The importance of wildland fire management to Department of Defense (DoD) is evidenced by Department of Defense Instruction 6055.06, *DoD Fire and Emergency Services Certification Program*, 21 December 2006 (DoDI 6055.06), which mandates that any installation with burnable vegetation have a WFMP. In order to facilitate interagency cooperation and standardization, this plan is written following the general guidance and standard chapter format of the Interagency WFMP template, with slight modifications to streamline and to address mission-specific aspects of wildland fire management not encountered by other federal land management agencies.

1.1 Purpose of the WFMP

The WFMP is written as a supporting document for implementation of the INRMP as mandated by AFI 32-7064. It also supports a coordinated approach to wildfire response and risk mitigation that includes FES, installation Natural Resources (NR) personnel and the AFCEC/CZOF. This plan addresses the specific fire-related supporting goals and objectives identified in the INRMP as well as existing Standard Operating Procedures (SOPs) for wildfire response. Implementation of this WFMP will assure achievement of fire-related resource management and mission support objectives.

This WFMP has been developed to provide guidance for the suppression and prevention of wildfires on BAFB lands and to implement ecosystem management and fuels reduction goals using mechanical fuels treatments and prescribed fire in support of the 2016 INRMP.

The scope of this WFMP is to lay out responsibilities and procedures for prescribed fire management and the prevention, preparedness, and suppression of wildfires on all BAFB lands in a manner that is safe, efficient, effective, and highly professional. This WFMP identifies and references appropriate planning documents that support and detail specific elements of the program.

The goal is to convey the methods and protocols necessary to minimize wildfire severity and size as well as the use of mechanical and prescribed fire treatments for ecosystem management and fuels reduction. This plan supports the installation mission by outlining the direction of wildfire suppression and the utilization of vegetation treatments to minimize damage to the landscape and impacts to the military mission by wildfire.

Improved fire management at BAFB will:

- Reduce the risk of damage to installation personnel, facilities, and operations.
- Reduce the risk of wildfire through reduction of hazardous fuels.
- Create maintainable firelines.
- Improve access to natural areas.
- Assist in the control of invasive species.
- Lower fuel loads for future prescribed fire.
- Promote forest health and growth.
- Improve wildlife habitat through a variety of ecological mechanisms.
- Enhance the aesthetic features of the land.
- Recycle nutrients returning them back to the soil.
- Perpetuate fire-dependent species.
- Encourage temporary changes in the vegetative makeup of the natural areas.
- Improve habitat conditions for federally-listed T&E species.

Implementation of this plan will satisfy applicable laws and regulations established by Chapter 13 of AFI 32-7064. It is incorporated into the INRMP for BAFB as a component plan.

1.2 General Description of the WFMP Area

According to *Description of Ecological Subregions: Sections of the Conterminous United States*, 2005 (Ecological Subregions), BAFB is located in the Great Valley Ecological Section and on the edge of the Sierra Nevada Foothills Ecological Section. It is comprised of approximately 23,000 acres in Yuba County, approximately 40 miles north of Sacramento, 13 miles east of Marysville, and 25 miles west of Grass Valley. The nearest airport with commercial service is Sacramento International Airport (SMF). Access to BAFB from the nearest large city (Marysville, California) is by taking State Route 65 south and turning east on South Beale Road.

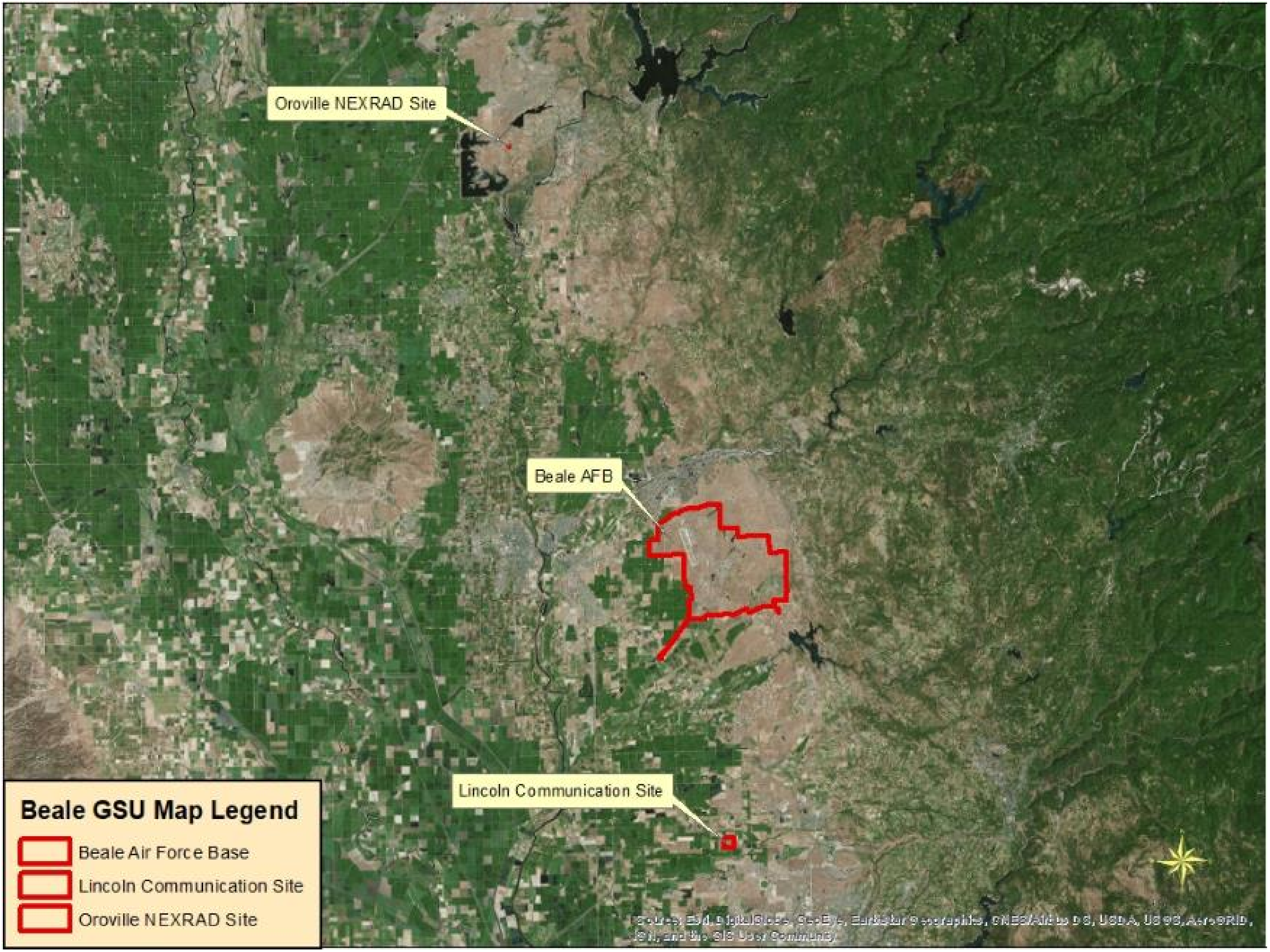
BAFB is bordered by agricultural and ranch lands on the south, southwest, and northeast. It is bordered primarily by residential property and commercial property on the west and northwest, respectively. Nearly the entire eastern boundary borders the Spenceville Wildlife Management and Recreation Area (SWMRA), which is owned by California Department of Fish and Wildlife (CDFW).

Two Geographically Separated Units (GSUs) totaling 256 acres are attached to BAFB. These 2 GSUs include the Lincoln Communication Annex Site (LCAS; referred to in the INRMP as Lincoln Receiver Site) and Oroville Next-Generation Radar (NEXRAD) Site. Refer to Table 1.1 for a list of GSUs and Figure 1.1 for a map of BAFB and GSU locations.

Table 1.1: Areas Covered in the Wildland Fire Complex

Areas Covered within the WFMP	Total Acres (Burnable Acres)
Beale Air Force Base	23,197(19,802)
Lincoln Communication Annex Site	255 (243)
Oroville NEXRAD Site	<1 (0)

1 **Figure 1.1: BAFB GSU Map**



Wildland fire management on BAFB is a threefold process, involving prescribed fire as a tool for managing natural resources, prescribed fire as a preventative measure, and wildfire management in the event a wildfire breaks out. As described in Section 3.8.1.2 of AFI 32-7064, fire and other disturbance regimes may be used as a component to ecosystem management when practical and consistent with the military mission. Prescribed fire is a useful tool to maintain open grasslands and vernal pools, both important for native wildlife species. BAFB has Mutual Aid Agreements (MAAs) in place with California Department of Forestry and Fire Protection (CAL FIRE)/Yuba County Operational Area Fire and Rescue Coordinator's Office, Linda Fire Protection District, Marysville Fire Department (FD), Olivehurst FD, Smartsville Fire Protection District, and Wheatland Fire Authority to assist with wildfire as needed. These Mutual Aid Agreements can be found in Appendix 1.1.

1.2.1 General Description of any GSU owned by the AF and used by the Installation

1.2.1.1 Lincoln Communication Annex Site (LCAS)

According to Ecological Subregions, LCAS is located in the Great Valley Ecological Section. It is comprised of 235 acres in Placer County, California, 15 miles south of BAFB and 5 miles west-southwest of Lincoln. The nearest airport with commercial service is SMF. Access to LCAS from the nearest city (Lincoln, California) is by taking State Route 65 south, Ferrari Ranch Road west, Sorrento Parkway north, and Moore Road west. It is on the north side of Moore Road. LCAS is bordered by agriculture to the south and northwest and by rangeland on all other sides. LCAS is a High Frequency Global Communications System (HFGCS) station. LCAS has an MAA in place with CAL FIRE/Placer County FD to assist with wildfire as needed.

1.2.1.2 Oroville NEXRAD Site

According to Ecological Subregions, Oroville NEXRAD Site is located in the Great Valley Ecological Section. It is comprised of less than 1 acre in Butte County, California, near Oroville. The nearest airport with commercial service is SMF. Access to Oroville NEXRAD Site from the nearest city (Oroville, California) is by taking State Route 162 west. The Oroville NEXRAD Site is on the south side of State Highway 162. It is bordered by the Table Mountain Golf Course on the east, rangeland on the south and southwest, and residential land on the west. Its only use is as a radar site.

1.2.2 General Description of any GSU Leased by the AF and used by the Installation

There are no GSUs leased by BAFB.

1.3 General Description of the DoD Mission

The host organization at BAFB is the 9 RW, an Air Combat Command (ACC) organization reporting to the 12th Air Force (12 AF), whose mission statement is "9th RW professionals providing America the world's finest high-altitude reconnaissance...anytime, anywhere." The wartime mission is to provide global aerial reconnaissance in accordance with the provision of the emergency war order. In peacetime, reconnaissance flights and reconnaissance air refueling support are conducted in response to the peacetime reconnaissance and certain sensitive operations programs and contingency taskings from the national command authorities and the Joint Chiefs of Staff.

BAFB currently operates the following resources:

- The U-2 Dragonlady, a single-seat, single-engine, high-altitude reconnaissance aircraft which serves as the highest flying manned aircraft in the world.
- The U-2S and U-2ST, 2-seat version.
- The Global Hawk, a high-altitude unmanned aerial vehicle battlefield reconnaissance platform designed to give joint-service commanders imagery in near-real time, which can operate at altitudes above 60,000 feet for over 30 hours, can be flown dynamically by the Global Hawk Pilot or in limited autonomous modes, can cover as much as 3,500 square miles per hour at resolutions between 1 and 3 feet, can detect up to 2,000 targets over 60 miles away, and can carry a variety of sensor packages including Synthetic Aperture Radar (SAR), a third- generation Infrared (IR) sensor, and an Electro-Optical (EO) sensor, which can operate concurrently and can cover 40,000 square miles in SAR, or take over 1,900 spot pictures with the EO/IR sensors over the length of a typical mission.
- The Mission Control Element (MCE), a trailer-based, 4-person ground station that operates the aircraft and sensors, can be located on another continent than the aircraft, and uses satellites for communication and data transfer.

As of 2016, BAFB hosts a reserve contingent (the 940th) with 6-8 aerial refueling tankers (KC-135s).

BAFB also manages the LCAS which contains a global High Frequency (HF) radio communications receiver that provides quality HF communications for United States Air Force/United States Navy (USAF/USN) west coast operations. The site provides rapid, reliable two-way long-haul HF communications between ground agencies, water vessels, DoD aircraft, and Mystic Star Presidential/VIP support. In addition, the USAF Global Communication program provides Commanders-in-Chief (CINC) United States Strategic Command (USSTRATCOM) a means of controlling strategic forces and also provides national command authorities the means to exercise command and control of tactical/strategic aircraft. LCAS technicians maintain automated communication systems, including System Capable of Planned Expansion (SCOPE) Command, Defense Information Systems Agency's (DISA) Integrated Digital Node Switching (IDNX) and

T1 circuit connections for long-haul data, voice, and remote control operations from the master netcontrol station at Andrews Air Force Base.

Four major associate units are located on BAFB:

- The 940th Wing, a USAF Reserve unit with multiple missions.
- The 7th Space Warning Squadron, which operates the Precision Acquisition Vehicle Entry Phased Array Warning System (PAVEPAWS) radar system to detect and warn of submarine-launched ballistic missile and intercontinental ballistic missile attacks and to track satellites as they orbit in space.
- The 13th Intelligence Squadron-ACC component of the Deployable Ground Station-2 (DGS-2) function that provides near real-time intelligence for military and nonmilitary customers.
- The 48th Intelligence Squadron-Air Intelligence Agency unit with the mission of maintaining, deploying, and operating the DGS-2.

The total employee population at BAFB is approximately 4,224 active duty military personnel, 15 Air Force Reserve/Air National Guard (AFR/ANG), 687 non-extended duty ANG, and 1,339 civilians. As of September 2016, housing facilities are provided for 76 officer and 424 enlisted families. Dormitories provide housing for 503 enlisted and transient personnel.

1.3.1 General Discussion of Wildland Fire Impacts to the DoD Mission

Wildfires, particularly under severe conditions, have the potential to pose a significant risk to AF personnel and their families, as well as to infrastructure on AF property and private property, should the fire spread off the installation. Smoke from wildfires or prescribed fires can reduce readiness by disrupting flightlines, target operations, and range operations. Under high fire danger conditions, the use of incendiary munitions may be curtailed. Bare ground from past wildfires and prescribed fires may increase blowing dust which could impact operations for a longer period of time. Disruption in operations can, in turn disrupt training schedules. Positive impacts of wildland fire, including prescribed fire, include the achievement of natural resource goals such as T&E species management requirements, outlined in the INRMP, which enable NR managers to achieve the "no net loss to mission" provision of the Sikes Act. These include a decrease in the severity of wildfires due to fuels reduction and a decrease in BASH due to the reduction in broad-leafed weeds, in particular yellow star-thistle (*Centaurea solstitialis*), that may attract flocks of birds along flightlines.

1.3.2 General Discussion of DoD Mission Impacts to Wildland Fire Activities

The mission itself can have impacts on wildland fire management. For instance, ignition sources associated with human habitation, roads, and powerlines, as well as the use of incendiary munitions, have the potential to cause wildfires. Prescribed fire has a narrow prescription window under which it would have a high degree of likelihood of both meeting objectives and being controllable. This window overlaps significantly with weather conditions required for DoD operations involving flight and the use of incendiary munitions. Because of this, and the fact that smoke from prescribed fires could impact DoD operations, windows for the appropriate use of prescribed fire are further narrowed. If fuels cannot be treated using prescribed fire, the installation may be unable to fully implement their Sikes-Act compliant INRMP, as required by AFI 32-7064 and the Sikes Act (16 USC 670a-670o, 74 Stat. 1052 [Sikes Act]).

Constraints exist that may affect ongoing prescribed fire and wildfire operations. Certain areas on BAFB, such as those designated for Explosive Ordinance Disposal (EOD), may pose a safety risk to firefighters because they contain Unexploded Ordinance (UXO). Other areas on BAFB and its GSUs may contain Hazardous Materials (HazMat) and would also pose a safety risk to firefighters. Security clearance is required of firefighters and issues may arise when outside personnel are providing mutual aid during wildland fire operations. Limited access points may affect tactics, especially on wildfires that cross jurisdictional boundaries. Missions involving flight may result in airspace restrictions that would impact the use of aerial firefighting resources.

1.4 Significant Values to Protect

1.4.1 Personnel Safety

The primary concern during any fire is human safety and protection. Firefighters on the line, in the air, and at the command post must all be properly trained, outfitted, and informed of all threats and safety risks.

1.4.2 Structures and Infrastructure

Structures and infrastructure are present in several concentrated areas on BAFB including the airfield area in the northwestern portion of BAFB, the Munitions Area in the north-central portion of BAFB, the training, main base, and golf course areas in the central portion of BAFB, and the family housing area in the southeastern portion of BAFB. Primary values to protect include powerline poles, buildings, towers, munitions bunkers, and above-ground fuel storage tanks. Of these, wooden powerline poles are most vulnerable due to the proximity to wildland fuels. Most other values will be adjacent to managed fuels, such as lawns, or unburnable fuels, such as pavement or bare ground. LCAS and Oroville NEXRAD Site both contain similar buildings and/or infrastructure that could be negatively affected by fire.

1.4.3 Natural Resources

Fire is generally considered beneficial to natural resources on BAFB and its GSUs in most cases. This is especially true in the annual grassland/vernal pool areas, provided that firefighting actions do not result in physical impacts. Exceptions where fire may have negative effects include riparian forests and stream reaches providing potential habitat for Central Valley steelhead

(*Oncorhynchus mykiss*) and valley elderberry long-horned beetle (*Desmocerus californicus* subspecies *dimorphus)*, federally threatened species. These exceptions exist only on BAFB itself.

The valley elderberry long horned beetle, a federally threatened species, utilizes elderberry (*Sambucus* species) plants for all stages of their life cycle. Elderberry grows in riparian forests and, while they often resprout prolifically after fire, individual plants are immediately negatively affected by fire which results in a disruption of the life cycle of any valley elderberry long horn beetles using them. In addition, several of the longer-lived overstory trees in riparian forests are negatively affected by fire in the short term.

Streams that provide potential habitat for the Central Valley steelhead may be negatively affected by fire due to increases in turbidity caused by runoff and erosion from nearby burned uplands. Water temperatures may also be affected if vegetation that provided pre-fire shade is now absent. Aerially applied fire retardant has the potential in affecting water quality if applied into the stream itself.

Fire can temporarily negatively affect grazing operations by removing forage required by cows. The impact is temporary as fire can lead to better forage quality in the year or two following a fire and may provide invasive species control benefits that improve forage quality for the animals. In general, grazing and fire are landscape-level land management tools that are mutually supportive of natural resource goals in California annual grasslands and California vernal pool ecosystems. Firefighting actions such as maintaining annual firebreaks and wildfire response actions like firelines often have negative effects on the vernal pool ecosystems when they plow through pool basins disrupting hydrology and injuring federally listed species that may be present.

1.4.4 Cultural Resources

Archeological surveys have been conducted on over 90% of BAFB. During these surveys, approximately 127 prehistoric and historic era archeological sites have been recorded. It is likely that most prehistoric era archeological sites have been burned over multiple times by either wildfire or prescribed fire. Consult the Cultural Resources Manager (CRM) and the Integrated Cultural Resources Management Plan (ICRMP) for details on the cultural resources present and any specific actions that will be taken to protect them. A checklist of recommended cultural resource actions can be found in Appendix 1.2. The CRM will be consulted during the prescribed fire planning process to identify any sensitive cultural resources requiring protection within the burn unit, and will be consulted during any wildfire events threatening cultural resources so that mitigating actions can be taken if feasible.

1.5 WFMP Roles and Responsibilities

A list of contacts related to wildland fire management on BAFB can be found in Appendix 1.3.

1.5.1 Wildland Fire Program Coordinator (WFPC)

As per Section 13.2.2 of AFI 32-7064, "The WFMP designates a Wildland Fire Program Manager (WFPM) and defines the roles and responsibilities for wildland fire management on the installation."

For the purpose of this document the WFPM and WFPC are interchangeable.

The WFPC will:

- Initiate, coordinate and ensure appropriate installation engagement and timely completion of the WFMP.
- Serve as the primary installation Point of Contact (POC) for the AFCEC/CZOF fuels treatment implementation, data collection, and large wildfire reporting.
- Assist with requests for Incident Qualification Cards for installations assets as specified in the WFMP.
- As soon as practical, report any significant wildfire incident that occurs on or threatens property under AF jurisdiction to the AFCEC/CZOF via the Regional Fire Management Officer (RFMO). A significant wildfire incident is defined as:
    - Any wildfire greater than 100 acres.
    - Any wildfire, regardless of size, that has met any of the following criteria:
        - Significant threat to installation infrastructure/resources.
        - Major or extended impact on AF missions.
        - Loss of life.
        - Negative impact to public health and safety.
        - Threat to T&E species.
- Work with the WSM Lead and AFCEC/CZOF training manager to identify National Wildfire Coordinating Group (NWCG) qualification requirements in the installation's WFMP.
- Serve as the primary POC between the installation and the AFCEC/CZOF for all matters concerning wildland fire.
- Coordinate with the installation assets and WSM Lead to ensure that manpower, supplies, equipment and other cooperative resources are available to meet the required goals and objectives of the WFMP.
- Be responsible for coordinating all internal and external notifications dealing with wildland fire activities.

- Coordinate with the AFCEC/CZOF's training manager with all matters related to training and qualifications.
- Coordinate with the BAFB Natural Resources Manager (NRM) to assess the need for Emergency Stabilization (ES) actions (such as the development of an Burned Area Emergency Response [BAER] plan) and/or development of a Burned Area Rehabilitation (BAR) plan.
- Ensure that wildland fire maps and fire history are properly reported to the Environmental Quality (EQ) Geographic Information Systems (GIS) geodatabase and to AFCEC/CZOF.

1.5.2 FES Fire Chief (FC)

The BAFB FES is currently responsible for suppressing Wildland Urban Interface (WUI) fires and supporting NR suppression efforts during wildfires and prescribed fires. The FES FC serves as the WFPC and shall be familiar with the provisions outlined in this plan and provide qualified personnel to support the wildland fire management program as necessary.

1.5.3 Natural Resources Manager (NRM)

The BAFB NRM will be involved with development of the WFMP to ensure that all planned actions in the WFMP that could affect natural resources are in line with, and directly supportive of the INRMP, and conversely that relevant NR goals and objectives are represented in the BAFB wildland fire management program. Related to this, the NRM will coordinate to ensure that the planned actions in the WFMP are covered under the National Environmental Policy Act (NEPA) process for the INRMP. The locations and plans for all prescribed fires in support of the goals and objectives of the INRMP will be approved by the BAFB NRM. The NRM alone will set prescribed fire priorities on the installation for the purpose of meeting NR program goals. The NRM will be consulted on all planned prescribed fire actions and will be notified of any wildfires impacting natural resources on the installation so that mitigating actions can be taken if possible to avoid damage to sensitive natural resources.

1.5.4 Incident Commander (IC)

All wildfires occurring on an AF installation and staffed with AF employees or cooperators will be supervised by a qualified IC. If a qualified IC is not available, one will be ordered through the local dispatch center.

The IC is a single individual responsible to the installation for all incident activities, including the development of incident management strategies and tactics, and the ordering, deployment, and release of resources. The IC will:

- Provide a size-up to dispatch as soon as possible upon arrival on scene. A size-up checklist is in the PMS 461/NFES 001077, *Incident Response Pocket Guide*, January 2014 (IRPG).

- Complete and file an incident report with the installation dispatch center.
- Assess potential management by suppression and/or by wildfire for resource benefits as incident objective(s).
- Contact AFCEC/CZOF with incident updates and recommended plan of action.
- Use guidance in this WFMP.
- Secure a Delegation of Authority to implement the selected suppression response and manage an organization to implement effective strategies and tactics.
- Minimize suppression impacts where possible without reducing the effectiveness of the actions being undertaken.
- Determine resource needs and order as needed through local dispatch.
- Ensure all resources assigned and those incoming receive a briefing and document these briefings. Refer to the Briefing Checklist in the IRPG.
- Continually re-assess incident complexity using the checklist in the IRPG.
- When a more qualified IC is needed, inform dispatch and delegated unit administrator and place the order for a higher-level IC.
- Provide all resources, including mutual aid resources (in person or by radio) an incident briefing prior to initiating a tactical assignment.
- Investigate all wildfires to determine fire cause. Document findings on an *Activity Log* (ICS 214) and determine if negligence or criminal intent were factors. If the IC suspects a fire cause is suspicious, a qualified Wildland Fire Investigator (INVF) can be ordered. The point of origin should be protected for investigation purposes.
- Depending on incident complexity, additional responsibilities for the IC may apply. Utilize AFI 32-7064, NWCG PMS 210, *Wildland Fire Incident Management Field Guide*, April 2013 (PMS 210), and AFCEC/CZOF for more detailed description of IC responsibilities.

The WFPC will ensure that a Delegation of Authority is provided to all qualified ICs, of any type, that command or may command a wildfire on BAFB of any size. This includes an annual Delegation of Authority provided to all initial attack ICs (Type 5 and Type 4) on the installation. A sample *Agency Administrator's Delegation of Authority to the Incident Commander* can be utilized to create a BAFB-specific Delegation of Authority for future use. The installation will use the current AFI 32-7064 or the NFES 2724, *Interagency Standards for Fire and Aviation Operations*, January 2017 (Red Book) for supporting guidelines which include the Agency Administrator's Briefing to Incident Management Team (IMT). An outgoing IC will in-brief an incoming IC using the Briefing Checklist found in the IRPG. Once a fire has expanded beyond the capabilities of the initial attack resources, or it is apparent that it will exceed these capabilities, the initial attack IC must request assistance.

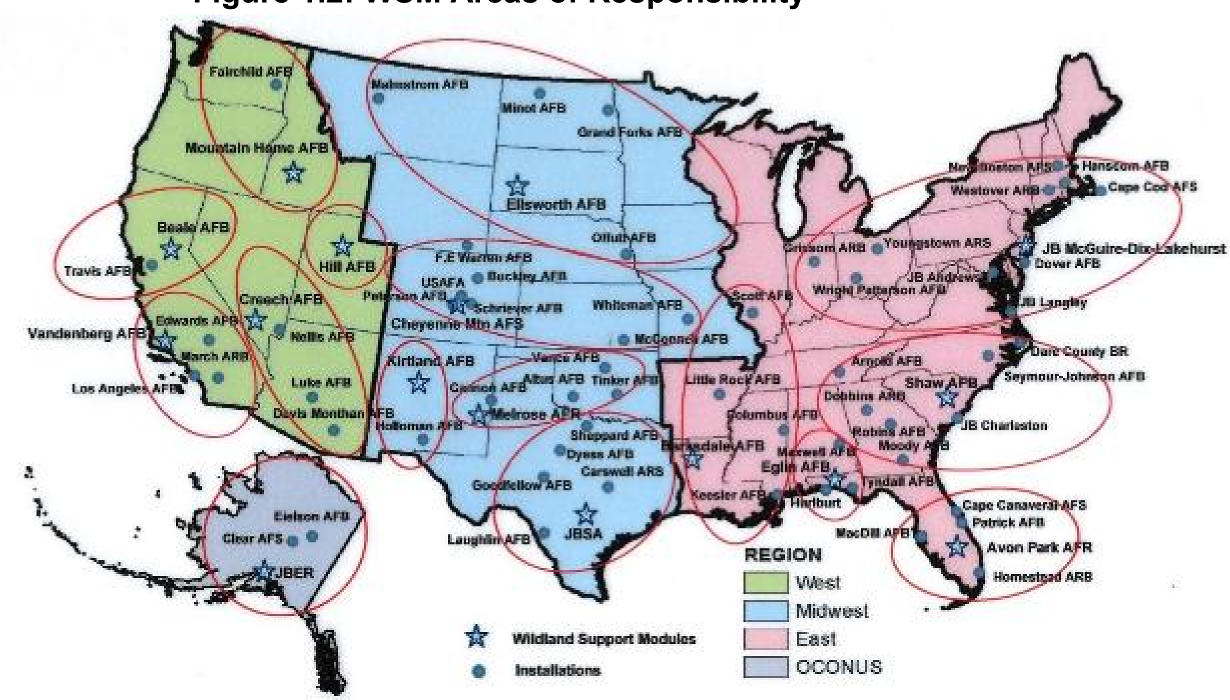
1.5.5 Wildland Support Modules (WSM)

AFCEC/CZOF will primarily use the WSMs, in conjunction with the NWCG-qualified and available installation personnel, to execute validated wildland fire management program requirements. If the resources in the WSMs are limited and cannot accomplish wildland fire requirements organically or in cooperation with qualified installation assets, AFCEC/CZOF will exercise reach back assistance from interagency detailers to supplement AFCEC/CZOF staff. After assessing interagency detailer's capability, AFCEC/CZOF may utilize qualified contracted personnel to assist with wildland fire fuels requirements. More details on the WSM can be found in *Air Force Wildland Fire Branch Playbook*, 2017 (AFCEC/CZOF Playbook).

The WSMs shall provide a high quality, mobile, qualified and experienced resource for installations to implement the goals and objectives of the WFMP. WSMs shall maintain expertise to plan and conduct wildfire suppression, prescribed fire, accredited training delivery and mechanical fuels reduction services. AFCEC/CZOF shall provide direction, support, and review processes that ensure WSM operations are safe, effective, and meet the wildland fire management operations standards as outlined in this document.

In the future, BAFB will host a WSM that will also serve Travis AFB. WSM Areas of Responsibility (AORs) are depicted in Figure 1.2.

Figure 1.2: WSM Areas of Responsibility



The WSM program facilitates the use of fire and other management techniques involving planned and unplanned wildland fire events. WSMs are highly skilled and versatile fire crews, which provide technical and ecological-based expertise in the areas of long term planning, ignitions, holding and suppression, prescribed fire preparation and implementation support, hazard fuels reduction, and fire effects monitoring, resulting in fire fulfilling its natural or historic role to meet resource and management objectives. The WSM will have sufficient expertise in natural resource management to adequately plan for prescribed fires on the installations within their AOR. At BAFB this should include skills such as identifying natural resource assets for avoidance or management, plant and wildlife identification skills, vegetation monitoring procedures, and surveying techniques.

The WSM provides fully qualified and equipped personnel to conduct prescribed fire and mechanical fuels reduction activities for the purposes of ecosystem management and mitigation of wildfire as a threat to the ecosystem. Mechanical fuels reduction activities completed for the purposes of mitigation of wildfires as a threat to mission activities and military readiness are not the responsibility of the WSM unless they receive installation operations and maintenance funding. Activities are conducted in accordance with INRMP and installation mission objectives. At a minimum, the WSM shall collaborate all activities extensively with the installation NR staff and FDs to ensure all actions are aligned to a common goal.

1.5.6 Installation Commander

The Installation Commander or his designee is responsible appointing the WFPC and for reviewing and approving the WFMP. A Delegation of Authority should specifically delegate duties from the Installation Commander to the WFPC. See Appendix 1.4 for a sample Delegation of Authority.

1.5.7 AF Wildland Fire Branch (AFCEC/CZOF)

AFCEC/CZOF provides technical and operational support to installations for a wide range of wildland fire related products and services, including writing and updating WFMPs, prescribed fire implementation, use of Decision Support Tools during wildfire emergencies, interagency liaisons, tracking of NWCG qualifications, and wildland fire training. AFCEC/CZOF is also responsible for issuing, maintaining and tracking the NWCG certifications and qualifications for AF personnel, to include contractors and volunteers where appropriate.

1.5.8 Environmental Operations Division West Region (AFCEC/CZOW)

AFCEC/CZOW programs EQ requirements and manages contracts and cooperative agreements for the Conservation Office and NRM which, at BAFB, support pre- and post-fire monitoring requirements and BAER analyses among other functions. AFCEC/CZOW, through the Installation Support Section (ISS), provides technical support to installation NRMs.

Chapter 2. Policy, Land Management Planning, and Partnerships

The intent of this chapter is to establish the linkage between higher level planning documents, legislation and policies and the actions described in this WFMP.

2.1 AF Wildland Fire Policy

The governing policy for wildland fire management can be found in DoDI 6055.06, Chapter 13 of AFI 32-7064, Chapter 3.2.4 of Air Force Instruction 32-2001, *Fire Emergency Services Program*, 24 February 2014 (AFI 32-2001), the AFCEC/CZOF Playbook, and Federal Wildland Fire Management Policy.

2.1.1 Federal Interagency Wildland Fire Policy

This WFMP meets the Air Force Instruction (AFI) and *Review and Update of the 1995 Federal Wildland Fire Management Policy*, January 2001 by implementing and following these guiding principles:

- Firefighter and public safety is the priority in every fire management activity.
- Support the AF mission by managing wildland fire fuels to protect assets, structures, infrastructure, natural areas, and other identified values-at-risk from catastrophic wildfire.
- The role of wildland fire as an essential ecological process and natural change agent has been incorporated into the planning process.
- INRMP and pertinent resource management plans set the objectives for the use and desired future condition of the various public lands.
- WFMPs, programs, and activities support land and resource management plans and their implementation.
- Sound risk management is a foundation for all wildland fire management activities. Risks and uncertainties relating to wildland fire management activities must be understood, analyzed, communicated, and managed as they relate to the cost of either doing or not doing an activity.
- Wildland fire management programs and activities are economically viable, based upon values to be protected, costs, and land and resource management objectives.
- WFMPs and activities are based upon the best available science.
- WFMPs and activities incorporate public health and environmental quality considerations.
- Federal, state, tribal, local, interagency, and international coordination and cooperation are essential.
- Standardization of policies and procedures for wildland fire management among AF installations is an ongoing objective.

This WFMP supports BAFB's compliance with the Sikes Act in management of natural resources on DoD lands as a component plan of the INRMP.

2.1.2 AF Wildland Fire Cost-Effectiveness Policy

Maximizing cost-effectiveness of any fire operation is the responsibility of all involved, including those who authorize, direct, or implement operations. Cost-effectiveness is the most economical use of resources necessary to accomplish project/incident objectives. Accomplishing the objectives safely and efficiently will not be sacrificed for the sole purpose of "cost-saving." Appropriate oversight will ensure that expenditures are commensurate with values to be protected. Other factors besides those in the biophysical environment may influence decisions, including those from the social, political, and economic realms. AFCEC/CZOF will provide direction and support in this area.

2.1.3 Cohesive Wildland Fire Management Strategy

This WFMP meets the direction in The National Strategy, the final phase in the Development of *A National Cohesive Wildland Fire Management Strategy* (National Cohesive Strategy) because it emphasizes the following primary goals:

- *Restore and maintain landscapes:* Landscapes across all jurisdictions are resilient to fire-related disturbances in accordance with management objectives.
- *Fire-adapted communities:* Human populations and infrastructure can withstand a wildfire without loss of life and property.
- *Wildfire response:* All jurisdictions participate in making and implementing safe, effective, efficient risk-based wildfire management decisions.

The National Strategy sets broad, strategic, and national-level direction as a foundation for implementation of actions across the Nation.

2.1.4 AF and DoD Guidance

The WFMP incorporates and adheres to DoD and AF policy by giving full consideration to the use of wildland fire as a natural process and as a tool in the land management planning process and by providing for the following:

- Wildfires, whether on or adjacent to lands administered by the AF, which threaten life, improvements, mission, or are determined to be a threat to riparian habitats and cultural resources under the AF's jurisdiction, will be considered emergencies and their suppression given priority over other AF programs. Fires that do not threaten these values will be allowed to burn to maximize ecological benefit to California annual grassland ecosystems.

- Installations shall cooperate in the development of interagency preparedness plans to ensure timely recognition of approaching critical wildfire situations, to establish processes for analyzing situations and establishing priorities, and for implementing management responses to these situations.
- Installations will enforce rules and regulations concerning the unauthorized ignition of wildfires, and aggressively pursue violations.

This WFMP addresses a full range of potential wildfires and considers a full spectrum of tactical options (from monitoring to intensive management actions) for wildfires in order to meet Fire Management Unit (FMU) objectives. It affirms these key elements of AFI interim policy:

- Firefighter and public safety is the first priority of the wildland fire management program and all associated activities.
- Only trained and qualified personnel will be responsible for, and conduct, wildfire management duties and operations.
- Fire management planning, preparedness, wildfire and prescribed fire operations, other hazardous fuels operations, monitoring, and research will be conducted on an interagency basis with involvement by all partners to the extent practicable.
- AFCEC/CZOF, in conjunction with the AFCEC/CZOW ISS and the BAFB NRM has coordinated, reviewed, and approved this WFMP with the installation to ensure consistency with approved land management plans, values to be protected, and natural and cultural resource management plans, and that it addresses public health issues related to smoke and air quality.
- Fire, as an ecological process, has been integrated into the INRMP and related resource management plans and activities on a landscape scale, across agency boundaries, based upon the best available science.
- Wildfire is used to meet identified resource management objectives and benefits when appropriate.
- Prescribed fire and other treatment types will be employed whenever they are the appropriate tool to reduce hazardous fuels and the associated risk of wildfire to human life, property, and cultural and natural resources and to manage our lands for habitats as mandated by statute, treaty, and other authorities.
- Management response to wildfire will consider firefighter and public safety, cost-effectiveness, values to protect, and natural and cultural resource objectives. Fires not threatening these values and when judged to be of value to natural resources will be allowed to burn to meet ecological objectives.
- Staff members will work with mission planners, local cooperators, and the public to prevent unauthorized ignition of wildfires on AF lands.

2.1.5 Installation Specific Fire Management Policy

Wildland fire management policy on BAFB is governed by the WFMP. No other installation-specific policy documents are currently in place.

2.2 Land & Resource Management Planning

2.2.1 Relationship to INRMP

The BAFB INRMP, approved October 2016, is the primary document directing natural resources activities on the installation. This document includes overarching natural resources management goals, as well as objectives and projects to support these goals. The INRMP is updated annually by the NRM and signed by the Base Civil Engineer (BCE) per AFI 32-7064. It is also re-signed by the United States Fish and Wildlife Service (USFWS), CDFW, and National Marine Fisheries Service (NMFS) every five years in compliance with the Sikes Act. The following goals, objectives, and projects relevant to fire and fuels management are taken directly from the INRMP; goals and objectives listed below will be updated annually as the INRMP is updated. The BAFB INRMP is currently undergoing a significant revision, to be signed in September 2018.

GOAL 3:	Protect and manage wetlands at BAFB in accordance with current laws, regulations, and mitigation obligations
Objective 3.1:	Preserve, restore, create, and monitor wetland areas
Project 3.1.2:	Minimize potential impacts on wetlands resulting from routine land management activities (e.g., firebreak disking, prescribed burning)

GOAL 6:	Enhance the visual quality of the base's developed areas through high-quality landscape design and development
Objective 6.5:	Minimize the risk of wildfire and its potential effects on base facilities and natural resources; pursue improvements to firebreak processes to enhance fire protection and natural resources protection
Project 6.5.1:	Continue to use a combination of firebreaks, mowing, and grazing to reduce the risk of damage from wildfire
Project 6.5.2:	Review firebreak maps and plans periodically
Project 6.5.3:	Look for ways to minimize the number of disked/plowed firebreaks needed to provide adequate fire safety
Project 6.5.4:	Use prescribed fire to reduce fuel loading in areas where it is compatible with smoke management or other guidelines
Project 6.5.5:	Increase use of prescribed grazing to provide firebreaks and to reduce fuel

GOAL 8: Manage rangeland vegetation to provide high quality forage on a sustainable basis and provide a healthy ecosystem

Objective 8.2: Coordinate grazing with prescribed burning to improve range conditions, promote desirable and native forage species, and reduce undesirable species

Project 8.2.1 Collaborate with Fire Department and Air Quality Manager to conduct prescribed burns to reduce fire load and improve forage in accordance with the Wildland Fire Management Plan

Overall goals of the INRMP include:

- Ensure compliance with applicable federal and state laws and regulations related to natural resource protection.
- Maintain/increase populations of special-status species, improve habitat conditions.
- Protect and manage wetlands at BAFB in accordance with current laws, regulations, and mitigation obligations.
- Minimize nonpoint sources of water pollution that result from land management activities.
- Improve management practices and enhance habitat for wildlife species on BAFB.
- Enhance the visual quality of the base's developed areas through high-quality landscape design and development.
- Maintain, enhance, and expand outdoor recreational opportunities at BAFB to serve the needs of the base population.
- Manage rangeland vegetation to provide high quality forage on a sustainable basis and provide a healthy ecosystem.
- Use digital spatial data for natural resources management decision making.
- Use prescribed fire as an ecological and landscape-level land management tool to control invasive species and provide a conservation benefit to federally listed species in vernal pool habitats.

2.2.2 Other Relevant Plans

In addition to this WFMP, the following component plans comprise the 2016 INRMP and are in place at BAFB. Work plans listed are found in Chapter 10 of the 2016 INRMP.

- Special Area Management Plan (SAMP) Programmatic Biological Opinion (PBO), 2011. Renewal due 2017.
- T&E Species Work Plan.
- Wetlands Work Plan.
- Watershed Protection and Water Quality Management Work Plan.
- Fish and Wildlife Management Work Plan.
- Grounds Maintenance and Land Management Work Plan.
- Outdoor Recreation and Public Access Work Plan.

- Agricultural Outleasing and Cropland Management Work Plan.
- Bird/Wildlife Aircraft Strike Hazard (BASH) Plan.
- Golf Environmental Management (GEM) Plan.
- Integrated Cultural Resources Management Plan (ICRMP).
- Integrated Pest Management Plan (IPMP).
- Invasive Species Management Plan (ISMP).
- Grazing Management Plan.

2.2.3 Environmental Compliance

The AF has procedures for assessing and analyzing the environmental effects of specific prescribed fire, fuels reduction and wildfire suppression rehabilitation actions. These procedures follow law, policy and regulations relating to the following:

- National Environmental Policy Act 1969 (42 U.S.C. §4321 et seq.).
- Endangered Species Act of 1973 (16 U.S.C. §1531 et seq.; ESA).
- National Historic Preservation Act of 1966 (54 U.S.C. §300101 et seq.; NHPA).
- Archeological Resources Protection Act of 1979 (16 U.S.C. §470 et seq.; ARPA).
- Native American Graves Protection and Repatriation Act (25 U.S.C. §3001 et seq.; NAGPRA).
- Executive Order 13175: Consultation and Coordination with Indian Tribal Governments (EO 13175).
- Clean Water Act of 1963 (33 U.S.C. §1251 et seq.).
- Clean Air Act of 1972 (42 U.S.C. Ch. 85, Subch. I §7401 et seq.).
- Bald and Golden Eagle Protection Act of 1940 (16 U.S.C. §668-668c).
- Migratory Bird Treaty Act of 1918 (16 U.S.C. §703 et seq.).
- Environmental Impact Analysis Process (32 CFR Part 989).
- Executive Order 13112: Invasive Species (EO 13112).
- California Environmental Quality Act of 1970 (Public Resources Code §21000 et seq.).
- Native Plant Protection Act of 1977 (Fish and Game §1900 et seq.).
- California Endangered Species Act of 1984 (Fish and Game §2050 et seq.; CESA).
- Smoke Management Guidelines for Agricultural and Prescribed Burning (17 California CR, Subch. 2).

These procedures call for site specific and interdisciplinary analysis of the effects of each action and require consultation with pertinent agencies, including but not limited to the USFWS, California Office of Historic Preservation (COHP), CDFW, California Environmental Protection Agency (CEPA), California Air Resources Board (CARB), Butte County Air Quality Management District (BCAQMD), Feather River Air Quality Management District (FRAQMD), Placer County

Air Pollution Control District (PCAPCD), CAL FIRE, and United States Army Corps of Engineers (USACE).

2.2.3.1 NEPA Compliance

The procedures and policy for performing an environmental impact analysis are documented in the 32 CFR Part 989. The AF uses Request for Environmental Impact Analysis (AF Form 813) to document the need for environmental analysis or for certain categorical exclusion (CATEX) determinations for proposed actions. This form is retained with the Environmental Assessment (EA) or Environmental Impact Statement (EIS). No existing NEPA documentation was available at the time of writing. However, a Programmatic Invasive Species EA is currently being prepared that covers invasive species, fire, and grazing management activities as tools for ecosystem management. It is currently being executed with a final expected Summer 2018. Consult with the installation NEPA Coordinator for more details.

All prescribed fires, mechanical fuels treatments and chemical fuels treatments must comply with NEPA requirements. Also, regardless of the NEPA type, all project NEPA copies need to be placed within the project documentation file. An EA is typically prepared for each Prescribed Fire Plan (PFP) unless the installation's approved WFMP or planning documents and the accompanying environmental document adequately discuss the action or a CATEX covers the activity.

At a minimum, NR projects including prescribed fire and mechanical fuels treatments will be proposed on Base Civil Engineering Work Request (AF Form 332) and evaluated by the installation NEPA manager to determine if more advanced environmental analysis is warranted.

NEPA analysis is not required for wildfires because wildfires are unplanned events. Suppression activities are covered by a CATEX from NEPA, though emergency ESA consultation will be conducted during or immediately following a wildfire if the wildfire or suppression actions could potentially impact a federally listed species. Minimizing potential smoke incursions into non-attainment areas will require aggressive suppression actions during periods of air quality alerts.

2.2.3.2 Air Quality

Individual PFPs will specify conditions required for burning that will minimize impacts to air quality from prescribed fire, including compliance with the requirements of state and local air quality regulatory agencies. Smoke management on BAFB and its GSUs will follow recommendations of the latest edition of the NWCG PMS 420-4/NFES 1279, *Smoke Management Guide for Prescribed Fire and Wildland Fire 2001 Edition*, December 2001 (PMS 420-4).

Smoke management in California is governed by CARB, who implements the guidelines found in 17 California CR, Subch. 2. The purpose of these guidelines is to provide direction to air pollution control and air quality management districts (air districts) in the regulation and control of agricultural burning, including prescribed fire, in California. These guidelines are intended to provide for the continuation of agricultural burning, including prescribed fire, as a resource management tool, and provide increased opportunities for prescribed fire and agricultural burning, while minimizing smoke impacts on the public. The regulatory actions called for are intended to assure that each air district has a program that meets air district and regional needs.

All prescribed fires require prior permission from the local air district. Permission is obtained by completing the following planning steps: 1) register the prescribed fire with the local air district; 2) obtain an air district and/or fire agency burn permit; 3) submit a Smoke Management Plan (SMP) to the air district; and 4) obtain air district approval of the SMP. Each air district has developed specific requirements for SMPs based upon §80160 of 17 California CR, Subch. 2.

All prescribed fires also require burn day authorization from the local air district and must be coordinated with the local air district, through the BAFB Environmental Compliance Manager (9 CES/CEIEC). Air districts for BAFB and its GSUs include FRAQMD (for BAFB), PCAPCD (for LCAS), and BCAQMD (for Oroville NEXRAD Site). Coordination with the air district will occur at least 5 days prior to the prescribed fire for weather considerations, the day prior to the prescribed fire for weather updates, and the morning of the prescribed fire to determine state allocated acreage for the area and the acreage that will be allocated by the air district.

2.2.3.3 ESA Consultation

Consultation under the ESA regarding wildfires is governed by ESA Section 7. Where fire suppression actions could potentially impact T&E species, as soon as practicable after a suppression action, the NRM will determine whether the action has caused any adverse impacts to T&E species or their habitat. Impacted areas include the burn area itself, firelines or firebreaks constructed, or aerially delivered retardant or foam applied within 300 feet of a waterway. If the NRM judges that there have been no adverse effects on T&E species or their habitat, there is no requirement for further consultation with USFWS or NMFS. If it is determined that there were adverse actions on T&E species or their habitat, the installation must consult with USFWS and NMFS as required by 50 CFR 402.05. In the case of an extended attack wildfire, emergency consultation should be initiated as soon as practical during the fire. Post-fire consultation is appropriate for initial attack wildfires. Mitigating actions required under Section 7 will be funded by Installation or EQ Operations and Maintenance (O&M) funding. For this reason, it is critical that T&E species locations be communicated to wildland fire managers so that suppression actions within their habitats can be avoided except to protect life safety.

Fuels treatment projects, including prescribed fires and mechanical fuels reduction, are subject to ESA Section 7 if they have the potential to impact T&E species or their habitat. Section 7 consultation with USFWS will be initiated by the NRM, who will provide information required in 50 CFR 402.14(c). The USFWS has developed design criteria for fuels treatment projects to streamline their approval process under Section 7. Design criteria are listed in a memorandum from the USFWS. As with wildfire suppression actions, avoidance of impacts to T&E species or their habitat should be a priority to avoid potentially costly mitigation of impacts requiring Installation or EQ O&M funds.

Chapter 3. Wildland Fire Management & Wildfire Risk Mitigation

3.1 Area Wide Management Considerations

3.1.1 Wildland Fire Management Goals, Strategies, and Guidance from INRMP or Similar Installation Plans

The overarching goal of the wildland fire management program at BAFB is firefighter and public safety during wildland fire events on the installation.

The WFMP is a stand-alone document that supports the BAFB INRMP which outlines management goals and strategies for this installation. This plan is meant to complement the INRMP and provide detailed land management procedures that are essential to achieving the ecosystem management goals outlined in the INRMP.

The BAFB INRMP, approved October 2016, is the primary document directing natural resources activities on the installation. This document includes overarching natural resources management goals and objectives and strategies to support these goals. The goals, objectives, and projects relevant to fire and fuels management found in the INRMP are discussed in Section 2.2.1.

The INRMP goals were formulated from a comprehensive analysis of regulatory requirements, the current condition of the natural resources on BAFB and a consideration of the value of these resources to the people who live and work on the installation. Chapter 8 of the INRMP identifies the specific objectives and projects that will be implemented to achieve each goal.

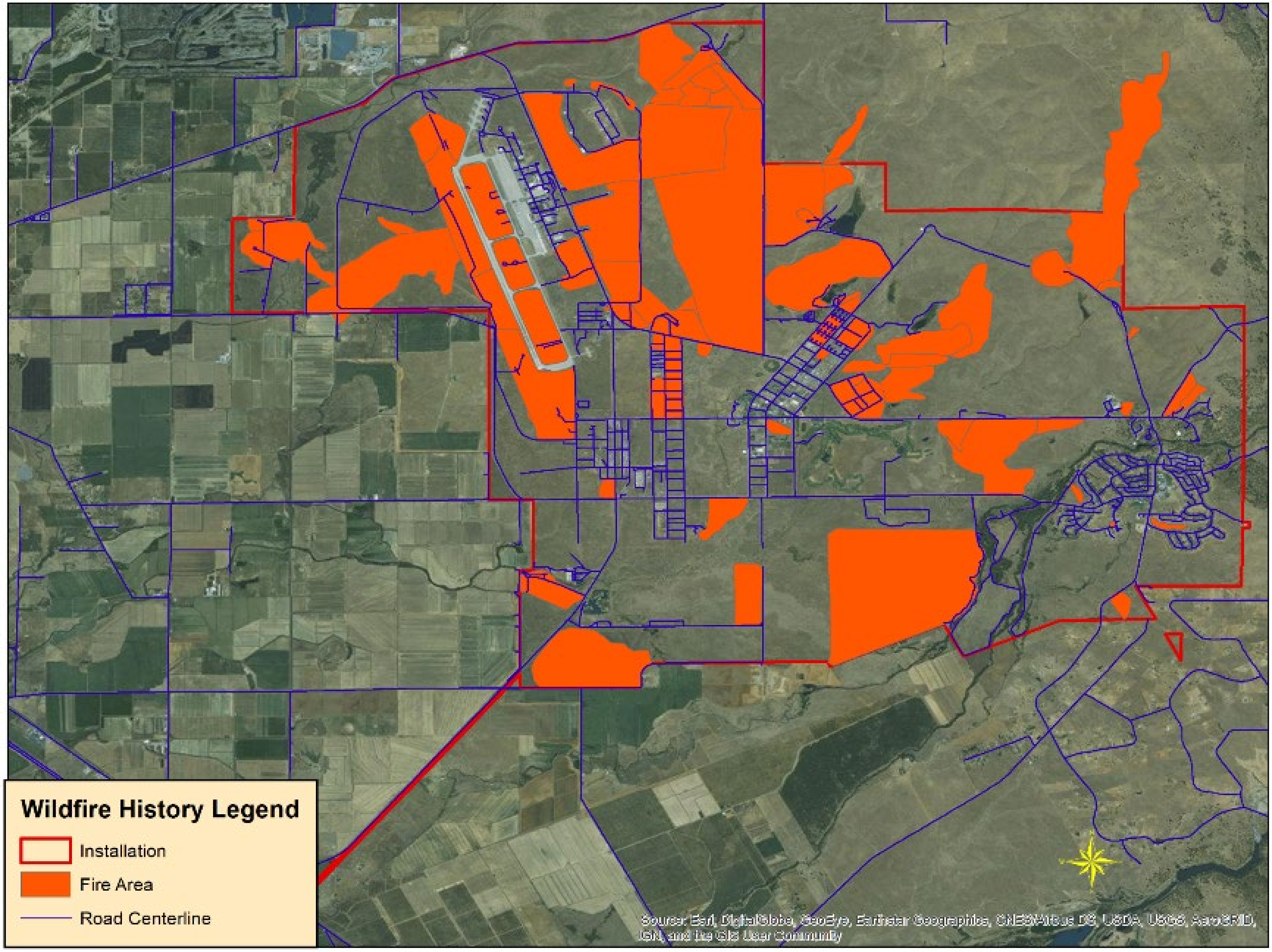
Objectives in the INRMP are multi-use with emphasis restoration and enhancement of native ecosystems and habitats. Many of the installation personnel, facilities, and operations would be adversely affected if a wildfire were to ignite within the natural areas and spread close to personnel, facilities, and operations. Otherwise, the burning of natural areas is not a threat to mission operations as the primary mission purpose of BAFB's natural areas are to provide safety/stand-off buffers to the flight mission. The smoke from a wildfire could compromise flightlines and the heat of the flames could threaten buildings and other strategic facilities with catastrophic results. Prescribed fire and alternate fuels reduction measures create a safer atmosphere for an undisturbed continuation of installation operations, and have the secondary benefit of restoring natural ecosystems and improving habitat for flora and fauna.

3.1.2 Wildfire and Prescribed Fire History

3.1.2.1 Wildfire History

Wildfires are a regular occurrence on BAFB. Records indicate that there were 131 wildfires from 4 September 1998 through 9 June 2015, although early records are spotty. During that same period, there were 15 potential wildfires accounting for 1,014 acres identified from satellite imagery, although some or all may have been prescribed fires. No records for wildfires on LCAS or Oroville NEXRAD Site were available. Details of known wildfires can be found in Appendix 3.1 and Figure 3.1. It should be noted that tabular data and GIS data conflicted, so fewer prescribed fires are depicted spatially in Figure 3.1 than are listed in Appendix 3.1.

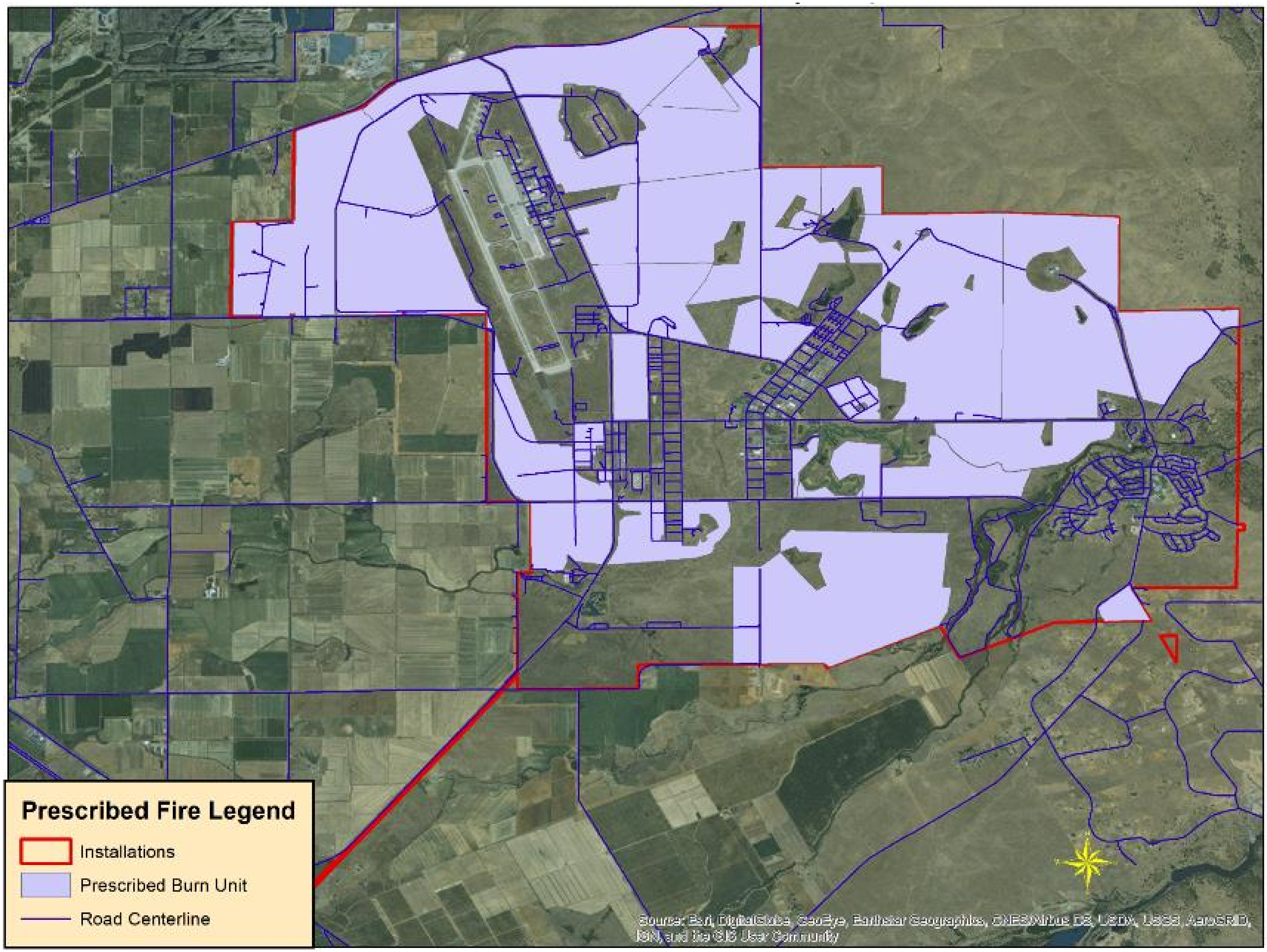
Figure 3.1: BAFB Wildfire History



3.1.2.2 Prescribed Fire History

BAFB has a strong prescribed fire program. Tabular and GIS data provided by the installation indicate that from 18 June 2001 through 27 July 2015, 70 prescribed fires were implemented at BAFB, although early records may be spotty. During that same period, there were 15 potential prescribed fires accounting for 1,014 acres identified from satellite imagery, although some or all may have been wildfires. Based upon these data, BAFB has averaged 4.7 prescribed fires (with a range from 1 to 18) and 622 acres treated (with a range from 7 acres to 1,043 acres) per year. No prescribed fires were recorded in 2016 or 2017. Despite this, prescribed fire acreage goals (1,500 acres per year) identified in Section 7.9 of the BAFB INRMP are not currently being met. All but 4 prescribed fires were completed during the months of May through September with June through September being the primary prescribed fire season, accounting for all but 8. Note that prescribed fire or wildfires that occur after June are limited in their ability to provide ecological benefit and thus meet natural resource management goals. Prescribed fire not conducted between approximately May and June, therefore, only meet hazardous fuel reduction (mission asset protection) goals. No records for prescribed fires on LCAS or Oroville NEXRAD Site were available. Details of known prescribed fires can be found in Appendix 3.2 and Figure 3.2. It should be noted that tabular data and GIS data conflicted, so fewer prescribed fires are depicted spatially in Figure 3.2 than are listed in Appendix 3.2.

Figure 3.2: BAFB Prescribed Fire History



3.2 Wildland Fire Management Partnerships

BAFB utilizes partnerships for both the implementation of fuels reduction activities, as laid out in the INRMP, and in the suppression and response to wildfire incidents. Without these partnerships, wildland fire could have the potential to hinder the overall objectives and mission of the installation.

3.2.1 Internal Partnerships

BAFB NR efforts are aided by the following partnerships within BAFB and the 9 RW:

- **Air Force Civil Engineering Center (AFCEC)** – provides technical expertise to assist base level natural resource management.
- **Air Force Safety Center (AFSEC/SEFW)** – assists and advises on safety matters to maintain compliance with Federal and Department of Defense regulations.
- **Air Force Wildland Fire Branch (AFCEC/CZOF)** – provides technical and operational support to installations for a wide range of wildland fire related products and services.
- **BAFB Civil Engineering Services (CES)** – provides heavy equipment for firebreak construction and maintenance, as well as fireline construction during wildfires.
- **BAFB Fire and Emergency Services (FES)** – provides incident command and primary wildland firefighting response force.
- **BAFB Legal Services (JAG)** – provides professional legal support and advice to command and other staff agencies on a variety of issues including military justice, contracts, labor, environmental and operations law.
- **BAFB Mission Support Group (MSG)** – provides support to the nation's air power.
- **BAFB NR Office** – provide the input, data and support needed to maintain a high-quality NR program.
- **BAFB NR Manager (NRM)** – responsible for steering the natural resources program through the collection and interpretation of data, adjusting management practices, building community partnerships, briefing leadership, and generally ensuring the base natural resources continue to support the military mission. Ensures AF compliance with federal natural resources laws and regulations.
- **BAFB Public Affairs Office (9 RW/PA)** – interfaces between 9 RW, the media, and civilian groups to disseminate environmental and educational information.
- **Installation Support Section (ISS) Staff** – AFCEC personnel who provide support to base level natural resources management through expert advice and management recommendations, as well as the evaluation and support of projects developed to directly support natural resource management.

3.2.2 External Partnerships

BAFB has partnerships with external partners to provide guidance for natural resource and wildland fire activities on BAFB, including:

- **California Department of Fish and Wildlife (CDFW)** – a state agency responsible for providing oversight of fish and wildlife management within the state of California.
- **Fire Departments (FDs)** – provide mutual aid for wildfire response and suppression.
- **National Oceanographic and Atmospheric Administration (NOAA)** – a federal agency responsible for providing weather forecasts during wildfires and prior to prescribed fires.
- **NOAA National Marine Fisheries Service (NMFS)** – a federal agency responsible for ensuring the resiliency of marine ecosystems and coastal communities.
- **United States Army Corps of Engineers (USACE)** – a federal agency responsible for permitting and management of activities involving riparian areas.
- **U.S. Department of Agriculture (USDA) Wildlife Services** – provides technical assistance regarding BASH and wildlife issues.
- **USDA Natural Resources Conservation Service (NRCS)** – provides technical assistance for natural resources and agricultural processes.
- **U.S. Fish and Wildlife Service (USFWS)** – a federal agency providing oversight and guidance for natural resources activities that have a potential to affect terrestrial and select marine resources, especially those protected under the ESA. Under the Sikes Act, coordinates with DoD installations on the preparation of INRMPs.

3.3 Wildfire Prevention

3.3.1 Wildfire Occurrence

According to records from 131 wildfires between 4 September 1998 and 9 June 2015, most wildfires occurred between May and September with only 17 documented outside of that range and only 5 documented outside of an April to October time period. Nearly half (59) of the wildfires had an unknown cause. Of those with known causes, wildfires started by powerlines (34) were most common, followed by AF mission (12), miscellaneous (12), cigarette (9), escaped prescribed fire (3), Army mission (1), and fireworks (1). The EOD area is responsible for frequent wildfires.

The BAFB Type 3 Wildfire Risk Assessment (see Appendix 3.3) analyzed 80 wildfires between 2008 and 2013 and found that most wildfire starts were associated with civilian causes, based upon their proximity to the family housing area and roads with all military training and powerlines as secondary hazards. Most wildfire starts occurred between 1200 and 1800 with a peak around 1400. Average fire size was 31 acres with a maximum size of 2,753 acres.

3.3.2 Prevention Activities

The primary objective of Prevention Activities is to prevent human-caused fires and encourage installation personnel to implement mitigation measures around at-risk AF assets.

This objective is primarily achieved by:

- Making personnel aware of precautions to prevent an unwanted ignition.
- Informing visitors of fire danger through personal contact and posted signs.
- Implementing trail and/or area closures during periods of extreme fire danger.
- Coordinating with internal and external partners during periods of extreme fire danger.

Prevention Program Goals are to:

- Reduce the likelihood of both human-caused and naturally-ignited wildfires.
- Decrease the frequency of human-caused wildfires.
- Reduce emergency suppression costs.
- Reduce fire size and intensity by developing programs such as fuels reduction/modification.
- Establish a cost-effective prevention program.
- Integrate and coordinate prevention program with local installation FD, CAL FIRE, nearby land management agencies, and wildfire protection organizations.
- Promote the creation of incentives for building and maintaining fire-safe structures and fire-safe communities to reduce the unwanted consequences of fire.
- Minimize damage from wildfires.
- Incorporate prevention programs into the wildland fire management outreach program.

Prevention priorities of the installation are to:

- Prevent catastrophic fires and human-caused wildfires (highest priority).
- Minimize losses from wildfire while considering resource management objectives.
- Collaborate through an interagency approach among all federal, state, county, and municipal agencies/entities.
- Investigate human-caused wildfires.

Specific prevention activities include:

- Cross-training with local agencies.
- Posting current fire behavior and danger levels to local message boards.
- Educating youth of the dangers pertaining to playing with lighters or other fire-causing items.
- Performing fuels mitigation/reduction.

- Informing military commanders of current fire danger while utilizing training ranges.
- Closing of ranges and trails that are at a high risk for wildfire.
- Restricting outdoor activities such as open fires and fireworks use when fire danger is elevated.
- Maintaining equipment, such as vehicles, Personal Protective Equipment (PPE), tools, All-Terrain Vehicles (ATVs) and/or Utility Task Vehicles (UTVs), radio communications, etc. to be effective and successful in suppression efforts.

As described in Section 2.9 of AFI 32-7064, fire and other disturbance regimes may be used as a component to ecosystem management when practical and consistent with the military mission. Prescribed fires reduce fuel load in an area, making subsequent wildfire breakouts easier to control or preventing them completely. Prescribed fire can also be a useful tool for habitat management and restoring vegetation to a more historical state, as well as to manage fuels near the airfield in order to reduce BASH concerns.

3.4 Public Information, Education, and Outreach

The outreach goal is to enhance knowledge and understanding of wildland fire management policies and practices through internal and external communication and education. Information about fire ecology and the differences between planned and unplanned ignitions will be incorporated into outreach programs and informal contacts. Information and education are critical to increasing support for prescribed fires. Wildfire prevention centers around education and awareness. Education begins with schools teaching children about the detriments of wildfire and fire safety. Prescribed fire classes for interested landowners can be used to reduce the chance of an escaped fire on adjacent land.

Signs indicating current fire danger can be placed in high traffic areas to warn local residents and installation personnel when fire danger is high. Local television news channels can be contacted as to when to mention fire danger warnings to the public and to publicize prescribed fire activities on the installation.

Integrated education and outreach activities are considered a standard component of any comprehensive WFMP, and decreasing human caused ignitions that could result in a catastrophic wildfire is a directive from AFCEC and AFCEC/CZOF. Educating the public adjacent to installations about the need for responsible prescribed fire utilization as a land management tool is essential to developing and maintaining Fire Adapted Communities (FACs) per the National Cohesive Strategy.

Communication and cooperation with the public is a critical component of any natural resources management effort. The goal of public outreach efforts is to encourage understanding of, support for, and involvement in the many management and monitoring programs at BAFB. Without the support of partner organizations and local citizens, it becomes very difficult to run effective management programs. Outreach is accomplished through:

- Research partnerships and internships.
- Presentations and guided tours.
- Volunteer involvement.

Currently there are no known wildland fire-specific outreach programs on BAFB aside from newspaper publication of summer activity restrictions involving open fires and fireworks use. Existing public outreach programs where a wildland fire message could easily be integrated include:

- Earth Week.
- National Public Lands Day.
- Natural resources awareness programs on the installation.
- Tours and classes with local colleges and elementary schools.
- Hunter briefings.
- Brochures, posters, videos and other natural resources program educational materials.

Community involvement from installation personnel will include dissemination of information to the public on well-established national interagency wildland fire prevention and mitigation programs such as *Firewise*, *Fire Adapted Communities*, and *Ready, Set, Go!* The directive for community assistance as part of a comprehensive wildland fire management program has been set forth by AFCEC and AFCEC/CZOF, in support of the National Cohesive Strategy.

During a wildfire, it is the responsibility of the IC to make initial and periodic status updates to 9 RW/PA as needed. This will be done through a Public Information Officer (PIO), if one is assigned to the incident. The information will include current and predicted fire behavior, rates of spread, fire impact or threat to installation activates or infrastructure, detours, or other pertinent public safety information.

When planning for prescribed fires, an approved notification list will be developed prior to ignition, and residences near the prescribed fire area will be notified in advance by phone or other media sources (i.e. newspapers, television, radio stations, message boards, etc.). The BAFB WFPC will notify the 9 RW/PA whenever there is a wildfire or prescribed fire in progress.

3.5 Wildland Fire Management Units (FMUs)

FMUs are areas defined by similar overall strategic fire management objectives with consideration for specific (or dominant) constraints, requirements, and guidelines for implementation. Unique characteristics (such as fuels, topography, and natural resources concerns) are also considered and depicted graphically when appropriate.

3.5.1 Common Characteristics of Wildland FMUs

3.5.1.1 Climate

The regional climate is influenced by its location in an interior valley between the Coast Range and the Sierra Nevada Range. Because it is located inland from the Pacific Ocean, the valley experiences warm summers and cool winters. Summer high temperatures can be extreme, reaching as high as 113°F and persisting above 100°F for many days at a time. The year-round average high temperature is 74°F, whereas the year-round average low temperature is 50°F. The hottest and driest month of the year, with the highest temperature ever recorded at BAFB (113°F), is July. From May through October, 100-degree days can be experienced, though most occur late June through September. The relative humidity (RH) is variable, with the average annual RH being 61%.

The mean annual precipitation at BAFB is 22.16 inches, with almost 95% of all rainfall occurring from October through April. Annual precipitation in California has fluctuated widely over the past decade.

Winds at BAFB are channeled by the topography of the Sacramento Valley, with the prevailing wind direction at the base being south-southeast. The average wind speed is 5 knots and the maximum annual gust is 77 knots. Table 3.1 provides a summary of the monthly and annual weather characteristics for BAFB.

Table 3.1: Monthly and Annual Weather Characteristics for BAFB

BEALE AFB CLIMATOLOGY

Period of Record JUL 59-MAY 08

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANN
TEMPERATURE (F)													
EXTREME MAX	78	80	85	96	104	112	113	112	109	104	87	77	113
MEAN DAILY MAX	55	61	66	72	81	90	96	94	89	80	65	55	75
MEAN DAILY MIN	40	44	46	49	55	61	65	63	60	54	46	41	52
EXTREME MIN	22	21	26	32	37	44	50	49	42	35	26	16	16
PRECIPITATION (INCHES)													
MAXIMUM	11.2	12.0	9.4	5.9	4.0	1.4	1.9	1.0	2.7	11.0	8.9	10.3	38.5
MEAN	4.3	3.9	3.2	1.7	0.7	0.2	#	0.1	0.3	1.2	3.4	3.3	22.3
MINIMUM	0.1	0.1	0.2	#	0	0	0	0	0	0	#	0	8.4
MAX 24 HR	3.1	3.5	2.5	2.4	1.5	0.7	1.8	1.0	2.0	5.5	3.2	3.7	5.5
# DAYS GE TRACE	14	12	11	8	5	3	1	1	3	5	10	13	85
SNOWFALL (INCHES)													
MEAN	#	#	#	0	0	0	0	0	0	0	0	#	#
MAXIMUM	0.6	0.4	#	0	0	0	0	0	0	0	0	1.5	1.5
MAX 24 HR	0.6	0.4	#	0	0	0	0	0	0	0	0	1.5	1.5
MEAN RELATIVE HUMIDITY (%)													
RH (5 LST)	88	84	82	80	75	70	67	68	68	73	82	86	77
RH (16 LST)	71	60	52	42	33	28	24	25	28	36	56	69	44
SURFACE WINDS KTS													
PVLG DRCTN	SSE	SSE	SSE	SSE	S	S	S	S	S	S	SSE	SSE	S
MEAN SPEED	10	11	9	9	7	7	7	6	6	6	9	10	8
MAX PEAK GUST	54	54	56	46	37	40	33	30	42	48	56	77	77
MEAN CLOUD COVER (8THS) / THUNDERSTORMS / FOG													
CLD COVER	5	5	4	4	3	2	1	1	2	3	4	5	3
DAYS TSTMS	#	1	1	1	1	1	#	#	#	1	#	#	7
DAYS FOG LT 7*	19	11	6	3	1	1	#	#	1	3	12	18	75

The climatic zone for LCAS is Mediterranean subtropical. LCAS is on the border between the cold-air basins zone of California's Central Valley and the thermal belt zone of California's Central Valley. The difference between these 2 zones is that cold air from the thermal belts zone flows into the cold air basins (low spots) zone.

LCAS has 2 seasons: a dry season lasting from May through October, and a wet season lasting from November through April. The dry season is characterized by very low precipitation, warm temperatures averaging 71.4°F, and a dry landscape. The wet season is characterized by sometimes piercing northern winds and gusting southern winds, moderate precipitation, cool temperatures averaging 51.7°F, cloud cover and tule fog, and vernal pools. The first average date of freezing temperature is the first week in December, and the last average date of freezing temperature is the first week of March. Freezing temperatures rarely last than more a few nights at a time. Total rainfall for the year averages 19.5 inches.

The climate at Oroville NEXRAD Site is similar to that at BAFB.

According to the EPA 430-F-16-007, *What Climate Change means for California*, August 2016, the average temperature in the northern Sacramento Valley has risen 1°F to 1.5°F in the last century. Climate change may result in altered fire regimes in California. Higher temperatures and drought are likely to increase the severity, frequency, and extent of wildfires, which could harm property, livelihoods, and human health. Increased wildfire smoke can reduce air quality and increase medical visits for chest pains, respiratory problems, and heart problems. Climate change may have effects on annual grasslands. Increasing late spring moisture may increase the abundance and productivity of non-native annuals that thrive through late summer, including medusahead (*Taeniatherum caput-medusae*) and barbed goatgrass (*Aegilops triuncialis*), and non-native forbs like yellow star-thistle (Eskelinen & Harrison 2014; Eviner 2014).. Overall, grassland species are largely adapted to seasonal summer drought characteristic of Mediterranean climates, but all grassland components are vulnerable to prolonged or severe drought (Reever Morghan et al. 2007). Warm spring temperatures typically increase annual grass growth rates and will likely favor increased exotic dominance in the future (Sandel & Dangremond 2012).

3.5.1.2 Topography

The western and central portions of BAFB (which include the airfield and main base areas) consist of relatively flat grasslands, characteristic of the topography of the Central Valley. The eastern portion of the base (containing the family housing area) contains low, rolling hills that gradually merge with the foothills of the Sierra Nevada. The elevation of BAFB ranges from 80-90 feet above Mean Sea Level (MSL; National Geodetic Vertical Datum of 1929) along the western and southern boundary, toward the Central Valley, to more than 600 feet in the northeastern part of the base towards the Sierra Nevada foothills.

The topography of the LCAS is essentially level, with some shallow depressions and 1 drainage swale trending from south-southwest to north-northeast within the southeast area of the property. Markham Ravine is located 1 mile to the north, and Auburn Ravine is located 1/2 mile to the south. The elevation of the site ranges between 84-95 feet above sea level. Surface drainage primarily flows toward the onsite swale.

The Oroville NEXRAD Site is a level pavement in a mostly level semi-developed area.

3.5.1.3 Public Use

Access to BAFB and recreational facilities on base is permitted on a controlled basis. Only DoD personnel and their dependents have open access to BAFB opportunities. When accompanied by an authorized host, guests may be permitted access to the base. The general public is permitted on the base for special events (e.g., Earth Day activities) and special arrangements may be made for certain groups (e.g., Boy Scouts, student groups) to utilize the recreational facilities and outdoor recreation areas. There is no access to LCAS or Oroville NEXRAD Site for public use.

3.5.1.4 Access

The main access to BAFB from the nearest large city (Marysville, California) is by taking State Route 65 south, turning east on South Beale Road, and continuing northeast and through the security checkpoint near the southwest corner of the installation. In addition, there are 3 other checkpoints. One is just south of the family housing area and can be accessed by taking Camp Beale Highway (also called Spenceville Road) to the northeast from Wheatland, California and through the security checkpoint. Another is just west of the airfield and can be accessed by taking North Beale Road east from Linda, California and through the security checkpoint. The third is just northeast of the airfield and can be accessed by taking Hammonton Smartville Road northeast from Linda California, turning southeast on Doolittle Drive, and continuing southeast and through the security checkpoint. The nearest airport with commercial service is SMF.

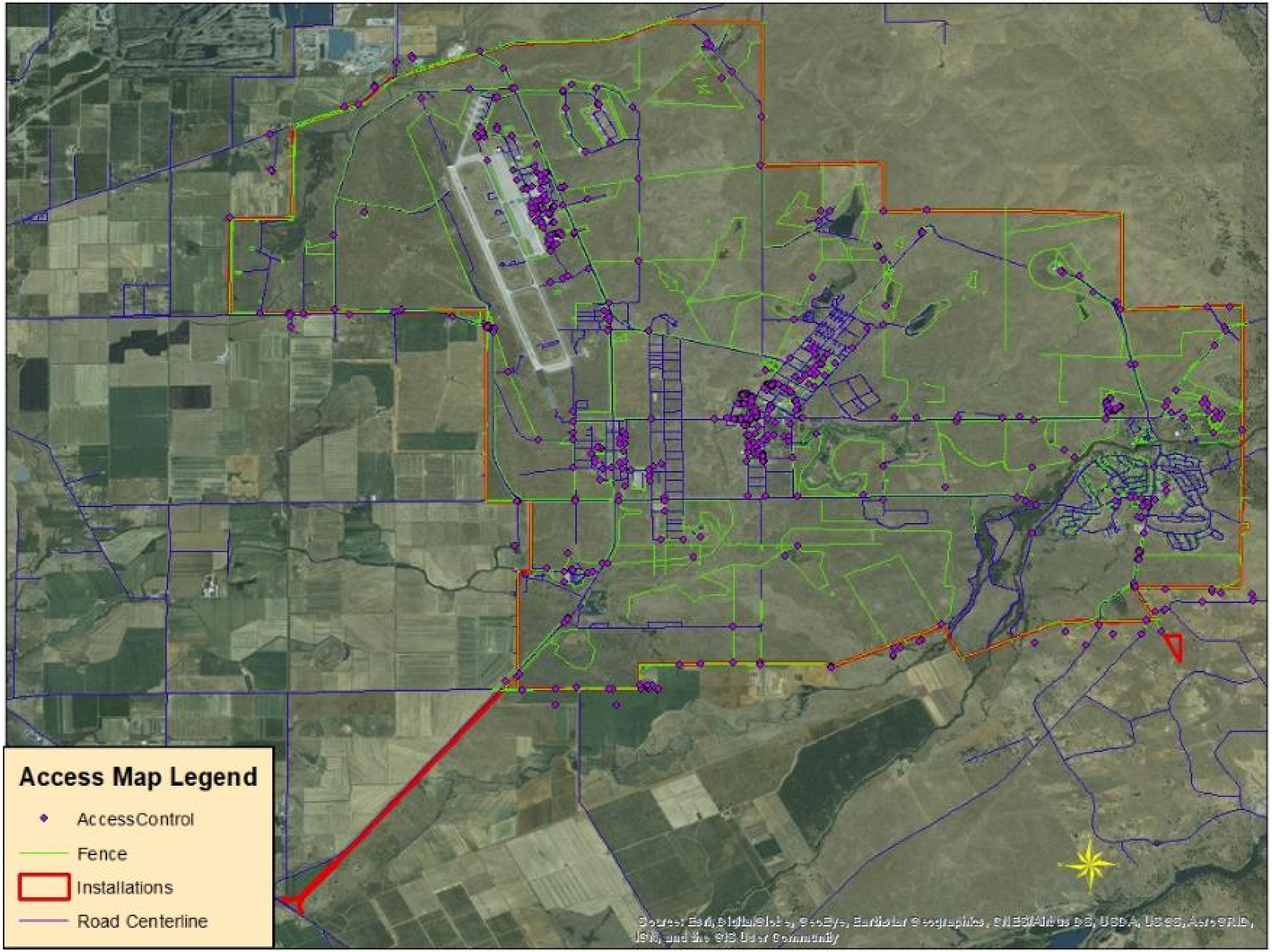
Access to LCAS from the nearest city (Lincoln, California) is by taking State Route 65 south, Ferrari Ranch Road west, Sorrento Parkway north, and Moore Road west. LCAS is on the north side of Moore Road. The nearest airport with commercial service is SMF.

Access to Oroville NEXRAD Site from the nearest city (Oroville, California) is by taking State Route 162 west. The Oroville NEXRAD Site is on the south side of State Highway 162. The nearest airport with commercial service is SMF.

The gentle slopes that characterize the topography of BAFB and its GSUs, for the most part, allow for good access throughout the installation, including off-road. There are some creeks and vernal pools that will limit access by vehicles and mechanized equipment to portions of the BAFB and LCAS.

An access map for BAFB can be found in Figure 3.3.

Figure 3.3: BAFB Access Map



3.5.1.5 Vegetation

An area's Biophysical Setting (BpS) represents the vegetation that may have been dominant on the landscape prior to Euro-American settlement and is based upon both the current biophysical environment and an approximation of the historical disturbance regime. While there is no way to go back in time and ground-truth the accuracy of the predicted BpSs, it can be a convenient way to describe the historical conditions that most likely existed in an area. It can also provide a basis upon which to compare present day conditions. According to data available at the LANDFIRE Data Distribution webpage, BAFB likely contained 4 dominant BpSs historically while LCAS likely contained 2. Maps of current vegetation for BAFB and LCAS can be found in Figure 3.4 and Figure 3.5, respectively. Oroville NEXRAD Site has been completely paved. Additional information on the vegetation types found on BAFB can be found in Section 2.3.2 of the 2016 INRMP.

Annual grasslands dominate the vegetation of BAFB, covering 18,835 acres of land on BAFB and 231 acres at the Lincoln Receiver Site. Small isolated groves of oak woodlands and isolated riparian areas are also found on the installation. A list of special status plant species that occur or have the potential to occur on BAFB can be found in Table 6 of Section 2.3.2.2 of the 2016 INRMP.

Figure 3.4: BAFB Vegetation Map

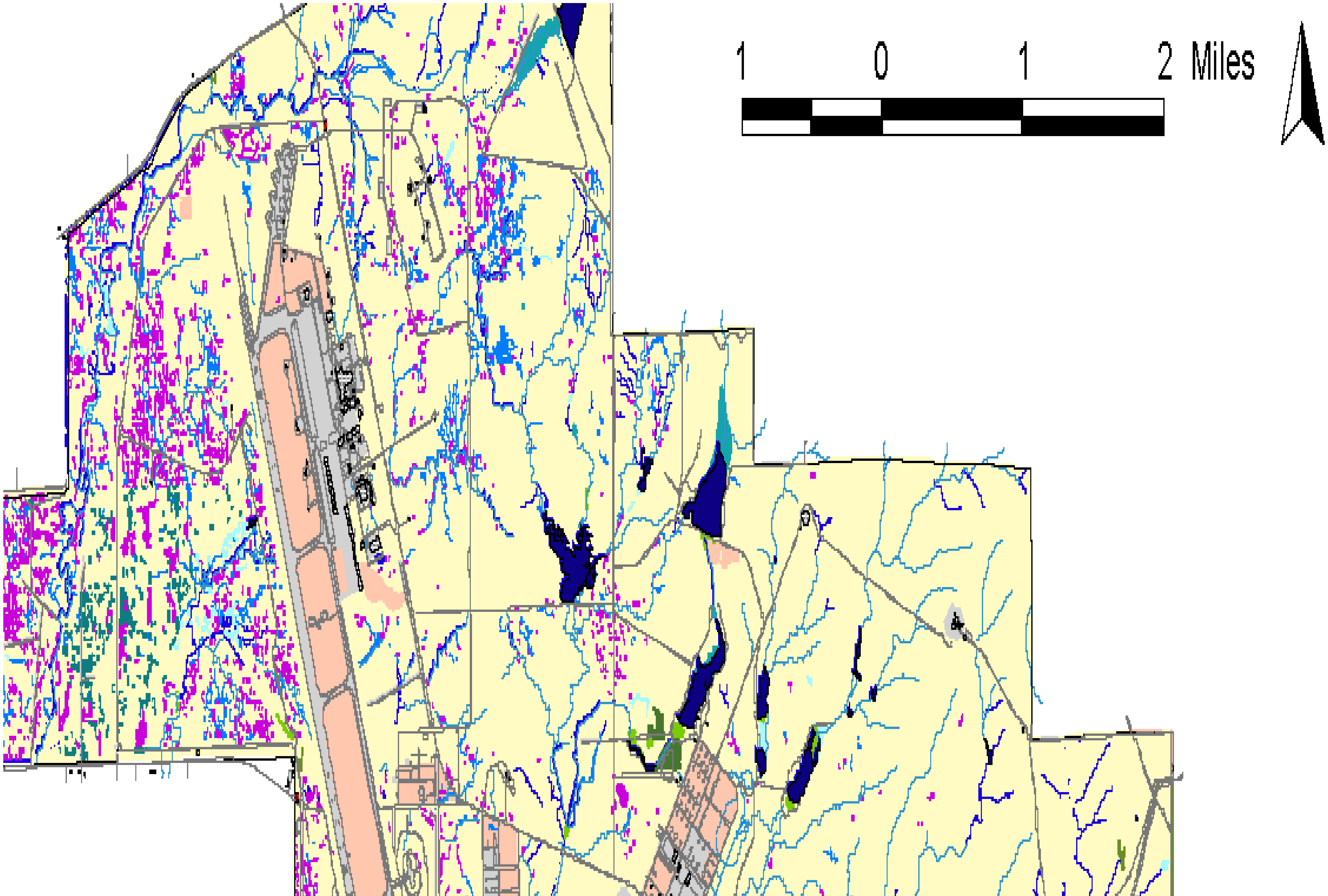
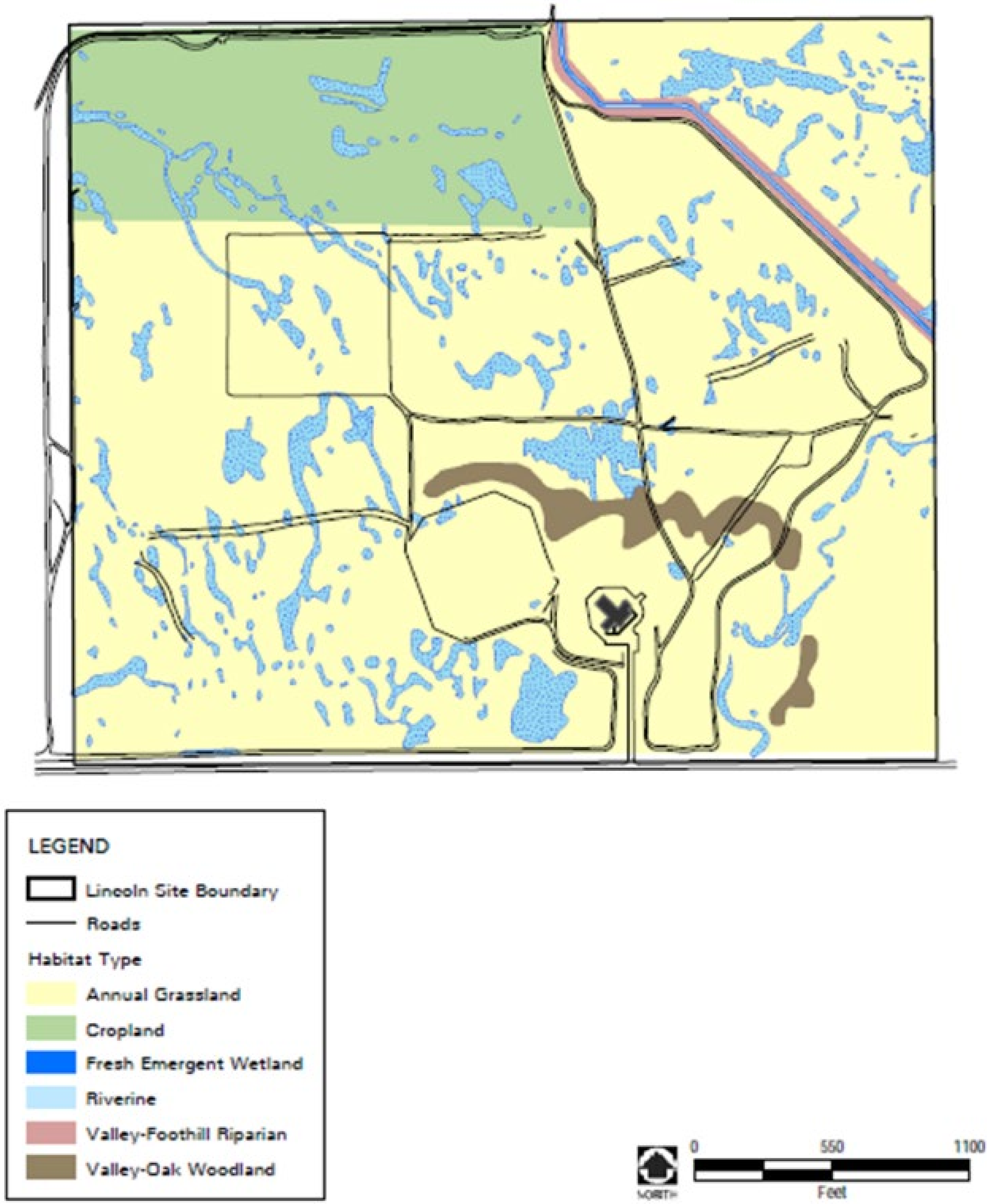


Figure 3.5: LCAS Vegetation Map



3.5.1.6 Fuel Conditions

The BAFB Type 3 Wildfire Risk Assessment (see Appendix 3.3) identified 13 burnable Fire Behavior Fuel Models (FBFMs). Of these, 5 account for at least 0.1% of the total land area of BAFB. These will be described below. FBFMs follow *Standard Fire Behavior Fuel Models: A Comprehensive Set for Use with Rothermel's Surface Fire Spread Model*, 2005. The fuel at LCAS is much more uniform and can likely be characterized by the SH3 fuel model and the custom fuel model described below. Fuels on Oroville NEXRAD Site are unburnable, but adjacent fuels are grasses similar to the custom fuel model described below.

3.5.1.6.1 GR1 (101) – Short, Sparse Dry Climate Grass (Dynamic):

The primary carrier of fire in GR1 is sparse grass, though small amounts of fine dead fuel may be present. The grass in GR1 is generally short, either naturally or by grazing, and may be sparse or discontinuous. The moisture of extinction of GR1 is indicative of a dry climate fuelbed, but GR1 may also be applied in high-extinction moisture fuelbeds because in both cases predicted spread rate and flame length are low compared to other grass fuel models. This accounts for about 385 acres or 1.66% of the total area of BAFB. Locations where GR1 (fuel model number 101) is present on BAFB can be found in figure 6 of the BAFB Type 3 Wildfire Risk Assessment (see Appendix 3.3).

3.5.1.6.2 GR3 (103) – Low Load, Very Coarse, Humid Climate Grass (Dynamic):

The primary carrier of fire in GR3 is continuous, coarse, humid-climate grass. Grass and herb fuel load is relatively light. Fuelbed depth is about 2 feet. Shrubs are not present in significant quantity to affect fire behavior. This accounts for about 26 acres or 0.11% of the total area of BAFB. Locations where GR3 (fuel model number 103) is present on BAFB can be found in figure 6 of the BAFB Type 3 Wildfire Risk Assessment (see Appendix 3.3).

3.5.1.6.3 SH3 (143) – Moderate Load, Humid Climate Shrub:

The primary carrier of fire in SH3 is woody shrubs and shrub litter. It has a moderate shrub load, possibly with pine overstory or herbaceous fuel. Fuel bed depth is 2 to 3 feet. Spread rate is low. Flame length low. This accounts for about 70 acres or 0.30% of the total area of BAFB. The majority of oak woodlands on BAFB are represented by this FBFM. It is assumed that this is also the representative FBFM where oak woodlands exist on LCAS. Locations where SH3 (fuel model number 143) is present on BAFB can be found in figure 6 of the BAFB Type 3 Wildfire Risk Assessment (see Appendix 3.3).

3.5.1.6.4 TL6 (186) – Moderate Load, Humid Climate Shrub:

The primary carrier of fire in TL6 is moderate load broadleaf litter, less compact than TL2. Spread rate is moderate. Flame length is low. This accounts for about 123 acres or 0.53% of the total area of BAFB. The majority of riparian woodlands on BAFB are represented by this FBFM. Locations where TL6 (fuel model number 186) is present on BAFB can be found in figure 6 of the BAFB Type 3 Wildfire Risk Assessment (see Appendix 3.3).

3.5.1.6.5 Custom Fuel Model (21):

The BAFB Type 3 Wildfire Risk Assessment (see Appendix 3.3) developed a custom fuel model to describe fuels present in most grasslands on BAFB because existing FBFMs tend to over-predict fire spread rates. The primary carrier of fire in the custom fuel model is dormant short grass. Unlike the other grassland FBFMs this is a static fuel model, meaning that it will overestimate fire behavior when fuel is not dormant. This, however, is likely to be the case only for 2-3 months out of the year. This accounts for about 19,082 acres or 82.43% of the total area of BAFB. The majority of grasslands on BAFB are represented by this FBFM. It is assumed that this is also the representative FBFM where grasslands exist on LCAS. Locations where the custom fuel model (fuel model number 21) is present on BAFB can be found in figure 6 of the BAFB Type 3 Wildfire Risk Assessment (see Appendix 3.3).

3.5.1.6.6 Other Fuel Models:

Eight other FBFMs accounted for about 68 acres or 0.30% of the total area of BAFB, and included the following:

- SH1 (141) – Low Load Dry Climate Shrub (Dynamic); ~7 acres, 0.03%.
- SH5 (145) – High Load, Dry Climate Shrub; ~20 acres, 0.09%.
- SH7 (147) – Very High Load, Dry Climate Shrub; ~2 acres, 0.01%.
- TU2 (162) – Moderate Load, Humid Climate Timber-Shrub; ~2 acres, 0.01%.
- TL2 (182) – Low Load Broadleaf Litter; ~8 acres, 0.03%.
- TL3 (183) – Moderate Load Conifer Litter; ~7 acres, 0.03%.
- TL4 (184) – Small Downed Logs; ~2 acres, 0.01%.
- TL8 (188) – Long-Needle Litter; ~21 acres, 0.09%.

Locations where these other fuel models (fuel model numbers 141, 145, 147, 162, 182, 183, 184, and 188) are present on BAFB can be found in figure 6 of the BAFB Type 3 Wildfire Risk Assessment (see Appendix 3.3).

3.5.1.6.7 Unburnable Fuel Models:

Eight unburnable FBFMs, including 4 custom FBFMs designed to allow fire to burn across roads during modelling of certain circumstances, accounted for about 3,395 acres or 14.67% of the total area of BAFB, and included the following:

- Custom (60) – Custom Road Model; ~340 acres, 1.47%.
- Custom (61) – Custom Road Model; ~493 acres, 2.13%.
- Custom (62) – Custom Road Model; ~1,394 acres, 6.02%.
- Custom (63) – Custom Road Model; ~59 acres, 0.26%.

- NB1 (91) – Urban/Developed; ~329 acres, 1.42%.
- NB3 (93) – Agricultural; ~31 acres, 0.13%.
- NB8 (98) – Open Water; ~127 acres, 0.55%.
- NB9 (99) – Bare Ground; ~622 acres, 2.69%.

Locations where these unburnable fuel models (fuel model numbers 60, 61, 62, 63, 91, 93, 98, and 99) are present on BAFB can be found in figure 6 of the BAFB Type 3 Wildfire Risk Assessment (see Appendix 3.3).

3.5.1.7 Soils

There are a variety of soil types on BAFB that can be grouped into 2 main categories: Central Valley Terraces and Sierra Nevada Foothill. The main base and airfield areas are on the Central Valley Terraces soils. The family housing area is on Sierra Nevada Foothill soils. The soils at BAFB, due to a high clay content and an underlying hardpan become so soft during the winter time that even small ATVs get stuck off road. The Central Valley Terraces soils have a slow permeability, a shallow rooting depth, are droughty, and have a slope of 0-3%. They favor annual grasses and forbs. It is these soils that facilitate the formation of vernal pools. The Sierra Nevada Foothill soils are good for wildlife habitat and livestock grazing. They favor native oaks, shrubs, forbs and annual grasses. Restrictions are soil depth (highly variable), slope (3-75%), and water erosion. A more complete description of soils can be found in the INRMP. Soils on LCAS are of a sandy loam texture. There are no exposed soils at Oroville NEXRAD Site, as it is entirely paved.

3.5.1.8 Wildlife

Fire management is expected to have little negative impacts on wildlife. Primary concerns surround the potential for operations to have deleterious effects on vernal pool, riparian woodland, and oak woodland habitats. Fireline construction (handlines, scraped firebreaks, etc.) will avoid all sensitive habitats and active wildlife dens. Any prescribed fire units that contain nesting wildlife species will be surveyed prior to burning to ensure the nests are not active. If active nests are found, the NRM will be notified and will determine the appropriate mitigation action. A more complete description of wildlife can be found in the INRMP.

A list of special status wildlife species that occur or have the potential to occur on BAFB or LCAS can be found in Table 7 of Section 2.3.4 of the INRMP. Because it is entirely paved, any wildlife present at Oroville NEXRAD Site will be considered incidental.

3.5.2 FMUs – Specific Descriptions

3.5.2.1 Wildland FMU Description

The FMUs of BAFB and its GSUs are based primarily on the presence or absence of development and the primary response strategy. FMU 1 consists of the undeveloped areas of

BAFB (areas designated as Fire Response District (FRD) 4 in the 2015 WFMP that is located on page A6-216 of the 2016 INRMP) and all of LCAS. FMU 2 consists of the developed areas of BAFB (FRDs 1-3). FMU 3 consists Oroville NEXRAD Site.

3.5.2.1.1 FMU 1: BAFB FRD4 and LCAS

FMU 1 consists of the undeveloped areas of BAFB, areas considered FRD 4 by FES, along with all of LCAS (see Figure 3.6 and Figure 3.7). FMU 1 makes up the majority of BAFB, accounting for about 15,000 acres. Grasslands, oak woodlands, riparian woodlands, and vernal pools are present within FMU 1. While some improvements exist within FMU 1, the majority is open country with few values to protect. Prescribed fire is recommended in FMU 1.

Figure 3.6: BAFB FMU 1 and 2 Map

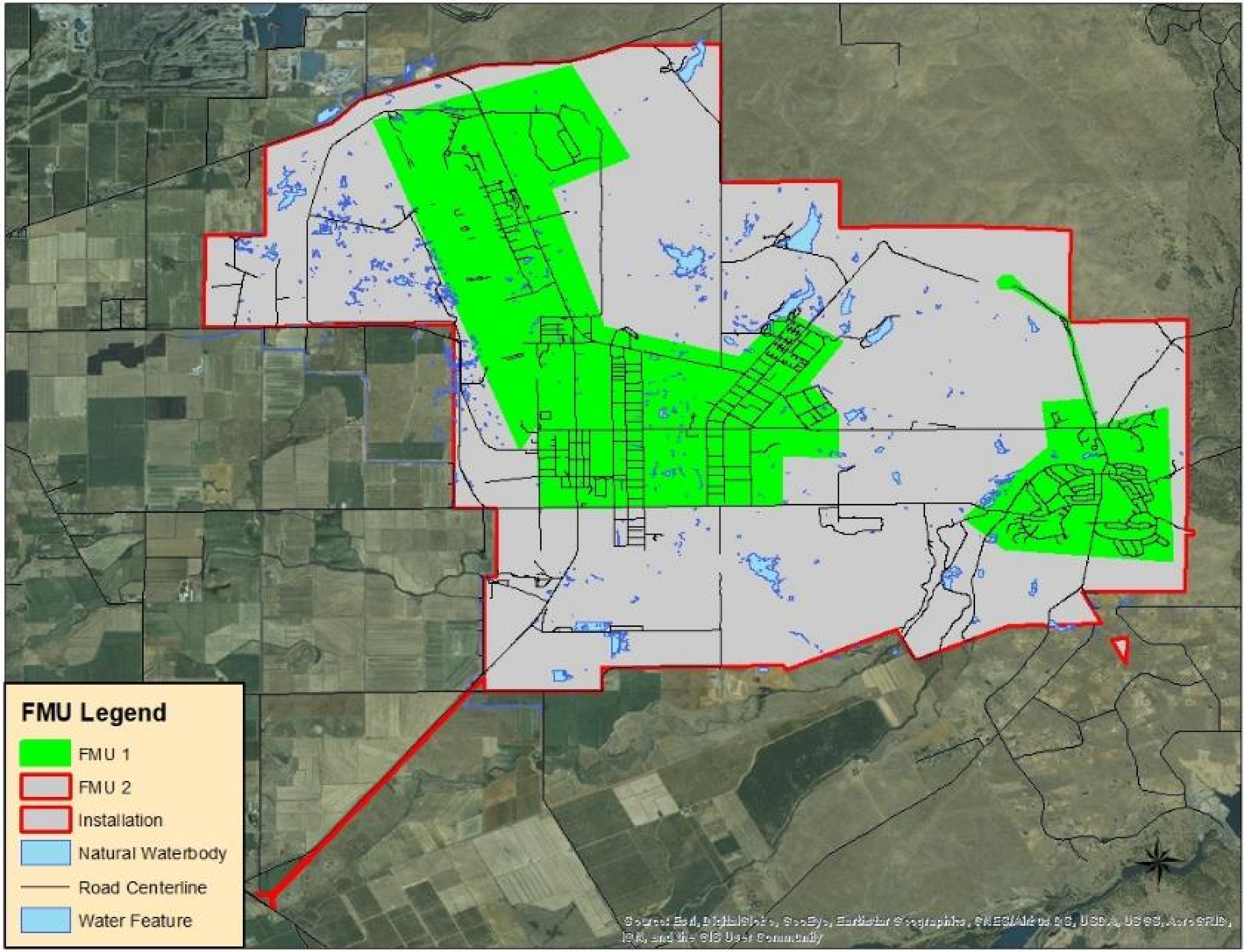
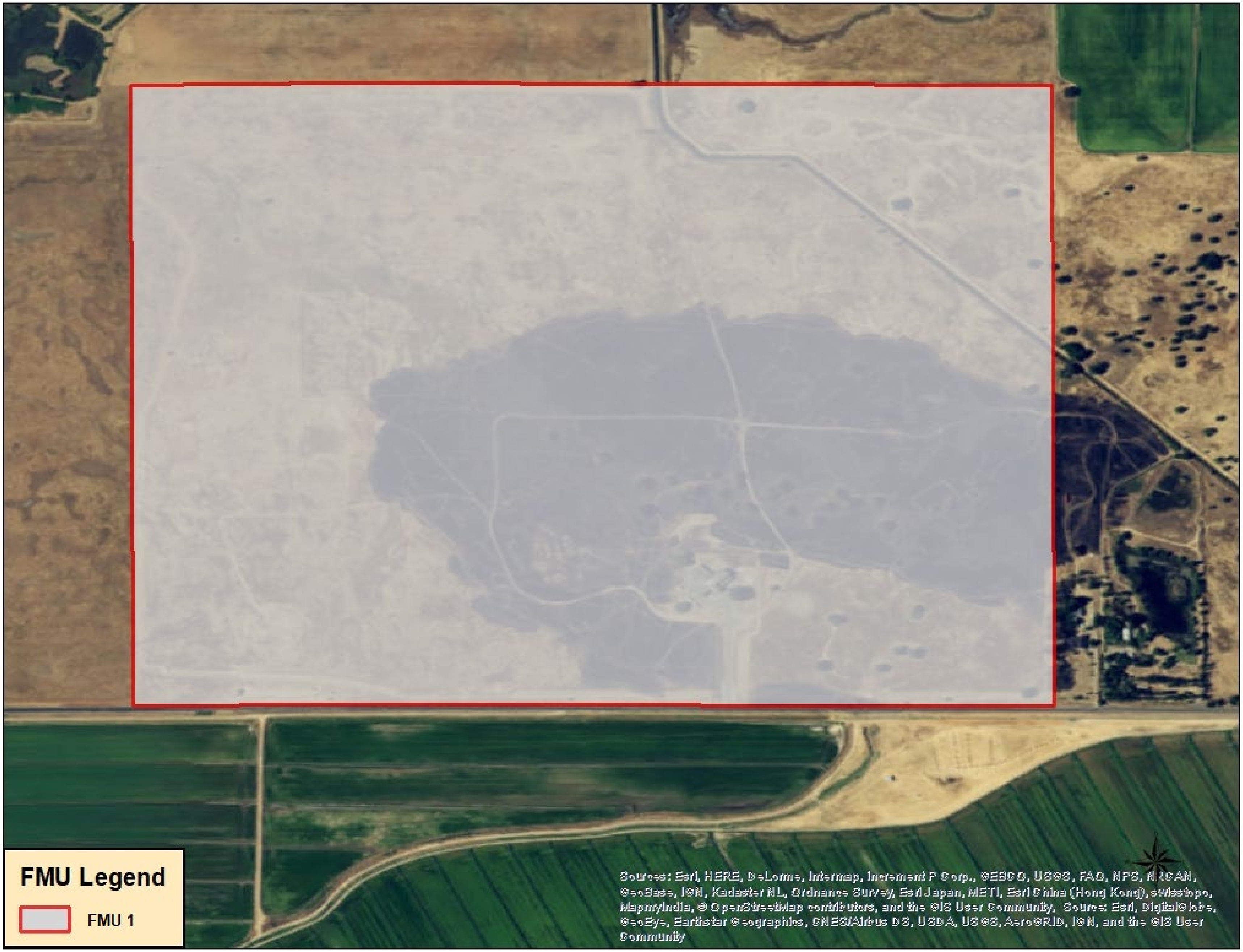


Figure 3.7: LCAS FMU 1 Map



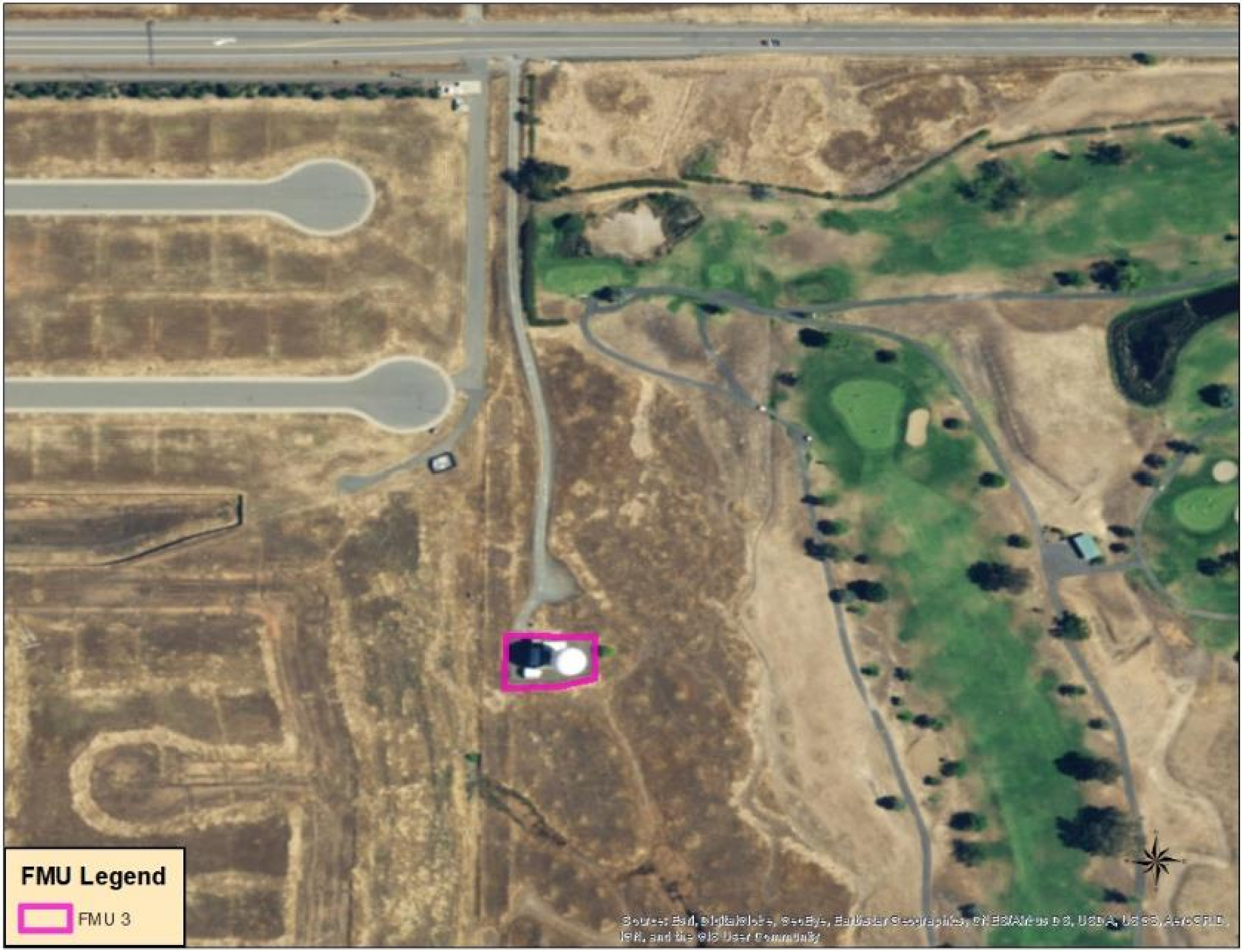
3.5.2.1.2 FMU 2: BAFB FRDs 1-3

FMU 2 consists of developed areas of BAFB, areas considered FRDs 1-3 by FES. FMU 2 accounts for about 8,000 acres of BAFB (see Figure 3.6). Grasslands, oak woodlands, riparian woodlands, and vernal pools are present within FMU 2. FMU 2 contains all of the WUI and most of the values to protect present on BAFB. Limited prescribed fire is recommended in FMU 2.

3.5.2.1.3 FMU 3: Oroville NEXRAD Site

FMU 3 consists of only the Oroville NEXRAD Site (see Figure 3.8). Because this entire FMU is paved, there are no wildland fire concerns except for the threat of heat and flames from a wildfire on adjacent properties impacting the NEXRAD equipment. Surrounding fuels are light and, thus, this risk is believed to be minimal. While point protection is a possibility, AF resources are unlikely to engage a wildfire that would affect Oroville NEXRAD Site from AF property, but rather as a mutual aid response on adjacent property. Prescribed fire is not recommended in FMU 3.

Figure 3.8: Oroville NEXRAD Site FMU 3 Map



3.5.2.2 Wildland FMU Goals and Objectives

3.5.2.2.1 FMU 1: BAFB FRD4 and LCAS

The following goals and objectives drive the wildland fire management program in FMU 1:

- Achieve a program where firefighters and public safety are the highest priorities in every fire management activity.
- Suppress wildfires that may impact the limited values at risk on the FMU. Wildfires not threatening safety, property, natural resources, or cultural resources may be allowed to burn for ecological benefit.
- Use prescribed fire wherever appropriate as a tool to meet resource management objectives.
- Reduce the abundance of undesirable plant species base-wide.
- Use Minimum Impact Suppression Techniques (MIST) tactics to minimize damage to natural and cultural resources.
- Perpetuate natural resources and processes as naturally influenced by fire.
- Promote desirable and native forage species in rangelands.
- Improve range conditions for cattle.
- Reduce the fuel load for wildfires.
- Improve vernal pool habitat and provide a conservation benefit to federally-listed species by removing thatch layers of n on-native annual grasses.

3.5.2.2.2 FMU 2: BAFB FRDs 1-3

The following goals and objectives drive the wildland fire management program in FMU 2:

- Achieve a program where firefighters and public safety are the highest priorities in every fire management activity.
- Suppress all unwanted and undesirable wildland fires, regardless of ignition source, to protect the public, property, and natural and cultural resources.
- Use prescribed fire wherever appropriate as a tool to meet resource management objectives.
- Reduce the abundance of undesirable plant species base-wide.
- Use MIST tactics to minimize damage to natural and cultural resources.
- Perpetuate natural resources and processes as naturally influenced by fire.
- Promote desirable and native forage species in rangelands.
- Improve range conditions for cattle.
- Reduce the fuel load for wildfires.
- The objectives of WUI fire management are:
    - To facilitate fire prevention and protection and minimize fire loss and damage to structures, other human development, and wildland resources.
    - To prevent a structure fire from spreading into wildland fuels.

- To encourage facility or property owners to take an active role in establishing and maintaining their own fire prevention and safety measures in the WUI.

3.5.2.2.3 FMU 3: Oroville NEXRAD Site

The following goals and objectives drive the wildland fire management program in FMU 3:

- Achieve a program where firefighters and public safety are the highest priorities in every fire management activity.
- Suppress all unwanted and undesirable wildland fires, regardless of ignition source, to protect the public, property, and natural and cultural resources.

3.5.2.3 Wildland FMU Planned Fuels Treatments

3.5.2.3.1 FMU 1: BAFB FRD4 and LCAS

Grassland is the dominant natural vegetation community on BAFB. A review of BpS 0511290 – California Central Valley and Southern Coastal Grassland reveals that this vegetation community likely had an historic Mean Fire Return Interval (MFRI) of about 4 years. Areas with oak woodland as the dominant vegetation community, represented by BpS 0511140 – California Lower Montane Blue Oak -Foothill Pine Woodland and Savanna, likely had an historic MFRI of 12 years, most of which were surface-severity fires. It is recommended that all grassland-dominated wildland areas in FMU 1 will be burned in prescribed fires in a ~4-year interval with oak woodland-dominated wildlands burned in a ~12-year interval. Annual prescribed fire acreage for the entire installation would need to average 3,434-5,723 acres to achieve this goal. Where objectives include invasive species control, see Table 3.2 for the recommended interval. Because increased native plant biodiversity has been documented to last >3 years when prescribed fire is applied to vernal pools, it is recommended that vernal pool habitat management follows the MFRI prescribed for surrounding grassland areas. Prescribed fire in FMU 1 would serve 2 primary purposes, hazardous fuels mitigation and rangeland improvement for wildlife and livestock. Prescribed fire units for FMU 1 on BAFB can be found in Figure 3.9. Prescribed fire units for FMU 1 on LCAS can be found in Figure 3.10. Environmental Flight NRM will determine the prescribed fire units to be burned each year whose purpose is to target natural resource goals; FES FC will determine the prescribed fire units to be burned each year whose purpose is to target hazardous fuels reduction goals. As these goals may not always align, burns will be prioritized and funded based on their goal. The WSM is responsible for fuel reduction for ecological management (EQ dollars).

Table 3.2: BAFB Prescribed Fire Recommendations for Control of Invasive Species

Potential Objective	Prescribed Fire Recommendation
Control barbed goatgrass (*Aegilops triuncialis*)	Early summer or late spring prescribed fire in 2 consecutive years.*
Control yellow star-thistle (*Centaurea solstitialis*)	Early summer or late spring prescribed fire in 3 consecutive years. Repeat treatments may be necessary every 2-4 years.*
Control Himalayan blackberry (*Rubus discolor*)	Prescribed fire at any time of the year with followup herbicide treatment of resprouts.*
Control medusahead (*Taeniatherum caput-medusae*)	Late spring (after seedhead dispersal but before the seed moisture drops below 30%) prescribed fire followed by fall application of lmazapic. Repeat treatments may be necessary every 2-4 years.*
*Recommendations follow those found in the 2010 Invasive Species Management Plan for Beale Air Force Base and the 2017 Invasive Plant Species Management Guidelines for Beale Air Force Base, California.	

Mechanical fuels treatments in FMU 1 are limited to firebreak establishment and maintenance. Temporary mineral (except through wetlands) firebreaks will be established adjacent to prescribed fire units prior to prescribed fire treatments and rehabbed afterward, unless they serve a dual purpose. Mowed firebreaks or other protective measures will be created around any ground water monitoring and extraction wells in any prescribed fire unit to ensure that they are properly protected from the fire. Mineral (except through wetlands) firebreaks along installation boundaries will be maintained annually (see Figure 3.9 for FMU 1 on BAFB and Figure 3.10 for FMU 1 on LCAS). Shredded or mowed firebreaks will be maintained annually around LCAS communication infrastructure (see Figure 3.10). Fireline construction (handlines, scraped firebreaks, etc.) will avoid all sensitive habitats and active wildlife dens.

3.5.2.3.2 FMU 2: BAFB FRDs 1-3

It is recommended that all grassland-dominated wildland areas in FMU 2 will be burned in prescribed fires in a ~4-year interval. Annual prescribed fire acreage for the entire installation would need to average 3,434-5,723 acres to achieve this goal. Where objectives include invasive species control, see Table 3.2 for the recommended interval, particularly those areas adjacent to the airfield where yellow star-thistle occurs in order to achieve goals related to BASH reduction. Prescribed fires planned for BASH purposes should be planned carefully, as fire could potentially increase BASH risk if subsequent vegetation is attractive to wildlife. Prescribed fire in FMU 2 would mostly serve the purpose of hazardous fuels reduction near developments. Prescribed fire units for FMU 2 on BAFB can be found in Figure 3.9. The FES FC will determine the prescribed fire units to be burned each year.

Mechanical treatments will take on 4 primary forms.

Mineral firebreaks (except through wetlands) will be established adjacent to prescribed fire units and along installation boundaries. Temporary mineral (except through wetlands) firebreaks will be established adjacent to prescribed fire units prior to prescribed fire treatments and rehabbed afterward, unless they serve a dual purpose. Mowed firebreaks or other protective measures will be created around any ground water monitoring and extraction wells in any prescribed fire unit to ensure that they are properly protected from the fire. Mineral (except through wetlands) firebreaks around the family housing area, the EOD area, and other critical infrastructure will be maintained annually (see Figure 3.9). Fireline construction (handlines, scraped firebreaks, etc.) will avoid all sensitive habitats and active wildlife dens.

Defensible space will be established along a 1-mile strip adjacent to the north end of the family housing area as well in 3 areas amounting to 70 acres around the medical facility and other dispersed infrastructure north of the family housing area (see Figure 3.11). This will include fire-resistant landscaping, targeted thinning and limbing up trees and shrubs near buildings, and, regular lawn watering and maintenance.

Thinning will be completed on 309 acres on the north end of the family housing area, as well as areas on the eastern installation boundary and to the southwest of the lake at the north end of the main base (see Figure 3.11). The latter area is comprised of gum (*Eucalyptus* species) trees that were planted by BAFB while other areas are riparian woodland or oak woodland with interspersed California foothill pine. According to BpS 0511510 – California Central Valley Riparian Woodland and Shrubland, riparian woodlands rarely burn. As such, thinning will only include interspersed volatile fuels and not typical riparian vegetation. Similar thinning will be considered in and adjacent to riparian woodlands for the protection of these habitats, though these areas were not mapped. In all other cases, canopy spacing will be increased by whole-tree removal, where necessary, and ladder fuels will be eliminated by limb removal within 6 feet of the ground on remaining trees. Such thinning will serve multiple purposes. Fires originating in these woodlands or adjacent grasslands will remain surface fires and pose less of a threat to nearby structures. The woodlands themselves provide high quality wildlife habitat and, according to BpS 0511140 – California Lower Montane Blue Oak -Foothill Pine Woodland and Savanna, thinning will produce an open community, which will protect them from replacement-severity fires that could result in type conversion to annual grassland, like has happened in other areas locally. Finally, thinning the oak woodlands that are adjacent to the installation boundary will decrease the likelihood that fires will spread on or off the base in these areas. Whole oak tree removal is not addressed by the current INRMP and generally, except for the important benefit of eliminating canopy-spread fire, has negative repercussions for natural resources and thus does not align with current goals and objectives in the INRMP. Future versions of the INRMP should include some discussion of this conflict and a proposed path forward approved by the NRM. NEPA analysis of thinning projects shall identify and recommend best alternative scenarios to address this conflict.

Whole-tree removal will be completed on 2 acres of gum trees just south of the 3 above-ground fuel storage tanks (see Figure 3.11). Gum trees are highly flammable and their proximity to the above-ground fuel storage tanks creates a significant safety hazard.

Figure 3.9: BAFB 5-Year Planned Prescribed Fire Map

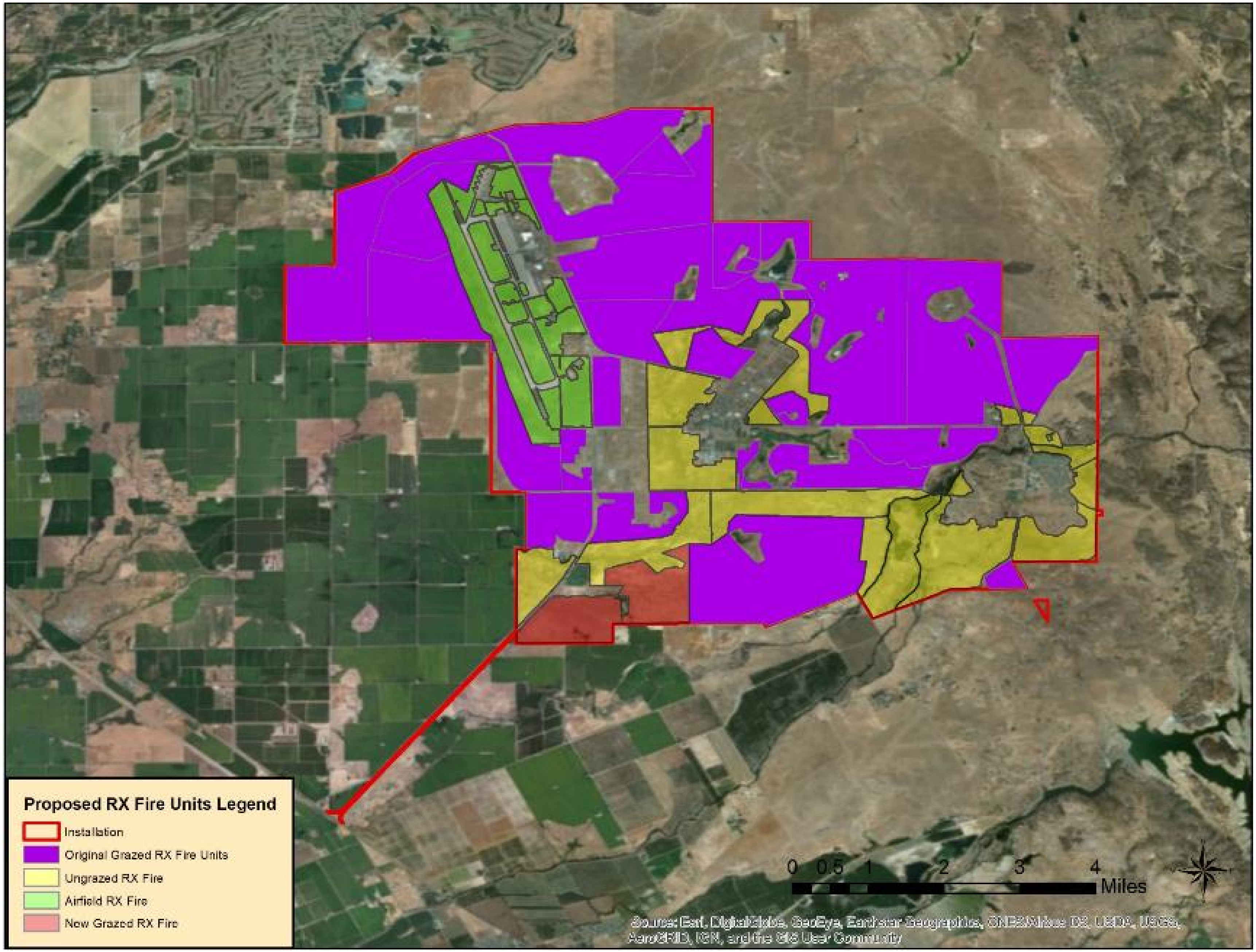


Figure 3.10: LCAS 5-Year Planned Prescribed Fire Map

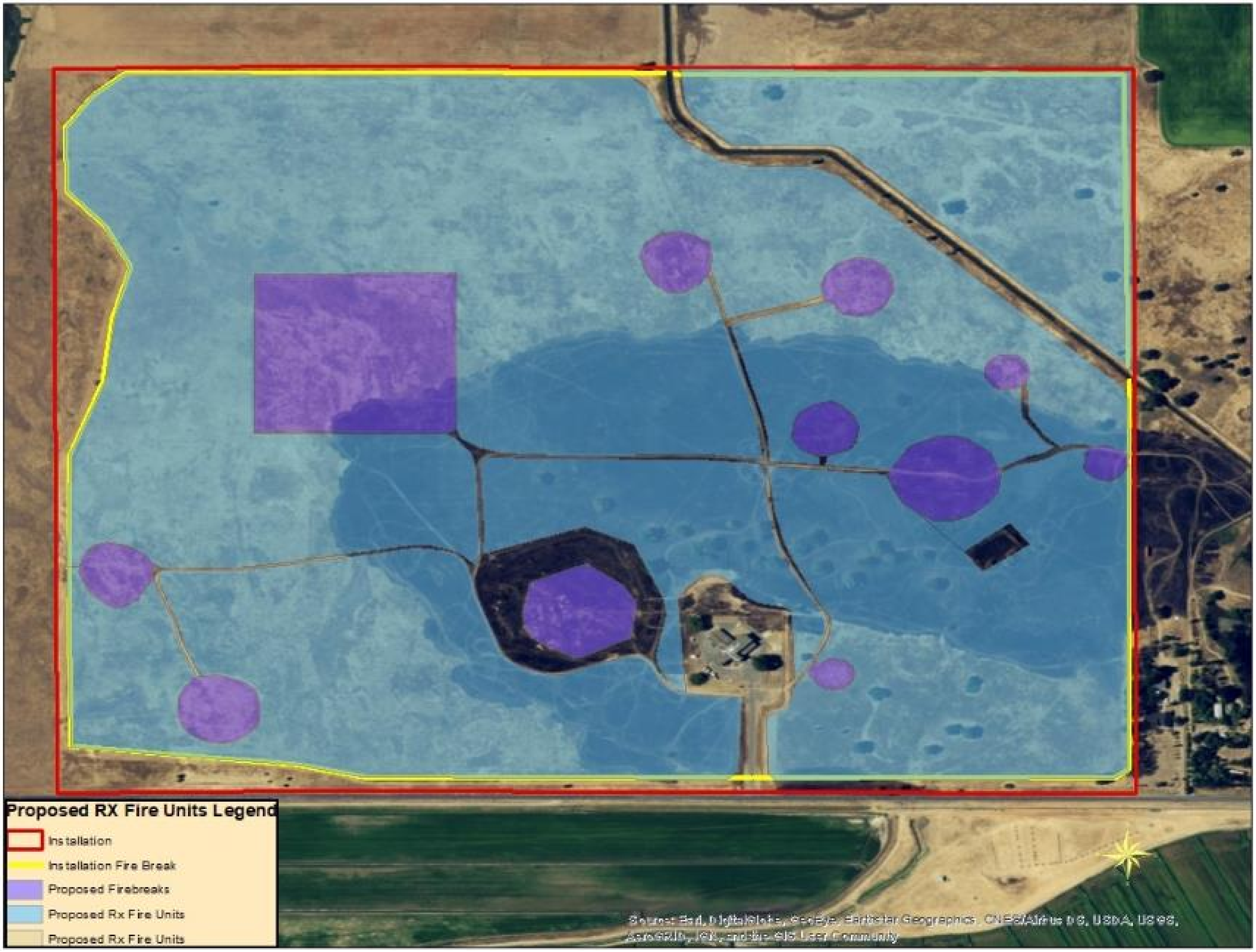
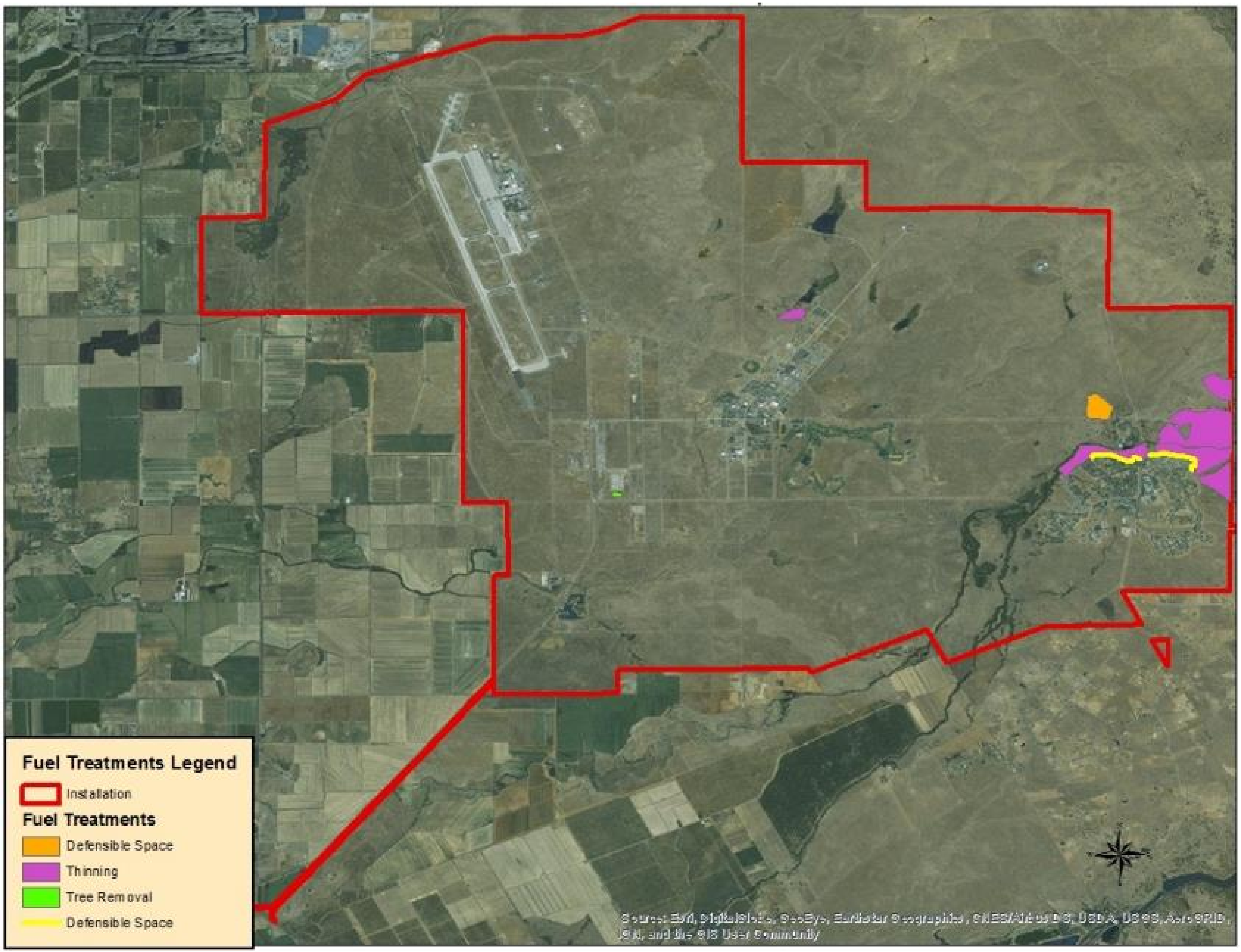


Figure 3.11: BAFB 5-Year Planned Fuels Treatment Map



3.5.2.3.3 FMU 3: Oroville NEXRAD Site

No fuels treatments are planned or recommended in FMU 3.

3.5.2.4 Wildland FMU Values to Protect

3.5.2.4.1 FMU 1: BAFB FRD4 and LCAS

Principle values to protect in FMU 1 include:

- Human safety.
- LCAS buildings (although buildings are adjacent to pavement or bare ground).
- Powerline poles (many are wooden and adjacent to wildland fuels; see Figure 3.12 for BAFB).
- LCAS communications infrastructure.
- T&E species habitat (fire is beneficial for grasslands; need to avoid firelines through vernal pools; protect streams, riparian woodlands, and oak woodlands from fire in some circumstances; see Figure 3.13 for BAFB).
- Historic and archeological resources – structures, sites, etc. (consult CRM and ICRMP for details).
- BAFB livestock forage and improvements (fire is beneficial for grasslands; pastures should be allowed to burn unless cattle cannot be moved out of danger; large fires could temporarily affect the cattle lessee but have a long-term positive benefit for the leases; see Figure 3.14 for BAFB).
- Air quality (mostly just an issue if prescribed fire or wildlife occurrence is abnormally high locally).
- BAFB hunting and recreation areas (trail signs, picnic tables, shelters, etc. are susceptible to damage from fire).
- Adjacent lands (lands to the east are of BAFB especially susceptible to fires moving off BAFB due to volatile fuel loads adjacent to the installation boundary and the prevailing winds during most high fire danger days).

MIST will be used in and around vernal pools, streams, riparian woodlands, oak woodlands, and known active wildlife dens to decrease the likelihood of damaging these sensitive wildlife habitats. In addition, class A foam will not be used within 250 feet of any drainage, vernal pool, or other water source.

3.5.2.4.2 FMU 2: BAFB FRDs 1-3

Principle values to protect in FMU 2 include:

- Human safety.
- Main base buildings and training infrastructure (although most values will be adjacent to managed fuels, such as lawns, or unburnable fuels, such as pavement or bare ground; see Figure 3.12).

- Family housing area and medical facility (some specific WUI concerns here may be addressed in recommended fuels treatments; see Figure 3.12 and Figure 3.16).
- Powerline poles (many are wooden and adjacent to wildland fuels; see Figure 3.12).
- Flightline (primarily smoke impact to missions and training and reduction in BASH potential; see Figure 3.12).
- T&E species habitat (primarily vernal pools, streams, riparian woodlands, and oak woodlands; see Figure 3.13).
- Historic and archeological resources – structures, sites, etc. (consult CRM and ICRMP for details).
- Livestock forage and improvements (fire is generally positive for grasslands, however large fires could temporarily affect the cattle lessee; see Figure 3.14).
- Air quality (mostly just an issue if prescribed fire or wildlife occurrence is abnormally high locally).
- Above-ground fuel storage tanks (safety issue for fire operations; see Figure 3.12).
- EOD area and weapons storage areas (safety issue for fire operations; see Figure 3.15).
- Hunting and recreation areas (trail signs, picnic tables, shelters, etc. are susceptible to damage from fire).
- Adjacent lands (lands to the east of BAFB are especially susceptible to fires moving off BAFB due to volatile fuel loads adjacent to the installation boundary and the prevailing winds during most high fire danger days).

MIST will be used in and around vernal pools, streams, riparian woodlands, oak woodlands, and known active wildlife dens to decrease the likelihood of damaging these sensitive wildlife habitats. In addition, class A foam will not be used within 250 feet of any drainage, vernal pool, or other water source.

3.5.2.4.3 FMU 3: Oroville NEXRAD Site

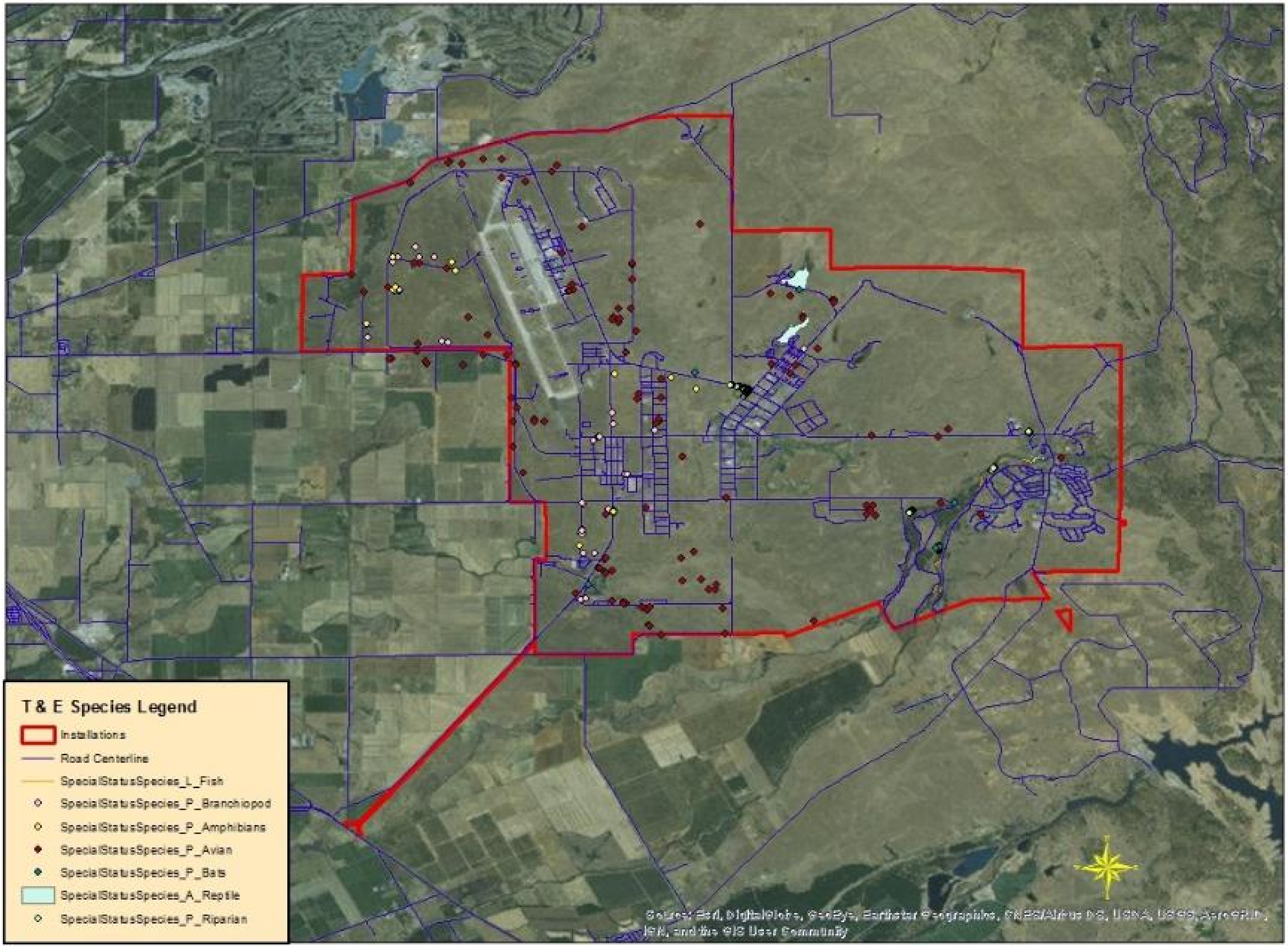
Principle values to protect in FMU 3 include:

- Human safety.
- NEXRAD station (although the NEXRAD station is adjacent to pavement).

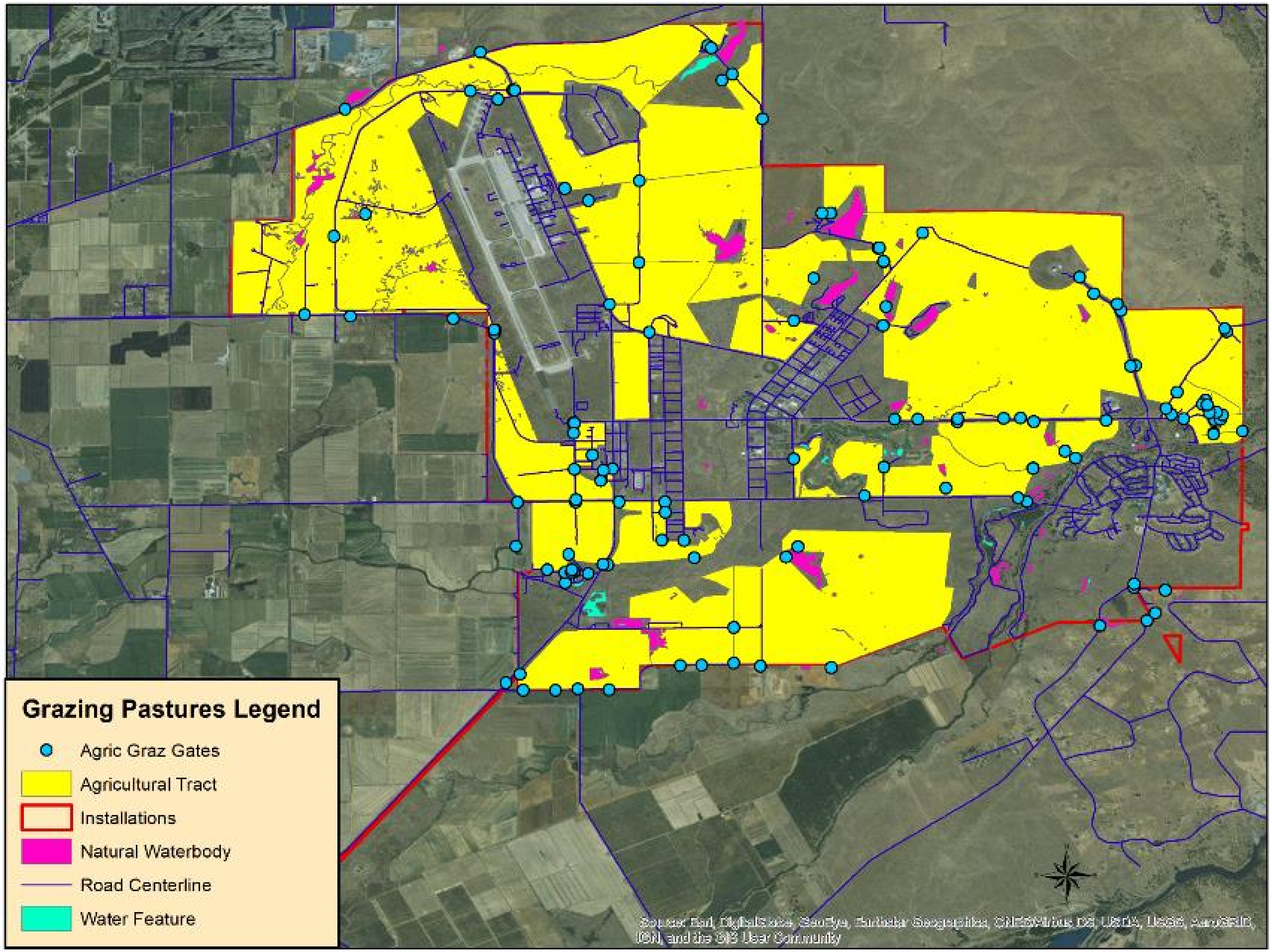
Figure 3.12: BAFB Values to Protect Map

The picture can't be displayed.

Figure 3.13: BAFB Threatened & Endangered Species Map



1 **Figure 3.14: BAFB Grazing Map**



2

3.5.2.5 Wildland FMU Safety Considerations

The safety of installation and cooperator firefighters is of the utmost concern in all wildland fire operations. Several national requirements, including the PMS 310-1, *National Incident Management System (NIMS): Wildland Fire Qualification System Guide*, October 2017 (PMS 310-1), are in place to aid the conduct of safe operations. It is of the highest importance that all firefighters have the training and experience for their positions and equipment they operate. All personnel will be issued fire-resistant clothing, a hard hat with chinstrap, fire shelter, leather gloves, leather boots minimum of 8 inches tall, eye protection and hearing protection. Personnel must use the appropriate PPE in conjunction with their assigned task. Additionally, chainsaw chaps are available and required for sawyer assignments. PPE requirements are detailed in Section 4.1.1.2.1.

3.5.2.5.1 FMU 1: BAFB FRD4 and LCAS

Safety hazards in FMU 1 include:

- Entrapment in flashy and dense fuels.
- Heat stress.
- Difficulty of movement in marshes/wetlands and on clay soils during the wet season.
- Access.
- Off-road driving.
- Traffic and public safety.
- Barbed wire and/or concertina wire.
- Power lines.
- Military training and range operations.
- EOD Range.
- Steep slopes.
- Difficulty of movement on uneven, rocky terrain.
- Chainsaw usage.
- Snags.
- Poisonous plants.
- Venomous and predatory animals.
- Repeater locations and radio dead spots.
- Smoke impacts to aviation and nearby populations.

3.5.2.5.2 FMU 2: BAFB FRDs 1-3

Safety hazards in FMU 2 include:

- Entrapment in flashy and dense fuels.
- Heat stress.
- Difficulty of movement in marshes/wetlands and on clay soils during the wet season.

- Access.
- Off-road driving.
- Traffic and public safety.
- Public evacuation routes.
- Installation WUI Areas.
- Barbed wire and/or concertina wire.
- Power lines.
- Landfills.
- Gas lines.
- Weapons storage areas.
- Military training and range operations.
- Hazardous waste storage areas.
- Steep slopes.
- Difficulty of movement on uneven, rocky terrain.
- Chainsaw usage.
- Snags.
- Poisonous plants.
- Venomous and predatory animals.
- Repeater locations and radio dead spots.
- Smoke impacts to aviation and nearby populations.

3.5.2.5.3 FMU 3: Oroville NEXRAD Site

Safety hazards in FMU 3 include:

- Heat stress.
- Venomous animals.

3.5.2.5.4 Special Safety Information

Firefighter and public safety is the first priority in every wildland fire management activity. The WFMP will ensure that installation-specific safety and emergency operations protocols are identified to mutual aid crews and in PFPs.

3.5.2.5.4.1 Use of Red Lights and Sirens

Red lights and sirens are to be used by AFCEC/CZOF fire personnel only to provide visibility or an audible signal or warning while on the scene of a wildfire or prescribed fire. AFCEC/CZOF personnel are not authorized or properly trained to use these devices while traveling to a fire on public highways. Red lights are required to be turned on when at a fire scene unless the Prescribed Fire Burn Bosses (RXB#) or IC gives permission to turn them off.

3.5.2.5.4.2 Communicating Safety Concerns

Any safety issues that have the potential to cause an aviation-related mishap will be reported on the Aviation Safety Communiqué (SAFECOM) webpage. This website is intended as an "accident prevention tool" developed for the United States Department of the Interior (USDI) and the United States Department of Agriculture (USDA) Forest Service (USFS) and uses the OAS-34/FS-5700-14 Safety Communiqué Form to report aviation safety issues. It is also important to review SAFECOMs that have been submitted from other programs in order to learn from their mistakes.

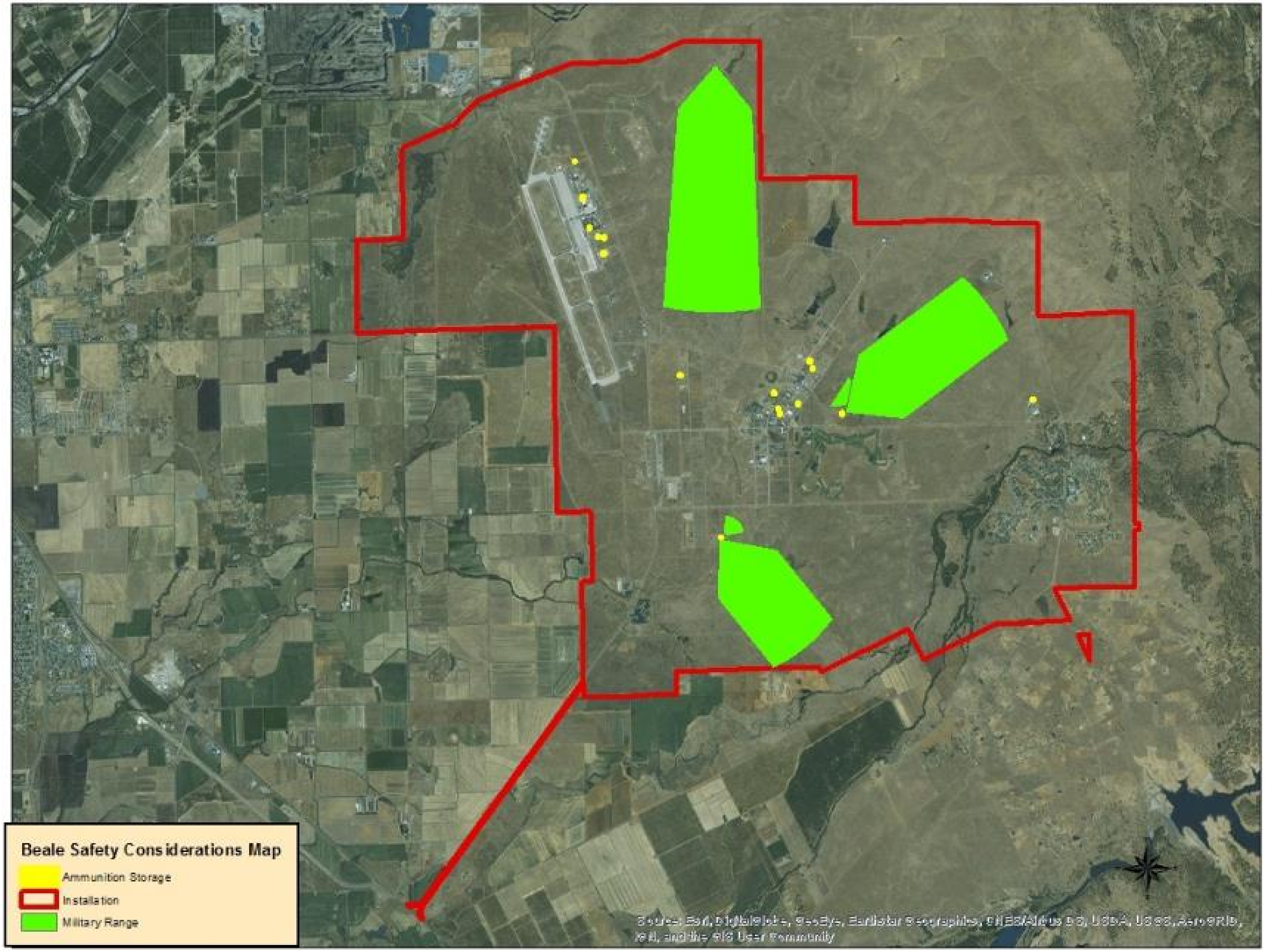
A number of items can be found on the National Interagency Fire Center (NIFC) webpage as works in progress resulting from the Wildland Firefighter Safety Awareness Study. Constant reminders of the 10 Standard Fire Orders and the 18 Situations That Shout Watch Out help keep the individual's attention on safety. In compliance with the NWCG standards, annual safety refresher training is a requirement.

Application of the information concerning Fire Suppression Actions and Limits to Suppression Activities in this plan will also contribute to the safety of fire operations and the firefighters.

3.5.2.5.4.3 Unexploded Ordinance (UXO) Areas

A number of DoD mission considerations affect firefighter safety. The most critical is the issue of UXO. Because of the installation's history, the potential for encountering UXO is a remote possibility. Unfortunately, it is unknown where the probability of such an encounter is greatest. Fires can cause some UXO to explode, as can tractors and plows used in suppression activities, posing a serious risk to firefighter safety. Therefore, extreme caution should be exercised by personnel leading heavy equipment. Engines will stay on existing roads and firebreaks. Personnel should refrain from disturbing UXO if any is found. The EOD area (see Figure 3.15) does house live explosives.

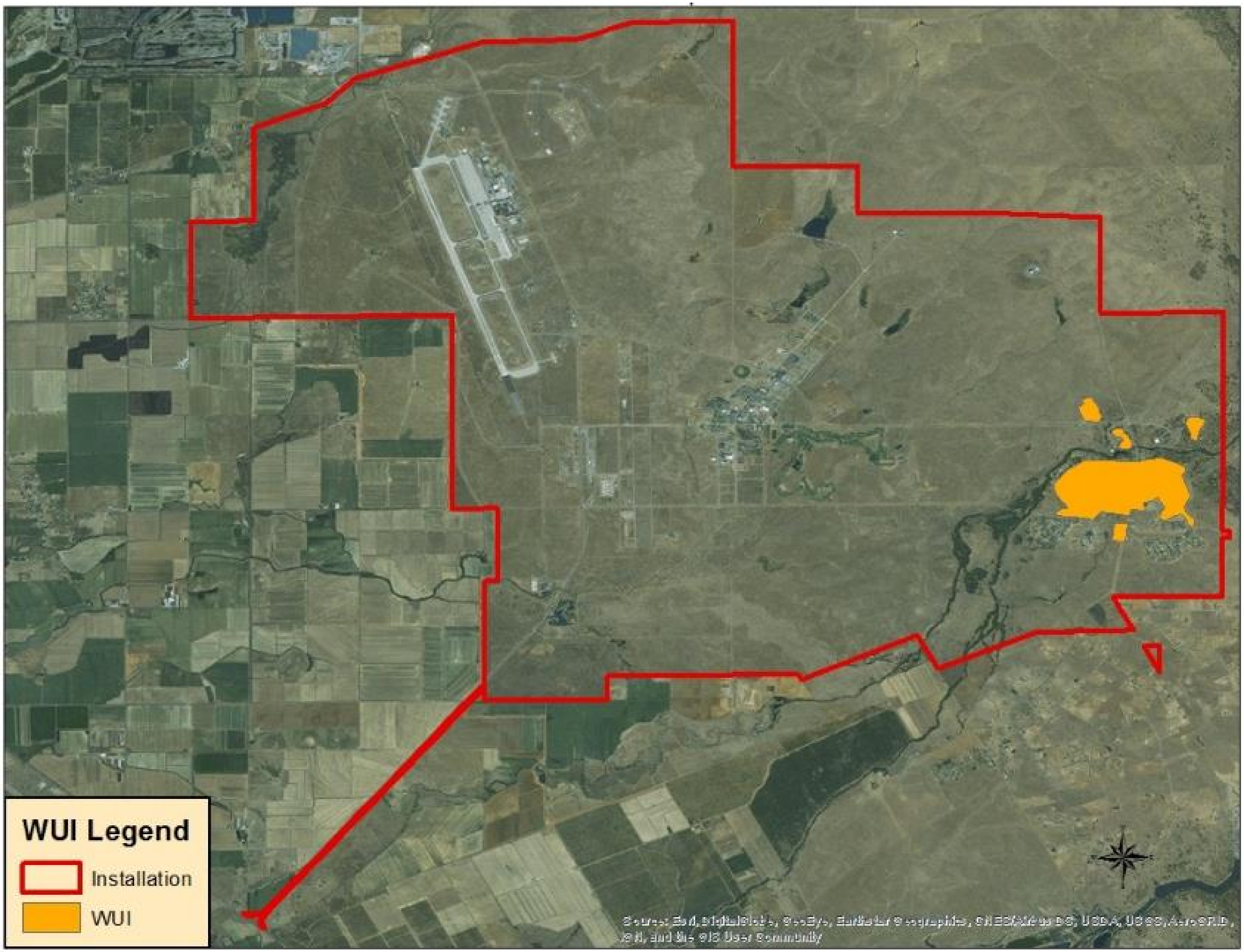
Figure 3.15: BAFB Safety Considerations Map



3.5.2.5.4.4 Wildland Urban Interface (WUI)

During a wildfire in the WUI on BAFB, firefighter and public safety will be the top priority, with protection of structures and other values-at-risk as a secondary goal. Fire suppression personnel suppressing WUI fires will provide adequate defensible space for fire crews employed in structure protection to minimize the risk of entrapment. Firefighters in the WUI will base all decisions on anticipated fire behavior based upon fuels, topography, prevailing winds, and other information. Fires in the WUI can be mitigated through implementation of education programs discussed in Section 3.4. A map of WUI areas on BAFB can be found in Figure 3.16.

Figure 3.16: BAFB Wildland Urban Interface Map



3.5.2.6 Wildland FMU Fire Risk Mitigation Strategies

Overall wildfire risk on BAFB and its GSUs is low to moderate, though not non-existent. Wildfires on BAFB and LCAS, while typically small, have the potential for rapid growth resulting in risk to firefighter and public safety, homes, infrastructure, and military missions. Fire risk mitigation strategies will primarily consist of efforts to prevent wildfire ignitions, implementing fire and non-fire fuels treatments, and creating defensible space in the WUI areas of the installation to reduce the probabilities of a wildfire spreading to the structures in the developed areas of the installation. Following are steps that can be taken to reduce the wildfire risk in these areas.

A WSM will soon be available at BAFB. Members will be qualified to NWCG standards. The crew's overhead will be competent in managing a fast moving, complex wildfire. Training of crew members will be ongoing along with a physical fitness program. Minimum personnel qualifications are discussed further in Section 4.1.1.1.7 and additional recommended wildfire suppression equipment is discussed further in Section 4.1.1.2.

3.5.2.6.1 FMU 1: BAFB FRD4 and LCAS

The following are steps that can be taken to reduce the wildfire risk in FMU 1:

- Conduct public outreach and notification as described in Section 3.4.
- Limit "hot" missions during periods of high wildfire danger. At a minimum, restrict these missions during the peak burning period of the day (1200-1800).
- Ensure powerline retrofits are planned and implemented to reduce and eliminate bird electrocution hazards; refer to the *Beale Avian Protection Plan*.
- Use prescribed fire to manage hazardous fuels near values to protect.
- Maintain past mechanical fuels treatments with prescribed fire.
- Maintain improved or mowed firebreaks in flashy fuels on the perimeter of the installation to minimize the possibility of a fire spreading onto or off of the installation.
- Implement fuels treatments recommended in Section 3.5.2.3.
- Following wildfires consider reseeding grasslands with native perennial grasses and annual forbs to limit the occurrence of flashy invasive annual vegetation.
- Prune trees 6 feet above the ground to eliminate ladder fuels.
- Address specific risks identified in the BAFB Type 3 Wildfire Risk Assessment (see Appendix 3.3).
- Preposition wildland firefighting resources in areas most at risk from wildfire on high fire danger days. Conduct patrols for wildfire starts during the peak fire activity period of the day (1200-1800).
- Conduct prescribed fire to meet NR goals for improving T&E species habitat.
- Expand grazing or mowing operations to meet NR goals for controlling tall grass, thatch build-up, and weed cover in areas not currently managed.

3.5.2.6.2 FMU 2: BAFB FRDs 1-3

The following are steps that can be taken to reduce the wildfire risk in FMU 2:

- Write a Community Wildfire Protection Plan (CWPP) covering the developed parts of BAFB to identify values-at-risk, ignition likelihood, and mitigation plans for individual structures.
- Conduct public outreach and notification as described in Section 3.4.
- Limit "hot" missions during periods of high wildfire danger. At a minimum, restrict these missions during the peak burning period of the day (1200-1800).
- Ensure powerline retrofits are planned and implemented to reduce and eliminate bird electrocution hazards; refer to the *Beale Avian Protection Plan*.
- Use prescribed fire to manage hazardous fuels near values to protect.
- Maintain past mechanical fuels treatments with prescribed fire.
- Maintain improved or mowed firebreaks in flashy fuels on the perimeter of the installation to minimize the possibility of a fire spreading onto or off of the installation.
- Implement fuels treatments recommended in Section 3.5.2.3.
- Keep grass around training structures low to minimize intensity from grassland fires.
- Following wildfires consider reseeding grasslands with native perennial grasses to limit the occurrence of flashy invasive annual vegetation.
- Remove flammable vegetation and debris within 30 feet of WUI structures. This zone is known as the "Structure Ignition Zone."
- Only plant native vegetation with high moisture content. Consider using "xeriscaping" landscaping where adequate irrigation of vegetation is not available.
- Choose fire-resistant materials for new construction and renovations.
- Choose fire-resistant materials for outdoor fixtures, such as outdoor furniture.
- Prune trees 6 feet above the ground to eliminate ladder fuels.
- Address specific risks identified in the BAFB Type 3 Wildfire Risk Assessment (see Appendix 3.3).
- Preposition wildland firefighting resources in areas most at risk from wildfire on high fire danger days. Conduct patrols for wildfire starts during the peak fire activity period of the day (1200-1800).

3.5.2.6.3 FMU 3: Oroville NEXRAD Site

No steps have been identified to reduce the wildfire risk in FMU 3.

3.6 Management of Planned Fuels Treatments

AFCEC/CZOF will primarily use the WSMs, in conjunction with NWCG qualified and available installation personnel, to execute prescribed fire requirements in support of ecosystem management and mitigation of wildfire. Prescribed fire requirements at the installation will be prioritized with the FES FC for wildfire mitigation goals and NRM for natural resource management goals. If the resources in the WSMs are limited and cannot accomplish wildland fire requirements organically or in cooperation with qualified installation assets, AFCEC/CZOF will exercise reach back assistance from interagency detailers to supplement AFCEC/CZOF staff. After assessing interagency detailer's capability, AFCEC/CZOF may utilize qualified contracted personnel to assist with wildland fire fuels requirements. More detail on the WSMs can be found in AFCEC/CZOF Playbook.

3.6.1 Processes to Identify and Prioritize Fuels Treatments

Fuels treatments will be identified and prioritized based upon the anticipated treatment outcomes for the following objectives from the INRMP (not a prioritized list, except for enhancing human safety):

- Enhance human safety.
- Improve habitat conditions for special status species and their habitat.
- Preserve, restore, create, and monitor wetland areas.
- Preserve, restore, and enhance existing wetland-associated vegetation communities (e.g., riparian forest, riparian scrub, tule marsh).
- Improve habitat for fish and game species.
- Improve habitat for nongame wildlife species at BAFB.
- Minimize conflicts between wildlife and base missions. Standardize coordination procedures between the NRM, airfield manager, flight safety, operations, and pest management personnel to enhance the BASH reduction program.
- Protect and restore native vegetative communities that contribute to fish and wildlife biological diversity.
- Minimize the risk of wildfire and its potential effects on base facilities and natural resources; pursue improvements to firebreak processes to enhance fire protection and natural resources protection.
- Implement land management measures around the airfield that discourage use by wildlife.
- Coordinate grazing with prescribed fire to improve range conditions, promote desirable and native forage species, and reduce undesirable species.

The WFPC and the NRM will meet with the assigned WSM Lead to identify and prioritize projects and fuels treatments needed to support INRMP and WFMP objectives.

3.6.2 Fuels Treatment Performance Information and Targets

A goal for prescribed fire on BAFB is to conduct prescribed fires of available grazed and ungrazed land as described in Section 3.5.2.3. This will be accomplished by annually burning a minimum of 2,426 acres per year. Ungrazed lands may also be burned. Planned mechanical fuels treatments include mowed and mineral firebreak maintenance, creating defensible space within the WUI, tree thinning in riparian and oak woodlands near WUI areas as well as to reduce the potential for wildfires to spread onto or off of the installation, and tree removal near the above-ground fuel tanks. See Section 3.5.2.3 for details of planned prescribed fires and mechanical fuels treatments.

While prescribed fire will typically cause temporary changes in the vegetation composition in grassland ecosystems such as those found on BAFB, permanent changes in the vegetation composition of the grasslands of northern California will typically not occur unless prescribed fires are conducted on a frequent cycle, which even then may not permanent changes. Vegetation composition in the grasslands is primarily controlled by weather, including precipitation and temperature, as well as ecological factors including seed availability and interactions between species. Additional information can be found in the IPMP and Grazing Management Plan.

3.6.3 Prescribed Fire Project Implementation

Prescribed fire is defined as fire applied in a knowledgeable manner to fuels on a specific land area under selected weather conditions to accomplish predetermined and well-defined management objectives. Prescribed fire is a desirable and economically sound practice on the vegetation types present on BAFB. Few, if any, alternative treatments have been developed that can compete with fire from the standpoint of cost-effectiveness.

Prescribed fire is applied to:

- Reduce hazardous fuels.
- Dispose of mechanical fuels treatment debris.
- Prepare sites for seeding or planting.
- Improve wildlife habitat (by decreasing thatch, destroying weed seeds, reducing weed cover, increasing native species cover and diversity).
- Manage competing vegetation.

Priorities for what a prescribed fire is meant to accomplish will be established in a review of management goals, analysis of past fire records, and a series of field checks to determine need, adequate fuel load, and to identify any potential safety problems in the target area. Each prescribed fire must have its own PFP with the size of the prescribed fire specified. A detailed record of events be kept for the day of the prescribed fire.

3.6.3.1 Prescribed Fire Planning

Prescribed fire projects will be implemented to attain goals and objectives of the INRMP and to support AF Mission Requirements. Implementation will follow state prescribed fire regulations and will follow a site-specific PFP using the *AF Prescribed Fire Plan Template* (AF PFP Template; see Appendix 3.4 or AFCEC/CZOF), which is based upon the PMS 484, *Interagency Prescribed Fire Planning and Implementation Procedures Guide*, July 2017 (PMS

484). RXB#s must comply with California smoke management guidelines found in 17 California CR, Subch. 2. An NWCG RXB#, qualified at the complexity level of the prescribed fire to be conducted, is required. If qualified individuals are not available on base to write prescriptions or implement plans, outside resources may be used on a contractual basis.

All prescribed fire planning will be coordinated through the assigned WSM Lead. Any proposed PFPs for prescribed fires in the controlled airfield area must be approved in advance by the Air Force Safety Center (AFSEC/SEFW). The approved AF PFP template (see Appendix 3.4 or the AFCEC/CZOF) will be completed along with the complexity analysis following the PMS 424, *Prescribed Fire Complexity Rating System Guide*, July 2017 by a qualified RXB#. Contact the WSM Lead or AFCEC/CZOF for assistance with the PFP.

3.6.3.1.1 Areas which have Prescribed Fire Requirements

Prescribed fire will be implemented on grazed and ungrazed Prescribed Fire Units denoted on the map in Figure 3.9. Prescribed fire will also be implemented on LCAS (see Figure 3.10). Fire in the Airfield Prescribed Fire Units will be implemented whenever necessary in order to support AF missions by reducing BASH hazards (see Figure 3.9). This will likely vary over time in response to wet and dry periods as well as presence of yellow star-thistle. Recommendations for the use of prescribed fire to control yellow star-thistle can be found in the Invasive Species Management Plan for BAFB in Appendix 3.5 or in Table 3.2. General recommendations are found in Table 3.3.

Table 3.3: BAFB Prescribed Fire Requirements*

Prescribed Fire Unit Type	Acres	Desired Return Interval (Years)	Average Return Interval (Years)	Minimum Acres	Maximum Acres	Average Acres
Original Grazed Units	12,224	3-5	4	2,444	4,075	3,056
New Grazed Units on BAFB	3,744	3-5	4	749	1,248	936
Ungrazed Units on BAFB	1,015	3-5	4	203	338	254
Ungrazed Units on LCAS	185	3-5	4	37	62	46
Airfield Units	1,436	As Needed	N/A	N/A	N/A	N/A
Totals*	17,168	5-7	6	3,434	5,723	4,292
*Does not include Airfield Units, which will be burned as needed for mission operations.						

3.6.3.2 Prescribed Fire Operations

A robust prescribed fire program at BAFB serves to maintain and enhance habitat to support a multitude of grassland and woodland species. For prescribed fires to accomplish short term as well as long term goals, to project costs, and to best allocate resources a Programmatic Burn Plan needs to be developed.

Prescribed fire operations will adhere to protocol set forth in the approved PFP for that specific unit/site. At Regional or National Preparedness Levels (PL) 4 or 5, consult AFCEC/CZOF for instruction on prescribed fire authorization. Cooperators and contractors may be used to implement prescribed fires. Cooperators and contractors must meet NWCG standards. Cooperators, such as members of VFDs, must have appropriate qualifications certified by their agency. Those who supervise AF employees or contractors during prescribed fires must meet AF standards.

Typically, all prescribed fire preparations and implementation will take place when fuels are dry (May through October). Note, as previously discussed in Section 3.1.2.2, fires that occur after June will not meet invasive species goals as they would not affect the season's seed crop.

Fires that occur after June can meet fuels reduction and thatch reduction goals. In variable rain years, prescribed fire can be conducted outside of this time period in 2 cases:

- If little to no rain has occurred in November and wetland vegetation in the prescribed fire areas has not germinated, prescribed fires may be implemented at the discretion of the NRM.
- If rain has subsided early enough in the spring that all wetland vegetation in the burn areas has senesced, prescribed fires may be implemented at the discretion of the NRM.

The NRM and CRM will consult on all PFPs to ensure that all potential natural and cultural resources, respectively, are identified and protected during the burn. Fire crews will be made aware of all sensitive resources within the prescribed fire units and will avoid driving through or otherwise disturbing these areas except in cases of emergency. Any prescribed fire units that contain nesting wildlife species will be surveyed prior to burning to ensure the nests are not active. If active nests are found, the base NRM will be notified and will determine the appropriate mitigation action. Prescribed fire areas that are susceptible to erosion (such as hilly areas near streams, lakes, and ponds) will include site-specific plans for protection/restoration post-burn to mitigate these negative effects. Actions such as seeding and installation of wattles will be considered to minimize erosion and promote the growth of desirable species. Actions shall be outlined in the IPMP or Programmatic Burn Plan and performed by the WSM.

3.6.3.2.1 Operational Checklist

The following can be used as an operational checklist during prescribed fire implementation:

- Each year prior to their pasture being burned, cattle grazing program lessees will be notified. The Grazing leases and associated Operating Agreement describe provisions for possible Animal Unit Month (AUM) reductions as a result of prescribed fire.
- At least 30 days prior to the planned prescribed fire, the RXB# will ensure all local, state, and smoke management permits are in place and current.
- At least 2 weeks prior to the planned prescribed fire, the RXB# will notify staff assigned to the project to ensure adequate planning of work and leave schedules.
- At least 2 weeks prior to the planned prescribed fire, the RXB# will notify the NRM to allow for sufficient time to identify sensitive natural resources concerns to be monitored during the burn and to conduct pre-burn assessments if necessary.
- At least 1 week before the prescribed fire, all engines, tools, supplies, etc., will be checked.
- At least 5-7 days prior to the planned prescribed fire, notifications will be made via e-mail by the RXB#. The WFPC will confirm that these contacts have been made according to the PFP notification list.

- At least 5 days prior to the planned prescribed fire, coordinate with the air district for weather considerations.
- Several days before the prescribed fire (timeframe will vary depending upon other activities):
  - Obtain approval from Senior Leaders (Base Civil Engineer [9 CES/CC], and the Mission Support Group Commander [9 MSG/CC] or Deputy Mission Support Group Commander [9 MSG/CD]) via phone or e-mail. In reality, this should be done with greater lead time.
  - Notify the Environmental Restoration Program Manager with sufficient time to shut down nearby restoration infrastructure systems and ensure that monitoring and extraction wells are properly protected from the fire.
- At least 2 days (48 hours) prior to the planned prescribed fire, adjacent landowners with living quarters within 1 mile of a prescribed fire will be notified.
- The day prior to the planned prescribed fire:
  - RXB#s will report to the WFPC.
  - Coordinate with the air district for weather updates.
- On the morning of the planned prescribed fire:
  - Coordinate with the air district to receive burn day authorization.
  - Obtain weather information from sources such as the National Weather Service Fire weather webpage and the Combat Weather Team (9 OSS/CWT).
  - Prescribed fire notifications will be made by the RXB#.
  - Media notifications will be completed as designated in the PFP.
  - Warning signs and/or road guards will be used to advise motorists of a prescribed fire in progress, especially if smoke could reduce visibility.
  - AF roads adjacent to prescribed fire units will be closed temporarily as needed.
  - All resources on the prescribed fire will receive a complete operational briefing.
  - Designate a safety officer.
  - The following will be notified prior to ignition:
    - FES FC.
    - Fire Alarm Communications Center (FACC).
    - Senior Leaders (9 CES/CC, 9 MSG/CC, 9 MSG/CD).
    - CES for Heavy Equipment.
    - CAL FIRE.
    - Local FDs.
  - Prescribed fires will not be ignited until all contingency resources are confirmed as being in the required status specified in the PFP.

        - Test fires will be used to assess holding capability and smoke dispersal. Weather forecasts for the day of the prescribed fire and the next 2 forecast periods will be obtained.
- After the prescribed fire is complete:
    - Senior Leaders (9 CES/CC and 9 MSG/CC or 9 MSG/CD), FES FC, Deputy FES FC, CAL FIRE, and local FDs will be notified.
    - The prescribed fire will be mopped up and confirmed fire safe by the IC.
    - Impacts to natural resources will be evaluated by the NRM.
    - At the discretion of the NRM, fire effects monitoring will be conducted by NR in accordance with Section 5.2.1.

Prior to ignition of a prescribed fire, the RXB# must determine if the current and forecast weather parameters meet the prescription criteria as stated in the PFP. Additional factors include such smoke management parameters as mixing height, transport wind speed, and ventilation rate.

3.6.3.2.2 Prescribed Fire Public Notification

When planning for prescribed fires, an approved notification list will be developed prior to ignition of the fire and residences in the smoke impact area will be notified in advance by phone or other media sources. Use the elements in the PFP to help determine who will be notified.

Example 1: Prescribed fire planned adjacent to or visible from highway. Prescribed fire leadership contact Sherriff's Office or Department of Transportation to keep them informed of operations.

Example 2: Prescribed fire planned in view of residential homes. Prescribed fire leadership use neighborhood kiosks with prescribed fire information, contact information and a Quick Response (QR) code to link to electronic media to inform residents in a more up to date manner.

There will be information periodically given about the prescribed fire program to local media. 9 RW/PA will handle PIO responsibilities. The NRM will work with 9 RW/PA to ensure these contacts are made. Notification will be given to all internal and external stakeholders who may be impacted by prescribed fire operations. Required notifications are a required component of a PFP.

Prescribed fire notifications are done on the day of the prescribed fire by the RXB# and are done via email 5-7 days before a planned prescribed fire. The WFPC will confirm that these contacts have been made according to the PFP notification list. Adjacent landowners with living quarters within 1 mile of a prescribed fire will be notified of plans to burn at least 48 hours ahead of the scheduled prescribed fire.

3.6.3.2.3 Multiple Concurrent Prescribed Fire Projects

If multiple non-adjacent prescribed fires are being conducted on BAFB grounds at the same time, prescribed fire resources committed to 1 prescribed fire cannot be considered a contingency resource for any other prescribed fire. They can; however, be released at the discretion of the RXB# of the unit assigned to assist other prescribed fires, if needed.

3.6.3.2.4 Smoke Management

Smoke management on BAFB and its GSUs will follow recommendations of the latest edition of the NWCG PMS 420-4. Individual PFPs will specify conditions required for burning that will minimize impacts to air quality from prescribed fire, including compliance with the requirements of state and local air quality regulatory agencies.

Smoke Management Guidelines for Prescribed Fire:

- BAFB will adhere to smoke management regulations set forth by the CARB. NR will obtain and use weather and smoke management forecasts issued as part of fire weather forecasts. Particular attention will be paid to the ventilation rate, or the combination of mixing height and transport wind speed.
- Caution will be used when burning near or upwind of smoke-sensitive areas and permitted when wind will carry smoke into the upper atmosphere away from public roads, airports, and populated areas. Specific smoke sensitive areas on BAFB include the medical facility, the school, the family housing area, the main base, the airfield, and main travel routes.
- No burning will be permitted if a smoke-sensitive area is within ½ mile downwind of the proposed prescribed fire and atmospheric conditions suggest smoke will not lift to a sufficient height to avoid impacting the area. Poor smoke dispersal is most likely to occur during persistent atmospheric inversions and low winds. Smoke will typically be heaviest when high concentrations of fuels burn.
- Because smoke flows downhill and tends to pool in stream drainages and other low-lying areas at night, nighttime burning will be avoided if possible.
- Smoke planning will incorporate the following:
    - Plot direction of the smoke plume.
    - Identify smoke-sensitive areas.
    - Determine fuel type which influences smoke intensity and duration.
    - Minimize smoke by burning during the middle of the day when possible, in small blocks when needed, and mopping up along roads early.
    - Have an emergency plan. Be prepared to extinguish a prescribed fire if it is not burning according to plan or if weather conditions change.

The following techniques can be used to reduce the emissions:

- Reduce the area burned by:
  - Isolating fuels. Large logs, snags, deep pockets of duff, sawdust piles, squirrel middens, or other fuel concentrations that have the potential to smolder for long periods of time can be isolated from burning. This can be accomplished by several techniques including:
    - Constructing fireline around the fuels of concern.
    - Not lighting individual or concentrated fuels.
    - Using natural barriers.
    - Scattering the fuels.
    - Spraying with foam or other fire-retardant material. Eliminating these fuels from burning is often faster, safer, and less costly than mop-up, and allows targeted fuels to remain following the prescribed fire.
  - Mosaic burning. Landscapes often contain a variety of fuel types that are noncontinuous and vary in fuel moisture content. Prescribed fire prescriptions and lighting patterns can be assigned to use this fuel and fuel moisture non-homogeneity to mimic a natural wildfire and create patches of burned and non-burned areas or burn only selected fuels. Areas or fuels that do not burn do not contribute to emissions.
- Reduce fuel load by:
  - Mechanical removal such as chipping the area to slow the fire in certain areas.
  - Mechanical processing.

All prescribed fires require burn day authorization from the local air district and must be coordinated with the local air district, through the 9 CES/CEIEC. Air districts for BAFB and its GSUs include FRAQMD (for BAFB), PCAPCD (for LCAS), and BCAQMD (for Oroville NEXRAD Site). Coordination with the air district will occur at least 5 days prior to the prescribed fire for weather considerations, the day prior to the prescribed fire for weather updates, and the morning of the prescribed fire to determine state allocated acreage for the area and the acreage that will be allocated by the air district.

3.6.3.3 Prescribed Fire Conversion to Wildfire and Required Reviews

All prescribed fires converted to a wildfire will have a Declared Wildfire Review (DWR) in accordance with PMS 484. Immediate notification to dispatch and NR head staff, as well as to AFCEC/CZOF, is required when a prescribed fire is converted to a wildfire. After the incident is over, the process will focus on the "what" and not the "who" of what led to the conversion in the form of an After Action Review (AAR). The following are the minimum requirements that must be addressed in the prescribed fire unit PFP regarding conversion to wildfire:

- Wildfire declaration (by whom).
- IC assignment: If a wildfire is declared, the RXB# or appropriate level IC will be the IC. An ICT5 or ICT4 will be identified prior to ignitions.
- Notifications: RXB# or IC will:
  - Notify Dispatch as soon as the prescribed fire is converted to a wildfire.
  - Notify all personnel on the fireline of the conversion and identify the IC.
  - Remove any non-red carded arduous duty rated fire fighters.
  - Give timely updates to Dispatch.
- Extended attack actions and opportunities to aid in wildfire:
  - Individuals working on the converted prescribed fire will only do so at their qualified level as determined by the Incident Qualifications and Certification System (IQCS).

IC will initiate immediate recall of off-duty military fire fighters and mutual aid when it becomes apparent that BAFB resources are inadequate to control any escaped prescribed fire.

3.6.4 Non-Fire Fuels Treatments

All fuels treatment activities must be done so with the approval of the NRM to ensure the most efficient use of resources, non-duplication of tasks, project goal tracking, prevention of the spread of noxious plants, limited disturbance of sensitive areas, proper use of pesticides, and to prevent accidental ignitions. Proposed non-fire fuels treatments include firebreak maintenance, creating defensible space in the WUI, thinning riparian woodlands and oak woodlands adjacent to the WUI and the installation boundary, and gum tree removal near the above-ground fuel storage tanks.

3.6.4.1 Fuels Treatment Regulatory Compliance

When conducting non-fire fuels treatments, the installation must identify and adhere to all federal, state, or local laws applicable on installation lands regarding the environmental impact of the planned action. All federal actions not previously covered under a CATEX must undergo NEPA analysis. Where actions may affect cultural resources, CRM must be consulted to ensure proper coordination with COHP and to determine if the action is consistent with the ICRMP. If T&E species or their habitat may be affected, the NRM will consult USFWS under ESA Section 7. If the action is taking place in a wetland or riparian area, USACE will be consulted to ensure any applicable permits are obtained. All permitting will be routed through the BAFB Environmental Office for review, approval, and signature; the WSM and WFPC shall have no contact with environmental regulators. Proponents of the action or WSMs shall prepare all appropriate documentation.

3.6.4.2 Areas Scheduled for Mechanical or Chemical Fuels Treatments

See Section 3.5.2.3.1 for planned non-fire fuels treatments.

3.6.5 Prescribed Fire Monitoring Protocol

On a prescribed fire, the RXB# must adhere to the parameters set forth in the PFP. The RXB# must regularly check and record weather conditions to determine if the prescribed fire is in prescription. Prior to ignition, the RXB# must request a Spot Weather Forecast through the National Weather Service (NWS) Fire Weather webpage. These tasks can be delegated to anyone at the Firefighter Type 1 (FFT1) level and above.

On non-fire fuels treatments, the project manager will make sure that work is done in compliance with the guidelines set forth by the NRM and that project work goals are met or setbacks are documented to improve future project safety and efficiency. A pre- and post-action report shall be prepared by the project manager and reviewed and approved by the NRM to ensure proper documentation of work for the INRMP and AFI 32-7064 agency coordination.

3.7 Fuels Treatment Reporting Requirements

3.7.1 Prescribed Fire Reporting

In accordance with AFI 32-7064, installations conducting prescribed fire will report their activities to the AFCEC/CZOF. Tier 1 installation prescribed fire activities will be coordinated, conducted, and reported through the assigned WSMs. BAFB is a Tier 1 installation.

WSMs will write and submit the prescribed fire reports to the BAFB WFPC and NRM for review and approval. WSM shall then submit the prescribed fire report to AFCEC/CZOF for inclusion in the AF Wildland Fire Database within 10 days of treatment completion. The prescribed fire report will include:

- Installation/range.
- Treatment date.
- Acres treated.
- Start time.
- Control time.
- Fire zone/prescribed fire unit.
- Anderson fuel model.
- Prescribed fire objective.
- All equipment used on the treatment and the assigned organization.
- All personnel used on the treatment and their assigned organization.
- NWCG positions personnel held on the treatment.
- Geospatial data showing treatment boundaries.
- GIS data for any fire containment activities (firelines, dozer lines, etc.).

- Prescribed fire results/success based on objective.
- Lessons learned.
- Future recommendations.
- Follow-up actions needed.

For instructions on reporting, contact AFCEC.CZOF.FIRECENTER@US.AF.MIL.

3.7.2 Mechanical Treatment Reporting

Mechanical treatments supported by the WSMs will be reported to AFCEC/CZOF. WSMs will submit the mechanical treatment report to AFCEC/CZOF within 10 days of treatment completion. The mechanical treatment report will include:

- Installation/range.
- Treatment date.
- Acres/miles treated.
- Treatment type.
- Treatment objective.
- Start time.
- End time.
- Location of treatment.
- All equipment used on the treatment and the assigned organization.
- All personnel used on the treatment and their assigned organization.
- Geospatial data showing treatment boundaries.
- Treatment results/success based on objective.
- Lessons learned.
- Future recommendations.
- Follow-up actions needed.

For instructions on reporting, contact AFCEC.CZOF.FIRECENTER@US.AF.MIL.

3.8 Fuels Funding Processes

Fuels funding will follow guidelines found in Chapter 13, Section 7 of AFI 32-7064. The WFPC along with the WSM Lead will work with AFCEC/CZOF to determine fuels requirements and assist in forecasting funding needed to meet those requirements. Identification of the funding requirements to train and equip wildland fire management personnel ensures safe, effective, and cost-efficient operations in support of the WFMP. The WSM Lead, Assistant Fire Management Officer (AFMO) and AFCEC/CZOF will identify the appropriate sources of funding for wildland fire activities.

Wildland fire management activities that are conducted for the purpose of compliance with environmental laws and regulations will be supported by conservation funds. Wildfire suppression, prescribed fire, and other wildland fire management activities to support training, range use, munitions testing and evaluation, or other mission activity will be supported by the responsible activity through direct funding or reimbursement.

Funding for wildfire prevention and fuels management for hazard reduction is an installation operations and maintenance responsibility.

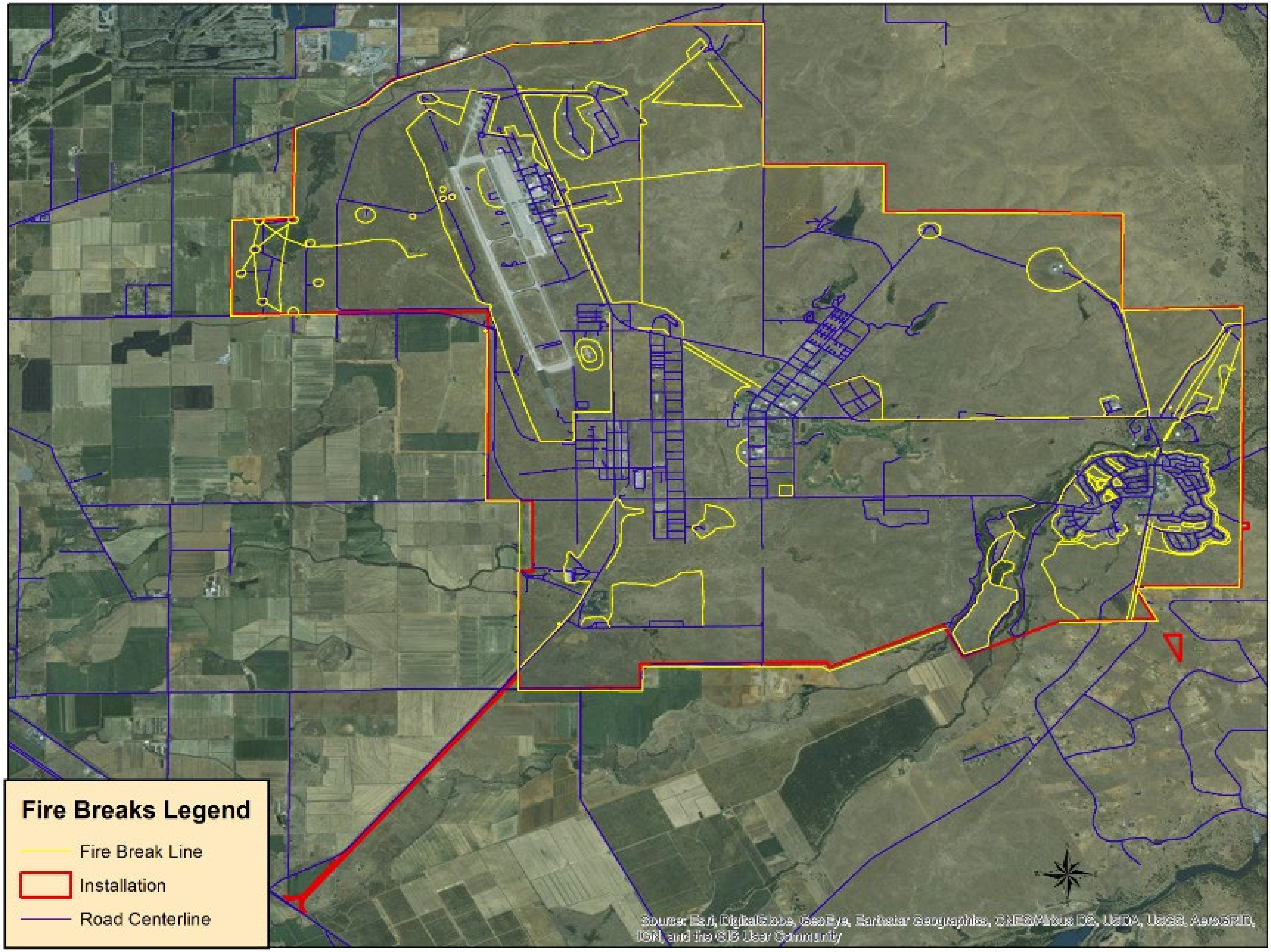
3.9 Debris Burning

Planned fuels treatments could result in a substantial amount of debris. It is critical for this debris to either be removed using prescribed fire or other methods. By not removing the debris, suppression efforts will be hindered due to the amount of fuel available for consumption by a wildfire. While debris burning has not been extensively used on BAFB, future debris burning is possible and is approved if burning is done in accordance to the AF PFP template (see Appendix 3.4 or the AFCEC/CZOF) at a minimum. All applicable state regulations for debris burning will be followed.

3.10 Fire and Fuel Break System and Maintenance Plan

Major firebreaks at BAFB include mineral firebreaks around the family housing area, medical facility, weapons storage area, EOD area, and gun range, as well as mineral firebreaks adjacent to the installation boundary. Major firebreaks at LCAS include mineral firebreaks adjacent to the installation boundary. These will be kept in a vegetation-free state, except where they cross wetlands or streams. Here, they will be shredded or left in their natural condition. Minor firebreaks are those adjacent to prescribed fire units and will be reopened in preparation for prescribed fire implementation and rehabbed afterward. Their character, i.e., mineral or masticated, will be determined in the PFP preparation process. Mowed firebreaks or other protective measures will be created around any ground water monitoring and extraction wells in any prescribed fire unit to ensure that they are properly protected from the fire. Shredding will also occur prior to the fire season around infrastructure to reduce fire intensity in these areas, especially around communication infrastructure at LCAS. Fireline construction (handlines, scraped firebreaks, etc.) will avoid all sensitive habitats and active wildlife dens. See Figure 3.9 and Figure 3.10 for firebreaks at BAFB and LCAS, respectively, in relation to prescribed burn units. Firebreaks on BAFB are shown in Figure 3.17.

Figure 3.17: BAFB Fire Break Map



3.11 Asset and Infrastructure Protection Plan

No known asset or infrastructure protection plan exists currently for the installation. A stand-alone plan is recommended to be composed during future WFMP revision processes. For any asset protection plan, firefighter and public safety is the first priority. There is no standardized template for such a plan but several helpful resources are available on the Forests and Rangelands CWPP webpage, including *Preparing a Community Wildfire Protection Plan: A Handbook for Wildland-Urban Interface Communities*, March 2004 and *Community Guide to Preparing and Implementing a Community Wildfire Protection Plan*, August 2008. The following steps are recommended for plan preparation:

- Convene decisionmakers.
- Involve Memorandum of Understanding (MOU)/MAA agencies and the USFS.
- Engage interested parties.
- Establish an installation base map.
- Develop a risk assessment.
- Establish installation hazard reduction priorities and recommendations to reduce structural ignitability.
- Develop an action plan and assessment strategy.
- Finalize the asset and infrastructure protection plan.

The WFPC will lead the development of this plan.

Chapter 4. Wildland Fire Operational Guidance

4.1 Management of Wildfires (Unplanned Ignitions)

Any incident or wildfire reported on base will be assessed by the WFPC or his designee. After the condition assessment, FES personnel will be recalled if warranted. FES will continue to attack any fires until they are contained. If at any point, FES can no longer actively contain the fire, the E-911 Center would be contacted by the on-scene IC. At this point, the WFPC would become the base liaison to the state IC to ensure that the base mission is thoroughly considered in all efforts and actions to contain the fire.

BAFB will in the future host a WSM. The nearest WSM is currently located at Vandenberg AFB in Southern California. The WSM will provide a high-quality resource to assist with wildland fire management on BAFB. The WSM will provide wildland fire management support activities such as fuels treatment planning, conducting training for NR and FES personnel and implementing prescribed fire on BAFB and on Temporary Duty (TDY) status to other AF installations in California. The WSM is available for wildfire suppression if requested by FES and if available.

Fire management on BAFB will include the full suppression of all wildfires impacting or threatening human safety, infrastructure, and natural or cultural resources. Wildfires not impacting these resources will be allowed to burn for ecological benefit. Suppression response will be swift and appropriately sized based upon the IC's size-up and resource needs to contain all new ignitions within 1 operational period. The primary objective of initial attack and extended attack operations will be wildland fire suppression performed prioritizing firefighter and public safety over all other considerations. Protection of cultural and biological resources will be prioritized, but protection of those resources will be secondary to the primary objective. Strategies and tactics used will be at the discretion of the IC to achieve the suppression objectives with the following considerations as guidance:

Natural Resources Checklist

- If possible, consult the CRM and NRM or their representative Resource Advisor (READ) prior to the usage of heavy equipment in firefighting operations. Inform the CRM of cultural sites discovered during wildland fire operations.
- Use MIST to the greatest extent possible in sensitive cultural areas and in or near wetlands, particularly vernal pools.
- Retardant will not be used within 300 feet of any drainage, wetland, vernal pool, or other water source. The only exception to this rule will be for the protection of life or safety (public and firefighter).
- Repair ground disturbed by suppression activities to pre-incident condition.
- Natural recovery is the preferred choice for recovery following wildfires. However, when natural recovery is not likely, ES treatments may be needed to prevent further

degradation of cultural and natural resources in the burned area. Any seeding or planting will use seeds and plant materials from native sources whenever feasible.

If a wildfire exceeds the capacity of the installation personnel to contain, then assistance will be requested from surrounding FDs with MOUs/MAAs in place as well as CAL FIRE. If an incident transitions into extended attack despite these local mutual aid resources' assistance, AFCEC/CZOF and the Northern California Geographic Area Coordination Center (ONCC) will be notified immediately. Additionally, an MOU with ONCC will be formalized going forward.

4.1.1 Preparedness

Preparedness is defined as activities that lead to a safe, efficient, and cost-effective fire management program in support of land and resource management objectives through appropriate planning and coordination prior to wildfire ignitions. This includes actions which are completed on a routine basis prior to each fire season as well as actions conducted in response to increasing fire danger. Preparedness activities need to be scaled to available funding each year and will prioritize the goals and objectives of the INRMP. Some examples of preparedness are:

- Pre-season wildfire planning with state and local coordinators.
- WUI assessments on-installation and with adjacent landowners.
- Tactical and initial response planning.

There is currently no stand-alone wildfire preparedness plan in place at the installation. The following is a list of preparedness efforts suggested for FES and NR to undertake with BAFB cooperators to improve wildfire preparedness:

- Obtain NWCG training and complete necessary Position Task Books (PTBs) for all FES and/or NR personnel assigned to wildfires or participating on prescribed fires, commensurate with the position being held on the incident/project.
- Maintain NWCG compliant equipment, typed appropriately and stocked to Normal Unit Stocking (NUS; also referred to as National Unit Stocking or Normal Unit Strength; see Appendix M of the NFES 2724, *Interagency Standards for Fire and Aviation Operations*, January 2017 [Red Book]) levels, for on-installation initial attack suppression assignments as well as off-installation extended attack details.
- Conduct daily equipment checks to ensure readiness.
- Conduct an annual wildfire readiness review utilizing interagency standards.
- Conduct WUI assessments on-installation and with adjacent landowners.
- Conduct annual interagency cooperator meetings with all wildland fire stakeholders to increase collaboration and thereby safety and efficiency of efforts.
- Conduct annual initial/extended attack wildfire drills with local interagency cooperators, to be coordinated by the WFPC and hosted by FES.

Though fire weather conditions are monitored through ONCC, there are no additional preparedness activities or readiness drills currently in place. It is recommended that annual drills, WUI Assessments, and pre-season wildfire planning with state and local coordinators will be implemented.

4.1.1.1 Training and Qualifications

Standards for fire job position certification, required training and experience, physical fitness testing, and medical examinations will follow the guidelines of the NFES 2724, *Interagency Standards for Fire and Aviation Operations*, January 2017 (Red Book), the PMS 310-1, *Federal Wildland Fire Qualifications Supplement*, January 2017 (PMS 310-1 Supplement), and additional guidance from AFCEC/CZOF.

The IQCS is the official wildland and prescribed fire system or record used by the federal government. It serves as the official repository of incident management positions performance standards and their respective qualifications and certification requirements. IQCS is used to track personnel information related to an individual's qualifications, certification currency, and history. The PMS 310-1, developed under the sponsorship of the NWCG, is designed to:

- Establish minimum requirements for training, experience, physical fitness level, and currency standards for wildland fire positions, which all participating agencies have agreed to meet for national mobilization. Standards may be augmented to meet specific needs within an agency, but the augmentation cannot be imposed by an agency on its cooperators who meet the minimums outlined in this guide.
- Allow cooperating agencies to jointly agree upon training, experience, physical fitness level, and currency standards to meet fire management needs for wildland fire (which includes wildfire and prescribed fire).
- Establish minimum qualifications for personnel involved in prescribed fires on which resources of more than 1 agency are utilized, unless local agreements specify otherwise. Any organization or agency providing resources to fill a national interagency request for all types of wildland fire incidents will meet the minimum NWCG requirements described in this guide. NWCG recognizes the ability of cooperating agencies at the local level to jointly define and accept each other's qualifications for initial attack, extended attack, large fire operations, and prescribed fire.

4.1.1.1.1 Training and Qualifications Responsibilities

AFCEC/CZOF is responsible for certifying and re-certifying qualifications of AF personnel based upon the documentation provided by the WFPC and in accordance with the PMS 310-1. The following are responsibilities as they relate to training and qualifications:

- WFPC:

        - The WFPC is responsible for providing AFCEC/CZOF with documentation of all wildland fire training, completed PTBs, and work capacity tests.

        - Coordinate with the AFCEC/CZOF Training Manager for all matters regarding training and qualifications.
- Commanders, Directors, Supervisors, and Leaders:
    - Ensure individuals assigned to ICS positions are qualified.
    - Ensure individuals are available for scheduled training.
    - Notify the WFPC when qualification of personnel expires.
- IC:
    - The supervisor or IC on an incident is responsible for managing a training and qualification program on the incident, should one be used.
    - Consider the qualifications of outside FDs or cooperating responders for duties at the incident.
    - Ensure qualified/certified personnel are assigned fire duties.
    - Ensure that when personnel are assigned in a trainee position they are directly supervised by someone who is fully qualified.
- Individual Firefighters:
    - Responsible for showing proof of qualifications and completing training.
    - Responsible for informing their supervisor when qualification requirements have expired.

A complete work chart breakdown for all NWCG positions can be found in the PMS 308, *NIMS Wildland Fire Qualification System Flow Chart*, October 2015. Standards for fire job position training and experience, annual refresher training, physical fitness testing, and medical examinations will follow the guidelines of the NFES 2724, *Interagency Standards for Fire and Aviation Operations*, January 2017 (Red Book), AFCEC/CZOF, and the installation (for AF-specific positions).

All military, civilian, contractor, and emergency services personnel involved in wildland fire management must possess certifications appropriate for their expected level of involvement in the wildland fire organization. All AF personnel must meet applicable NWCG standards for wildland fire activities. Any instructor utilized must be NWCG qualified and must adhere to the standards stated in PMS 901-1, *Field Manager's Course Guide*, April 2017. Additionally, AF personnel who participate in wildland fire activities will be certified, as a minimum requirement, in Cardio-Pulmonary Resuscitation (CPR) and Standard First Aid by the American Red Cross or comparable certification authority. All personnel operating ATVs or UTVs on the fireline are required to obtain ATV/UTV safety certification from the ATV Safety Institute (ASI) or an equivalent certifying agency. ATV operator certification is valid five (5) years, though biennial refresher training is recommended.

All personnel that are assigned to a wildfire beyond the initial response or participating on a prescribed fire are required to successfully complete as a minimum IS-100.b – Introduction to the Incident Command System, IS-700.A – NIMS An Introduction, S-130 – Firefighter Training, S-190 – Introduction to Wildland Fire Behavior, and L-180 – Human Factors in the Wildland Fire Service in addition to the Work Capacity Test (WCT) at the arduous level. This can be completed entirely on-line, except for the instructor-led one-day field exercise. Onsite firefighters will be physically capable of firefighting and know how to operate the necessary equipment.

All assigned BAFB FES personnel, whether on wildfires or prescribed fires, must meet NWCG training standards. Individuals will not be assigned to duties for which they are not adequately trained or certified, unless they are assigned as a trainee under the direct supervision of a qualified person. The PMS 310-1 and PMS 310-1 Supplement will be used for standard training requirements for wildfire and prescribed fire positions.

4.1.1.1.2 Fitness Standards

Personnel assigned to wildland fire duties are required to meet fitness standards in the PMS 310-1 and PMS 310-1 Supplement specified for ICS position to which they are assigned. Both FES personnel and NR employees are required to annually complete both the RT-130 – Annual Fireline Safety Refresher Training (8 hours) and the WCT, in accordance with the PMS 307/NFES 1109, *Work Capacity Test Administrator's Guide*, April 2003, appropriate to their qualifications. Personnel not possessing the level of NWCG qualification pertinent to the position they are fulfilling on a wildfire incident or prescribed fire project, shall not be allowed onto the fireline.

4.1.1.1.2.1 Fitness Categories

The following are descriptions of the level of work capacity for the 4 fitness categories:

- ***Arduous:*** Duties involve fieldwork requiring physical performance, over an extended period, calling for above-average endurance and superior conditioning. These duties may include a demand for extraordinarily strenuous activities in emergencies under adverse environmental conditions and over extended periods of time. Requirements include running, walking, climbing, jumping, twisting, bending, and lifting more than 50 pounds. The pace of work typically is set by the emergency.
- ***Moderate:*** Duties involve field work requiring complete control of all physical faculties and may include considerable walking over irregular ground, standing for long periods of time, lifting 25 to 50 pounds, climbing, bending, stooping, squatting, twisting, and reaching. Occasional demands may be required for

moderately strenuous activities in emergencies over long periods of time. Individuals usually set their own work pace.

- ***Light:*** Duties mainly involve office type work with occasional field activity characterized by light physical exertion. Activities may include climbing stairs, standing, operating a vehicle, and long hours of work, as well as some bending, stooping, or light lifting. Individuals almost always can govern the extent and pace of their physical activity.
- ***None:*** Duties are normally performed in a controlled environment, such as an incident base or camp.

4.1.1.1.2.2 Fitness Testing.

The WCT is used to determine whether individuals are fit enough to perform wildland firefighting duties. The individual carries a backpack a prescribed level distance within a prescribed time:

- ***Arduous:*** Individual must carry a 45 pound backpack 3 miles in 45 minutes or less.
- ***Moderate:*** Individual must carry a 25 pound backpack 2 miles in 30 minutes or less.
- ***Light:*** Individual must hike 1 mile in 16 minutes with no pack.

No time adjustment for elevation is given at BAFB.

Personnel in the NR Job Series whose job descriptions state they are Primary or Secondary Wildland Firefighters are required to meet the Arduous fitness criteria annually. AF personnel, contractors, and volunteers that serve as collateral duty wildland fire personnel must meet the appropriate fitness level for the position they are performing in accordance with standards in the PMS 310-1.

AF personnel whose job description requires participation in wildland fire management activities as a Primary or Secondary Wildland Firefighter on AF installations must meet the pre-employment medical and physical examination criteria contained in the most recent version of NFPA 1582, *Standard on Comprehensive Occupational Medical Program for Fire Departments*.

4.1.1.1.3 Training Method

The following describes the training method:

- Wildland Firefighter Qualification Program is an “educational-based” and “performance-based” qualifications program that aligns with the NWCG qualification system. In this program, the primary criteria for qualification is an individual’s education in the courses appropriate to the qualification, and hands on performance as observed by qualified individuals using approved standards.

- The educational base of the program uses the completion of approved training courses with a passing score on an examination.
- The performance base of the program uses hands on evaluation under realistic conditions to ensure potential performance under live field conditions and is recorded in an individual's PTB.
- Qualification is based upon completion of NWCG formal classroom instruction followed by demonstrating the abilities to perform the position in the completion of an NWCG PTB.

4.1.1.1.4 Training Components

The following describes the training components:

- ***Courses of Instruction:*** Courses of instruction have been developed by the NWCG and Federal Emergency Management Agency (FEMA) for each position in the ICS in accordance with NIMS. These courses have been designed to teach the basic information required to gain a general understanding of the position and provide technical knowledge required to perform duties required by the job. These courses are like college courses in that they start out at a basic level (100 level basic firefighter skills) and work up through higher levels of the ICS (up to 500 level national ICS skills). Courses are to be taught by trained and qualified instructors, experienced in the skill being taught. In all cases, only qualified and trained instructors shall be used. Instructor requirements for each course can be found in PMS-901-1.
- ***PTBs:*** PTBs are used to document performance demonstrations. PTBs are NWCG published booklets that apply to a specific position in the ICS. PTBs can be found on the NWCG PTB webpage. A PTB contains all critical tasks that are required to perform a given job. Wildland fire managers and supervisors will use these booklets to keep track of an individual's training experience. There will be a PTB for most positions included in the program. The tasks in each PTB have been established by the NWCG. PTBs have been designed in a format that allows documentation of a trainee's ability to perform each task. Tasks pertaining to tactical decision making and safety are flagged and require a position performance on a wildfire. Remaining tasks can be evaluated through other means such as simulation or other emergency and non-emergency work. Successful completion of all tasks required of the position will be the basis for recommending certification for a specific position in the ICS.

4.1.1.1.5 Initial Certification

The following describes the initial certification:

- Certification of qualifications for a position in the ICS will be documented and tracked by the AFCEC/CZOF Training Manager. Upon completion of each training course the WFPC will forward the documentation to AFCEC/CZOF for entry into IQCS. The WFPC is responsible for providing all records of NWCG training to AFCEC/CZOF. Additionally, AFCEC/CZOF may issue an Incident Qualification Card to all NWCG-qualified personnel at the request of the WFPC.

- The quality of experiences gained in each position will be closely evaluated when making a recommendation for advancement to the next higher position or to a different position. The quality of experience may relate to the number of assignments in which an individual performed, the size of the incident, and the complexity of operations overseen.
- This program will not determine the number of times an individual should serve as a trainee or how many times a given position should be filled before advancement. Determination will be made by the supervisor based upon task evaluations, position performance evaluations, and their own judgment on the quality of an individual's experience. There is however a time limit of 3 years for completing each PTB. Supervisors will submit recommendations for advancement or change in positions to the WFPC who will then furnish the documentation/information to AFCEC/CZOF Training Manager.
- Personnel will not be assigned any wildland fire duties without proper certification. Personnel that are fully qualified in a position may be assigned the next level position as a trainee provided they have an initiated PTB and are directly supervised by an individual that is fully qualified in the position being evaluated.

4.1.1.1.5.1 Training Courses

The following describes the procedures for required training courses:

- Training certification requirements include completion of all NWCG-required training courses and the PTB. Use of the training courses is required to prepare the employee to perform in the position. An employee will not be given a position assignment unless they have completed all necessary training courses training and applicable PTBs.
- Training courses provide the specific skills and knowledge required to perform expected duties. These are available in the PMS 310-1.
- Required training has been held to the minimum required for safe operations on a wildfire. All training will be available and is intended as the primary means by which personnel can prepare for qualification.

4.1.1.1.5.2 NWCG Position Task Books

The following describes the procedures for PTBs:

- NWCG PTBs can be initiated/issued by the FES FC, WFPC, RFMO, or their designees for AF personnel that meet the appropriate pre-requisites in accordance with the PMS 310-1.

- AF minimum standards for certification of a PTB will be in accordance with the PMS 310-1. Standards may be augmented to meet specific needs within an installation or WSM at the discretion of the FES FC, WFPC, RFMO, or their designees.
- Once the PTB and required training are completed and a recommendation for agency certification has been made by the final evaluator, 2 signatures will be required for agency certification. The PTB will be forwarded for review and verification of compliance to the FES FC, WFPC, or RFMO for the first signature on the Agency Certification PTB page (see Appendix 4.1). The PTB will then be forwarded to the AFCEC/CZOF Training Manager for final signature/agency certification and updated in IQCS.

4.1.1.1.5.3 Incident Qualification Card (Red Card) Issuance

The following describes the procedures for issuing Incident Qualification Cards:

- The installation FES FC will submit a request to AFCEC/CZOF for FES personnel requiring an Incident Qualification Card (optional, not a core requirement). This request will state the specific requirement for obtaining an Incident Qualification Card and must be signed by the FES FC. FES personnel that meet NWCG standards as described in the appropriate qualification standards document may be issued Incident Qualification Cards on a case-by-case basis. All installation requests for Incident Qualification Cards must prioritize their personnel.
- For non-FES personnel, the request must come from the local installation WFPC as designated in the WFMP or the RFMO for WSMs. All personnel must meet NWCG standards, including WCT requirements, as described in the appropriate qualification standards document and demonstrate a valid need for the qualification.

4.1.1.1.6 Currency Requirements

The following describes the currency requirements:

- For FES personnel requiring Incident Qualification Cards, the FES FC (or designee) will submit a completed AF IQCS Individual Responder Update Form to AFCEC/CZOF by the end of each month in which their personnel participated in wildland fire activity.
- For non-FES personnel, the AF IQCS Individual Responder Update Form will be submitted by the local installation WFPC as designated in the WFMP or the RFMO for WSMs.
- Unless otherwise noted, the maximum time allowed for maintaining currency is 5 years for all positions. There are exemptions from this rule for dispatch, aviation, and Faller (FAL#) positions, which have a 3-year currency limit.

- Currency requirements for positions may be met by performing the position or may be met by performing any higher position or any specified lower position as identified in the PMS 310-1. This type of position experience will be considered as qualifying only if the individual has previously met all training and prerequisite experience requirements for the position. Serving in a position for which the individual is qualified will maintain the currency of a prerequisite position, if the individual was previously qualified in that position.
- Annual refresher training is required to maintain currency and must cover 4 core topics as a minimum: Entrapment Avoidance, Current Issues, Other Hazards and Safety Issues, and Fire Shelter.
- Re-certification includes evaluation of personnel for certification in cases where position qualifications have been lost because of a lack of current experience. A key component in the certification or re-certification process is the subjective evaluation by management of an individual's capability to perform in a position. Managers can request re-certification of prior qualified personnel by submitting a memo to AFCEC/CZOF stating the reasons for re-certification and any mitigating issues that can show the individual has either maintained or re learned skills necessary to accomplish the job. AFCEC/CZOF may design a specific individual refresher course prior to re-certification.

4.1.1.1.7 NWCG Qualification and Equipment Requirements Specific to Installation

Current BAFB FES personnel NWCG qualifications can be found in Table 4.1. The final column should be completed once qualification tracks are identified for each person.

Table 4.1: Current BAFB FES NWCG Qualifications

FES Personnel	NWCG Qualification	Additional NWCG Qualification Needed
Dennis Reinhardt	-	-
Alec Giles	FFT1, ENGB, CRWB	-
William Hock	FFT1, ENGB, CRWB	-
Steven Dobbs	FFT1, ENGB, CRWB	-
Andy Jasken	FFT1, ENGB, CRWB	-
Brain Atkins	FFT1, ENGB, CRWB	-
Daniel Figar	-	-
Michael Hulcy	-	-
Brian Patterson	-	-

The majority of wildfire responses on BAFB are of low complexity and short (single operational period) duration. However, the potential exists for large fires that could threaten values to protect due to the presence of flashy fuels. To adequately respond to this level of occurrence, the following number and types of NWCG certifications (Table 4.2) are required for BAFB and may be held by FES, the WSM, or MAA agencies. Prescribed fire qualifications will either be held by FES or WSM personnel (Table 4.3).

Table 4.2: Minimum BAFB NWCG Qualification Requirements

NWCG Mnemonic	Wildfire Suppression Position Title	Number Needed per Shift
ICT3	Incident Commander Type 3	1
ICT4	Incident Commander Type 4	2
ICT5	Incident Commander Type 5	4
DIVS	Division/Group Supervisor	1
STEN	Strike Team Leader Engine	1
TFLD	Task Force Leader	1
ENGB	Engine Boss, Single Resource	4
CRWB	Crew Boss, Single Resource	1
FFT1	Firefighter Type 1	4
FFT2	Firefighter Type 2	8
HEQB	Heavy Equipment Boss, Single Resource	2
DZOP	Dozer Operator	2
EMTP	Paramedic	4
FAL2	Intermediate Faller	2
FAL3	Basic Faller	4
INVF	Wildland Fire Investigator	1
Notes: Personnel may hold more than 1 qualification.		

Table 4.3: Minimum BAFB NWCG Prescribed Fire Qualification Requirements

NWCG Mnemonic	Prescribed Fire Position Title	Number Needed per Shift
RXB1	Prescribed Burn Boss Type 1	1
RXB2	Prescribed Burn Boss Type 2	2
FIRB	Firing Boss, Single Resource	4
Notes: Personnel may hold more than 1 qualification.		

4.1.1.2 Readiness

Seasonal preparedness will include readiness reviews prior to the historic fire season for personnel and equipment using standard forms found on the NIFC Policy Reference Materials and Guides webpage. Additionally, an inventory of cache supplies will be conducted on an annual basis. The WFPC will prepare communication and medical plans and they will be reviewed annually. A current frequency list can be found in Appendix 4.2. A proposed readiness activities table can be found in Appendix 4.3.

A step-up plan must be developed by the WFPC utilizing an analysis of historic fire weather. This analysis must identify National Fire Danger Rating System (NFDRS) indices that will be used to determine daily fire danger. The step-up plan must identify staffing levels needed for each adjective level. A proposed step-up plan can be found in Appendix 4.4. The ONCC Predictive Services webpage provides maps showing Northern California fire danger, fuel dryness, weather observations, NFDRS indices, and forecasts. Table 4.4 lists the FES equipment available at BAFB. Table 4.5 lists the NR equipment available at BAFB.

Table 4.4: Current BAFB FES Equipment List

Quantity	Equipment Size	Tank capacity	GPM/PSI
2	Type 3 Engine	500 Gallons	1000 GPM @ 150 PSI
4	UTV	100 Gallons	29 GPM @ 1400 PSI
1	Type 1 Support Water Tender	4000 Gallons	1250 GPM @ 150 PSI
Notes: GPM = Gallons per Minute. PSI = Pounds per Square Inch.			

Table 4.5: Current BAFB NR Equipment List

Quantity	Resource	Location
4	5-gallon Water Backpack Pump	NR Yard
Multiple	Hand Tools: Rakes, Shovels, McLeod	NR Yard
4	Chainsaws	NR Yard
4	Weed Eaters	NR Yard
2	CE Radios and Chargers	Building 2561
Multiple	PPE: Gloves, Hard Hats, Safety Glasses	Building 2561
Multiple	Fire Extinguishers	Building 2561, GOV Trucks
1	Farm Tractor with Blade and Scoop	NR Yard

In order to have a fully compliant and capable wildland fire suppression capability, it is recommended that the additional equipment be acquired by FES (Table 4.6) and NR (Table 4.7).

Table 4.6: Required Additional BAFB FES Equipment

Quantity	Resource	Location
2	Type 2 Dozer with Transport	FES
2	Type 6 Engine	FES
1	Type 3 Engine	FES
3	4-Door 4x4 Half-Ton Truck	FES
1	Type 1 Support Water Tender	FES

Table 4.7: Required Additional BAFB NR Equipment

Quantity	Resource	Location
2	4-Door 4x4 Half-Ton Truck	NR

4.1.1.2.1 Personal Protective Equipment (PPE)

PPE is required for all personnel engaged in wildland fire operations on BAFB. PPE includes the equipment and clothing required to mitigate the risk of injury from or exposure to hazardous conditions encountered during the performance of duty. NWCG standard PPE for wildland firefighting includes the following per person:

- Protective outerwear, such as Nomex® shirt and fire pants.
- Fire resistant gloves.
- Wildland Fire boots:
  - 8-inch minimum boot height.
  - All leather uppers (no synthetic collars or panels).
  - Lace up (no zippers).
  - Defined heel.
  - Oil-resistant soles.
  - Rating of "Good" or "Better" on sole heat resistance.
  - Non-slip sole.
  - No steel toe.
- Hard hat.
- Eye protection.
- Hearing protection.
- Fire shelter ("new generation").
- Web gear.
- Food/hydration.
- IRPG.
- Chainsaw chaps (if applicable).
- Flat (bastard) files (if applicable).

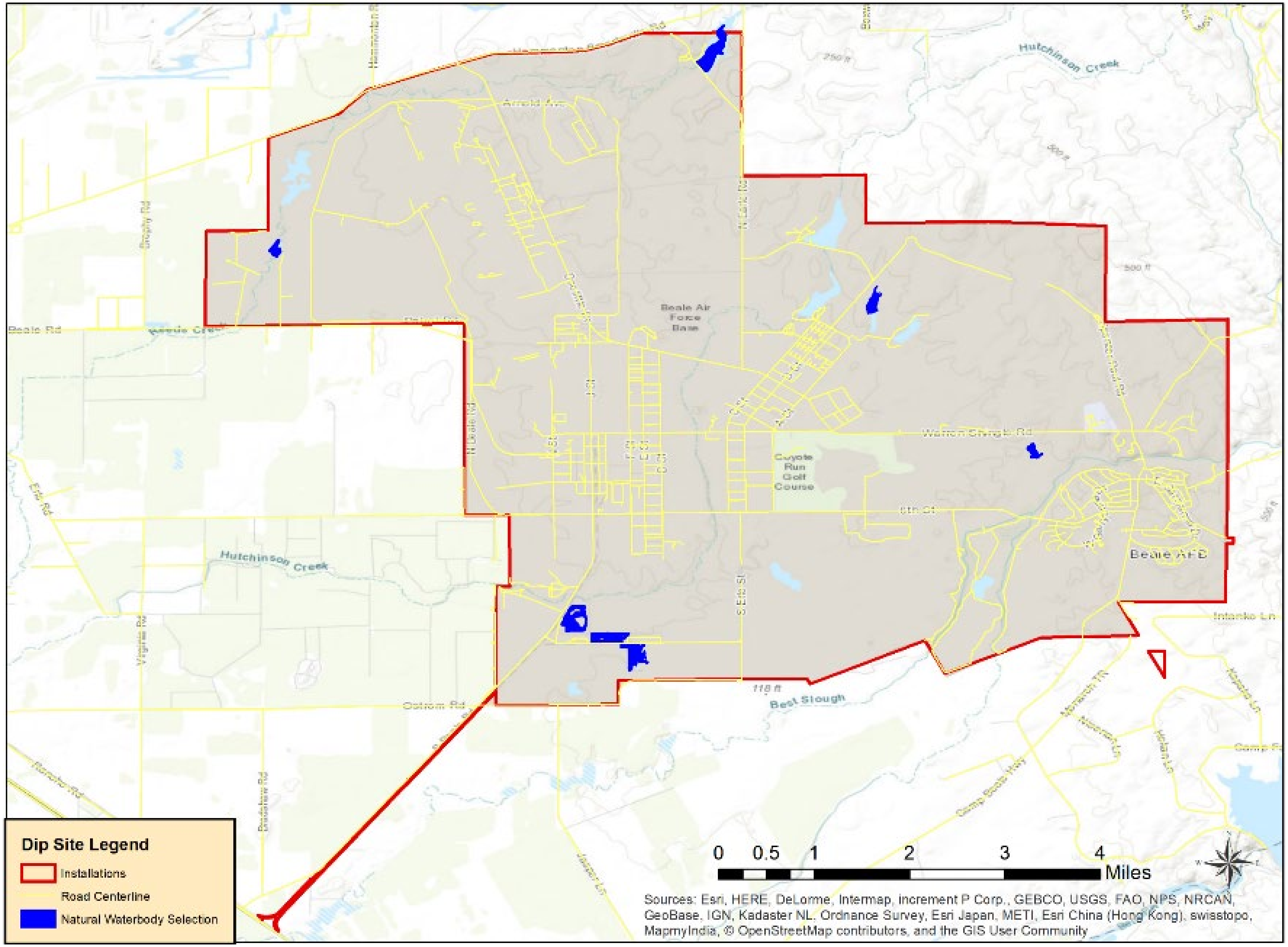
All PPE must meet standards set forth in NFPA 1977, *Standard on Protective Clothing and Equipment for Wildland Fire Fighting*.

4.1.1.2.2 Water Resources

BAFB has multiple water sources available on the installation. The developed areas of airfield, main base, and family housing area are served by hydrants. Numerous wetlands, lakes, and streams can be found across the unimproved areas of the installation and can be used as dip sites when life safety or structures are at risk, though confirmed or potential T&E species habitat within certain water features could trigger costly mitigation measures under the ESA. Known T&E species habitat includes Reeds Creek and Dry Creek. See Figure 4.1 for a map of dip site locations on BAFB along with T&E species locations.

Due to its deleterious effects on drinking water, aqueous film forming foam (AFFF) for firefighting containing perfluorooctanesulfonic acid (PFOS) and perfluorooctanoic (PFOA) organic compounds is being phased out for use by AFCEC. Due to the significant remediation actions required in areas of PFOA/PFOS contamination, use of firefighting foam will be avoided in areas where direct impact or runoff into drinking water sources will occur unless such use is determined necessary by the IC to protect public safety. Should any AFFF be released, a site inspection is required by AFCEC to sample groundwater, surface water, soil, and sediment for contamination. More information on PFOS/PFOA contamination from AFFF can be found in the *Air Force Response to PHOS/PFOA Fact Sheet* (November 2017).

Figure 4.1: BAFB Dip Site Location Map



4.1.1.3 Wildland Fire Aviation Management

Due to the aviation mission at BAFB and the importance of aerial firefighting resources, in the event of a wildfire there may be an inherent conflict between flight operations and wildland fire operations. To ensure the safety of both aerial firefighting resources and military aircraft, if needed the IC will contact the E-911 Center or the control tower to request all aviation missions in the fire area to be halted and attempt to end ongoing missions in the area as quickly and safely as possible to clear the airspace for firefighting resources. If an initial attack wildfire incident is adjacent to the installation boundary, then Yuba County Sheriff's Department will contact the E-911 Center. The E-911 Center will then notify the FES FC or his designated senior official and/or control tower. In the event of an extended attack wildfire on the installation, a Temporary Flight Restriction (TFR) shall be filed with the Federal Aviation Administration (FAA) through the control tower.

Any fire-related aviation operations will follow applicable guidelines of AFI 32-7064 and the NFES 2724, *Interagency Standards for Fire and Aviation Operations*, January 2017 (Red Book), which establishes uniform safety, communications, and organizational standards for firefighting operations across organizations.

4.1.1.4 Wildfire Detection

Early detection of wildfires increases the effectiveness of initial attack response. Any agency, unit leader, or individual noticing a fire is responsible for reporting it to the E-911 Center as soon as it is detected. Although fire occurrence is low, the number of visitors and terrain should allow for relatively easy visual detection of fires by the public or AF personnel.

Weather conditions will be monitored during wildfires and prescribed fires. It is the responsibility of the IC on a wildfire, and the RXB# on a prescribed fire to see that weather conditions are monitored. Weather monitoring may be as simple as estimating wind speed and direction by ocular observation on a small wildfire, to taking regular detailed observations during a prescribed fire using a belt weather kit. Fire behavior expected under the measured weather conditions will be compared with actual behavior on postfire assessments.

Conditions indicating possible adverse fire behavior include:

- Wind speed and RH (see Table 4.8).
- Abundant or dry lightning.
- Shifting winds.
- Dry cold fronts.

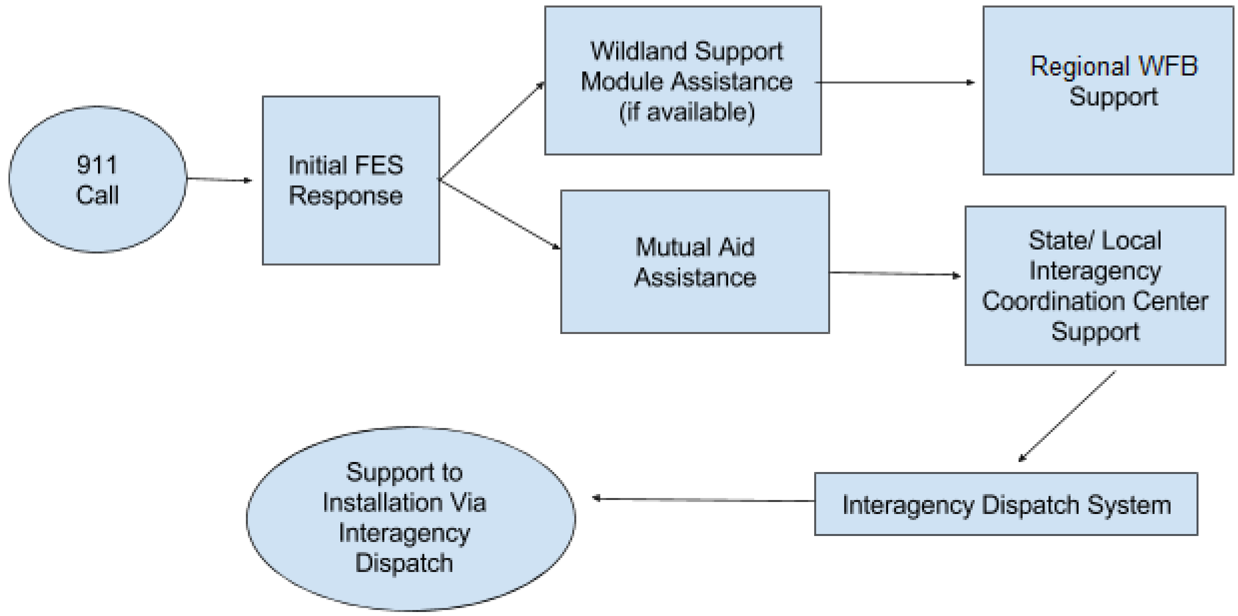
Table 4.8: Wind/RH Red Flag Warning Decision Matrix for Northern California West of the Sierra Crest

RH	Sustained Wind 6-11 mph	Sustained Wind 12-20 mph	Sustained Wind 21-29 mph	Sustained Wind 30+ mph
Daytime Minimum RH 29-42% and/or Nighttime Maximum RH 60-80%				W
Daytime Minimum RH 19-28% and/or Nighttime Maximum RH 46-60%			W	W
Daytime Minimum RH 9-18% and/or Nighttime Maximum RH 31-45%		W	W	W
Daytime Minimum RH < 9% and/or Nighttime Maximum RH < 31%	W	W	W	W
Notes: Matrix assumes daytime ten-hour timelag fuel moisture content (NFDRS observation time) is ≤6%, annual grasses have cured, and no wetting rain (>0.10 inch) has fallen in the past 24 hours. The sustained wind refers to the standard 20-foot, 10-minute average fire weather wind speed. The wind event should be expected to last for at least 8 hours to qualify for a Red Flag warning. [This guidance was developed for Foehn wind events, which normally exceed 12 hours duration, and may last as long as 3-5 days]. A 'W' in the matrix indicates that a Watch or Warning should be considered. Source information can be found here.				

4.1.1.5 Initial Report of Wildfire and Initial Attack Dispatching

BAFB FES is responsible for suppressing wildfires on the installation. Utilizing the AF Incident Management System, the FES FC or his designated Senior Field Officer (SFO) will become the Initial Attack IC of any wildfire on installation property. The IC will initially size up the incident to determine the safest and most efficient Incident Action Plan (IAP) to provide the maximum protection for the safety of personnel, facilities, and natural resources. Typically, an engine crew of 2-3 qualified personnel will be dispatched to wildland incidents for initial attack. The E-911 Center operator will make notifications to the Yuba County Sheriff's Department (Placer County Communications Division for LCAS and Butte County FD for Oroville NEXRAD Site) once size-up information is available. The E-911 Center will also contact the WSM if necessary. All wildland fire personnel will document wildfires on an ICS 214. There are no response time standards for wildfires for BAFB FES. On-installation wildfire response procedures are summarized in Figure 4.2.

Figure 4.2: On Installation Wildfire Response



Current MAAs are required for off installation wildfire response. Response procedures will be written into the MAAs, which must be followed.

4.1.1.6 Use of Decision Support Tools

The WFMP will be the primarily Decision Support Tool for initial attack operations. If implemented in the future, WFDSS will be the primary decision support tool utilized for extended attack operations. WFDSS provides an analytic process for documenting strategic operational decisions to protect values-at-risk and firefighter safety. AFCEC/CZOF will aid the WFPC in completing a WFDSS analysis for each operational period of the fire, should WFDSS be implemented in the future.

Sound operational risk management will be the foundation for all wildfire management plans and activities. Forecast fire weather and expected fire behavior are keys to all management decisions and will be monitored daily. BAFB has a Meteorological Terminal Aviation Routine (METAR) weather station (Marysville, Beale Air Force Base, California – KBAB) onsite. BAFB does not have a Remote Automated Weather Station (RAWS) fire weather station that monitors and calculates NFDRS fire danger onsite. However, there is one about 15 miles to the north at an elevation about 250 feet higher than the highest point on BAFB (Bangor, California – BNGC1), as well as one about 15 miles to the south-southeast at a similar elevation (Lincoln, California – LICC1). This is also the closest RAWS station to LCAS, about 6.5 miles to the east at an elevation about 120 feet higher than the highest point on LCAS. Oroville NEXRAD Site has a METAR weather station (Oroville Municipal Airport, California – KOVE) onsite. The nearest RAWS station is 15 miles to the southeast at an elevation about 650 feet higher than Oroville NEXRAD Site (Bangor, California – BNGC1). Fire weather forecasts are available at NWS Fire Weather webpage. It is the responsibility of the IC on a wildfire, and the RXB# on a prescribed fire to see that weather conditions are monitored.

4.1.2 Wildfire Investigation

Enforcement of policies outlined in the 2016 INRMP follows guidance specified in the Sikes Act and AFI 32-7064. Enforcement activities of all conservation laws and regulations, including the ESA, Migratory Bird Treaty Act, Clean Water Act, and many DoD, AF, and BAFB directives are the responsibility of the Conservation Law Enforcement Officer (CLEO). Security forces are responsible for enforcement of laws and AFI to support natural resources management.

Any fire that damages property, be it installation lands or private property, will be investigated for cause, origin, and responsibility. Investigations may range from a documented determination of cause by an IC to a criminal investigation by a qualified arson investigator, such as a State Fire Investigator or INVF ordered through dispatch or Emergency Operations Center (EOC).

4.1.2.1 Reviews and Formal Investigations

4.1.2.1.1 Informal Reviews

The following are the procedures for informal reviews:

- All wildfires and prescribed fires will be informally reviewed. All informal reviews will be conducted as constructive critiques aimed at determining the facts related to the specific fire. Reviews are intended to resolve operational issues, not impose punitive actions. Reviews are also conducted for the following purposes:
    - To examine the progress of an ongoing fire incident and to confirm effectiveness of decisions or to correct deficiencies.
    - To identify new or improved procedures, techniques, or tactics.
    - To determine the cost-effectiveness of a fire operation.
    - To review the safety of suppression actions.
    - To review the effectiveness of the ICS.
    - To examine impacts to natural resources.
    - To provide lessons learned for future responses to minimize impact to natural resources.
- The WFPC or comparable NR staff members can conduct informal reviews. Informal reviews alone are sufficient for all fires less than 4 hectares (10 acres) in which no unusual events occurred.

4.1.2.1.2 After Action Reviews (AAR)

AARs are conducted by participating personnel immediately after all wildfire suppression actions and prescribed fire operations. The IC and other personnel as needed will review each significant initial attack, and all extended attack operations. AARs for prescribed fires will be held by the RXB#. The purpose of these reviews will be to address safety, organizational, operational, fiscal, and biological issues with regard to suppression actions on wildfires and to offer a venue for learning opportunities on all fire operations. Following a major wildfire incident, the WFPC will conduct an AAR immediately after containing the fire. The AAR will be included as a portion of the Wildland Fire Investigation Report (WFIR). The NRM will be consulted to provide feedback on biological issues encountered during the fire.

4.1.2.1.3 Formal Investigations

The following are the procedures for formal investigations:

- The Installation Commander will decide after any major incidents if a formal investigation is necessary. The Installation Commander will base this decision on advice or recommendations from the fire investigator(s), the Staff Judge Advocate, Inspector General, or the NRM or designee. If the Installation Commander deems a formal investigation is required, an investigating officer or review board shall be assigned to conduct a formal investigation. Formal investigations will be executed in accordance with AFI 32-2001. The Installation Commander shall review the findings and recommendations of the assigned investigating officer or review board.
- Normal post-fire investigations (like structural fires) will be conducted by the WFPC or FES. These offices will act together to form a team to investigate and determine the cause of the fire. A qualified INVF will head this investigation team.
- Surveys:
  - Besides reports and reviews that are completed after a wildfire, a post-fire survey of the burned area will be required depending on the fire's location and vegetation damaged. The post-fire analysis will be combined with any of the informal or formal investigations. A post-fire analysis will need to determine all or some of the following:
    - The effect the fire may have had on native or non-native flora and fauna resources and cultural resources.
    - The effectiveness of the pre-suppression measures to include fuels modifications.
    - The effectiveness of the suppression measures used.
    - The effectiveness of fire/fuel models used.
  - A post-fire survey of the fire area will be conducted with the coordination of the NR element.

        - The effects of fire on T&E species or effects from catastrophic fire events must be surveyed at the earliest possible time. Soliciting support from other cooperators or contracting subject matter experts is encouraged.
        - If during the survey, it becomes evident that a wildfire has affected a T&E species, the USFWS will be notified by the NRM.
- Post-fire analysis will be made to determine the effects of the fire as described in Section 5.2.1. This analysis should be completed prior to the following wet season and be incorporated into normal land/natural resource condition studies. Data will be gathered to the extent possible and shared with other cooperating agencies to better understand the fire ecology of BAFB.
- Damaging fires may require post-fire restoration, rehabilitation, and revegetation. This may involve dead and down timber removal, planting or seeding trees, or erosion mitigation.

4.1.3 Wildland Fire Mutual Aid and/or Cross Boundary Operations

AF installations are encouraged to develop regional partnerships for wildland fire management support by means of reciprocal agreements with other federal, state, local and private entities to share human, logistical, and operational resources (see Section 13.3.3 of AFI 32-7064). Emergency assistance and MAAs will conform to the guidelines stated in DoDI 6055.06 and AFI 32-2001.

Requests for mutual aid by the BAFB IC or outside agency requests for installation resources will be routed through the E-911 Center. Requests for air support are made through CAL FIRE Grass Valley Interagency Emergency Command Center. The FES FC, 9 CES/CC, the 9 MSG/CC, and the 9 RW Commander are all immediately notified of the mutual aid requested or provided.

The E-911 Center is the central dispatch entity for fire protection assets. The center will be the information source for wildfire status, deployment of resources, and initial contact point for responding mutual aid resources. The center is tasked with all fire ground communications that are directed to mutual aid agencies and is the link between the IC and Yuba County Sheriff's Department (Placer County Communications Division for LCAS and Butte County FD for Oroville NEXRAD Site). Once inbound mutual aid resources have arrived at a predetermined staging area, appropriate ground communication links between mutual aid agencies and command will be established.

BAFB currently has MAAs with the following entities:

- CAL FIRE/Yuba County Operational Area Fire and Rescue Coordinator's Office.
- CAL FIRE/Placer County FD.
- Linda Fire Protection District.

- Marysville FD.
- Olivehurst FD
- Smartsville Fire Protection District.
- Wheatland Fire Authority.

It is recommended that MAAs be made with the following entities:

- CAL FIRE/Butte County.
- Oroville FD.

Copies of each of these MAAs are located in Appendix 1.1. These MAAs will be revisited on an annual basis collaboratively between the assisting entity, the FES FC and the WFPC.

Unified command will be established when the installation is responding to a vegetation fire that has crossed or is likely to cross an installation boundary.

4.1.4 Wildland Fire Incident Management

Wildfires occurring on AF managed lands will have a response consistent with firefighter safety, known and potential hazards, and resource values-at-risk. Consistent with Department of Homeland Security (DHS) Presidential Directive/HSPD-5, *Management of Domestic Incidents*, 22 February 2003, AF wildfire response will incorporate NIMS standards into the organizational structure to facilitate cooperation and integration with other federal and state wildland fire organizations across jurisdictional boundaries.

Installation resources will conduct initial attack of wildfires, and will be dispatched through the E-911 Center. The primary objectives will be firefighter and public safety. The NFES 2724, *Interagency Standards for Fire and Aviation Operations*, January 2017 (Red Book) may be used as a reference. ICs will follow the direction in Section 1.5.4 for managing the initial attack response. A *Wildland Fire Risk and Complexity Assessment* (WFRCA) may be completed to determine the proper level of IC or IMT needed. In addition to the preceding link, this form can be found in the PMS 210. If the fire moves into extended attack, another WFRCA may be completed. Typically, an extended attack fire would be indicative of a Type 3 incident. The vast majority of fires on BAFB are of Type 4 or Type 5 complexity.

If a Type 2 or Type 1 IMT is recommended by the WFRCA, the WFPC must discuss the order with the Wing Commander and AFCEC/CZOF. The order would then be placed through ONCC. Within California, the ONCC and the Southern California Geographic Area Coordination Center (OSCC) share 4 Type 1 and 7 Type 2 IMTs. In addition, CAL FIRE has an additional 6 IMTs. Any order for an IMT, whether it be Type 1 or Type 2, would need to come from the installation WFPC in consultation with AFCEC/CZOF, and would ultimately be routed to ONCC for fulfillment. It is highly recommended that BAFB establish an MOU with ONCC.

4.1.4.1 Dispatching beyond Initial Attack

The WFPC will notify AFCEC/CZOF of any wildfire on or threatening AF infrastructure as soon as practical. Reports will include as a minimum, the date, fire name, fire location (latitude and longitude), total fire area, number of resources assigned, injuries to date, and an assessment of damage to infrastructure, and geospatial data as it becomes available.

A daily report will be provided by the WFPC to AFCEC/CZOF for any wildfires that remain uncontrolled beyond 24 hours. This report will include growth potential, current and expected weather conditions, values-at-risk, resource needs, and multi-jurisdictional agency involvement.

Wildfires 100 acres or larger in timber fuels, or 300 acres or larger in grass fuels will require completion of an Incident Status Summary (ICS 209) daily for the incident duration. The ICS 209 will be sent to ONCC and AFCEC/CZOF.

The IC will notify the E-911 Center and the WFPC whenever it appears a fire will escape initial response efforts, leave installation lands, or when fire complexity will exceed the capabilities of command or operational forces. Additional resources needed beyond MAA resources will be ordered by the E-911 Center first through standing MOUs and then through ONCC, which will mobilize any additional resources, including higher level ICs, IMTs, or additional operational resources.

The E-911 Center or WFPC will notify AFCEC/CZOF, which will aid with extended attack support such as assisting the WFPC complete a Delegation of Authority, if needed.

4.1.4.2 Delegation of Authority to IC

The WFPC will ensure that a Delegation of Authority is provided to all qualified ICs, of any type, that command or may command a wildfire on BAFB of any size. This includes an annual Delegation of Authority provided to all initial attack ICs (Type 5 and Type 4) on the installation. A sample *Agency Administrator's Delegation of Authority to the Incident Commander* can be utilized to create a BAFB-specific Delegation of Authority for future use. The installation will use the current AFI 32-7064 or the NFES 2724, *Interagency Standards for Fire and Aviation Operations*, January 2017 (Red Book) for supporting guidelines which include the Agency Administrator's Briefing to IMT.

4.1.4.3 Resource Allocation and Prioritization

In the event of multiple ignitions on the installation, the IC will prioritize the suppression response. The protection of life, property, and resources must be considered in that order when determining priorities. Fires in the initial attack phase would also generally be given higher priority than those in the extended attack phase.

The Annual Operating Plan (AOP) developed in conjunction with local cooperators during the annual meeting must outline the priority process and determine a decision-making matrix. If significant fire activity is occurring on lands managed by the cooperators group, a local Multi-Agency Coordinating Group (MAC Group) may be initiated.

4.1.4.4 Wildfire Reporting Requirements

Initial response reporting for all wildfires is accomplished through Automated Civil Engineering System – Fire Department (ACES-FD) by the responding FES. In the event a wildfire exceeds the capability of the local FES and a WSM is called to assist, the WSM Lead will retrieve the ACES-FD fire report, complete an AFCEC/CZOF Fire Report form, collect BAFB's Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE)-compliant geospatial dataset, and submit it to AFCEC/CZOF for inclusion in the Wildland Fire Database.

AFCEC/CZOF integrates ACES-FD records not captured by a WSM into the AFCEC/CZOF database, and uses remote sensed satellite imagery and other GIS data to map and analyze wildland fire perimeters that can be detected.

FES utilizes the Fire Emergency Response Network System (FERNS) and National Fire Incident Reporting System (NFIRS) for documenting wildfire starts on the installation. Additionally FES completes the following ICS forms as part of an IAP:

- ICS 201 – Incident Briefing (initial size-up only).
- ICS 202 – Incident Objectives.
- ICS 203 – Organization Assignment List.
- ICS 204 WF – Division/Group Assignment List.
- ICS 205 – Incident Radio Communications Plan.
- ICS 205A – Communications List.
- ICS 206 WF – Medical Plan.
- ICS 207 – Incident Organization Chart.
- ICS 208 – Safety Message/Plan.

For significant wildfires affecting AF assets or missions, AFCEC/CZOF, in partnership with the installation, provides updates to the AFCEC Environmental Management Directorate Operations Branch (AFCEC/CZO) for dissemination to AF and DoD leadership. As soon as practical, the installation WFPC will report any significant wildfire incident that occurs on or threatens property under AF jurisdiction to AFCEC/CZOF via the RFMO.

A significant wildfire incident is defined as:

- Any wildfire greater than 100 acres.
- Any wildfire, regardless of size, that has met any of the following criteria:
  - Significant threat to installation infrastructure/resources.
  - Major or extended impact on AF missions.
  - Loss of life.
  - Negative impact to public health and safety.
  - Threat to T&E species.

Significant wildfires defined by threat to T&E species will also be reported to the AFCEC/CZOW ISS.

At a minimum, reports will include the following:

- Date.
- Fire name.
- Fire location (latitude and longitude).
- Fire size(acres).
- Number of personnel/resources involved.
- Fire injuries.
- Infrastructure damage.
- Geospatial data on fire boundary (if available).

For uncontrolled wildfires lasting more than 24 hours, the installation WFPC will provide AFCEC/CZOF, via the RFMO, a daily report on the potential for fire growth, current and expected weather, resource values-at-risk, multi-jurisdictional agency involvement, and information on additional resources needed. For any wildfires greater in size than 100 acres in timber fuel types or 300 acres in grass fuel types, information will need to be reported to ONCC.

An AFCEC/CZOF level review will be conducted if any of the following occur:

- Fire crosses the installation boundary onto another jurisdiction.
- Fire resulted in adverse media attention.
- Fire involved serious injury or death, significant property damage, or has the potential to do so.
- Fire results in controversy involving another agency.

All entrapments and fire shelter deployments will be reported and investigated as soon as possible after the deployment incident.

For instructions on reporting, contact AFCEC.CZOF.FIRECENTER@US.AF.MIL.

4.1.4.5 Wildfire Damage Repair

The NRM is responsible for evaluating wildfire suppression damage, recommending repair needs, and monitoring repair measures to ensure that the area is restored to as close to the natural condition as possible. For incidents suppressed during initial attack, this damage will be assessed by the NRM following the issuance of a containment declaration by the IC. While firefighting resources are still on scene to perform repair work, as appropriate, and without jeopardizing the control declaration, fireline and other damage caused by the suppression of the wildfire will be repaired.

For extended attack incidents, a READ with biological expertise can be ordered by the AFCEC/CZOF AFMO through the Resource Ordering and Status System (ROSS), who will be assigned to the fire and will work with the NRM to assess wildfire suppression damage and coordinate with Operations to perform repair work to sections of fireline, as they are no longer needed, and to repair any infrastructure damaged because of suppression forces and actions. Repair of suppression damage will occur prior to crew release from the fire and will include at a minimum the following:

- Removing all trash from incident facilities, work areas, and firelines.
- Replacing soil dug from firelines to refill them to level, adding water bars as needed.
- Felling and bucking up hazardous trees and snags.
- Flush cutting all stumps as close to ground level as practicable.
- Rolling back and compacting sod overturned by plowing (with a grader or by hand) to preserve native grass root stock.
- Identifying and inventorying potential invasive plant species in suppression areas.

4.1.4.5.1 Emergency Stabilization (ES)

ES refers to planned actions to stabilize and prevent unacceptable degradation to natural and cultural resources, to minimize threats to life or property resulting from the effects of a fire, or to repair, replace, or construct physical improvements necessary to prevent degradation of land or resources. BAER refers to an agency response to a wildfire implementing the ES program.

Each installation will determine if the emergency nature of a fire event warrants the development of a BAER plan. If so, the BAER plan must be developed expeditiously and is frequently developed by a local unit or designated BAER team. The WFPC is responsible for ordering or assigning teams to develop BAER plans. The installation may not have sufficient expertise to conduct burned area assessments. Resource specialists from cooperating installations, partner agencies, and/or the AFCEC/CZOF may be needed to assist in developing a BAER plan. It is the responsibility of NR to immediately implement the recommendations in the BAER plan.

A BAER plan is an ES document that specifies treatments approved to implement post-wildfire ES policies on an individual incident. This plan/report is prepared by an interdisciplinary team of specialists during or immediately after the containment of a wildfire. USDI uses the term "plan" and the USFS uses the term "report". The ES plan and BAER plan are synonymous. The *Interagency Burned Area Emergency Response Guidebook*, Version 4.0, February 2006 provides guidance on how the USDI and USFS implement the ES program and may be useful to guide ES actions on BAFB and its GSUs.

4.1.4.5.2 Burned Area Rehabilitation (BAR)

BAR refers to non-emergency efforts undertaken within three years of a wildfire to repair or improve fire-damaged lands which are unlikely to recover to management approved conditions, or to repair or replace minor facilities damaged by fire.

A BAR plan is a document that specifies treatments required to implement post-fire rehabilitation policies. This plan may be programmatic (prepared in advance) and applicable to clearly defined types of incidents and situations, or prepared by an interdisciplinary team of specialists (BAR team) during or immediately following the containment of a wildland fire. The *Interagency Burned Area Rehabilitation Guidebook*, Version 1.3, October 2006 provides guidance on how the USDI implements the BAR program and may be useful to guide BAR actions on BAFB and its GSUs.

Chapter 5. Monitoring and Evaluation

5.1 WFMP Review and Updates

WFMPs will be reviewed annually and updated as outlined in the national WFMP review process in the AFCEC/CZOF Playbook. The WFPC and NRM are responsible for determining WFMP updates needed annually. Revisions of WFMPs will be required during the completion of a new (or significantly revised) INRMP and thus will follow the revision schedule of the INRMP from that point forward.

This WFMP will undergo an annual review process to determine the validity of the content and whether any changes/updates are needed. At BAFB this process is performed by the FES FC and Deputy FC and verified by the NRM. A table for keeping track of the Annual Review History can be found in Appendix 5.1. Signatures of the WFPC, NRM, and BCE are required on the Annual Review History.

5.2 Treatment Effectiveness Monitoring

5.2.1 Fire Effects Monitoring

Fire effects monitoring is the short- and long-term data gathering done prior to and after each prescribed fire to show trends. This data collection will show the level of effectiveness that an activity will or will not achieve. Monitoring schedules will be made based upon the objective(s) of the prescribed fire. This will ensure the timely capture of data so that the success or failure to achieve objective(s) may be evaluated. Several methods of monitoring are available to choose from once objectives and limitations are defined. The NR staff will be responsible for collection and storage of this data. Wildlife monitoring shall also occur in burned areas when necessary, especially if potential effects to T&E or at-risk species were identified.

It may be helpful to determine whether prescribed fire treatments are meeting objectives by assessing the factors such as fuel loading, invasive species cover, native species cover, T&E habitat quality, etc. before and after prescribed fires. There are numerous methods to measure fuel loading, however using a photo series is a good way to minimize the time and cost involved. The *Fuel and Fire Effects Monitoring Guide*, which was developed by the USFWS, may be a useful reference when designing fuels and fire effects monitoring methods. Regardless of the methods used, every fuels monitoring program must be designed to measure whether fuels reduction objectives and natural resources objectives have been met.

WSMs will be used to support pre- and post-fire NR monitoring efforts, guided and directed by the NRM.

5.2.2 Non-fire Fuels Treatment Effects Monitoring

Non-fire fuels treatment effects monitoring is the long-term data gathering done prior to and after each fuels treatment. It can show trends that are supported by non-prescribed fuels management strategies. Several methods of monitoring are available to choose from once objectives and limitations are defined. Proponents of non-fire fuels treatments should pay for and perform monitoring of these treatments, with approval and review by the NRM. For invasive plant issues and monitoring and control actions, refer to the INRMP and other installation or site-pertinent plans.

Conclusion and Recommendations

- BAFB currently has an active prescribed fire program in support of BASH objectives in the grasslands surrounding the runways and the majority of the pastures included in the livestock grazing program. In addition to these areas already on a regular rotation, prescribed fire use on the installation can be expanded to the remaining grazed areas, as well as ungrazed areas. Prescribed fire is also recommended on most grassland areas of LCAS. Recommended prescribed fire fuels treatments can be found in Section 3.5.2.3.

- A non-fire fuels treatment plan will be created to prioritize and map out future chemical and mechanical fuels treatments. Recommended non-fire fuels treatments can be found in Section 3.5.2.3.

- BAFB and LCAS have many firebreaks along the installation boundaries, as well as around critical infrastructure. The minimum annually-maintained permanent firebreaks can be found in Figure 3.9 and Figure 3.10 for BAFB and LCAS, respectively.

- FES currently possesses a low degree of NWCG qualifications for wildfire suppression. While the overall wildfire risk on the installation is low to moderate, a higher level of qualifications are nonetheless necessary for the risk that is present. It is recommended that FES personnel begin training and working on additional PTBs to enhance their qualifications. Recommended minimum NWCG qualifications can be found in Section 4.1.1.1.7.

- FES currently possesses a fair amount of wildland firefighting equipment. Recommended additional equipment can be found in Section 4.1.1.2.

- An annual readiness drill will be conducted annually with all cooperators. The best approach for this annual field exercise is likely to have the WFPC coordinate the event with FES personnel hosting and leading the training exercise. This annual exercise will allow mutual aid cooperators to simulate a rapidly expanding wildfire occurring on BAFB property and threatening WUI resources, while simultaneously building relationships with partners and testing communications interoperability.

- In addition to the annual readiness drill, WUI Assessments, pre-season wildfire planning, and tactical and initial response planning with state and local coordinators will be implemented.

- A stand-alone wildfire preparedness plan will be developed by FES and the NRM.

- A stand-alone asset and infrastructure protection plan will be created to outline mitigation strategies for individual assets at risk.

- A stand-alone readiness activities plan will be created in order to adequately prepare for wildfires. A proposed readiness activities plan can be found in Appendix 4.3.

- A stand-alone step-up plan utilizing NFDRS indicators will be created in order to adequately prepare for wildfires. A proposed step-up plan can be found in Appendix 4.4.

- An MOU will be pursued with ONCC to facilitate access to resources during a wildfire.

WFMP Terminology

Action Plan
Any tactical plan developed by any element of ICS in support of the incident action plan.

Administratively Determined
A person hired and compensated under the Pay Plan for Emergency Workers.

After Action Review (AAR)
A structured review or de-brief process of an event, focused on performance standards, that enables participants to discover for themselves what happened, why it happened, and how to sustain strengths and improve on weaknesses. After action reviews, informal or formal, follow the same general format, involve the exchange of ideas and observations, and focus on improving performance.

Agency
An administrative division of a government with a specific function, or a non-governmental organization (e.g., private contractor, business, etc.) that offers a particular kind of assistance. A federal, tribal, state or local agency that has direct fire management or land management responsibilities or that has programs and activies that support fire management activities.

Agency Certification
The process whereby the employing agency or contractor documents that the individual is fully qualified to perform duties and responsibilities for a specified position.

Agency Administrator
The official responsible for the management of a geographic unit or functional area. The managing officer of an agency, division thereof, or jurisdiction having statutory responsibility for incident mitigation and management. Examples: National Park Service Park Superintendent, Bureau of Indian Affairs Agency Superintendent, U.S. Forest Service Forest Supervisor, Bureau of Land Management District Manager, U.S. Fish and Wildlife Service Refuge Manager, State Forest Officer, Tribal Chairperson, Fire Chief, Police Chief. In the case of AF installations, this will most often be the Installation Commander.

Air Force Wildland Fire Branch (AFCEC/CZOF)
Part of the Civil Engineering Directorate, AFCEC/CZOF was founded in 2012 to manage increasing wildland fire threats to Air Force missions and is a collaborative operation with the U.S. Fish and Wildlife Service and the U.S. Forest Service to focus on fire threats using risk-based data and maximizing shared resources.

Air Pollution

The general term referring to the undesirable addition of substances (gases, liquids, or solid particles) to the atmosphere that are foreign to the natural atmosphere or are present in quantities exceeding natural concentrations.

Air Quality

The composition of air with respect to quantities of pollution therein; used most frequently in connection with "standards" of maximum acceptable pollutant concentrations. Used instead of "air pollution" when referring to programs.

All-Terrain Vehicle (ATV)

Any motorized vehicle designed for or capable of cross-country travel on or immediately over land, water, sand, snow, ice, marsh, swampland, or other terrain.

Annual (Plant)

A plant that lives for one growing season, starting from a seed each year.

Arson

At common law, the malicious and willful burning of another's dwelling, outhouse or parcel; by most modern statutes, the intentional and wrongful burning of someone else's, or one's own, property. Frequently requires proof of malicious or wrongful intent.

Aspect

Cardinal direction toward which a slope faces.

Assessment

1. A fire weather fire danger product based on a thorough evaluation of all pertinent sources of meteorological, fire danger and resource information.
2. The evaluation and interpretation of measurements, intelligence, and other information to provide a basis for decision-making.

Assignment

Tasks given to resources to perform within a given operational period, based upon tactical objectives in the incident action plan.

Atmospheric Inversion

According to the American Meteorological Society, (also called barometric pressure), the net force per unit area exerted by the atmosphere as a consequence of gravitational attraction exerted upon the column of air lying directly above the point in question. Atmospheric pressure is independent of the orientation of the surface on which it acts. Source: http://glossary.ametsoc.org/wiki/Atmospheric_pressure.

Attack (a Fire)

Limit the spread of fire by any appropriate means.

Average Temperature

According to the American Meteorological Society, (also called the mean temperature), the average temperature of the air as indicated by a properly exposed thermometer during a given time period, usually a day, a month, or a year. Source: http://glossary.ametsoc.org/wiki/Mean_temperature.

Awareness

The continual process of collecting, analyzing, and disseminating intelligence, information, and knowledge to allow organizations and individuals to anticipate requirements and to react effectively and safely.

Backpack Pump

A portable sprayer with hand-pump, fed from a liquid filled container fitted with straps, used mainly in fire and pest control.

Behavior

An observable activity or action demonstrated by an individual in a particular context.

Belt Weather Kit

Belt-mounted case with pockets fitted for anemometer, compass, sling psychrometer, slide rule, water bottle, pencils, and book of weather report forms. Used to take weather observations to provide on-site conditions to the fire weather forecaster or fire behavior analyst. Observations include air temperature, wind speed and direction, and relative humidity.

Benefit

Something that represents, promotes or enhances a desired outcome, being of positive value and contributing to the attainment of organizational goals. Benefits represent one end of the spectrum of outcomes from fire, with the opposite end being harm, loss or damage.

Brush

A collective term that refers to stands of vegetation dominated by shrubby, woody plants, or low growing trees, usually of a type undesirable for livestock or timber management.

Bucking
Sawing through the bole of a tree after it has been felled.

Burned Area Rehabilitation (BAR)
The post-fire activities prescribed and implemented to rehabilitate and restore fire damaged lands.

Burn
1. An area burned over by wildland fire.
2. A reference to a working fire.
3. An injury to flesh caused by a cauterizing agent, heat from a fire, or a heated object.

- First Degree Burn: A burn which causes only pain, redness, and swelling.
- Second Degree Burn: A burn in which the skin is blistered.
- Third Degree Burn: A flesh burn in which charring occurs.

4. To be on fire.
5. To consume fuel during rapid combustion.
6. A fire in progress or under investigation.

Burning
Decomposition of material by the application of heat and oxidation. Also applied to propellants and other pyrotechnic mixtures, though the proper term there is "reacting". Also often an element of the crime of arson.

Burning Period
That part of each 24-hour period when fires spread most rapidly; typically from 10:00 AM to sundown.

Cache
A pre-determined complement of tools, equipment and/or supplies stored in a designated location, available for incident use.

Camp
A geographical site(s), within the general incident area, separate from the incident base, equipped and staffed to provide sleeping, food, water, and sanitary services to incident personnel.

Canopy
The stratum containing the crowns of the tallest vegetation present (living or dead), usually above 20 feet.

Class A Foam

Foam intended for use on Class A or woody fuels; made from hydrocarbon-based surfactant, therefore lacking the strong filming properties of Class B foam, but possessing excellent wetting properties.

Clean Air Act

A federal law enacted to ensure that air quality standards are attained and maintained. Initially passed by Congress in 1963, it has been amended several times.

Climate

The prevalent or characteristic meteorological conditions of any place or region, and their extremes.

Closure

An administrative action limiting or prohibiting access to a specific geographic or jurisdictional area for the purposes of reducing wildfire or the risk it poses to life, property, and/or resources. Example of use: "Pursuant to 36 C.F.R. 261.50 (a) and (b), it is hereby ordered that the prohibitions hereinafter set forth apply to the general forest area of the Ozark-St. Francis National Forests until further notice."

Cloud

A visible cluster of minute water/ice particles in the atmosphere.

Cold Front

The leading edge of a relatively cold air mass which displaces warmer air, causing it to rise. If the lifted air contains enough moisture, cloudiness, precipitation and even thunderstorms may result. As fronts move through a region, in the Northern Hemisphere, the winds at a given location will experience a marked shift in direction. Ahead of an approaching cold front, winds will usually shift gradually from southeast to south, and on to southwest. As a cold front passes, winds shift rapidly to west, then northwest. Typical cold front windspeeds range between 15 and 30 mph but can be much higher.

Command

The act of directing, and/or controlling resources by virtue of explicit legal, agency, or delegated authority.

Community Wildfire Protection Plan

A plan developed in the collaborative framework established by the Wildland Fire Leadership Council and agreed to by state, tribal, and local government, local fire department, other stakeholders and federal land management agencies managing land in the vicinity of the planning area. A Community Wildfire Protection Plan (CWPP) identifies and prioritizes areas for hazardous fuels reduction treatments and recommends the types and methods of treatment on Federal and non-Federal land that will protect one or more at-risk communities and essential infrastructure and recommends measures to reduce structural ignitability throughout the at-risk community. A CWPP may address issues such as wildfire response, hazard mitigation, community preparedness, or structure protection – or all of the above.

Consumption

The amount of a specified fuel type or strata that is removed through the fire process, often expressed as a percentage of the preburn weight.

Contained/Containment

1. The status of a wildfire suppression action signifying that a control line has been completed around the fire, and any associated spot fires, which can reasonably be expected to stop the fire's spread.
2. The act of controlling hazardous spilled or leaking materials.

Contingency Resource

Planned and identified fire suppression personnel and equipment that mitigate possible but unlikely events that exceed or are expected to exceed holding resource capabilities.

Control Time

The time a fire is declared controlled.

Control/Controlled

The completion of control line around a fire, any spot fires therefrom, and any interior islands to be saved; burned out any unburned area adjacent to the fire side of the control lines; and cool down all hotspots that are immediate threats to the control line, until the lines can reasonably be expected to hold under the foreseeable conditions.

Cooperator

A federal, tribal, state, or local agency that participates with another agency(s) in planning and conducting fire or emergency management projects and activities.

Coordination

The process of systematically analyzing a situation, developing relevant information, and informing appropriate command authority of viable alternatives for selection of the most effective combination of available resources to meet specific objectives. The coordination process (which can be either intra- or interagency) does not involve dispatch actions. However, personnel responsible for coordination may perform command or dispatch functions within limits established by specific agency delegations, procedures, legal authority, etc.

Cover
The area on the ground covered by the combined aerial parts of plants expressed as a percent of the total area.

Crew
An organized group of firefighters under the leadership of a crew boss or other designated official.

Cured
In the 1978 version of NFDRS, the herbaceous stage when herbaceous fuel moisture falls to 30% or less.

Dead Fuel
Fuels with no living tissue in which moisture content is governed almost entirely by absorption or evaporation of atmospheric moisture (relative humidity and precipitation).

Debris Burning
1. In fire suppression terminology, a fire spreading from any fire originally ignited to clear land or burn rubbish, garbage, crop stubble, or meadows (excluding incendiary fires).
2. In prescribed fire terminology, a fire used to dispose of scattered, piled, or windrowed dead woody fuel, generally in the absence of a merchantable overstory. Its purpose is to reduce unsightly fuel concentrations, or consume unwanted natural fuels to facilitate subsequent resource management or land use actions on the area.

Delegation of Authority
A statement provided to the incident commander by the agency executive delegating authority and assigning responsibility. The delegation of authority can include objectives, priorities, expectations, constraints and other considerations or guidelines as needed. Many agencies require written delegation of authority to be given to incident commanders prior to their assuming command on larger incidents.

Deputy
A qualified individual who could be delegated the authority to manage a functional operation or perform a specific task. In some cases, a Deputy could act as relief for a superior. Deputies can be assigned to the incident commander, general staff, and branch directors.

Detection
The act or system of discovering and locating fires.

Director
The ICS title for an individual responsible for supervision of a branch.

Dispatch
The implementation of a command decision to move a resource or resources from one place to another.

Dispatch Center
A facility from which resources are assigned to an incident.

Division
The ICS organization level between the branch and the task force/strike team. Divisions are used to divide an incident into geographical areas of operation. Divisions are established when the number of resources exceeds the span of control of the operations chief.

Dozer
Any tracked vehicle with a front mounted blade used for exposing mineral soil.

Drought
A period of relatively long duration with substantially below-normal precipitation, usually occurring over a large area.

Ecosystem
An interacting natural system including all the component organisms together with the abiotic environment and processes affecting them.

Emergency
Any incident which requires the response of a fire protection organization's attack units and/or support units.

Emergency Firefighter (EFF)
A person employed as an emergency worker on a forest or wildland fire which threatens damage to property under public management. Emergency firefighters are hired for the duration of the emergency only.

Emergency Operations Center (EOC)
A pre-designated facility established by an agency or jurisdiction to coordinate the overall agency or jurisdictional response and support to an emergency.

Emergency Stabilization (ES)
Planned actions to stabilize and prevent unacceptable degradation to natural and cultural resource, to minimize threats to life or property resulting from the effects of a fire, or to repair/replace/construct physical improvements necessary to prevent degradation of land or resources.

Engine
Any ground vehicle providing specified levels of pumping, water, and hose capacity but with less than the specified level of personnel.

Entrapment
A situation where personnel are unexpectedly caught in a fire behavior-related, life-threatening position where planned escape routes or safety zones are absent, inadequate, or compromised. An entrapment may or may not include deployment of a fire shelter for its intended purpose. These situations may or may not result in injury. They include "near misses."

Entrapment Avoidance
A process used to improve the safety of personnel on the fireline, which emphasizes tools and tactics available to prevent being trapped in a burnover situation. This process includes appropriate decision making through risk management, application of LCES (Lookout[s], Communications, Escape Route[s], and Safety Zone[s]), use of pre-established trigger points, and recognition of suitable escape routes and safety zones.

Environment
The complex surroundings of an item or area of interest, such as air, water, natural resources, and their physical conditions (temperature, humidity).

Escaped Fire
Fire which has exceeded or is expected to exceed initial attack capabilities or prescription.

Escaped Prescribed Fire
Prescribed fire that has exceeded or is expected to exceed prescription parameters or otherwise meets the criteria for conversion to wildfire. A state in which a prescribed fire is no longer doing what was expected.

Evacuation
An organized, phased, and supervised withdrawal, dispersal, or removal of civilians from dangerous or potentially dangerous areas, and their reception and care in safe areas.

Evaluate
To review and compare outcomes with management and incident objectives desired for a wildland fire. One of the six component activities in an adaptive management process that may lead to adjusting future actions.

Evaluator
The individual who is qualified in the position being evaluated, or supervises the position being evaluated, having responsibility for observing task(s) being performed and documenting successful performance for agency certification or re-certification. Evaluator responsibilities must remain separate from the individual assigned as Trainer/Coach.

Event
A planned, non-emergency activity. ICS can be used as the management system for a wide range of events, e.g., parades, concerts or sporting events.

Extended Attack
Actions taken on a wildfire that has exceeded the initial response.

Extended Attack Incident
An incident that exceeds the capability of the initial attack resources and/or organization to successfully manage the incident to conclusion.

Faller
A person who fells trees. Also known as sawyer and cutter.

Final Evaluator
The individual responsible for completing the position task book's verification statement once all tasks in the position task book have been completed and signed off. Only the evaluator on the final position performance assignment (the assignment in which all remaining tasks have been evaluated and signed off) will complete the verification statement recommending certification.

Fire
Rapid oxidation, usually with the evolution of heat and light; heat fuel, oxygen and interaction of the three.

Fire Agency
Official group or organization compelled and authorized under statutes or law to control fires within a designated area or upon designated lands.

Fire Analysis
Review of fire management actions taken on a specific fire, group of fires, or fire season in order to identify reasons for both effective and ineffective actions, and to recommend or prescribe ways and means of doing a more efficient job. Also called hot line review.

Fire Behavior
The manner in which a fire reacts to the influences of fuel, weather, and topography.

Fire Cause
Agency or circumstance which started a fire or set the stage for its occurrence; source of a fire's ignition. For statistical purposes fires are grouped into broad cause classes. The nine general causes used in the U.S. are lightning, campfire, smoking, debris burning, incendiary, machine use (equipment), railroad, children, and miscellaneous.

Fire Crew
General term for two or more firefighters organized to work as a unit.

Fire Damage
Detrimental fire effects expressed in monetary or other units, including the unfavorable effects of fire-induced changes in the resource base on the attainment of organizational goals.

Fire Danger
Sum of constant danger and variable danger factors affecting the inception, spread, and resistance to control, and subsequent fire damage; often expressed as an index.

Fire Danger Rating System
The complete program necessary to produce and apply fire danger ratings, including data collection, data processing, fire danger modeling, communications, and data storage.

Fire Detection
Act or system of discovering and locating fires.

Fire Ecology
The study of the effects of fire on living organisms and their environment.

Fire Effect
The physical, biological, and ecological impacts of fire on the environment.

Fire Hazard
A fuel complex, defined by volume, type condition, arrangement, and location, that determines the degree of ease of ignition and of resistance to control.

Fire Investigation
The process of determining the ignition source, materials first ignited, ignition factors, and party responsible for a fire.

Fire Load
The number and size of fires historically experienced on a given unit over a given period (usually one day) at a given index of fire danger.

Fire Management
All activities for the management of wildland fires to meet land management objectives. Fire management includes the entire scope of activities from planning, prevention, fuels or vegetation modification, prescribed fire, hazard mitigation, fire response, rehabilitation, monitoring and evaluation.

Fire Management Objective
Planned, measurable result desired from fire protection and use based on land management goals and objectives.

Fire Management Plan
A plan that identifies and integrates all wildland fire management and related activities within the context of approved land/resource management plans. A fire management plan defines a program to manage wildland fires (wildfire and prescribed fire). The plan is supplemented by operational plans, including but not limited to preparedness plans, preplanned dispatch plans, prescribed fire burn plans, and prevention plans. Fire management plans assure that wildland fire management goals and components are coordinated.

Fire Management Unit (FMU)
A land area definable by specified management objectives, constraints, topographic features, access, values to be protected, political boundaries, fuel types, major fire regime groups, and other defined elements that set it apart from an adjacent area. The primary purpose of developing Fire Management Units in fire management planning is to assist in organizing information in complex

landscapes. A fire management unit may have dominant management objectives and pre-selected strategies assigned to accomplish these objectives.

Fire Perimeter
The entire outer edge or boundary of a fire.

Fire Planning
Systematic technological and administrative management process of designing organization, facilities, and procedures, including fire use, to protect wildland from fire.

Fire Prevention
Activities such as public education, community outreach, law enforcement, engineering, and reduction of fuel hazards that are intended to reduce the incidence of unwanted human-caused wildfires and the risks they pose to life, property or resources.

Fire Qualification
Computerized interagency summary of fire suppression qualifications of listed personnel. Available information includes fire training record, fire experience record, and physical fitness testing score for each individual.

Fire Regime
Description of the patterns of fire occurrences, frequency, size, severity, and sometimes vegetation and fire effects as well, in a given area or ecosystem. A fire regime is a generalization based on fire histories at individual sites. Fire regimes can often be described as cycles because some parts of the histories usually get repeated, and the repetitions can be counted and measured, such as fire return interval.

Fire Report
An official record of a fire, generally including information on cause, location, action taken, damage, costs, etc., from start of the fire until completion of suppression action. These reports vary in form and detail from agency to agency.

Fire Resource
All personnel and equipment available or potentially available for assignment to incidents.

Fire Retardant
Any substance except plain water that by chemical or physical action reduces flammability of fuels or slows their rate of combustion.

Fire Risk

1. The chance of fire starting, as determined by the presence and activity of causative agents.
2. A causative agent.
3. A number related to the potential number of firebrands to which a given area will be exposed during the rating day (National Fire Danger Rating System).

Fire Season

1. Period(s) of the year during which wildland fires are likely to occur, spread, and affect resources values sufficient to warrant organized fire management activities.
2. A legally enacted time during which burning activities are regulated by federal, state or local authority.

Fire Service

The organized fire protection service; its members, individually and collectively; allied organizations assisting protection agencies.

Fire Severity

Degree to which a site has been altered or disrupted by fire; loosely, a product of fire intensity and residence time.

Fire Shelter

An aluminized cloth tent that offers protection in a fire entrapment situation by reflecting radiant heat and providing a volume of breathable air. Fire shelters are not a fail-safe. Firefighters should avoid situations where a fire shelter is needed, but they are trained to deploy it if they cannot escape and feel the shelter is needed for protection from heat, smoke, and/or ember showers.

Fire Shelter Deployment

Removing a fire shelter from its case and unfolding it to use as protection against heat, smoke, and burning embers. Shelter deployments can be categorized as: (1) Life Saved – Saved the life of the firefighter; (2) Injury Prevented – Prevented burns and/or smoke inhalation to the firefighter; (3) Precautionary – Deployed in a situation with perceived potential danger. The environment did not materialize into a situation where the firefighter would have been killed or injured without the use of a fire shelter; (4) Fatality – Fatality occurred in a fully or partially deployed fire shelter.

Fire Suppression

All work and activities connected with control and fire-extinguishing operations, beginning with discovery and continuing until the fire is completely extinguished.

Fire Treatment
The use of fire to accomplish a specified objective.

Fire Weather
Weather conditions which influence fire ignition, behavior, and suppression.

Fire Weather Forecast
A weather prediction specially prepared for use in wildland fire operations and prescribed fire.

Fire Weather Station
A meteorological station specially equipped to measure weather elements that have an important effect on fire behavior.

Firebreak
A natural or constructed barrier used to stop or check fires that may occur, or to provide a control line from which to work.

Firefighter
Person whose principal function is fire suppression.

Fireline
The part of a containment or control line that is scraped or dug to mineral soil.

Flame
1. A mass of gas undergoing rapid combustion, generally accompanied by evolution of sensible heat and incandescence.
2. Light given off by burning gasses during the combustion process.

Flame Length
The distance between the flame tip and the midpoint of the flame depth at the base of the flame (generally the ground surface), an indicator of fire intensity.

Flammable
Easily ignitable and capable of burning and producing flames.

Foehn Wind
A warm, dry and strong general wind that flows down into the valleys when stable, high pressure air is forced across and then down the lee slopes of a mountain range. The descending air is

warmed and dried due to adiabatic compression producing critical fire weather conditions. Locally called by various names such as Santa Ana winds, Devil winds, North winds, Mono winds, etc.

Forb
A plant with an herbaceous (soft, rather than permanent woody) stem, that is not a grass or grasslike plant. Often a flowering plant.

Fuel
Any combustible material, especially petroleum-based products and wildland fuels.

Fuel Bed
An array of fuels usually constructed with specific loading, depth, and particle size to meet experimental requirements; also, commonly used to describe the fuel composition.

Fuel Bed Depth
Average height of surface fuels contained in the combustion zone of a spreading fire front.

Fuel Break
A natural or manmade change in fuel characteristics which affects fire behavior so that fires burning into them can be more readily controlled.

Fuel Break System
A series of modified strips or blocks tied together to form continuous strategically located fuel breaks around land units.

Fuel Condition
Relative flammability of fuel as determined by fuel type and environmental conditions.

Fuel Loading
The amount of fuel present expressed quantitatively in terms of weight of fuel per unit area. This may be available fuel (consumable fuel) or total fuel and is usually dry weight.

Fuel Model
Simulated fuel complex for which all fuel descriptors required for the solution of a mathematical rate of spread model have been specified.

Fuel Moisture Content
The quantity of moisture in fuel expressed as a percentage of the weight when thoroughly dried at 212 degrees F.

Fuel Reduction
Manipulation, including combustion, or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control.

Fuel Type
An identifiable association of fuel elements of distinctive species, form, size, arrangement, or other characteristics that will cause a predictable rate of spread or resistance to control under specified weather conditions.

Fuels Treatment
Manipulation or removal of fuels to reduce the likelihood of ignition and/or to lessen potential damage and resistance to control (e.g., lopping, chipping, crushing, piling and burning).

Fuels Management
Act or practice of controlling flammability and reducing resistance to control of wildland fuels through mechanical, chemical, biological, or manual means, or by fire, in support of land management objectives.

Gallons per Minute (GPM)
The measure of water flow in firefighting. It is used to measure the output of wildland and structural fire engines, pumps, hose streams, nozzles, hydrants, and water mains.

Geographic Area Coordination Center (GACC)
The physical location of an interagency, regional operation center for the effective coordination, mobilization and demobilization of emergency management resources. A coordination center serves federal, state and local wildland fire agencies through logistical coordination of resources throughout the geographic area, and with other geographic areas, as well. Listings of geographic coordination centers and their respective geographic coordinating areas can be found within the National Interagency Mobilization Guide.

Group
Groups are established to divide the incident into functional areas of operation. Groups are composed of resources assembled to perform a special function not necessarily within a single geographic division. Groups, when activated, are located between branches and resources in the operations section.

Gust
Rapid fluctuations in wind speed with a variation of 10 knots (11.5 mph) or more between peaks and lulls.

Handline
Fireline constructed with hand tools.

Hazard
Any real or potential condition that can cause injury, illness or death of personnel, or damage to, or loss of equipment or property.

Hazard Fuel
A fuel complex defined by kind, arrangement, volume, condition, and location that presents a threat of ignition and resistance to control.

Hazard Reduction
Any treatment of living and dead fuels that reduces the potential spread or consequences of fire.

Hazardous Material (HazMat)
1. Substances that are identified, classified, and regulated in the Code of Federal Regulations, Title 49 and Hazardous Materials Regulations 175.
2. A substance or material which has been determined by the Secretary of Transportation to be capable of posing an unreasonable risk to health, safety, and property when transported in commerce and which has been so designated.

Herb
A plant that does not develop woody, persistent tissue but is relatively soft or succulent and sprouts from the base (perennials) or develops from seed (annuals) each year. Includes grasses, forbs and ferns.

Human-caused Fire
Any fire caused directly or indirectly by person(s).

Humidity
General term referring to the moisture content of the atmosphere.

Ignition Source
Any process or event capable of causing a fire.

Incendiary
A burning compound or metal used to produce intense heat or flame, like a bomb.

Incident
An occurrence either human-caused or natural phenomenon, that requires action or support by emergency service personnel to prevent or minimize loss of life or damage to property and/or natural resources.

Incident Action Plan (IAP)
Contains objectives reflecting the overall incident strategy and specific tactical actions and supporting information for the next operational period. The plan may be oral or written. When written, the plan may have a number of attachments, including: incident objectives, organization assignment list, division assignment, incident radio communication plan, medical plan, traffic plan, safety plan, and incident map. Formerly called shift plan.

Incident Base
Location at the incident where the primary logistics functions are coordinated and administered. Incident name or other designator will be added to the term Base. The incident command post may be collocated with the base. There is only one Base per incident.

Incident Command System (ICS)
A standardized on-scene emergency management concept specifically designed to allow its user(s) to adopt an integrated organizational structure equal to the complexity and demands of single or multiple incidents, without being hindered by jurisdictional boundaries.

Incident Commander (IC)
This ICS position is responsible for overall management of the incident and reports to the Agency Administrator for the agency having incident jurisdiction. This position may have 1 or more deputies assigned from the same agency or from an assisting agency(s).

Incident Management Team (IMT)
The incident commander and appropriate general and command staff personnel assigned to an incident.

Incident Objective
Statements of guidance and direction necessary for the selection of appropriate strategy(s), and the tactical direction of resources. Incident objectives are based upon agency administrators direction and constraints. Incident objectives must be achievable and measurable, yet flexible enough to allow for strategic and tactical alternatives

Incident Qualification Card
A card issued to persons showing their incident management and trainee qualifications to fill specified fire management positions in an incident management organization.

Initial Attack
A preplanned response to a wildfire given the wildfire's potential. Initial attack may include size up, patrolling, monitoring, holding action or suppression.

Initial Attack Incident Commander
The incident commander at the time the first attack forces commence suppression work on a fire.

Jurisdiction
The range or sphere of authority. Public agencies have jurisdiction at an incident related to their legal responsibilities and authority for incident mitigation. Jurisdictional authority at an incident can be political/geographical (e.g., city, county, state or federal boundary lines), or functional (e.g., police department, health department, etc.).

Jurisdictional Agency
The agency having land and resource management responsibility for a specific geographical or functional area as provided by federal, state or local law.

Knot
Nautical miles per hour, equal to 1.15 mph.

Ladder Fuel
Fuels which provide vertical continuity between strata, thereby allowing fire to carry from surface fuels into the crowns of trees or shrubs with relative ease. They help initiate and assure the continuation of crowning.

Landowner
The person or entity that owns the land or has the authority to convey title to others.

Large Fire
1. For statistical purposes, a fire burning more than a specified area of land e.g., 300 acres.
2. A fire burning with a size and intensity such that its behavior is determined by interaction between its own convection column and weather conditions above the surface.

Leader
The ICS title for an individual responsible for a task force, strike team, or functional unit.

Leadership
The art of providing purpose, direction, and motivation to a group of people in order to accomplish a mission and improve the organization. Leaders provide purpose by clearly communicating their intent and describing the desired end state of an assignment to their followers. Leaders provide direction by maintaining standards of performance for their followers. Leaders provide motivation by setting the example for their followers.

Limbing
Removing branches from a felled or standing tree, or from brush.

Line Officer
Managing officer, or designee, of the agency, division thereof, or jurisdiction having statutory responsibility for incident mitigation and management.

Litter
The top layer of forest floor, composed of loose debris of dead sticks, branches, twigs, and recently fallen leaves or needles; little altered in structure by decomposition.

Maximum Relative Humidity
The highest value for relative humidity measured at the observation site during the preceding 24-hour period.

McLeod
A combination hoe or cutting tool and rake, with or without removable blades.

Mean Fire Return Interval (MFRI)
Arithmetic average of all fire intervals in a given area over a given time.

Mean Sea Level (MSL)
Average height of the surface of the sea for all stages of the tide over a 19-year period. NOTE: when the abbreviation MSL is used in conjunction with a number of feet, it implies altitude above sea level (e.g., 1000 feet MSL).

Minimum Impact Suppression Techniques (MIST)
The application of strategy and tactics that effectively meet suppression and resource objectives with the least environmental, cultural and social impacts.

Minimum Relative Humidity
The lowest value for relative humidity measured at the observation site during the preceding 24-hour period.

Mitigation Action
Actions that are implemented to reduce or eliminate (mitigate) risks to persons, property or natural resources. These actions can include mechanical and physical tasks, specific fire applications, and limited suppression actions. Mitigation actions may include: fireline construction, fuel treatments and reductions, fuel breaks or barriers around critical or sensitive sites or resources, and creating "black lines" through the use of controlled burnouts to limit fire spread and behavior.

Mixing Height
Measured from the surface upward, the height to which relatively vigorous mixing occurs due to convection. Also called mixing depth.

Mobilization
The process and procedures used by all organizations, federal, state and local, for activating, assembling, and transporting all resources that have been requested to respond to or support an incident.

Model
A simplified or generalized representation of reality; a description, analogy, picture, or hypothesis to help visualize something that cannot be directly observed.

Moisture of Extinction
The fuel moisture content, weighed over all the fuel classes, at which the fire will not spread. Also called Extinction Moisture Content (EMC).

Monitoring
The orderly collection, analysis, and interpretation of environmental data to evaluate management's progress toward meeting objectives, and to identify changes in natural systems. Monitoring is also conducted on wildland fires to observe fire effects, fire behavior, or both. For example, the work done by Fire Effects Monitor (FEMO) or Field Observer (FOBS) positions.

Multi-Agency Coordinating Group (MAC Group)
A national, regional, or local management group for interagency planning, coordination, and operations leadership for incidents. Provides an essential management mechanism for strategic coordination to ensure incident resources are efficiently and appropriately managed in a cost-effective manner.

Mutual Aid

Assistance in firefighting or investigation by fire agencies, without regard for jurisdictional boundaries.

Mutual Aid Agreement (MAA)

Written agreement between agencies and/or jurisdictions in which they agree to assist one another upon request, by furnishing personnel and equipment.

National Fire Danger Rating System (NFDRS)

A uniform fire danger rating system that focuses on the environmental factors that control the moisture content of fuels.

National Fire Protection Association (NFPA)

A private, non-profit organization dedicated to reducing fire hazards and improving fire service.

National Fire Protection Association (NFPA) Standards

Standards of the National Fire Protection Association are frequently adopted by insurance agencies such as the National Board of Fire Underwriters as a basis for their regulations and used as a guide for municipal, state, or provincial laws, ordinances, and regulations.

National Interagency Fire Center (NIFC)

A facility located in Boise, Idaho, jointly operated by several federal agencies, dedicated to coordination, logistical support, and improved weather services in support of fire management operations throughout the United States.

National Wildland Fire Coordinating Group (NWCG)

An intergovernmental body that provides national leadership to develop, maintain and communicate standards, guidelines, qualifications, training, and other capabilities that enable interoperable operations among federal and non-federal entities for wildland fire program management.

Natural Fuel

Fuels resulting from natural processes and not directly generated or altered by land management practices.

Nomex®

Trade name for a fire resistant synthetic material used in the manufacturing of flight suits and pants and shirts used by firefighters. Aramid is the generic name.

Non-attainment Area

An area identified by an air quality regulatory agency through ambient air monitoring (and designated by the Environmental Protection Agency), that presently exceeds federal ambient air standards.

NWCG Standard

A defined behavior, action, process, or equipment type, agreed upon by the National Wildfire Coordinating Group for wildland fire performance, and is necessary to meet consistent, interagency fire management activities.

Objective

1. A description of a desired condition; quantified and measured, and where possible, with established time frames for achievement.
2. Specific, achievable, measurable, time-limited results to be achieved through land management practices, either through a description of a desired condition or the degree of desired change in an attribute.

Observation Time

Time of day required to record meteorological data at a fire danger station.

Officer

The ICS title for personnel responsible for the Command Staff positions of Safety, Liaison, and Information.

Operational Period

The period of time scheduled for execution of a given set of tactical actions as specified in the Incident Action Plan. Operational Periods can be of various lengths, although usually not over 24 hours.

Parameter

A variable which can be measured quantitatively; sometimes, an arbitrary constant; associated with populations. One of the unknown values that determine a model.

Partner

All agencies and organizations that engage in joint decision making with federal agencies in planning and conducting fire management projects and activities.

Patrol

1. To travel over a given route to prevent, detect, and suppress fires. Includes interaction with the

public for wildland fire prevention and educational purposes.
2 To go back and forth vigilantly over a length of control line during and/or after construction to prevent breakovers, suppress spot fires, and extinguish overlooked hotspots.
3. A person or group of persons who carry out patrol actions.

Perennial (Plant)
A plant that lives for more than two growing seasons. For fire danger rating purposes, biennial plants are classed with perennial plants.

Personal Protective Equipment (PPE)
That equipment and clothing required to mitigate the risk of injury from or exposure to hazardous conditions encountered during the performance of duty. PPE includes but is not limited to: fire resistant clothing, hard hat, flight helmets, shroud, goggles, gloves, respirators, hearing protection, chainsaw chaps, and shelter.

Planned Ignition
The intentional initiation of a wildland fire by management actions to meet specific objectives.

Plume
A convection column generated by combustion (of wildland fuel).

Point of Origin
The location where a competent ignition source came into contact with the material first ignited and sustained combustion occurred.

Position Task Book (PTB)
A document listing the performance requirements (competencies and behaviors) for a position in a format that allows for the evaluation of individual (trainee) performance to determine if an individual is qualified in the position. Successful performance of PTB tasks, as observed and recorded by a qualified evaluator, will result in a recommendation to the trainee's home unit that the individual be certified in the position.

Pounds per Square Inch (PSI)
Measurement of pressure (e.g., pump pressure, nozzle pressure, friction loss in hose, pressure loss or gain due to elevation).

Precipitation
Any or all forms of water particles, liquid or solid, that fall from the atmosphere and reach the ground.

Predictive Services
Those Geographic Area and National-level fire weather or fire danger services and products produced by wildland fire agency meteorologists and intelligence staffs in support of resource allocation and prioritization.

Preparedness
1. Activities that lead to a safe, efficient, and cost-effective fire management program in support of land and resource management objectives through appropriate planning and coordination.
2. Mental readiness to recognize changes in fire danger and act promptly when action is appropriate.
3. The range of deliberate, critical tasks, and activities necessary to build, sustain, and improve the capability to protect against, respond to, and recover from domestic incidents.

Preparedness Plan
A written plan providing for timely recognition of approaching critical fire situations, priority setting, the deployment of forces, and other actions to respond to those situations.

Preparedness Level
Increments of planning and organizational readiness dictated by burning conditions, fire activity, and resource availability. Response and support to non-fire incidents requiring a significant commitment of resources may also affect Preparedness Levels.

Prescribed Burning
Application of prescribed fire.

Prescribed Fire
Any fire intentionally ignited by management actions in accordance with applicable laws, policies, and regulations to meet specific objectives.

Prescribed Fire Burn Boss
Person responsible for supervising a prescribed fire from ignition through mop up.

Prescribed Fire Plan (PFP)
A plan for each prescribed fire, prepared by qualified personnel, approved by the agency administrator, which includes criteria for the conditions under which the fire will be conducted (a prescription).

Prescription
In the context of wildland fire, a prescription is measurable criteria that define conditions under which a prescribed fire may be ignited. Prescriptions may also be used to guide selection of

management responses to wildfire to define conditions under which management actions are most likely to achieve incident management objectives. Prescription criteria typically describe environmental conditions such as temperature, humidity and fuel moisture, but may also include safety, economic, public health, geographic, administrative, social, or legal considerations.

Prevention

Activities directed at reducing the incidence of fires, including public education, law enforcement, personal contact, and reduction of fuel hazards (fuels management). Actions to avoid an incident, to intervene for the purpose of stopping an incident from occurring, or to mitigate an incident's effect to protect life and property. Includes measures designed to mitigate damage by reducing or eliminating risks to persons or property, lessening the potential effects or consequences of an incident.

Protection

The actions taken to mitigate the adverse effects of fire on environmental, social, political, economic, and community values-at-risk.

Qualifications and Certification

This subsystem of NIIMS provides recommended qualification and certification for those personnel responding to an incident regionally or nationally, allowing for the development of local minimum standards to meet local needs. Standards typically include training, experience, and physical fitness.

Re-Certification

Confirmation through the re-issuance of an incident qualification card that an individual has regained qualifications for a specified position that was lost through a lack of current experience. A key component in the certification or re-certification process is the subjective evaluation by the appropriate agency official of an individual's capability to perform in a position.

Readiness

1. Condition or degree of being completely ready to cope with a potential fire situation.
2. Mental readiness to recognize changes in fire danger and act promptly when action is appropriate.

Red Book

The NWCG Interagency Standards for Fire and Aviation Operations. Guidelines for implementation of national interagency wildland fire operations policy.

Red Flag Warning
Term used by fire weather forecasters to alert forecast users to an ongoing or imminent critical fire weather pattern.

Rehabilitation
Efforts undertaken within three years of a wildland fire to repair or improve fire damaged lands unlikely to recover to a management approved conditions or to repair or replace minor facilities damaged by fire.

Relative Humidity (RH)
The ratio of the amount of moisture in the air, to the maximum amount of moisture that air would contain if it were saturated. The ratio of the actual vapor pressure to the saturated vapor pressure.

Remote Automated Weather Station (RAWS)
A weather station that transmits weather observations via GOES satellite to the Wildland Fire Management Information system.

Repeater
A radio signal station that automatically relays a radio transmission, sometimes over a different frequency, thereby increasing the range of transmission. Repeaters are often named for the mountaintops or peaks where they are installed.

Required Training
A course or courses that must be completed prior to initiating a position task book. Training which has been identified as required cannot be challenged; an agency equivalent course may be used as a substitute when the course meets or exceeds a required course's learning and performance objectives.

Resource Order
The form used by dispatchers, service personnel, and logistics coordinators to document the request, ordering or release of resources, and the tracking of those resources on an incident.

Resource Ordering and Status System (ROSS)
A national system that provides automated support to interagency and agency dispatch and coordination offices. The system will provide current status of resources available to support all-risk activities; enable dispatch offices to exchange and track resource ordering information electronically; enable dispatch offices to rapidly and reliably exchange mission-critical emergency electronic messages.

Resource

1. Personnel, equipment, services and supplies available, or potentially available, for assignment to incidents. Personnel and equipment are described by kind and type, e.g., ground, water, air, etc., and may be used in tactical, support or overhead capacities at an incident.
2. The natural resources of an area, such as timber, grass, watershed values, recreation values, and wildlife habitat.

Restoration

The continuation of rehabilitation beyond the initial three years or the repair or replacement of major facilities damaged by the fire.

Restriction

Measures taken by jurisdictional agencies to impose bans and standards of use on certain human activities that could lead to the cause of wildland fire. Restrictions may be applied to: smoking in designated areas; open flame; mechanical operations in high-risk areas; and off-road use.

Retardant

A substance or chemical agent which reduces the flammability of combustibles.

Risk

1. The chance of fire starting as determined by the presence and activity of causative agents.
2. A chance of suffering harm or loss.
3. A causative agent.
4. (NFDRS) A number related to the potential of firebrands to which a given area will be exposed during the rating day.

Risk Management

A continuous, five-step process that provides a systematic method for identifying and managing the risks associated with any operation.

Shrub

A woody perennial plant differing from a perennial herb by its persistent and woody stem; and from a tree by its low stature and habit of branching from the base.

Simulation

An activity that imitates something real, but it's not real itself and it can be altered by users for the specific purpose of providing an experiential learning environment. Examples: Sand Table Exercise or CBT/WBT Forest Service Wildland Fire Simulation Scenario Editor.

Single Resource
An individual, a piece of equipment and its personnel complement, or a crew or team of individuals with an identified work supervisor that can be used on an incident.

Size Up
The evaluation of the fire to determine a course of action for suppression.

Smoke
Small particles of carbon, tarry and water vapor resulting from the incomplete combustion of carbonaceous materials such as wood, coal or oil.

Smoke Management
The policies and practices implemented by air and natural resource managers directed at minimizing the amount of smoke entering populated areas or impacting sensitive sites, avoiding significant deterioration of air quality and violations of National Ambient Air Quality Standards, and mitigating human-caused visibility impacts in Class I areas.

Smoke Plume
The gases, smoke, and debris that rise slowly from a fire while being carried along the ground because the buoyant forces are exceeded by those of the ambient surface wind.

Snag
A standing dead tree or part of a dead tree from which at least the leaves and smaller branches have fallen. Often known as a stub, if less than 20 feet tall.

Spot Weather Forecast
A special forecast issued to fit the time, topography, and weather of a specific incident. These forecasts are issued upon request of the user agency and are more detailed, timely, and specific than zone forecasts. Usually, on-site weather observations or a close, representative observation is required for a forecast to be issued.

Staffing Level
The basis for decision support for daily staffing of initial attack resources and other activities. A level of readiness and an indicator or daily preparedness.

Staging Area
Locations set up at an incident where resources can be placed while awaiting a tactical assignment on a three (3) minute available basis. Staging Areas are managed by the Operations Section.

Stand Replacing Fire
Fire which kills all or most of the living overstory trees in a forest and initiates forest succession or regrowth. Also explicitly describes the nature of fire in grasslands and some shrublands.

Standard Operating Procedure (SOP)
Specific instructions clearly spelling out what is expected of an individual every time they perform a given task. A standard operating procedure can be used as a performance standard for tasks that are routinely done in the operational environment.

Strategy
The general plan or direction selected to accomplish incident objectives.

Strike Team
Specified combinations of the same kind and type of resources, with common communications, and a leader.

Structure
A constructed object, usually a free-standing building above ground.

Structure Fire
Fire originating in and burning any part or all of any building, shelter, or other structure.

Structure Protection Plan
A plan developed by the Structure Protection Specialist that provides operational guidelines to suppression resources responsible for providing wildland fire structure protection.

Succession
The process of vegetational development whereby an area becomes successively occupied by different plant communities of higher ecological order.

Supervisor
The ICS title for individuals responsible for command of a division or group.

Supplies
Minor items of equipment and all expendable items assigned to an incident.

Suppression
A wildfire response strategy to "put the fire out", as efficiently and effectively as possible, while providing for firefighter and public safety. Also known as "perimeter containment" and "control". The goal of this strategy is to minimize acres burned.

Surface Fire
Fire that burns loose debris on the surface, which includes dead branches, leaves, and low vegetation.

Tactic
Deploying and directing resources on an incident to accomplish the objectives designated by strategy.

Task
A unit of work activity that is a logical and necessary action in the performance of a behavior; how the behavior is demonstrated or performed in a particular context.

Task Force
Any combination of single resources assembled for a particular tactical need, with common communications and a leader. A task force may be pre-established and sent to an incident, or formed at an incident.

Temporary Flight Restriction (TFR)
A restriction requested by an agency and put into effect by the Federal Aviation Administration in the vicinity of an incident which restricts the operation of nonessential aircraft in the airspace around that incident.

Ten-Hour Timelag Fuel Moisture
The moisture content of the l0-hour timelag roundwood fuels.

Test Fire
A prescribed fire set to evaluate such things as fire behavior, fire effects, detection performance, or control measures.

Thermal Belt
An area of mountainous slope (characteristically the middle third), where the top of the radiation inversion intersects the slope. It typically experiences the least variation in diurnal temperatures and has the highest average temperatures and, thus, the lowest relative humidity. Its presence is most evident during clear weather with light wind.

Tractor
A rubber tired or tracked rider-controlled automotive vehicle, used in wildland fire management for pulling a disk or a plow to construct fireline by exposing mineral soil.

Trainee
An individual who has met all required training and position experience for a specified position and is approved by their home unit's certifying official, to initiate a performance based training assignment in order to become qualified in the position.

Transport Wind Speed
A measure of the average rate of the horizontal transport of air within the Mixing Layer. May also be the wind speed at the final height of plume rise. Generally refers to the rate at which emissions will be transported from one area to another.

Type
Refers to resource capability. A Type 1 resource provides a greater overall capability due to power, size, capacity, etc., than would be found in a Type 2 resource. Resource typing provides managers with additional information in selecting the best resource for the task.

Unified Command
In ICS, unified command is a unified team effort which allows all agencies with jurisdictional responsibility for the incident, either geographical or functional, to manage an incident by establishing a common set of incident objectives and strategies. This is accomplished without losing or abdicating authority, responsibility, or accountability.

Unit
The organizational element of an incident having functional responsibility for a specific activity in the planning, logistics, or finance/administration activity.

Unplanned Ignition
The initiation of a wildland fire that was unplanned, regardless of cause.

Use of Wildland Fire
Management of wildfire or prescribed fire to meet resource objectives specified in land/resource management plans.

Value To Be Protected
Include property, structures, physical improvements, natural and cultural resources, community infrastructure, and economic, environmental, and social values.

Visibility
The greatest horizontal distance at which selected objects can be seen and identified, or its equivalent derived from instrumental measurements.

Volatile
Readily changeable into vapor at low temperatures.

Water Bar
A shallow channel or raised barrier, e.g., a ridge of packed earth or a thin pole laid diagonally across the surface of a road or trail so as to lead off water, particularly storm water. Frequently installed in firelines on steep slopes to prevent erosion.

Water Source
Any strategically located supply of water that is readily available for pumps, tanks, trucks, helicopters, or fire camp use.

Water Tender
Any ground vehicle capable of transporting specified quantities of water.

Wetting Rain
A widespread rain that over an extended period of time significantly reduces fire danger. One-tenth of an inch may be sufficient to reduce fire danger in grass fuel models. One half inch may be necessary for timber fuels under closed canopies.

Wildfire
An unplanned, unwanted wildland fire including unauthorized human-caused fires, escaped wildland fire use events, escaped prescribed fire projects, and all other wildland fires where the objective is to put the fire out.

Wildfire Suppression
An appropriate management response to wildfire or prescribed fire that results in curtailment of fire spread and eliminates all identified threats from the particular fire.

Wildland
An area in which development is essentially non-existent, except for roads, railroads, powerlines, and similar transportation facilities. Structures, if any, are widely scattered.

Wildland Fire

Any non-structure fire that occurs in vegetation or natural fuels. Wildland fire includes prescribed fire and wildfire.

Wildland Support Module

Provides fully qualified and equipped personnel to conduct prescribed fire and mechanical fuels reduction activities for the purposes of ecosystem management and mitigation of wildfire as a threat to the ecosystem. Activities are conducted in accordance with INRMP and installation mission objectives. At a minimum, the WSM shall collaborate all activities extensively with the installation NR staff and FES to ensure all actions are aligned to a common goal.

Wildland Urban Interface (WUI)

The line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels. Describes an area within or adjacent to private and public property where mitigation actions can prevent damage or loss from wildfire.

Wind

The horizontal movement of air relative to the surface of the earth.

Wind Direction

Compass direction from which wind is blowing.

Wind Speed

1. Wind, in miles per hour, measured at 20 feet above open, level ground or as adjusted to meet this standard to compensate for height of ground cover, uneven ground, and nearby obstructions.
2. (NFDRS) Wind, in mph, measured at 20 feet above ground, or above the average height of vegetation, and averaged over at least a 10-minute period. Also known as wind velocity.

Work Capacity Test (WCT)

A family of tests to determine firefighter physical capabilities. Work capacity tests are used to ensure that persons assigned to fire activities are physically capable of performing the duties of wildland firefighting and to meet National Wildfire Coordinating Group (NWCG) standards for wildland firefighters (PMS 310-1).

A complete listing of wildland fire terminology can be found at https://www.nwcg.gov/glossary/a-z.

List of Acronyms

12 AF	12th Air Force
9 CES/CEIEC	Environmental Compliance Manager
9 CES/CC	Base Civil Engineer
9 OSS/CWT	Combat Weather Team
9 MSG/CC	Mission Support Group Commander
9 MSG/CD	Deputy Mission Support Group Commander
9 RW	9th Reconnaissance Wing
9 RW/PA	Public Affairs
AAR	After Action Review
ACC	Air Combat Command
ACES-FD	Automated Civil Engineering System – Fire Department
AD	Administratively Determined
AF	Air Force
AFCEC	Air Force Civil Engineering Center
AFCEC/CZO	AFCEC Environmental Management Directorate Operations Branch
AFCEC/CZOF	Air Force Wildland Fire Branch
AFCEC/CZOW	AFCEC Environmental Operations Division West Region
AFI	Air Force Instruction
AFFF	Aqueous Film Forming Foam
AFMO	Assistant Fire Management Officer
AFR/ANG	Air Force Reserve/Air National Guard
AFSEC/SEFW	Air Force Safety Center
AOP	Annual Operating Plan
AOR	Area of Responsibility
APE	Area of Potential Effect
ARPA	Archeological Resources Protection Act
ASI	ATV Safety Institute
ASMIS	Archeological Sites Management Information System
ATV	All-Terrain Vehicle
AUM	Animal Unit Month
BAER	Burned Area Emergency Response
BAFB	Beale Air Force Base
BAR	Burned Area Rehabilitation
BASH	Bird/Wildlife Aircraft Strike Hazard
BCAQMD	Butte County Air Quality Management District
BCE	Base Civil Engineer
BpS	Biophysical Setting
CAL FIRE	California Department of Forestry and Fire Protection

CARB	California Air Resources Board
CATEX	Categorical Exclusion
CDFW	California Department of Fish and Wildlife
CEPA	California Environmental Protection Agency
CES	Civil Engineering Services
CESA	California Endangered Species Act
CINC	Commanders-in-Chief
CLEO	Conservation Law Enforcement Officer
CLI	Cultural Landscaped Inventory
COHP	California Office of Historic Preservation
CNPS	California Native Plant Society
CPR	Cardio-Pulmonary Resuscitation
CRM	Cultural Resources Manager
CRWB	Crew Boss, Single Resource
CSU	Colorado State University
CWPP	Community Wildfire Protection Plan
DGS-2	Deployable Ground Station-2
DHS	Department of Homeland Security
DISA	Defense Information Systems Agency
DIVS	Division/Group Supervisor
DoD	Department of Defense
DZOP	Dozer Operator
DWR	Declared Wildfire Review
EA	Environmental Assessment
EFF	Emergency Firefighter
EIS	Environmental Impact Statement
EMTP	Paramedic
ENGB	Engine Boss, Single Resource
EO	Electro-Optical
EOC	Emergency Operations Center
EOD	Explosive Ordinance Disposal
EPA	Environmental Protection Agency
EQ	Environmental Quality
ES	Emergency Stabilization
ESA	Endangered Species Act
FAA	Federal Aviation Administration
FAC	Fire Adapted Community
FACC	Fire Alarm Communications Center
FAL2	Intermediate Faller
FAL3	Basic Faller

FAL#	Faller
FBFM	Fire Behavior Fuel Model
FC	Fire Chief
FD	Fire Department
FEMA	Federal Emergency Management Agency
FERNS	Fire Emergency Response Network System
FES	Fire and Emergency Services
FFT1	Firefighter Type 1
FFT2	Firefighter Type 2
FIRB	Firing Boss, Single Resource
FMU	Fire Management Unit
FRAQMD	Feather River Air Quality Management District
FRD	Fire Response District
GIS	Geographic Information System
GPM	Gallons per Minute
GSU	Geographically Separated Unit
HazMat	Hazardous Material
HEQB	Heavy Equipment Boss, Single Resource
HF	High Frequency
HFGCS	High Frequency Global Communications System
IAP	Incident Action Plan
IC	Incident Commander
ICRMP	Integrated Cultural Resources Management Plan
ICT3	Incident Commander Type 3
ICT4	Incident Commander Type 4
ICT5	Incident Commander Type 5
ICS	Incident Command System
IDNX	Integrated Digital Node Switching
IMT	Incident Management Team
INRMP	Integrated Natural Resources Management Plan
INVF	Wildland Fire Investigator
IQCS	Incident Qualifications and Certification System
IR	Infrared
ISMP	Invasive Species Management Plan
ISS	Installation Support Section
JAG	Legal Services (stands for Judge Advocate General)
LCAS	Lincoln Communication Annex Site
MAA	Mutual Aid Agreement
MAC Group	Multi-Agency Coordinating Group
MCE	Mission Control Element

MFRI	Mean Fire Return Interval
MIST	Minimum Impact Suppression Techniques
MOU	Memorandum of Understanding
MSG	Mission Support Group
MSL	Mean Sea Level
NAGPRA	Native American Graves Protection and Repatriation Act
NEPA	National Environmental Policy Act
NEXRAD	Next-Generation Radar
NFDRS	National Fire Danger Rating System
NFIRS	National Fire Incident Reporting System
NFPA	National Fire Protection Association
NHPA	National Historic Preservation Act
NIFC	National Interagency Fire Center
NIMS	National Incident Management System
NMFS	National Marine Fisheries Service
NOAA	National Oceanographic and Atmospheric Administration
NR	Natural Resources (Program)
NRCS	Natural Resources Conservation Service
NRM	Natural Resources Manager
NUS	National Unit Stocking
NUS	Normal Unit Stocking
NUS	Normal Unit Strength
NWCG	National Wildfire Coordinating Group
NWS	National Weather Service
O&M	Operations and Maintenance
ONCC	Northern California Geographic Area Coordination Center
OSCC	Southern California Geographic Area Coordination Center
PAVEPAWS	Precision Acquisition Vehicle Entry Phased Array Warning System
PCAPCD	Placer County Air Pollution Control District
PFOA	Perfluoroocanoic Acid
PFOS	Perfluorooctanesulfonic Acid
PFP	Prescribed Fire Plan
PIO	Public Information Officer
PL	Preparedness Level
POC	Point of Contact
PPE	Personal Protective Equipment
PSI	Pounds per Square Inch
PTB	Position Task Book
QR	Quick Response
RAWS	Remote Automated Weather Station

READ	Resource Advisor
RFMO	Regional Fire Management Officer
RH	Relative Humidity
ROSS	Resource Ordering and Status System
RXB1	Prescribed Fire Burn Boss Type 1
RXB2	Prescribed Fire Burn Boss Type 2
RXB#	Prescribed Fire Burn Boss
SAFECOM	Aviation Safety Communiqué
SAR	Synthetic Aperture Radar
SCOPE	System Capable of Planned Expansion
SFO	Senior Field Officer
SMF	Sacramento International Airport
SMP	Smoke Management Plan
SOP	Standard Operating Procedure
STEN	Strike Team Leader Engine
SWMRA	Spenceville Wildlife Management and Recreation Area
T&E	Threatened and Endangered
TDY	Temporary Duty
TFLD	Task Force Leader
TFR	Temporary Flight Restriction
USACE	United States Army Corps of Engineers
USAF	United States Air Force
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USN	United States Navy
USSTRATCOM	United States Strategic Command
UTV	Utility Task Vehicle
UXO	Unexploded Ordinance
WBWG	Western Bat Working Group
WCT	Work Capacity Test
WFAS	Wildland Fire Assessment System
WFDSS	Wildland Fire Decision Support System
WFIR	Wildland Fire Investigation Report
WFMP	Wildland Fire Management Plan
WFPC	Wildland Fire Program Coordinator
WFPM	Wildland Fire Program Manager
WFRCA	Wildland Fire Risk and Complexity Assessment
WSM	Wildland Support Module

WUI	Wildland Urban Interface

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Appendix 1.1 MAAs

The following MAAs are in place at BAFB with the following entities for fire protection and incident response:

- CAL FIRE/Yuba County Operational Area Fire and Rescue Coordinator's Office (2016)

  Cal Fire Yuba.pdf

- CAL FIRE/Placer County Fire Department (2016)

  Cal Fire Placer County.pdf

- Linda Fire Protection District (2016)

  Linda Fire.pdf

- Marysville FD (2017)

  Signed Marysville MAA.pdf

- Smartsville Fire Protection District (2016)

  Smartsville Fire.pdf

- Wheatland Fire Authority (2016)

  Wheatland Fire.pdf

Appendix 1.2 Cultural Resources Checklist

The following is a cultural resources checklist adapted from National Park Service guidelines for review of cultural resources concerns prior to implementation of wildland fire projects. During a wildfire, procedures outlined in [PMS 313, *Resource Advisor's Guide for Wildland Fire*, August 2017], will be followed.

Strategic Wildland Fire Management Planning

Installation cultural resources staff:

- Ensure that cultural resources are thoroughly evaluated and discussed in the INRMP.
- Regularly review the ICRMP and ensure that the plan is complete and up to date.
- Regularly coordinate with the wildland fire management program to ensure that cultural resources are considered at all stages of fire planning and good communication is maintained between cultural resources and wildland fire management programs.
- Participate in the development and review of installation WFMPs.
- Prepare funding proposals for cultural resource inventory within the Area of Potential Effect (APE) of fuels reduction projects as soon as fuels reduction project is proposed.
- Ensure that planning activities comply with federal cultural resource laws, executive orders, and policies:
    - Coordinate with installation Section 106 coordinator to ensure that NHPA Section 106 compliance is completed in concordance with NEPA compliance activities.
    - Develop installation-specific NHPA Section 106 programmatic agreement, if appropriate.
- Ensure that appropriate tribal leadership is contacted for consultation if applicable, as per Native American Graves Protection and Repatriation Act (NAGPRA) (25 U.S.C. §3001 et seq.), DOI policy, and Executive Order 13175: Consultation and Coordination with Indian Tribal Governments (EO 13175).

Annual Wildland Fire Management Planning

Installation cultural resource staff:

- Annually identify, document and update records on cultural resources with potential to be adversely affected by fire (Archeological Sites Management Information System [ASMIS], Cultural Landscaped Inventory [CLI], etc.):
    - Ensure that updated information is reflected in relevant documents (WFMPs, PFPs, etc.).

- Participate in annual review of WFMP and update cultural resource information as indicated:
  - Evaluate past performance of mitigation measures and identify areas of needed improvement for stewardship of cultural resources.
  - Obtain information about upcoming fuels reduction activities that may affect cultural resources.
- Develop or update the installation's READ manual.
- Ensure that notification lists are current and reside in appropriate offices (with the FES FC, WSM Lead, E-911 Center, CRM, etc.).
- Ensure that planning activities comply with federal cultural resource laws, executive orders, and policies:
  - Coordinate with installation Section 106 coordinator to ensure that NHPA Section 106 compliance is completed in concordance with NEPA compliance activities.
  - Develop installation-specific NHPA Section 106 programmatic agreement, if appropriate.
  - Ensure that appropriate tribal leadership is contacted for consultation, if applicable, as per NAGPRA, DOI policy, and EO 13175.

Fuels Treatment Planning

- Review fuels treatment plans when project is proposed and when the plan is implemented.
- Ensure cultural resource mitigations are appropriately included in each treatment plan.
- Coordinate cultural resource documentation and assessment activities to support specific fuels projects:
  - Ensure that cultural resource inventory is complete before fuels reduction activities.
  - Determine eligibility of cultural resources for inclusion on National Register of Historic Places.
  - Determine potential for adverse effects on significant cultural resources within APE from fuels reduction activities.
  - Provide assessment analyses and mitigation to wildland fire management program.
- Ensure that planning activities comply with federal cultural resource laws, executive orders, and policies:
  - Coordinate with Section 106 coordinator for NHPA Section 106 compliance.
  - Determine whether planned activity qualifies for NHPA Section 106 programmatic agreements.

Project/Event Planning

Planning for Unplanned Ignitions

- Ensure that issues and concerns about cultural resources are incorporated into planning documents, and that mitigation protocols are included. Locations of critical resources that might be threatened by post-fire events such as flooding, slides, erosion, or debris flows, and the types of treatments to be carried out or excluded are listed.
- Ensure that private and sensitive information regarding location of cultural resources is protected but accessible to wildland fire managers.
- During periods of potential or existing high fire activity, ensure cultural resources advisors are prepared and ready to participate in active fire planning and management activities.
- Ensure that cultural resources will be considered in any post-fire rehabilitation or restoration, including: protection goals and measurable objectives for the BAER program.
- Contact information for cultural resource specialists who can prepare post-fire treatment plans, as well as individuals who can implement the treatments proposed.
- Ensure that planning activities comply with federal cultural resource laws, executive orders, and policies:
    - Coordinate with installation Section 106 coordinator to ensure that NHPA Section 106 compliance is completed in concordance with NEPA compliance activities.
    - Ensure that appropriate tribal leadership is contacted for consultation, if applicable, as per NAGPRA, DOI policy, and EO 13175.

Fuels Treatment Planning

- Review fuels treatment plans when project is proposed and when the plan is implemented.
- Ensure cultural resource mitigations are appropriately included in each treatment plan.
- Coordinate cultural resource documentation and assessment activities to support specific fuels projects:
    - Ensure that cultural resource inventory is complete before fuels reduction activities.
    - Determine eligibility of cultural resources for inclusion on National Register of Historic Places.
    - Determine potential for adverse effects on significant cultural resources within APE from fuels reduction activities.
    - Provide assessment analyses and mitigation to wildland fire management program.

- Ensure that planning activities comply with federal cultural resource laws, executive orders, and policies:
    - Coordinate with Section 106 coordinator for NHPA Section 106 compliance.
    - Determine whether planned activity qualifies for alternative NHPA Section 106 process.
    - Ensure that appropriate tribal leadership is contacted for consultation, if applicable, as per NAGPRA, DOI policy, and E.O. 13175.
- Ensure that monitors will be present during the fuels treatment activity.
- Ensure that monitors will inspect area after fuels treatment to ensure planned actions resulted in the desired protection.
- Ensure that planning activities comply with federal cultural resource laws, EO 13175, and policies.

Appendix 1.3 Installation and Interagency Contact Information

Contact Name	Position	Phone	Email
BAFB FES			
Kevin Smith	Fire Chief	530-634-8675 Option 1 530-634-8671	kevin.smith.150@us.af.mil
MSgt Michael Hulcy	Assistant Fire Chief (A-Shift)	530-634-8675 Option 4 530-634-8674	michael.hulcy@us.af.mil
Dennis Reinhardt	Assistant Fire Chief (B-Shift)	530-634-8675 Option 4 530-634-8674	dennis.reinhardt@us.af.mil
Alec Giles	Station Chief (A-Shift)	530-634-8675 Option 7 530-634-4978	alec.giles.2@us.af.mil
TSgt Brian Patterson	Station Chief (B-Shift)	530-634-8675 Option 7 530-634-4978	brian.patterson.7@us.af.mil
FES Dispatch (E-911)		530-634-8675	
Fire Station 2		530-634-4710	
BAFB NRM			
Tamara Gallentine	NRM		tamara.gallentine.2#@us.af.mil
AFCEC/CZOF			
Vacant	Branch Chief	-	-
Michelle Steinman	CSU Liaison	210-395-8412 201-260-9238	michelle.steinman.ctr@us.af.mil
Michael Amacker	FES Liaison	916-600-5761	michael.amacker.1.ctr@us.af.mil

Contact Name	Position	Phone	Email
Micah Shuler	Facilities PM		micah.shuler@us.af.mil
Roger Kennedy	Training PM		roger.kennedy@us.af.mil
Kelley Anderson	Fire Ecologist/ Planner	850-333-8274	kelley.anderson.3.ctr@us.af.mil
AFCEC/CZOW ISS			
Kirsten Christopherson	ISS Lead		kirsten.christopherson@us.af.mil
AFCEC/CZOW RSB			
Joe Hockaday	RSS - West		mailto:joseph.hockaday@us.af.mil
Cooperating Agencies & Other			
CAL FIRE Nevada-Yuba-Placer Unit – George Morris III			530-823-4904
CAL FIRE Butte Unit – Darren Read			530-538-7111
Linda Fire Protection District – Richard H. Webb			530 743-1553
Marysville Fire Department – Walter Munchheimer			530-741-6622
Olivehurst Fire Department			530-743-7117
Smartsville Fire Protection District – Marc Zamora			530-639-0405
Wheatland Fire Authority – Joseph Waggershauser			530-633-0861
Placer County Fire Department			530-823-4155
Oroville Fire Department			530-538-2480

Appendix 1.4 Sample Delegation of Authority

Sample

Wildland Fire Program Coordinator Delegation of Authority

United States Air Force

For

Beale Air Force Base

DELEGATION OF AUTHORITY FOR WILDLAND FIRE MANAGEMENT

The Wildland Fire Program Coordinator (WFPC) for the installation **Beale Air Force Base**, is hereby delegated authority to act on my behalf for the following duties and actions within the Zone:

1. Initiate, coordinate and ensure appropriate installation engagement and timely completion of the Wildland Fire Management Plan (WFMP).

2. Serve as the primary installation POC for AFCEC/CZOF fuels treatment implementation, data collection, and large wildfire reporting.

3. Assist with requests for Incident Qualification Cards for installations assets as specified in the WFMP.

4. As soon as practical, the installation's WFPC will report any significant wildfire incident that occurs on or threatened property under Air Force (AF) jurisdiction to the AFWFB via the Regional Fire Management Officer (RFMO).

   A significant wildfire incident is defined as:
   - Any wildfire greater than 100 acres
   - Any wildfire, regardless of size, that has met any of the following criteria:

- Significant threat to installation infrastructure/resources
- Major or extended impact on AF missions
- Loss of life
- Negative impact to public health and safety
- Threat to threatened and endangered species.

5. Work with the WSM lead and AFCEC/CZOF training manager to identify NWCG qualification requirements in the installation's WFMP.

6. Serve as the primary POC between the installation and AFCEC/CZOF for all matters concerning wildland fire.

7. Coordinate with the installation assets and Wildland Support Module (WSM) lead to ensure that manpower, supplies, equipment and other cooperative resources are available to meet the required goals and objectives of the WFMP.

8. Be responsible for coordinating all internal and external notifications dealing with wildland fire activities.

9. Coordinate with AFCEC/CZOF's training manager with all matters related to training and qualifications.

10. If needed, the WFPC will coordinate with installation's Natural Resource Manager (NRM) to assess the need and/or requirements for an Emergency Stabilization (ES) Plan and/or a Burned Area Emergency Response (BAER) Plan.

This delegation of authority for wildland fire management program operations will be in effect from ***DATE*** to ***DATE***, unless superseded. It will be reviewed as part of the annual WFMP review process.

____________________________ ____________

Installation Commander Date

____________________________ ____________

Wing Commander Date

____________________________ ____________

Installation Fire Chief Date

Appendix 3.1 BAFB Wildfire History

Wildfire Date	Acres	Cause
4 September 1998	1293.47	Unknown
23 July 2002	10.61	Unknown
27 October 2002	112.87	Unknown
26 June 2004	493.62	Unknown
11 May 2006	Unknown	Unknown
26 May 2006	Unknown	Cigarette
31 May 2006	Unknown	Unknown
13 June 2006	Unknown	Cigarette
28 June 2006	Unknown	Powerline
28 June 2006	Unknown	Unknown
1 August 2006	Unknown	Army Mission
3 August 2006	Unknown	AF Mission
18 August 2006	45	Powerline
19 August 2006	Unknown	Powerline
4 September 2006	11	Unknown
19 September 2006	Unknown	Powerline
22 September 2006	9	Powerline
17 October 2006	Unknown	Unknown
27 April 2007	Unknown	Powerline
5 May 2007	Unknown	Unknown
22 May 2007	Unknown	Powerline
25 May 2007	Unknown	Cigarette
5 June 2007	Unknown	Powerline
7 June 2007	Unknown	Unknown
7 June 2007	Unknown	Powerline
7 June 2007	Unknown	AF Mission
12 June 2007	Unknown	Powerline
20 June 2007	Unknown	Powerline
20 June 2007	10	Powerline
22 June 2007	Unknown	Unknown
22 June 2007	Unknown	Unknown
10 July 2007	Unknown	Unknown
28 July 2007	7.44	Unknown
8 August 2007	Unknown	Miscellaneous
22 August 2007	Unknown	Unknown
29 August 2007	Unknown	Unknown
6 September 2007	Unknown	Cigarette
6 September 2007	Unknown	Cigarette
9 September 2007	14	Unknown
10 September 2007	Unknown	Unknown
10 September 2007	Unknown	Unknown
15 September 2007	Unknown	Unknown

Wildfire Date	Acres	Cause
19 September 2007	Unknown	AF Mission
19 September 2007	Unknown	AF Mission
26 September 2007	Unknown	Powerline
2 June 2008	2.03	Powerline
4 June 2008	14.73	Unknown
6 June 2008	Unknown	Miscellaneous
27 July 2008	8.5	Powerline
6 August 2008	0.2	Unknown
1 September 2008	1.5	Unknown
18 April 2009	Unknown	Powerline
30 April 2009	0.1	Unknown
10 May 2009	Unknown	Powerline
14 May 2009	0.1	Powerline
19 May 2009	1	Unknown
4 June 2009	0.1	Powerline
10 June 2009	10.26	Unknown
19 June 2009	30	Escaped Prescribed Fire
2 July 2009	28.37	Unknown
10 July 2009	Unknown	Unknown
23 August 2009	0.5	AF Mission
28 August 2009	286	Escaped Prescribed Fire
29 August 2009	0.2	Powerline
9 October 2009	Unknown	AF Mission
12 November 2009	0.1	Unknown
11 June 2010	Unknown	Powerline
17 June 2010	0.5	AF Mission
24 June 2010	Unknown	Cigarette
15 July 2010	10	Escaped Prescribed Fire
16 July 2010	Unknown	Unknown
23 August 2010	2.5	Unknown
30 April 2011	Unknown	Unknown
18 July 2011	1	Miscellaneous
27 July 2011	1.5	Unknown
18 August 2011	0.1	Powerline
18 August 2011	20	AF Mission
2 April 2012	0.25	Unknown
5 May 2012	0.01	AF Mission
7 May 2012	0.01	Miscellaneous
11 June 2012	Unknown	Miscellaneous
7 July 2012	Unknown	Powerline
15 July 2012	0.01	Miscellaneous
11 August 2012	43.32	Miscellaneous
11 August 2012	Unknown	Unknown
12 August 2012	0.01	Powerline

Wildfire Date	Acres	Cause
29 August 2012	1	Unknown
12 September 2012	7	Unknown
13 September 2012	Unknown	Miscellaneous
17 September 2012	1	Miscellaneous
17 April 2013	Unknown	Powerline
8 May 2013	1	Unknown
13 May 2013	1.5	Miscellaneous
21 May 2013	0.1	Unknown
5 June 2013	1	Miscellaneous
13 June 2013	Unknown	Unknown
15 June 2013	348.88	Unknown
2 July 2013	17.06	AF Mission
3 July 2013	1	Unknown
5 July 2013	0.01	Unknown
12 July 2013	43	AF Mission
13 July 2013	0.1	Unknown
21 July 2013	43.13	Unknown
21 July 2013	0.25	Cigarette
21 July 2013	1	Fireworks
21 July 2013	1	Cigarette
4 August 2013	1	AF Mission
20 August 2013	0.11	Unknown
10 September 2013	191.16	Unknown
16 October 2013	0.01	Unknown
27 October 2013	Unknown	Cigarette
4 November 2013	1	Unknown
12 December 2013	0.5	Powerline
20 January 2014	0.01	Powerline
31 March 2014	1	Powerline
6 April 2014	0.25	Powerline
10 May 2014	0.21	Powerline
13 May 2014	0.6	Unknown
19 May 2014	1.25	Unknown
30 May 2014	0.5	Powerline
11 July 2014	3	Unknown
25 July 2014	0.04	Powerline
27 July 2014	0.1	Powerline
8 August 2014	2	Miscellaneous
23 September 2014	2	Unknown
14 May 2015	42.72	Unknown
17 May 2015	0.25	Unknown
17 May 2015	1	Unknown
1 June 2015	0.2	Unknown
9 June 2015	0.1	Powerline

Wildfire Date	Acres	Cause
9 June 2015	0.01	Unknown
Based upon tabular data provided by the installation. These data do not completely match GIS data. Furthermore, there were 15 fires accounting for 1,014 acres identified from satellite imagery, that were neither identified as prescribed fires or wildfires.		

1 # Appendix 3.2 BAFB Prescribed Fire History

Prescribed Fire Date	Acres
18-Jun-01	243.29
18-Jun-01	81.03
22-Sep-01	251.45
22-Sep-01	36.2
21-Jun-02	77.92
25-Sep-02	301.21
24-Jun-03	87.83
24-Jun-03	50.39
10-Jul-03	66.97
10-Jul-03	95.52
9-May-04	53.93
26-Jun-04	123.18
26-Jun-04	91.49
26-Jun-04	81.38
26-Jun-04	16.74
26-Jun-04	126.1
26-Jun-04	96.61
26-Jun-04	296.19
28-Jul-04	493.01
28-Jul-04	8.43
28-Jul-04	194.06
28-Jul-04	289.76
28-Jul-04	221.46
28-Jul-04	230.77
29-Aug-04	93.63
29-Aug-04	67.55
29-Aug-04	286.87
14-Sep-04	267.3
3-Jan-05	21.92
3-Jan-05	410.03
15-Jun-05	119.87
15-Jun-05	117.32
15-Jun-05	74.17
31-Jul-05	110.07
1-Sep-05	98.77
1-Sep-05	72.92
20-Nov-05	18.51
1-May-06	Unknown
2-Jul-06	18.51
2-Jul-06	110.07
3-Aug-06	237.05
4-Sep-06	27.96

Prescribed Fire Date	Acres
4-Sep-06	27.53
12-Jun-07	237.05
19-Jun-07	110.07
30-Jun-07	55.18
1-Jul-07	Unknown
5-Jul-07	17.42
22-Aug-07	43.29
12-Mar-08	1
5-Jun-08	5.89
23-May-09	5.89
23-May-09	29.49
24-Jun-09	289.73
24-Jun-09	114.86
29-Jul-10	121.43
29-Jul-10	78.56
17-Aug-11	77.39
17-Aug-11	115.31
2-Sep-11	212.79
2-Sep-11	32.75
18-Sep-11	18.14
26-Jul-12	111.42
26-Jul-12	239.13
19-Jun-13	Unknown
21-Jul-13	135.49
22-Aug-13	248.84
22-Jun-14	252.49
25-Jun-15	913.99
27-Jul-15	61.26
Based upon tabular data provided by the installation. These data do not completely match GIS data. Furthermore, there were 15 fires accounting for 1,014 acres identified from satellite imagery, that were neither identified as prescribed fires or wildfires.	

Appendix 3.3 BAFB Type 3 Wildfire Risk Assessment

The following is a Type 3 Risk Assessment prepared for BAFB.

Copy of Type 3 Risk Assessment - Beale AFB - FOUO.pdf

Appendix 3.4 AF Standard Prescribed Fire Plan

The following is a copy of the AF Standard PFP Template. For assistance with the plan contact AFCEC/CZOF:

USAF_PFP_08-22-2016.docx

Appendix 3.5 Invasive Species Management Plan for BAFB

The following is a copy of the Invasive Species Management Plan for BAFB. A more current Invasive Species Management Plan (November 2017) was recently published but was unavailable for review at the time of writing.

Invasive Species Management.pdf

Appendix 4.1 AF Agency Certification Position Task Book Page

The following is a copy of the Agency Certification Position Task Book Page.

Agency Certification Task Book Page.pdf

Appendix 4.2 Current BAFB Frequency List

The following is a copy of the current BAFB Frequency List.

2016 Local Radio
Freq load.xls

Appendix 4.3 Proposed Annual BAFB Wildland Fire Management Readiness Activities

There are currently no formal fire management readiness activities on BAFB. The following activities are recommended to be implemented annually.

Annual Installation Wildland Fire Management Readiness Activities												
Activities – Complete before end of month	**J**	**F**	**M**	**A**	**M**	**J**	**J**	**A**	**S**	**O**	**N**	**D**
Update Interagency Fire Agreements/AOP's	X											
Winterize Wildland Fire Management Equipment										X		
Inventory Wildland Fire Engine and Cache			X							X		
Complete Training Analysis											X	
Annual Refresher Training and Fitness Tests			X									
Pre-Season Engine Preparation				X								
Weigh Engines to verify GVW Compliance				X								
Prescribed Fire Plan Preparation		X										
Review and Update Wildland Fire Management Plan												X
Prescribed Fire Prioritization												X
Prepare Pre-season Risk Analysis				X								
Weather Station Maintenance and Calibration			X						X			

Appendix 4.4 Proposed BAFB Wildland Fire Management Step-up Plan

The following is a recommended wildfire specific action guide.

WILDFIRE SPECIFIC ACTION GUIDE					
Fire Danger	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Response Guide	1 T6 Engine 1 T1 Water Tender	1 T3 Engine 1 T2 Dozer 1 T1 Water Tender	1 T3 Engine 1 T6 Engine 1 T2 Dozer 1 T1 Water Tender	2 T3 Engines 1 T6 Engines 2 T2 Dozers 2 T1 Water Tender	2 T3 Engines 2 T6 Engines 2 T2 Dozers 2 T1 Water Tenders
Staffing Guide	1 ICT5 1 ENGB 2 FFT2s	1 ICT4 1 ENGB 1 HEQB 1 DOZOP 3 FFT2s	1 ICT4 2 ENGB 1 HEQB 1 DOZOP 4 FFT2s	1 ICT4 3 ENGB 2 HEQB 2 DOZOP 7 FFT2s	1 ICT3 4 ENGB 2 HEQB 2 DOZOP 8 FFT2s
Administrative Actions	Routine.	Routine.	May deny leave requests & cancel non-essential TDYs for Primary Duty firefighters. Overtime approved as needed to meet "Staffing Guide" above.	All scheduled leave and TDYs subject to cancellation for Primary Duty and Secondary Duty firefighters. Overtime approved as needed to meet "Staffing Guide" above.	All scheduled leave, TDYs and days off subject to cancellation for all qualified firefighters. Overtime approved as needed to meet "Staffing Guide" above.

WILDFIRE SPECIFIC ACTION GUIDE					
Fire Danger	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Fire Detection Actions (Civil Air Patrol, Fire Towers, etc.)	None.	1 Flight Per Day.	At Least 1 Flight Per Day. Ground patrols may be necessary from 1200-1800.	2 Flights Per Day. Ground patrols may be necessary from 1200-1800.	Flights as needed. Ground patrols are necessary from 1200-1800.
Public Education	Routine.	Routine.	Extra precautions with campfires.	No campfires. Coordinate with Range Patrol. PA requested on WUI fires.	No campfires. Coordinate with Range Patrol. PA requested on WUI fires.
Change in Personnel Duties	None.	None.	All fire qualified personnel carry PPE and keep dispatch apprised of location. Consider preposition of FES resources during missions that could start wildfires between 1200 and 1800.	Fire Leadership focus on planning and readiness. Preposition FES resources during all missions that could start wildfires.	All qualified Collateral Duty firefighters available to assist. Fire response is priority. Fire Leadership focus on planning and readiness. Preposition resources in WUI.

WILDFIRE SPECIFIC ACTION GUIDE					
Fire Danger	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Installation Support	None	May need NRM support.	Need for NRM support is likely.	Need for NRM support is likely. May need WSM support. Activate AD hires, if available.	Need for NRM or WSM support is likely. AD hires on duty daily, if available.
External Support from CAL FIRE, etc.	None	None	Not generally needed unless staffing levels are low and/or fire occurrence is high.	Check with CAL FIRE on resource availability. Check for other DoD fire personnel available for TDY, order as funding allows.	Order additional resources as needed (and approved by leadership if additional funding is required).

WILDFIRE SPECIFIC ACTION GUIDE					
Fire Danger	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Mission Restrictions	Little to no fire danger anticipated. No restrictions on missions.	No restrictions on use of pyrotechnics. A fire watch is required to be posted for a minimum of 20 minutes after use of pyrotechnics is complete.	Use caution with pyrotechnics and post a fire watch for a minimum of 30 minutes after use of pyrotechnics is complete.	Restrict pyrotechnics to hand-thrown simulators or smoke grenades on roads or in pits. No flares below 1000' AGL. Limit munitions that may start fires to safe areas. Cleared areas for pyrotechnics will be a minimum of 1.5 times the blast radius.	No pyrotechnics allowed without prior approval from the WFPC or their designee.

WILDFIRE SPECIFIC ACTION GUIDE					
Fire Danger	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Suppression Efforts and Mission Impacts	No difficulty in control or mop-up expected.	Little difficulty in control or mop-up expected.	Control through direct attack possible but may be difficult. Suppression efforts take longer, often more than 1 day.	Fast moving, high intensity fires are difficult to control. Aircraft are more likely to be used in suppression efforts, tying up airspace. Mop-up may require fire crews at scene for several days in areas with heavy fuel loadings. All local resources may be committed at times, requiring additional restrictions on mission activity.	Extreme, erratic fire behavior can be expected. All fire starts are potentially dangerous and likely to take several days for suppression. 100% commitment of local resources and presence of resources from outside agencies is high, including various fire suppression aircraft. Air space restrictions are likely to be in place at fire scene(s).

WILDFIRE SPECIFIC ACTION GUIDE					
Fire Danger	**Low**	**Moderate**	**High**	**Very High**	**Extreme**
Notifications	Routine	Routine	If going to "Very High" for 3 or more days looks imminent, notify "Very High +" email list.	Use "Very High +" notification list for all mission related updates on wildfire status, etc. Extra effort to keep PA, cooperators, and leadership apprised of fire situation.	Use "Very High +" notification list for all mission related updates on wildfire status, etc. Extra effort to keep PA, cooperators, and leadership apprised of fire situation.

Notes:

Fire Danger: is based upon the NFDRS adjective fire danger categories. Current and forecasted fire danger can be found on the Wildland Fire Assessment System (WFAS) Fire Danger Rating webpage.

Response Guide: describes the typical "response team", or "initial attack crew" that would be dispatched. There may be exceptions to these numbers, based upon various factors including values at risk, firefighter or equipment availability, firefighter experience and qualifications, fuel loading, etc.

Staffing Guide: is based upon the Response Guide. The numbers shown are used to determine "Administrative Actions" and "Changes in Personnel Duties" as described below. For Low and Moderate fire danger days, the ICT5 or ICT4 duties may be a collateral duty for the ENGB or HEQB.

Administrative Actions: are implemented based upon needs as determined above. Denial of leave requests and cancellation of TDYs and days off will be based upon a number of factors including: 1) can we meet numbers of qualified firefighters in the staffing guide, 2) can the firefighter be called back in to duty in a timely manner (<2 hour response), 3) will firefighters be out of the local area (>2 hour response), 4) specialized skills that may be required, i.e., HEQB, Class A CDL, ICT3, etc., 5) was leave scheduled at least 2 weeks in advance, or was it requested with less time, and 6) Primary Duty vs. Secondary Duty vs. Collateral Duty firefighter classification. Regarding #6, Primary Duty firefighters would be the first affected by any of these administrative actions and Collateral Duty firefighters would be last. This includes consideration for overtime opportunities as well as potential denial or cancellation of leave, days off, and TDYs. This does not include emergency leave due to bona fide family emergency or personal illness.

Fire Detection Actions: are implemented as shown, but may be adjusted due to aircraft availability, mission activity, etc.

Public Education: refers to our efforts to keep the general public apprised of the fire situation and restrictions that are placed on recreational activities, particularly at higher danger levels.

Change in Personnel Duties: refers to changes in general work assignments that affect wildland fire qualified personnel.

Installation Support: includes any locally available resources that can be used for fire suppression work, including local contract employees that can be picked up as Administratively Determined (AD) firefighters through ONCC.

External Support from CAL FIRE, etc.: includes CAL FIRE and resources ordered through the ONCC such as helicopters, air tankers, fire crews, etc.

Mission Restrictions: refers to mitigations that will be made by missions in order to prevent wildfires. Safe areas are areas that are very low risk for fire starts including but not limited to, cleared areas and recently burned areas.

Suppression Effort and Mission Impacts: describes how fire danger levels relate to suppression efforts, and how those can affect mission activity

Notifications: specifies the notifications that take place under the different fire danger levels. "Routine" notifications are made to those on appropriate notification lists for all wildfires. Notifications listed are those that are above and beyond the “Routine” and "Fire-related Emergency" notification procedures.

Appendix 5.1 Certification of Annual WFMP Review

The following table should be completed annually to document review of the WFMP. More information, including required signatories, can be found in Section 5.1.

Annual Review History		
Review Date	**Reviewer Signature**	**Reviewer Title**

APPENDIX E

Interagency/Intergovernmental Coordination

and Public Participation

Notice of Availability and Public Notices

PUBLIC NOTICE
NOTICE OF AVAILABILITY

Draft Environmental Assessment and Finding of no Significant Impact for Non-Native and Noxious Plant Species Management at Beale Air Force Base (AFB) and the Lincoln Receiver Site (LRS), Yuba and Placer counties, California.

Beale AFB (United States Air Force) has prepared a Draft Environmental Assessment (EA) for non-native and noxious plant species management at Beale AFB and the Lincoln Receiver Site, a geographically separate unit. On Beale AFB and the LRS, a long-standing and entrenched suit of non-native plant species threatens sensitive resources, the accomplishment of military objectives and missions, native ecosystem integrity, and other environmental and human values. To address the threats posed by non-native plant species, Beale AFB proposes to use various management techniques to control the infestations. Treatments could include but are not limited to broad-scale actions such as grazing and prescribed fire, targeted treatments including mechanical and chemical treatments, and habitat enhancement projects. The EA assesses known, potential, and reasonably foreseeable environmental consequences related to these activities. The analysis considered potential effects of Action and No-Action Alternatives on air installation compatible use zone; noise; air quality; land use; agriculture and forest resources; recreation; aesthetics; earth resources; geologic, mineral, and soil resources; water resources; biological/natural resources; safety and occupational health and public services; utilities and infrastructure; transportation and traffic; hazardous materials/wastes; socioeconomic resources and growth-inducing impacts; climate change; environmental justice; cultural and tribal cultural resources; energy resources; and wildfire.

The Air Force invites the public to provide comments on the proposal and any practicable alternatives that may reduce the impacts of non-native and invasive plant species. The Air Force is aware of the potential impact of the ongoing coronavirus (COVID-19) pandemic on the usual methods of access to information and ability to communicate, such as the mass closure of local public libraries and challenges with the internet access and connectivity. The Air Force seeks to implement appropriate additional measures to ensure that the public, and all interested stakeholders, have the opportunity to fully participate in the Draft Environmental Assessment review. Accordingly, please do not hesitate to contact us directly at the email address or telephone number provided below; we are available to discuss and help resolve issues involving access to the Draft EA and Proposed FONSI/FONPA, or the ability to comment.

Copies of the Draft EA and the proposed Finding of No Significant Impact (FONSI) and Finding of No Practicable Alternative (FONPA) are available for review at the following locations: Beale AFB direct link, https://www.beale.af.mil/Library/Units/Environmental-Information/; or by contacting Ms. Tamara Gallentine, via email to tamara.gallentine.2@us.af.mil. Beale AFB Public Affairs can also be contacted at 530-634-8887 or via email to 9rw.pa@us.af.mil. Public comments on the Draft EA must be received no later than Monday 17 May 2021. Comments should be directed to Ms. Tamara Gallentine, via email to tamara.gallentine.2@us.af.mil or 6425 B Street, Beale AFB, CA 95903. Beale AFB Public Affairs can also be contacted at 530-634-8887 or via email to 9rw.pa@us.af.mil.

PUBLIC NOTICE

Intent to Prepare an Environmental Assessment for Non-native Plant Species Management on Beale Air Force Base and Lincoln Receiver Site, Yuba and Placer Counties, California

The United States Air Force (USAF) announces the intent to prepare an Environmental Assessment for the proposed management of noxious non-native plant species on Beale Air Force Base and the Lincoln Receiver Site, a geographically separate unit. Because the Proposed Action will occur in wetlands and floodplains, and has the potential to result in impacts to wetlands, wetland buffers, and floodplains the action is subject to the requirements and objectives of Executive Order 11990, *Wetlands*, as amended and Executive Order 11988, *Floodplain Management*. As part of the Proposed Action, the USAF is considering a No Action Alternative, Preferred Alternative (mechanical removal, chemical application, grazing, and burning), and an additional action alternative (mechanical, grazing, and burning only). The project area encompasses all of Beale Air Force Base and the Lincoln Receiver Site, totaling 23,427 acres. Treatments will be conducted within the project area where noxious and non-native plants occur. Beale Air Force Base and the Lincoln Receiver Site contain over 3,000 acres of wetlands and wetland buffers and 2,500 acres of floodplains. Wetland impacts in the long-term would be beneficial from the removal of non-native plant biomass and restoration of native vegetation in wetlands and adjacent uplands. Long-term impacts to floodplains would be beneficial, by reducing the hazard and risk of flood loss by improving water flow and floodplain functionality. Short-term, temporary impacts would occur to wetlands, wetland buffers, and floodplains during control activities under the action alternatives. Under the No Action Alternative, minimal control activities would occur and non-native plant species would be expected to continue to spread into wetlands and floodplains.

The USAF invites the public to provide comments on the proposal and any practicable alternatives that may reduce these impacts. Comments should be sent by October 31, 2019 to Ms. Kathryn Curtis, Compliance Section Chief, 6425 B Street, Beale AFB, CA 95903 or emailed to kathryn.curtis@us.af.mil.

Yuba Community College district creates program to help students finish degrees

Jurisdiction includes Yuba, Woodland Community College, others

By Nicki Schedler
nschedler@appealdemocrat.com

The Yuba Community College District has become part of a national program called Degrees When Due which focuses on helping students with some college credits to complete a degree.

The college district is comprised of two community colleges, Yuba College and Woodland Community College and four campuses with 14,448 total students.

Sonja Lolland, interim vice chancellor of Education and Planning for the Yuba Community College District said the program will help the district come up with methods for how to reach out to students who have fallen off the college track, and institutionalize best practices for how to reach them.

"It's a national initiative that's really focused on making sure that students complete and obtain their degrees," Lolland said. "This initiative is working to make sure students actually attain their goals…the other purpose is to close an achievement gap."

Lolland said the achievement gap is related to variables such as one's gender, ethnicity or disability which could make their path to success more difficult.

"Part of this program is how do we systematically help students who have stopped attending and how do we get them back," Lolland said.

She did not have a specific cap on how far back the school will go to find those who haven't completed degrees. Regionally, there are about 31,000 residents combined in Yuba and Sutter counties who declare "some college" as their educational attainment, compared to 13,700 for a bachelor's degree, according to the Yuba-Sutter Economic Development Corporation which tracks local data.

The district will be part of the Sacramento State cohort which will allow the Yuba Community College District to collaborate and trade communication strategies for how to best reach people who have left school and help close the achievement gap.

"It's going to be for us to develop policies and procedures to identify and locate students who have stopped out and re-engage with them," Lolland said.

Working to engage with students is Aman Kandola, director of counseling at Yuba College who is developing strategies to not only reach out to students, but also help make college more accessible.

She said the top issue she sees as a barrier for college completion is the financial component.

"What we saw was that maybe some of our low-income students they might get their tuition covered but there are other expenses for college," Kandola said.

Kandola listed assistance like the Yuba College Promise which covers a student's first two full-time semesters, a campus food closet called Dusty's Pantry and a Cal-Fresh program which helps with grocery money as options for students.

Another barrier she said was closely tied to the issue of a financial burden is family issues.

"It could be a family emergency or maybe they have a young child…or personal issues or struggles that might get in the way," Kandola said.

She said the third barrier to college completion she often sees is a student's lack of direction.

"We often get students that come in as freshman in college with no real plan for what they want to do," Kandola said. "This means students may be taking classes they don't really need."

The final barrier, which both Kandola and Lolland noted, are institutional barriers within the colleges themselves.

"Our institutions are large and complex and sometimes we create barriers unintended for students," Lolland said. "We're taking a look at our college processes… looking to streamline enrollment processes, analyzing schedule, making changes to better provide information about majors and courses."

Kandola echoed Lolland's statement, noting she knew of students who never received a degree because of paperwork.

"I know that we have a lot of students who have left the college who actually have met the graduation requirements they just don't know it," Kandola said. "Because the student has to petition for a degree."

Kandola said the college is implementing solutions like a pilot financial literacy program and new communication strategies to help with degree completion.

"So for instance sending out an email – that is not the majority of how students communicate," Kandola said. "We've got to figure out other ways to communicate with students."

While the Degrees When Due program is new in the Yuba Community College District, Kandola and Lolland are hopeful it will be a tool for them to better help students achieve degree completion.

"Things happen in people's lives that are unanticipated," Lolland said. "But we really would hope to become more effective in getting students to achieve their educational goals."

CHASE / From A1

cers Dumbazu, one of the people involved in the accident had fled the scene with her 3-year-old son and stolen a school delivery truck.

According to a press release from Sutter County Sheriff's Office, witnesses followed the stolen vehicle and told authorities that Dumbazu was driving recklessly.

Deputies did not engage in a pursuit, but located the suspect when she was involved in another accident on Township and O'Banion Road. Dumbazu barricaded herself in the stolen vehicle with the child, according to Sutter County Undersheriff Scott Smallwood.

Deputies talked Dumbazu into exiting the vehicle, and the child and mother were taken to Adventist Health/Rideout Hospital and medically cleared. She was taken into custody and the child was released to Child Protective Services.

"Our deputies did a phenomenal job," Smallwood said.

No other injuries were reported at the two accident locations, according to Smallwood. Deputies learned that Dumbazu had been involved in a pursuit with Sacramento California Highway Patrol earlier in the day which was suspended due to speed.

Smallwood did not know the circumstances of the earlier pursuit.

She was booked into Sutter County Jail Tuesday afternoon.

Your Daily Calendar

Have submissions, clarifications or questions about Appeal-Democrat calendars? Contact Event Editor Chris Kaufman at 749-4785 or ckaufman @appealdemocrat.com.

TODAY
EVENTS

Women's Health Screening Days. Sutter Health will be offering free breast cancer and cervical cancer screenings for underinsured and noninsured women.

Mammograms will be offered to women age 40 and above. From 9:30 a.m.-3 p.m., Wednesday, Oct. 2., Sutter Medical Foundation Radiology (Mammograms), 440 Plumas Blvd., Yuba City. From 9 a.m.-4 p.m., Sutter Medical Foundation Obstetrics & Gynecology, 969 Plumas Street, Yuba City. Patients receiving mammograms must have an established primary care provider.

CLUB MEETINGS

Peach Bowl Lions Club meeting, 7 a.m., IHOP Restaurant, 1310 Franklin Road, Yuba City.

The Veterans of Foreign Wars Post 4095 will have their weekly Bingo Night. Doors open at 5 p.m., games start at 6 p.m. VFW Post 4095, 4956 Powerline Road, Olivehurst. Cost: $20. Call: 329-3045.

THURSDAY
EVENTS

First Thursday Night. 5 p.m-9 p.m. on Plumas Street, Yuba City. The Yuba City Downtown Business Association event offers live music, art, shopping, farmers market and more. Children 18 years old and under are encouraged to dress up in their Halloween costumes and some businesses will be handing out candy. Web: yubacitydowntown.com. Call: 755-1620.

Theater Art Gallery Artist Reception with Pamela Nowak, 5 p.m.-7 p.m., Thursday, Oct. 3, Theater Art Gallery, 756 Plumas Street, Yuba City. Cost: Free. Web: suttertheater.org/the-theater-gallery. Call: 908-5704 or 329-1733.

Thursday Farmers Market, 5 p.m.-8:30 p.m., Teegarden Avenue (between Plumas and Shasta streets), Yuba City. Farm fresh produce and arts and crafts vendors. Web: yubacitydowntown.com. Call: 755-1620. Email: info@yubacitydowntown.com.

Stand as 1 Open Mic!, 6:30 p.m., Yuba Sutter Arts, 624 E St., Marysville. An event for spoken word, poetry readings and other recitations. Call: 742-2787. Email: email@yubasutterarts.org. Web: yubasutterarts.org.

CLUB MEETINGS

Widowed Persons Association of California Mall Walk, 8:30 a.m., Yuba Sutter Mall, 1215 Colusa Ave., Yuba City. Social hour 9 a.m. at McDonald's, 866 Colusa Ave., Yuba City.

Kiwanis Club of Marysville will meet at noon at Peach Tree Restaurant, 1080 N Beale Road, Marysville. Web: marysvillekiwanis.org

The Kiwanis Club of Yuba City will meet at Noon at Ting's Refuge Restaurant, 1501 Butte House Road, Yuba City.

FRIDAY
EVENTS

Pasta for a Purpose, a benefit for Yuba-Sutter Food Bank hosted by the Yuba-Sutter Chamber of Commerce, 5 p.m.-8 p.m., Friday, Oct. 4, 1425 Veterans Memorial Circle, Yuba City. Cost $30 or $300 for a table of 8. Call: 743-6501.

Ruby's Market Fall Show, Friday, Oct. 4, 5 p.m.-9 p.m., 2121 Catlett Road, Pleasant Grove. Shop for vintage, retro, handmade and repurposed wares. Food and entertainment with live music night. Cost: Free. Facebook: Ruby's Market Fall Show.

"Annie" at The Acting Company, 7:30 p.m., Friday, Oct. 4, 815 B Street, Yuba City. Call: 751-1100. Email: info@actingcompany.org. Web: actingcompany.org. Facebook: The Acting Company. (Sept. 20 - Oct. 27)

Kimberly Marshall organ concert, 7:30 p.m., Friday, Oct. 4, 7:30 p.m., First Lutheran Church, 850 Cooper Ave., Yuba City.

APPEAL-DEMOCRAT

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Correction Policy

The Appeal-Democrat promptly corrects all errors of substance. To report an error or request a clarification, call 749-6552.

Who to Call

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FELONY ARRESTS

Scott M. Heitkemper, 50, of the 1189 block of Casita Drive, Yuba City, was arrested by the Yuba City Police Department at 1:31 p.m. Sept. 30 at the 1100 block of Butte House Road on suspicion of second degree burglary. He was booked into Sutter County Jail.

DUI ARRESTS

Dennis M. Ryan, 64, of the 1600 block of Dorothy Lane, Yuba City, was arrested by the Yuba City Police Department at 12:44 p.m. Sept. 30 at his residence. He was booked into Sutter County Jail.

Lottery

The winning numbers from the California State Lottery on Tuesday:

MEGA Millions
10, 17, 39, 42, 59, **3**
Fantasy 5
10, 14, 17, 23, 33
Daily 3
Afternoon – 0, 8, 2
Evening – 9, 4, 4
Daily 4
8, 1, 7, 7
Daily Derby
1st: 11, Money Bags
2nd: 7, Eureka
3rd: 4, Big Ben
Race time: 1:48.32

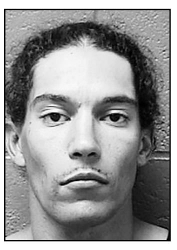
Suspect flees, jumps from moving van, is stopped by police dog

By David Wilson
dwilson@appealdemocrat.com

A Marysville Police dog was used Friday to conclude the pursuit of a man who fled the scene of an accident, jumped out of a moving vehicle and ran away.

Marysville police responded at 1:30 p.m. to a traffic accident in the 1100 block of H Street as one of the drivers, Henry Ramus, 30, drove away in a green van.

Police pursued Ramus, who later exited his van while it was still moving at 10th Street and I Street, and continued evading police on foot. The unmanned van crashed into another vehicle. Police chased Ramus on foot as he ran through backyards, but was eventually caught by a Marysville police dog at 9th and H Street, according to a news release from the department.


Henry Ramus

After his arrest, a loaded firearm was found in Ramus's van.

He was then taken into custody without further incident. Ramus was booked for felony evading, felony vandalism, hit and run, resisting arrest, driving on a suspended license and being a felon in possession of a firearm, according to the release.

Ramus was booked into Yuba County Jail Friday evening and is being held on $100,000 bail.

YWA awards grant for marijuana eradication equipment

Appeal-Democrat

The Yuba Water Agency awarded the Yuba County Sheriff's Office with a grant on Tuesday to help its marijuana eradication team purchase new safety equipment.

The $5,000 grant is through the agency's Bill Shaw Rescue Equipment and Training Grant Program and will help the sheriff's office purchase specialized uniforms and equipment used during its investigations.

"Illegal grows negatively impact the quantity and quality of our water because of the harmful chemicals that are used," said Brent Hastey, chairman of the water agency, in a press release. "Funding these new uniforms will help protect both our sheriff's deputies and our water."

The new uniforms will consist of chemical, fire and tear-resistant material meant to better protect deputies when processing unlawful grow operations. The water agency is funding the purchase because of the potential negative impacts that illegal marijuana grows can have on the watershed, according to a press release.

The grant program has supported 14 agencies with $163,500 in grants since it was established in 2018. It's meant to assist first-responder agencies in Yuba County to cover one-time costs of up to $10,000 per applicant annually for purchases of rescue equipment and specialized training.

DEBRIS / From A1

2018. It has posed a variety of issues for local motorists and law enforcement due to truck traffic clogging up the area's transportation arteries on their way to the Recology Yuba-Sutter Ostrom Road Landfill, which is one of two primary landfills in the north state accepting ash, debris, and contaminated soil.

At the peak of operations, 154 crews of three to five people each were up in Butte County helping with the debris removal. That number has been significantly reduced, now down to only 30 crews, Klug said. Each crew, on average, fills 10-20 truckloads of material per day.

Initially, the expectation was that debris removal would take until early 2020, but crews are significantly ahead of schedule. As of Oct. 1, there were 94 parcels that still needed to have the debris removed.

"We expect to complete debris removal in the coming weeks, although final soil sampling, erosion control installation and final inspections will take a bit more time to complete," Klug said. "Upon final inspections, a notice will be sent to the county making these properties eligible for building permits."

Camp Fire cleanup by the numbers:

Of the 10,888 sites participating in the Camp Fire Consolidated Debris Removal Program:

– 10,794 parcels had completed debris removal.

– 9,394 soil confirmation sampling results approved.

– 8,160 properties with erosion control installed or waived.

– 7,998 properties approved for redevelopment.

(*Statistics provided by CalRecycle; figures as of Oct. 1.)

CARRANZA / From A1

Aug. 19 arraignment.

"He has to serve the 30 years, at which point he will become eligible for parole," Curry said by phone.

Carranza walked into the Marysville Police Department Aug. 16, and told officers he stabbed his mother in their Marysville apartment. Roselinda Franco, 58, was found in the Ramirez Street apartment with multiple stab wounds and was pronounced dead at the scene.

"The early resolution was a surprise on a case of this magnitude," Curry said. "I think Mr. Carranza must have some remorse... that's probably chiefly what's behind the early resolution."

Carranza is scheduled for sentencing on Nov. 4 at 9 a.m. at the Yuba County Courthouse.

Police Blotter

Appeal-Democrat

FELONY ARRESTS

Daniel E. Woelk, 30, of the 3600 block of Nisenan Lane, Wheatland, was arrested by the Yuba County Sheriff's Office at 6:30 p.m. Oct. 3 at his residence on suspicion of inflicting corporal injury. He was booked into Yuba County Jail.

David L. Pate, 50, of the 1300 block of Freeman Street, Marysville, was arrested by the Yuba County Sheriff's Office at 4:09 a.m. Oct. 3 on suspicion of carrying a concealed dirk or dagger. He was booked into Yuba County Jail.

Tracy L. Mejaski, 37, of the 5800 block of Rupert Avenue, Marysville, was arrested by the Yuba County Sheriff's Office at 9:40 a.m. Oct. 3 on suspicion of obstructing and resisting an officer. She was booked into Yuba County Jail.

Andrew C. Dalton III, 18, of the 1600 block of Volk Street, Marysville, was arrested by the Yuba County Sheriff's Office at 12:56 p.m. Oct. 3 on suspicion of threatening to commit a crime, inflicting corporal injury and battery. He was booked into Yuba County Jail.

Mark A. Keesler, 38, of the 5700 block of Wildwood Drive, Linda, was arrested by the Yuba County Sheriff's Office at 2 a.m. Oct. 4 on suspicion of vehicle theft. He was booked into Yuba County Jail.

Your Daily Calendar

TODAY
EVENTS

4th annual Civil War Days, 9 a.m.-5 p.m., Saturday, Oct. 5, Cotton Rosser Arena Pavilion, Beckwourth Riverfront Park, Marysville. The event will feature battle reenactments at 1 p.m and 4 p.m. and is sponsored by the Civil War Days and Linda Lions Club. Cost: $5-$10, children under 5 free. Call: 216-6532.

Race for Awareness 5K Walk/Run, 8 a.m., Saturday, Oct. 5, Geweke Field, 871 East Onstott Road, Yuba City. Proceeds benefit Pink October and Geweke's Caring for Women Foundation. Cost: $30. Call: 821-4721. Web: pink-october.org. Email: ngeweke@geweke.com.

Ruby's Market Fall Show, Saturday, Oct. 5, 10 a.m.-4 p.m., 2121 Catlett Road, Pleasant Grove. Shop for vintage, retro, handmade and repurposed wares. Food and entertainment with live music night. Cost: Free. Facebook: Ruby's Market Fall Show.

Have submissions, clarifications or questions about Appeal-Democrat calendars? Contact Event Editor Chris Kaufman at 749-4785 or ckaufman @appealdemocrat.com.

"Annie" at The Acting Company, 7:30 p.m., Saturday, Oct. 5, 815 B Street, Yuba City. Call: 751-1100. Email: info@actingcompany.org. Web: actingcompany.org. Facebook: The Acting Company. (Sept. 20 - Oct. 27).

Yuba City Certified Farmers Market, 8 a.m.-noon, Town Square, Plumas Boulevard and C Street, Yuba City. Local and regional produce, arts and craft vendors. Cost: Free. Facebook: Yuba City Certified Farmers Market. Call: 671-2003.

1st Saturday Book Sale sponsored by Friends of the Sutter County Library from 10 a.m to 3 p.m. at the Sutter County Library, 750 Forbes Ave., Yuba City. 100 percent of all sales go directly to Library Services. Donations of gently used books, DVD's and CD's are appreciated.

Sutter County Public Health annual drive through flu clinic, 10 a.m.-noon, Saturday, Oct. 5, Sutter High School, 2665 Acacia Ave., Sutter. Call: 822-7215.

Fall Rummage Sale, 8 a.m.-1 p.m., Saturday, Oct. 5, First United Methodist Church of Yuba City, 3101 Colusa Highway, Yuba City. Web: fumcyubacity.com. Call: 673-5858.

Candlelight vigil for slain Harris County Deputy Sandeep Singh Dhaliwal, 6 p.m., Saturday, Oct. 5, Happy Park, 1871 Pebble Beach Drive, Yuba City.

Appeal-Democrat

Management

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All email addresses are first initial of the first name followed by the full last name @appealdemocrat.com. For example, Bob Jones: Bjones@appealdemocrat.com


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749-4770

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By mail – 13 weeks $66
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Correction Policy

The Appeal-Democrat promptly corrects all errors of substance. To report an error or request a clarification, call 749-6552.

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Online Poll

Our latest poll question at www.appealdemocrat.com asks: What's your favorite Thanksgiving food?

Your choices are:

■ Turkey
■ Stuffing
■ Mashed potatoes and gravy
■ Green bean casserole
■ Sweet potatoes
■ Cranberry sauce
■ Pie
■ Jello Salad

Email copy editor Ruby Larson with your online poll ideas at: rlarson@appealdemocrat.com

Lottery

The winning numbers from the California State Lottery on Friday:

MEGA Millions
11, 38, 44, 48, 70, MEGA: 17
Fantasy 5
6, 8, 9, 25, 30
Daily 3
Afternoon – 8, 5, 3
Evening – 9, 3, 2
Daily 4
5, 9, 8, 5
Daily Derby
1st: 04 - BIG BEN
2nd: 06 - WHIRL WIN
3rd: 08 - GORGEOUS GEORGE
Race time: 1:42.20

Interagency and Intergovernmental Coordination for Environmental Planning (IICEP) List

Federal Agencies	
Ms. Cathy Johnson U.S. Fish and Wildlife Service Habitat Conservation Division, Sacramento Office 2800 Cottage Way, W-2605 Sacramento, CA 95825	Ms. Maria Rea National Oceanic and Atmospheric Administration Marine Fisheries Service CA Central Valley Office 650 Capitol Mall, Suite 5-100 Sacramento, CA 95814
US Army Corps of Engineers, Sacramento District, Regulatory Division 1325 J Street - Room 1513 Sacramento, CA 95814	US Department of the Interior, US fish and Wildlife Services, California/Nevada Operations Office 2800 Cottage Way, Room W-2606 Sacramento, CA 95825
US Environmental Protection Agency, Region 9, Director, Officer of Federal Activities 75 Hawthorne Street San Francisco, CA 94105	
State Agencies	
Ms. Julianne Polanco State Historic Preservation Officer Department of Parks and Recreation Office of Historic Preservation 1725 23rd Street, Suite 100 Sacramento, CA 95816	Nadell Gayou California Department of Water Resource, Environmental Review Section, DPLA 901 P Street, 2nd Floor Sacramento, CA 95814
California Air Resource Board Air Quality and Transportation Division 1001 "I" Street, PO Box 2815 Sacramento, CA 95812	California Department of Fish and Wildlife Habitat Conservation Planning Branch PO Box 944209 Sacramento, CA 94244-2090
California Department of Fish and Wildlife, Regional Manager - North Central Region 1701 Nimbus Road Rancho Cordova, CA 95670	California Environmental Protection Agency (CalEPA) 1001 "I" Street, PO Box 2815 Sacramento, CA 95812
Mark Carroll CDFW Spenceville Wildlife Management Area 945 Oro Dam Boulevard W Oroville, CA 95965	State Water Resource Control Board Division of Water Quality 100 I Street, PO Box 806 Sacramento, CA 95812-4025
Local Agencies	
Feather River Air Quality Management District 541 Washington Avenue Yuba City, CA 95991	Central Valley Regional Water, Quality Control Board 11020 Sun Center Drive, #200 Rancho Cordova, CA 95670-6114
Nevada County Board of Supervisors District 4 Supervisors, Erric Rood Administrative Center 950 Maidu Avenue Nevada City, CA 95959	Yuba County Board of Supervisor, District 1 Supervisor 915 8th Street, Suite 109 Marysville, CA 95901

Yuba County Board of Supervisors, District 4 Supervisor 915 8th Street, Suite 109 Marysville, CA 95901	Yuba County Board of Supervisors, District 5 Supervisor 915 8th Street, Suite 109 Marysville, CA 95901
Yuba County Planning Department 918 8th Street, Suite 123 Marysville, CA 95901	Yuba County Water Agency 950 Maidu Avenue Marysville, CA 95901
Tribal Governments	
Ms. Glenda Nelson Chairperson Enterprise Rancheria 2133 Monte Vista Avenue Oroville, CA 95966	Mr. Reno Franklin Tribal Historic Preservation Officer Enterprise Rancheria 2133 Monte Vista Avenue Oroville, CA 95966
Ms. Regina Cuellar Chairperson Shingle Springs Rancheria PO Box 1340 Shingle Springs, CA 95682	Ms. Annie Jones Vice Chairperson Shingle Springs Rancheria PO Box 1340 Shingle Springs, CA 95682
Mr. Daniel Fonseca Cultural Resource Director/ Tribal Historic Preservation Officer Shingle Springs Rancheria PO Box 1340 Shingle Springs, CA 95682	Mr. Francis Steele Chairperson Berry Creek Rancheria 5 Tyme Way Oroville, CA 95966
Mr. Dennis Ramirez Chairperson Mechoopda Indian Tribe 125 Mission Ranch Blvd. Chico, CA 95926	Mr. Benjamin Clark Chairperson Mooretown Rancheria #1 Alverda Dr. Oroville, CA 95966
Mr. Matthew Hatcher Tribal Historic Preservation Officer Mooretown Rancheria #1 Alverda Dr. Oroville, CA 95966	Gene Whitehouse Chairperson United Auburn Indian Community 10720 Indian Hill Road Auburn, CA 95603
Ms. Jessica Lopez Chairperson Konkow Valley Band of Maidu 2136 Meyers Street Oroville, CA 95966	Mr. Matthew Moore Tribal Historic Preservation Officer United Auburn Indian Community 10720 Indian Hill Road Auburn, CA 95603
Ms. Tina Goodwin Chairperson Strawberry Valley Rancheria PO Box 984 Marysville CA 95901	Mr. Eric S. Josephson NAGPRA Coordinator Konkow Valley Band of Maidu PO Box 938 Cottonwood, CA 96022

Mr. Scott Dinsmore Tribal Chair Member Strawberry Valley Rancheria PO Box 984 Marysville CA 95901	Ms. Pamela Cubbler Treasurer Colfax-Todds Valley Consolidated Tribe PO Box 4884 Auburn, CA 95604

Certified Mail Tracking Sheets

Organization/Tribe	Name of contact	Title	Street address	City	Zip code	Certified Numbers	Date dropped in out going mail box (headshed)	Received/Delivery Date
Estom Yumeka Maidu Tribe of the Enterprise Rancheria (Enterprise Rancheria of Maidu Indians of California)	Ms. Glenda Nelson	Chairperson	2133 Monte Vista Ave	Oroville	CA 95966	7018 1130 0000 7732 2581	Thursday, September 26, 2019	3-Oct-19
Estom Yumeka Maidu Tribe of the Enterprise Rancheria (Enterprise Rancheria of Maidu Indians of California)	Mr. Reno Franklin	THPO	2133 Monte Vista Ave	Oroville	CA 95966			
Shingle Springs Band of Miwok Indians, Shingle Springs Rancheria	Mr. Nicholas Fonseca; Mr. Hermo Olanio; Mr. Daniel Fonseca	Chairperson; Vice Chairperson; Cultural Resources Director	PO Box 1340	Shingle Springs	CA 95682	7018 1130 0000 7732 2666	Thursday, September 26, 2019	8-Oct-19
Berry Creek Rancheria of Maidu Indians	Mr. Francis Steele	Chairperson	5 Tyme Way	Oroville	CA 95966	7018 1130 0000 7732 2611	Thursday, September 26, 2019	4-Oct-19
Mechoopda Indian Tribe of Chico Rancheria (Maidu)	Mr. Dennis Ramirez	Chairperson	125 Mission Ranch Blvd.	Chico	CA 95926	7018 1130 0000 7732 2598	Thursday, September 26, 2019	4-Oct-19
Mooretown Rancheria of Maidu Indians	Benjamin Clark	Chairperson	#1 Alverda Dr.	Oroville	CA 95966	7018 1130 0000 7732 2567	Thursday, September 26, 2019	no date/signed rcvd
United Auburn Indian Community	Mr. Gene Whitehouse	Chairperson	10720 Indian Hill Rd	Auburn	CA 95603	7018 1130 0000 7732 2659	Thursday, September 26, 2019	
	Mr. Matthew Moore	THPO	10720 Indian Hill Rd	Auburn	CA 95603			
Konkow Valley Band of Maidu	Ms. Jessica Lopez	Chairperson	2086 N. Villa St	Palermo	CA 95968	7018 1130 0000 7732 2635	Thursday, September 26, 2019	8-Oct-19
Konkow Valley Band of Maidu	Mr. Eric S. Josephson	NAGPRA Coordinator	PO Box 938	Cottonwood	CA 96022	7018 1130 0000 7732 2642	Thursday, September 26, 2019	9-Oct-19
Strawberry Valley Rancheria	Ms. Tina Goodwin	Chairperson	PO Box 984	Marysville	CA 95901	7018 1130 0000 7732 2628	Thursday, September 26, 2019	
Colfax-Todds Valley Consolidated Tribe	Ms. Pamela Cubbler	Treasurer	PO Box 4884	Auburn	CA 95604	7018 1130 0000 7732 2604	Thursday, September 26, 2019	11-Oct-19

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Gallentine, Tamara A.	GS-11	9 CES/CEIEC	2019/09/26	

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4	Enter your address and functional address symbol.	
5	Enter name, grade and office symbol of person dispatching the containers.	
6 and 7	Enter current date and time.	
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California Department of Fish and Wildlife Habitat Conservation Planning Branch			PO Boix 944209	Sacramento	94244-2090	7018 1130 0000 7732 2796	Thursday, September 26, 2019	
California Department of Fish and Wildlife, Regional Manager - North Central Region			1701 Nimbus Road	Ranco Cordova	95670	7018 1130 0000 7732 2727	Thursday, September 26, 2019	4-Oct-19
California Department of Water Resource, Environmental Review Seciton, DPLA	Nadell Gayou		901 P Street, 2nd Floor	Sacramento	95814	7018 1130 0000 7732 2819	Thursday, September 26, 2019	Signed w/no date
California Environmental Protection Agency (CalEPA)			1001 "I" Street, PO Box 2815	Sacramento	95812	7018 1130 0000 7732 2697	Thursday, September 26, 2019	3-Oct-19
CDFW Spenceville Wildlife Management Area	Mark Carroll		945 Oro Dam Boulevard W	Oroville	95965	7018 1130 0000 7732 2802	Thursday, September 26, 2019	8-Oct-19
Central Valley Regional Water, Quality Control Board			11020 Sun Center Drive, #200	Rancho Cordova	95670-6114	7018 1130 0000 7732 2710	Thursday, September 26, 2019	4-Oct-19
Feather River Air Quality Management District			541 Washington Avenue	Yuba City	95991	7018 1130 0000 7732 2864	Thursday, September 26, 2019	signed w/no date
National Ocenaic and Atmospheric Admininstration, National Marine Fisheries Service			650 Capitol Mall, Suite 5-100	Sacramento	95814	7018 1130 0000 7732 2758	Thursday, September 26, 2019	7-Oct-19
Nevada County Board of Supervisors District 4 Supervisors, Erric Rood Administrative Center			950 Maidu Avenue	Nevada City	95959	7018 1130 0000 7732 2857	Thursday, September 26, 2019	4-Oct-19
State Historic Preservation Officer, Department of Parks and Recreation			1725 23rd Street, Suite 100	Sacramento	95816	7018 1130 0000 7732 2772	Thursday, September 26, 2019	4-Oct-19
State Water Resource Control Board Division of Water Quality			100 I Street, PO Box 806	Sacramento	95812-4025	7018 1130 0000 7732 2871	Thursday, September 26, 2019	
US Army Corps of Engineers, Sacramento District, Regulatory Division			1325 J Street - Room 1513	Sacramento	95814	7018 1130 0000 7732 2680	Thursday, September 26, 2019	4-Oct-19
US Department of the Interior, US fish and Wildlife Services, California/Nevada Operations Office			2800 Cottage Way, Room W-2606	Sacramento	95825	7018 1130 0000 7732 2741	Thursday, September 26, 2019	4-Oct-19
US Environmental Protection Agency, Region 9, Director, Officer of Federal Activities			75 Hawthorne Street	San Francisco	94105	7018 1130 0000 7732 2673	Thursday, September 26, 2019	4-Oct-19
Yuba County Board of Supervisor, District 1 Supervisor			915 8th Street, Suite 109	Marysville	95901	7018 1130 0000 7732 2789	Thursday, September 26, 2019	Signed w/no date
Yuba County Board of Supervisors, District 4 Supervisor			915 8th Street, Suite 109	Marysville	95901	7018 1130 0000 7732 2826	Thursday, September 26, 2019	Signed w/no date
Yuba County Board of Supervisors, District 5 Supervisor			915 8th Street, Suite 109	Marysville	95901	7018 1130 0000 7732 2734	Thursday, September 26, 2019	Signed w/no date
Yuba County Planning Department			918 8th Street, Suite 123	Marysville	95901	7018 1130 0000 7732 2840	Thursday, September 26, 2019	Signed w/no date
Yuba County Water Agency			950 Maidu Avenue	Marysville	95901	7018 1130 0000 7732 2765	Thursday, September 26, 2019	**No date**
Yuba County Water Agency (RESEND)			950 Maidu Avenue	Marysville	95901	7018 1130 0000 7732 0990	Tuesday, October 29, 2019	Signed w/no date

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(2)	7018 1130 0000 7732 2680	USPS Certified Mail	(12)	7018 1130 0000 7732 2789	USPS Certified Mail
(3)	7018 1130 0000 7732 2697	USPS Certified Mail	(13)	7018 1130 0000 7732 2796	USPS Certified Mail
(4)	7018 1130 0000 7732 2703	USPS Certified Mail	(14)	7018 1130 0000 7732 2802	USPS Certified Mail
(5)	7018 1130 0000 7732 2710	USPS Certified Mail	(15)	7018 1130 0000 7732 2819	USPS Certified Mail
(6)	7018 1130 0000 7732 2727	USPS Certified Mail	(16)	7018 1130 0000 7732 2826	USPS Certified Mail
(7)	7018 1130 0000 7732 2734	USPS Certified Mail	(17)	7018 1130 0000 7732 2840	USPS Certified Mail
(8)	7018 1130 0000 7732 2741	USPS Certified Mail	(18)	7018 1130 0000 7732 2857	USPS Certified Mail
(9)	7018 1130 0000 7732 2758	USPS Certified Mail	(19)	7018 1130 0000 7732 2864	USPS Certified Mail
(10)	7018 1130 0000 7732 2765	USPS Certified Mail	(20)	7018 1130 0000 7732 2871	USPS Certified Mail

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a. NAME (Last, First, Middle Initial)	b. OFFICE SYMBOL	c. SIGNATURE	d. DATE (YYYYMMDD)	e. TIME

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INSTRUCTIONS

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1	Leave blank.	Mailing OMC enters carrier's registry, certified, serial number, etc.
2	For local use (optional).	
3	Enter address of receiving action office or ADO.	Enter address of OMC.
4	Enter your address and functional address symbol.	
5	Enter name, grade and office symbol of person dispatching the containers.	
6 and 7	Enter current date and time.	
8	Enter item's container number. List more than one container number if the items are going to the same action office, ADO, or OMC.	
9	Originating action office enters the type of special service required.	OMC enters type of special service used.
10 - 12	Completed by authorized recipient(s).	

INTERNAL RECEIPT *(Envelopes, Packages, Boxes, Crates, etc.)*	1. CARRIER'S NUMBER	2. DISPATCH NUMBER
3. TO Official Mail Center (OMC) 17852 16th Street, Suite 159 Beale AFB, CA 95903-1616	4. FROM 9 CES/CEIEC 6245 B Street, Bldg 25390 Beale AFB, CA 95903-1708	

5. DISPATCHED BY a. NAME *(Last, First, Middle Initial)*	b. GRADE	c. OFFICE SYMBOL	6. DATE *(YYYYMMDD)*	7. TIME
Gallentine, Tamara A.	GS-11	9 CES/XXX	2019/10/29	

ITEM	8. CONTAINER NUMBER(S)	9. SPECIAL SERVICE	ITEM	8. CONTAINER NUMBER(S)	9. SPECIAL SERVICE
(1)	7018 1130 0000 7732 0990	USPS Certified Mail	(11)		
(2)	XXXX LAST ITEM XXX	XXXXXXXXXXXXXX	(12)		
(3)			(13)		
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a. NAME *(Last, First, Middle Initial)*	b. OFFICE SYMBOL	c. SIGNATURE	d. DATE *(YYYYMMDD)*	e. TIME

11. RECEIVED BY

a. NAME *(Last, First, Middle Initial)*	b. OFFICE SYMBOL	c. SIGNATURE	d. DATE *(YYYYMMDD)*	e. TIME

12. RECEIVED BY

a. NAME *(Last, First, Middle Initial)*	b. OFFICE SYMBOL	c. SIGNATURE	d. DATE *(YYYYMMDD)*	e. TIME

INSTRUCTIONS

ITEM	FOR LOCAL DELIVERY *(Not through USPS or other carrier)*	FOR DELIVERY THROUGH USPS OR OTHER CARRIER
1	Leave blank.	Mailing OMC enters carrier's registry, certified, serial number, etc.
2	For local use (optional).	
3	Enter address of receiving action office or ADO.	Enter address of OMC.
4	Enter your address and functional address symbol.	
5	Enter name, grade and office symbol of person dispatching the containers.	
6 and 7	Enter current date and time.	
8	Enter item's container number. List more than one container number if the items are going to the same action office, ADO, or OMC.	
9	Originating action office enters the type of special service required.	OMC enters type of special service used.
10 - 12	Completed by authorized recipient(s).	

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- Complete items 1, 2, and 3.
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- Attach this card to the back of the mailpiece, or on the front if space permits.

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YUBA COUNTY WATER AGENCY
1220 F STREET
MARYSVILLE CA 95901

9590 9402 3613 7305 8435 20

2. Article Number *(Transfer from service label)*

7018 1130 0000 7732 0990

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A. Signature

X

☐ Agent
☐ Addressee

B. Received by *(Printed Name)*

C. Date of Delivery

D. Is delivery address different from item 1? ☐ Yes
If YES, enter delivery address below: ☐ No

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☐ Collect on Delivery Restricted Delivery
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Representative Agency IICEP Letter

California Department of Fish and Wildlife

Habitat Conservation Planning Branch

DEPARTMENT OF THE AIR FORCE
9TH CIVIL ENGINEER SQUADRON (ACC)
BEALE AIR FORCE BASE, CALIFORNIA

MEMORANDUM FOR CALIFORNIA DEPARTMENT OF FISH AND WILDLIFE
HABITAT CONSERVAITON PLANNING BRANCH
PO Box 944209
Sacramento, CA 94244-2090

FROM: 9 CES/CD
6425 B Street, Bldg. 25390
Beale AFB, CA 95903-1708

SUBJECT: Notification and Solicitation of Comments for Non-native and Noxious Plant Species Management, Beale Air Force Base and Lincoln Receiver Site, Yuba and Placer Counties, California

1. The U.S. Air Force (USAF) is in the process of preparing a Draft Environmental Assessment in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended; Council on Environmental Quality Regulations (40 Code of Federal Regulations 1500-1508); and USAF *Environmental Impact Analysis Process* (32 Code of Federal Regulations Part 989).

2. Under the Proposed Action, the USAF is seeking to manage non-native and noxious plant species in order to reduce their prevalence on Beale Air Force Base (AFB) and Lincoln Receiver Site (LRS), a geographically separate unit. On Beale AFB and LRS, a long-standing and entrenched suit of non-native plant species threatens sensitive resources, the accomplishment of military objectives and missions, native ecosystem integrity, and other environmental and human values. To address the threats posed by non-native plant species, the USAF proposes to use various management techniques to control non-native plant infestations. Treatments could include but are not limited to broad-scale actions such as grazing and prescribed fire, targeted treatments including mechanical and chemical treatments, habitat enhancement projects, and biosecurity actions.

3. The Environmental Assessment will assess the environmental consequences of two alternative options for the Proposed Action: management of non-native species on the installation and the No Action Alternative.

4. The Air Force requests your input on the Proposed Action as part of the consultation process with relevant agencies, property owners, and stakeholders. This process is formally referred to as the Interagency and Intergovernmental Coordination for Environmental Planning process. Through this notice, the USAF is contacting you to notify you of the Proposed Action and to solicit comments. This is the initial step in the review process, and a draft of the Environmental Assessment will be released once specific details on each Alternative have been developed.

5. Please address all questions and comments to Ms. Kathryn Curtis, Compliance Section Chief, at (530) 634-2642, kathryn.curtis@beale.af.mil, 9 CES/CEIE, 6425 B Street, Bldg. 25390, Beale AFB, CA 95903-1708.

CALVIN G. HENDRIX
Deputy Base Civil Engineer

Attachments:
1. Overall Project Area Location Map

Representative Tribal IICEP Letter

Mr. Benjamin Clark, Chairperson

Mooretown Rancheria of Maidu Indians

DEPARTMENT OF THE AIR FORCE
9TH CIVIL ENGINEER SQUADRON (ACC)
BEALE AIR FORCE BASE, CALIFORNIA

MEMORANDUM FOR MOORETOWN RANCHERIA OF MAIDU INDIANS
ATTN: MR. BENJAMIN CLARK
Chairperson
#1 Alverda Drive
Oroville, CA 95966

FROM: 9 CES/CD
6425 B Street, Bldg. 25390
Beale AFB, CA 95903-1708

SUBJECT: Notification and Solicitation of Comments for Non-native and Noxious Plant Species Management, Beale Air Force Base and Lincoln Receiver Site, Yuba and Placer Counties, California

1. The U.S. Air Force (USAF) is in the process of preparing a Draft Environmental Assessment in accordance with the National Environmental Policy Act (NEPA) of 1969, as amended; Council on Environmental Quality Regulations (40 Code of Federal Regulations 1500-1508); and USAF *Environmental Impact Analysis Process* (32 Code of Federal Regulations Part 989).

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details on each Alternative have been developed. Please note this letter does not cover Section 106 of the National Historic Preservation Act (54 United States Code (U.S.C.) § 306108) and 36 Code of Federal Regulations (CFR) Part 800, which will be sent at a future date.

5. Please address all questions and comments to Ms. Kathryn Curtis, Compliance Section Chief, at (530) 634-2642, kathryn.curtis@beale.af.mil, 9 CES/CEIE, 6425 B Street, Bldg. 25390, Beale AFB, CA 95903-1708.

CALVIN G. HENDRIX
Deputy Base Civil Engineer

Attachments:
1. Overall Project Area Location Map

Notification Responses

APPENDIX F

Permits and Consultations for Invasive Plant Control on Beale AFB

Informal Consultation with USFWS on Biological Assessment for Non-Native and Noxious Plant Species Management at Beale Air Force Base

03 June 2020

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 9TH RECONNAISSANCE WING (ACC)
BEALE AIR FORCE BASE, CALIFORNIA

03 JUNE 2020

MEMORANDUM FOR U.S. FISH AND WILDLIFE SERVICE
ATTN: MS. JENNIFER NORRIS
2800 Cottage Way, Room W2605
Sacramento, CA 95825-1846

FROM: 9 CES/CEIE
6425 B Street, Bldg. 25390
Beale AFB, CA 95903-1708

SUBJECT: Change from Formal to Informal Consultation – Biological Assessment for Non-Native and Noxious Plant Species Management at Beale Air Force Base (AFB), Yuba County, California

1. The intent of this letter is to submit a change, after re-evaluation, in the determination of the Biological Assessment (BA) to the U.S. Fish and Wildlife Service (USFWS) to initiate consultation pursuant to Section 7 of the Endangered Species Act (ESA) of 1973 (16 United States Code [U.S.C.] 1536) for Non-Native and Noxious Plant Species Management at Beale AFB, Yuba County, California. This BA evaluates the potential effects on federally-listed species and their habitat from non-native and noxious plant species management actions to be conducted on Beale AFB, located in Yuba County, California, and the Lincoln Receive Site, a geographically separated unit managed by Beale AFB, in Placer County, California.

2. The activities that will be authorized under this BA may affect, not likely to adversely affect vernal pool fairy shrimp (*Branchinecta lynchi*), vernal pool tadpole shrimp (*Lepidurus packardi*), western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) and valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*). Additionally, the activities in this BA may affect, likely to adversely affect the monarch butterfly (*Danaus plexippus*) that is currently under review for federal listing under the ESA. Beale AFB does not believe this Proposed Action is likely to affect other federally-listed species occurring in the general region of the Action Area on Beale AFB. This determination has been made based on field observations, prior consultations with USFWS, and past experience with other projects.

3. Please review the enclosed documents and if you have comments or need additional information on this project, contact Tamara Gallentine, Natural & Cultural Resources Program Manager, at (530) 634-2738 or tamara.gallentine.2@us.af.mil.

Gwendolyn E. Vergara
GWENDOLYN E. VERGARA, GS-13, USAF
Chief, Environmental Element
9th Civil Engineer Squadron

Attachment:
Biological Assessment for Non-Native and Noxious Plant Species Management at Beale Air Force Base (AFB), Yuba County, California

BIOLOGICAL ASSESSMENT FOR INVASIVE PLANT SPECIES MANAGEMENT

AT

BEALE AIR FORCE BASE, CALIFORNIA

JUNE 2020

PREPARED BY:

BEALE AIR FORCE BASE
9 CES/CEIE
6425 B STREET
BEALE AIR FORCE BASE, CA 95903-1712

CONTACT

Ms. Tamara Gallentine
(530) 634-2738
Tamara.Gallentine.2@us.af.mil

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ACRONYMS

AFB	Air Force Base
AMM	Avoidance and Minimization Measure
BASH	Bird/wildlife Air Strike Hazard
BA	Biological Assessment
BMP	Best Management Practice
BO	Biological Opinion
CDF	California Department of Forestry and Fire Protection
CDFW	California Department of Fish and Wildlife (previously California Department of Fish and Game)
Cal-IPC	California Invasive Plant Council
CEIE	Environmental Element
CES	Civil Engineer Squadron
CFR	Code of Federal Regulations
CFS	Conservation Fairy Shrimp
CNDDB	California Natural Diversity Database
CRLF	California Red-Legged Frog
CWA	Clean Water Act
DoD	Department of Defense
eDNA	Environmental DNA
ESA	Endangered Species Act
FAO	Food and Agriculture Organization
FR	Federal Register
GGS	Giant garter snake
GIS	Geographic Information System
GMU	Grazing Management Unit
GMG	Grazing Management Guidelines
IDP	Installation Development Plan
INRMP	Integrated Natural Resources Management Plan
IPSMG	Invasive Plant Species Management Guidelines
LIDAR	Light Detection and Ranging
NRCS	Natural Resource Conservation Service
NRM	Natural Resources Manager
POEA	Polyoxyethyleneamine
QAL	Qualified Applicator License
POI	Period of Inundation
RDM	Residual Dry Mass
RGP	Regional General Permit
RTK GPS	Real Time Kinematic Global Positioning System
RW	Reconnaissance Wing
T&E	Threatened and Endangered
U.S.	United States

USACE	United States Army Corps of Engineers
USAF	United States Air Force
U.S.C.	United States Code
USFWS	United States Fish and Wildlife Service (Service)
USGS	United States Geological Survey
VELB	Valley elderberry longhorn beetle
VPFS	Vernal pool fairy shrimp
VPTS	Vernal pool tadpole shrimp
WYBC	Western Yellow-billed Cuckoo

1.0 INTRODUCTION

1.1 Overview

This Biological Assessment (BA) is prepared pursuant to Section 7 of the Endangered Species Act (ESA) of 1973 (16 United States Code [U.S.C.] 1536). Section 7 of the ESA requires consultation with the USFWS to determine if federal actions will affect federally-listed threatened or endangered species and to ensure that any action will not jeopardize the continued existence of any federally-listed threatened or endangered species.

This BA evaluates the potential effects on federally-listed species and their habitat from non-native and noxious plant species management actions conducted on Beale Air Force Base (AFB), located in Yuba County, California, and the Lincoln Receive Site (LRS), a geographically separated unit (GSU) managed by Beale AFB, in Placer County, California (Figure 1). This BA also summarizes current data regarding federally-listed threatened and endangered (T&E) species or species that are proposed for federal listing as threatened or endangered species on Beale AFB. This BA does not address anadromous fish species under the jurisdiction of the National Marine Fisheries Service.

The activities that will be authorized under this BA may potentially affect federally-listed species. Therefore, this document analyzes the potential effects of the proposed invasive species control plans on federally-listed species known to occur or with potential to occur on Beale AFB.

To date, Beale AFB properties contain suitable habitat for five federally-listed threatened or endangered species (Beale AFB 2019): vernal pool tadpole shrimp (*Lepidurus* packardi), vernal pool fairy shrimp (*Branchinecta lynchi*), valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*), western yellow-billed cuckoo (*Coccyzus americanus occidentalis*), and giant garter snake (*Thamnophis gigas*). Of these five federally-listed T&E species, three are known to occur on Beale AFB properties and two have the potential to occur but have never been observed on Beale AFB properties. Two species, California red-legged frog (*Rana draytonii*) and conservancy fairy shrimp (*Branchinecta conservatio*), have been consulted on previously, but more recent surveys of habitat and distribution have confirmed there is no longer a need to consult on those species. The justification for not including these two species can be found below.

Additionally, this BA will analyze effects to one additional species that is currently under review for federal listing under the ESA, the monarch butterfly *(Danaus plexippus*). While the monarch butterfly is not at present eligible for protection under the ESA, it warrants inclusion in this BA because of the species' current review status, its known and extensive occurrence on Beale AFB, and it allows the United States Air Force (USAF) to avoid further consultation for non-native species control, and the establishment of minimization measures reduces uncertainty for future projects.

Federally-Threatened, Endangered, or Under Review Species Known to Occur on Beale AFB Properties:

- Vernal pool tadpole shrimp (VPTS) (*Lepidurus packardi*) (E)
- Vernal pool fairy shrimp (VPFS) (*Branchinecta lynchi*) (T)
- Valley elderberry longhorn beetle (VELB) (*Desmocerus californicus dimorphus*) (T)
- Monarch (*Danaus plexippus*) (SR)

Federally-Threatened or Endangered Species with the Potential to Occur on Beale AFB Properties:

- Western yellow-billed cuckoo (WYBC) (*Coccyzus americanus occidentalis*) (T)
- Giant garter snake (GGS) (*Thamnophis gigas*) (T)

Note: Federal Status: (T) = Threatened, (E) = Endangered, (SR) = Under Status Review

At the time of the initiation of this BA, there are no verified occurrences of the California red-legged frog (CRLF) or the conservancy fairy shrimp (CFS) on any Beale AFB properties. When vernal pool wet-season and dry-season surveys are done, biologists with qualifications to perform surveys for special status crustacean species will distinguish between *Branchinecta* species during species identification. If CFS are found, the U.S. Fish and Wildlife Service (USFWS) will be immediately contacted, and Beale AFB and the USFWS will initiate discussions on how to best proceed with future consultations for CFS.

CRLF habitat may be present on Beale AFB, but predators, including the American bullfrog (*Lithobates catesbianus*), would not allow populations to persist. If bullfrogs are eradicated at any habitats potentially suitable for CRLF and these habitats remain consistently devoid of CRLF predators, Beale AFB will initiate discussions on how to best proceed with future consultations with the USFWS. The closest populations are found 32.47 miles away from Beale AFB, according to California Natural Diversity Database (CNDDB) records. Several dispersal barriers exist between current populations of CRLF and Beale AFB properties, including major highways (Beale AFB 2019). Therefore, Beale AFB will not be consulting on either of those two species in the remainder of this BA.

This BA identifies proposed Avoidance and Minimization Measures (AMMs) intended to avoid or reduce potential effects of the proposed invasive plant species control activities conducted at Beale AFB (Section 2.4) and are considered to be part of the proposed activities, as applicable. As such, these measures are a required part of the proposed activity unless otherwise stated in the measure.

1.2 Background

On Beale AFB and the LRS, a long-standing and entrenched suite of non-native invasive plant species threatens sensitive resources, the accomplishment of military objectives and missions, and other environmental and human values. Invasive plant species are those species that are spreading outside their native range, transported to a new region by people either unwittingly or deliberately (Beale AFB 2017a). More than 50 species of invasive plants have been identified on Base, and an extensive watch list of species that have not been found but could spread to the base has been developed. Of particular management concern are barbed goatgrass (*Aegilops triuncialis*), giant reed (*Arundo donax*), Himalayan blackberry (*Rubus armeniacus)*, medusahead (*Elymus caput-medusae*), and yellow star thistle (*Centaurea solstitialis*). The LRS has not been surveyed for non-native species; however, the species list and watch list for Beale AFB are likely applicable to the LRS since the two locations are just 15 miles apart and share a common ecological setting.

Non-native invasive plant species at Beale AFB and the LRS have been managed since 2010 in accordance with the Beale AFB 2010 Invasive Species Management Plan (EM-Assist 2010), which was developed to implement recommendations from a 2004 Invasive Species Management Analysis (EDAW 2004). Since that time, the Installation Integrated Natural Resources Management Plan (INRMP; Beale AFB 2019), the chief tool for managing installation ecosystems and natural resources, as well as several management plans associated with non-native plant species management (i.e., Installation Pest Management Plan [IPMP; Beale AFB 2018b], Grazing Management Guidelines [GMG; Beale AFB 2017b], Wildland Fire Management Plan [WFMP; Beale AFB 2018a]) have been updated. New science and information pertaining to recommended non-native plant species management, results of invasive species mapping surveys at the installation (Center for Environmental Management of Military Lands (CEMML) 2017; H.T. Harvey & Associates 2015), and recommendations for enhancing the invasive species management program from a review of the program by the California Invasive Plant Council (Cal-IPC 2015a) have all become available. Additionally, infestation conditions are continually changing as a result of ongoing management actions as well as environmental factors. For these reasons, non-native plant species management at Beale AFB and the LRS has been reevaluated, and the *Updated Invasive Plant Species Management Guidelines* (IPSMG; Beale AFB 2017a) have been developed. The IPSMG addresses holistic, base-wide invasive species control with an appropriate scale of effort, prompting the development of this BA. Implementation of the IPSMG across all annual grasslands, riparian, wetland, and oak woodland habitats on Beale AFB and the LRS is the basis for this consultation document. Section 2 of this BA provides detailed descriptions of the Proposed Action.

1.2.1 Location

Beale AFB is located within the central valley of California, approximately 40 miles north of Sacramento at geographical coordinates 39º08ºN and 121º26ºW. The Base covers approximately 23,000 acres (Beale AFB 2019) and is the headquarters of the 9th Reconnaissance Wing (9RW of the USAF). The primary mission of Beale AFB is high altitude surveillance and reconnaissance using both manned and unmanned aircraft. Most of Beale AFB is open space used as security or safety buffer zones for flight activities. The topography of Beale AFB consists of open grassland, rolling hills, and floodplains. Beale AFB occurs within a transitional zone between the central valley and the Sierra Nevada foothills and includes large tracts of vernal pools, riparian forest, and oak woodland (Beale 2019).

The LRS is a 235-acre GSU located in Placer County, approximately 15 miles south of Beale AFB and 5 miles west-southwest of the town of Lincoln, CA. The location's primary purpose is the operation of Global High Frequency radio communications for the USAF and U.S. Navy West Coast Operations. The habitat found at the LRS consists of non-native annual grassland interspersed with valley oaks (*Quercus lobata*) and vernal pools. The surrounding properties consist mostly of agricultural fields (Beale 2019).

The regional climate around Beale AFB and the LRS is Mediterranean subtropical, created by the location in the interior valley between the coast and Sierra Nevada mountain ranges. The valley experiences hot, dry summers and cool, wet winters. The region effectively has two seasons: a dry season lasting from May through October and a wet season lasting from November through April. The average annual high temperature is 74 degrees Fahrenheit (°F), and the average annual low temperature is 50°F. Summer high temperatures can be extreme, reaching as high as 113°F and persisting above 100°F for many days at a time. The relative humidity is variable, with an annual average of 61 percent. The mean annual precipitation at Beale AFB is 21.9 inches with almost 95 percent of all rainfall occurring from October through April. Annual precipitation fluctuates significantly; however, with only seven out of the last 60 years experiencing actual rainfall between 21 and 23 inches. Average temperatures and weather patterns at the LRS are similar to Beale AFB. Additional information can be found in the INRMP (Beale AFB 2019).

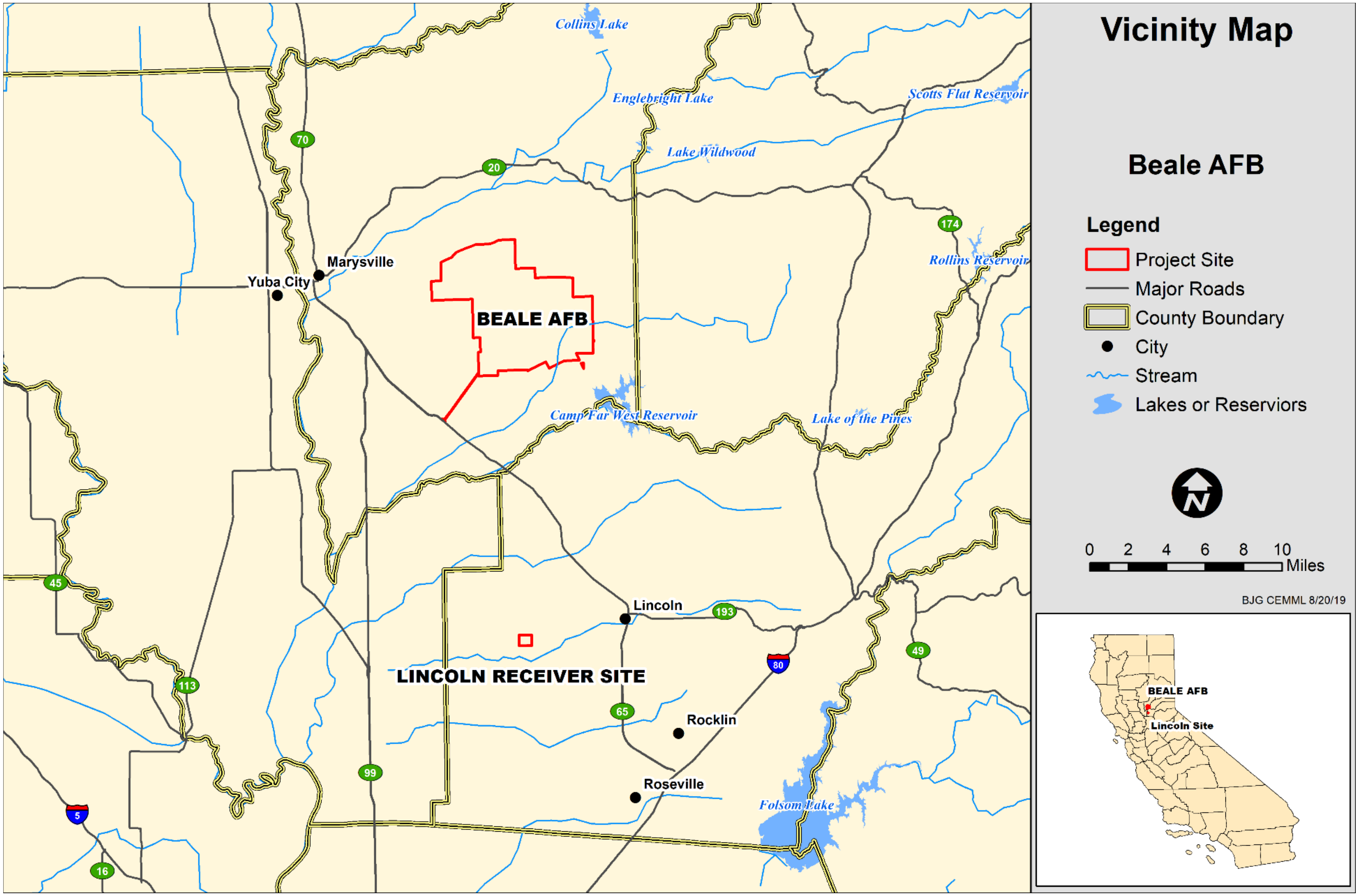

Figure 1.1. Beale AFB properties denoted as Action Area for this BA.

1.3 Proposed Action

Beale AFB proposes to implement a program to control and eradicate invasive plant species that may impact T&E species and their habitat, mission operations, and natural resource conservation programs base-wide. Beale AFB would annually treat a portion of infested areas found on the base using a combination of the following treatment methods:

1. Continue and expand livestock grazing (cattle, sheep, goats, and horses) including prescribed grazing management strategies and techniques, new grazing locations, and new infrastructure.

2. Burns (prescribed fires, torching/flaming, fire control lines).

3. Chemical treatments (herbicide application via broadcast, spot-spray, or cut-stump treatments).

4. Mechanical/hand treatments (e.g., mowing, weed-pulling, weed-whacking).

5. Habitat enhancement treatments (e.g., soil preparation, digging, planting, drill or broadcast seeding, hydroseeding, tilling, watering).

The acreage treated will depend on available funding and locations in relation to sensitive habitats and resources. Under the Proposed Action, up to 21,000 acres would be treated annually, using a combination of the methods described above. Beale AFB has developed the IPSMG to identify and prioritize treatment of invasive plant species that occur on Beale AFB, and work plans for implementation of target species control activities on the installation. The integrated pest management approach combines a mixture of preventative, control and restoration/reclamation measures. Control measures would involve integrated prescriptions that generally combine the use of herbicides with mechanical, manual, and cultural (aka changes in human activity) control methods over several years. All invasive species control activities would be coordinated with the Natural Resources Manager (NRM).

1.4 Purpose and Need for Proposed Action

The need for the Proposed Action is to address the threats of numerous non-native invasive plant species on Beale AFB. There is a need for elimination or control of known priority infestations, and for prevention of the establishment of new infestations of invasive plants. If allowed to spread unchecked, non-native plant species will degrade the remaining native habitat; interfere with management of sensitive resources, economic activities, and quality of life; and impede the military mission.

Threats associated with non-native vegetation on Beale AFB include

- Deteriorated native vegetative communities, restricting desired wildlife habitat and biodiversity.
- Degraded aquatic and riparian habitats (e.g., changes in streamflow, bed and bank levels) threatening the associated ecosystems, native and listed species, and recreational fishing.
- Altered vernal pool hydrology, water quality, and biomass levels, threatening the vernal pool ecosystem and associated listed species.
- Impaired wetlands and associated vegetation communities (e.g., reduces native plant species), threatening the ecosystem and associated plant and animal species.
- Increased fire risk, which can impede the military mission.
- Increased Residual Dry Mass (RDM) loads resulting in higher burn severity, cultural/natural resource damage, and increasing the threat of wildfires escaping off-base.
- Added habitat for birds and other undesirable wildlife near the airfield, increasing bird/wildlife aircraft strike hazard (BASH) potential.
- Diminished forage quality and quantity by reducing palatable forage species, threatening the existing grazing program.
- Toxic effects on humans and pets, degrading outdoor activity and quality of life.
- Growth on roads, sidewalks, trails, and parking areas reducing visibility, increasing erosion and flooding potential, degrading aesthetics and recreational opportunities, and contributing to the spread of undesirable species.
- Reduced open space, degrading quality of life and recreational opportunities.
- Invasion of decorative landscaping.
- Allowed to spread unchecked, degradation escalates.

A recent report by 16 federal agencies states that, "Invasive species pose one of the greatest ecological threats to America's lands and waters. Their control can be complex and expensive and is often conducted in perpetuity; their harm can be irreversible… [I]f left to spread, invasive species cost billions of dollars to manage and can have devastating consequences on the Nation's ecosystems" (United States Department of Interior (USDI) 2016). In a widely-cited article, Pimentel et al. (2005) calculated that invasive plants and animals cost the United States economy $120 billion per year in losses and damage and in control costs. They also estimated that 42 percent of the nation's federally-listed threatened and endangered species are at risk primarily because of the impacts of non-native species. For rangelands and pastures specifically, Pimentel et al. (2005) estimated national forage loss due to non-native weeds at $1 billion per year and invasive weed control costs at $5 billion per year (Beale AFB 2019).

Executive Order (EO) 13112, *Invasive Species*, issued on 3 February 1999, called on federal agencies to take steps to prevent the introduction and spread of invasive species and to support efforts to control and eradicate existing invasive species occurring on federal land. Beale AFB maintains an INRMP that sets forth goals and objectives that provide drivers for invasive species control on Beale AFB. These drivers for control include conserving and benefitting T&E species and their habitats, reducing BASH concerns, maintaining sustainable rangeland ecosystems, and reducing the risk of wildfires (Beale AFB 2019).

To comply with EO 13112 and fulfill the goals and objectives of the INRMP, Beale AFB has updated the IPSMG to provide a framework for managing vegetation at Beale AFB to increase opportunities for stewardship of sensitive species while decreasing the extent of invasive non-native plants (Beale AFB 2017a). The IPSMG uses species ratings developed by the Cal-IPCto rank species based on ecological impacts, invasive potential, and ecological distribution from high (severe impacts) to limited (minor known impacts). The IPSMG also uses an invasion curve model (Rodgers et al. 2015) to identify specific weeds to target. Using information from a 2014 survey by H. T. Harvey & Associates, a 2016 survey by Colorado State University (CSU) (Center for Environmental Management of Military Lands (CEMML) 2016) and a 2016 survey by HDR, and existing information from Cal-IPC of the undeveloped areas on Beale AFB, invasive species were categorized into four stages of invasion based on criteria described above (see Table 1-1). Table 1-2 lists the most current estimation of mapped infestations on Beale AFB. Note that these ratings, acreages and the species listed may change, based on future changes in infestation levels or the invasion of the installation by a new noxious non-native species.

To control or eradicate each targeted invasive species, the IPSMG recommends using a variety of control techniques including hand/mechanical removal, herbicide application, controlled burning, and grazing.

Table 1-1. Invasive species by invasion stage on Beale AFB.

Invasion Stage	*Eradication Stage*	*Containment Stage*	*Asset-Based Protection Stage*
Species	*Robinia psuedoacacia* (black locust), *Circium vulgare* (bull thistle), *Ficus carica* (edible fig), *Arundo donax* (giant reed), *Dittrichia graveolens* (stinkwort), *Ailanthus altissima* (tree of heaven)	*Aegilops triuncialis* (barbed goatgrass), *Silybum marianum* (blessed milkthistle), *Hypericum perforatum* (common St. John's wort), *Chondrilla juncea* (rush skeletonweed), *Verbena litoralis* (Seashore vervain), *Verbena bonariensis* (purple top vervain)	*Brassica nigra* (black mustard), *Rubus armeniacus* (Himalayan blackberry), *Carduus pycnocepalus* (Italian thistle), *Centaurea solstitialis* (yellow starthistle), *Elymus caput-medusae* (medusahead)

Table 1-2. Estimated mapped infestations per habitat in 2016 at Beale AFB.

Common Name	California Annual Grassland/Oak Woodland Acres	Riparian Acres	Generally Proximate to Open Water*
black locust	10	1	No
bull thistle	110	0	No
edible fig	37	11	Yes
giant reed	0	11	Yes
stinkwort	19	0	No
tree-of-heaven	9	4	Yes
barbed goatgrass	495	7	No
blessed milkthistle	248	157	No
common St. John's wort	778	46	No
rush skeletonweed	513	57	No
tall or seashore vervain	0	452	Yes
black mustard	615	248	No
Himalayan blackberry	0	596	Yes
Italian thistle	2,276	335	No
yellow starthistle	6,236	579	No
medusahead	19,914	539	No
Total Eradication Stage	**185**	**27**	**Yes**
Total Containment Stage	**2,034**	**719**	**Yes**
Total Asset-protection Stage	**29,041**	**2,297**	**Yes**

*Refers to plants that typically grow in aquatic features or wetlands including lakes, streams, and drainage ditches

Beale AFB has determined that certain activities may have beneficial effects on one or more of the listed species covered in this document and their habitat. These activities include routine mowing activities in grassland and vernal pool habitat that maintains vegetation height and thatch levels at optimal levels for listed species; livestock grazing that reduces the impacts of invasive species biomass in grasslands and vernal pools; grassland, pollinator, and riparian habitat enhancement; and targeted invasive species plant control that creates better quality habitat for any of the federally-listed species that occur on Beale AFB properties. Additionally, targeted invasive species goals will be incorporated into habitat enhancement projects with specific conservation goals for T&E species that occur on Beale AFB.

2.0 DESCRIPTION OF PROPOSED ACTIONS

The Proposed Action is to manage non-native invasive plant species on Beale AFB and the LRS in order to reduce or eliminate their populations using an efficient, sustainable, and long-term strategy that incorporates a programmatic adaptive approach, maximizes opportunities for stewardship of sensitive resources, and utilizes a varied toolkit of control methods. Methods used for the control and eradication of invasive species will include physical (hand/mechanical, and prescribed burning), chemical (herbicide), and biological (grazing and habitat enhancement) control (Beale AFB 2017a). This BA will identify and analyze the effects of each invasive plant species treatment method and restoration activities on federally protected species base-wide. Table 2-1 shows a proposed annual scope of work indicating maximum potential weed control activity and breaks up acreage based on treatment method. Actual scopes of work will be developed on a seasonal basis in accordance with changing needs and conditions. The AMMs described in Section 2.4 will be implemented for all projects described in this section. In addition, the species-specific conservation measures described in Section 6.2 may apply to some projects and activities. The annual scope of work presented for each treatment method and its associated AMMs allow for predictable reduction of non-native plant species and inform the associated effects analyses presented in Section 5.

Table 2-1. Proposed Actions for non-native plant species compared to current management practices.

Activity	Current Management*	Proposed Action
Grazing land available	12,800	Approximately 16,000 acres, add goats and sheep
Grazing capacities, timeframe, and stocking rates	Fixed	Adjustable
Prescribed burns (including hand torching/flaming methods)	Historical average 2001-2015 = 622 acres annually. No prescribed burns in 2016 & 2018. One 20-acre burn in 2017. No use of torching or flaming methods.	6,000 acres maximum burned annually to achieve fuels treatment goals outlined in the WFMP and INRMP. Include torch/flaming methodology.
Herbicide use	25 acres	Up to 2,000 acres
Mechanical/hand control	< 50 acres	Up to 10,000 acres
Habitat enhancement	< 5 acres	Up to 300 acres

*No invasive species control work using any method is currently on going at LRS so this column only reflects current work at Beale AFB. The Proposed Action includes acre estimates for both Beale AFB and LRS combined.

Control methods for non-native invasive plants will be based on site-specific conditions, can include multiple techniques, and will be timed according to the vulnerable phenological stage of target species. Table 2-2 provides an overview of 16 non-native invasive plants deemed in critical need of control, acres infested, and treatment methods.

Table 2-2. Overview of priority non-native species infestation areas, potential infestation expansions, and annual treatment options on Beale AFB.

	Common Name	**Scientific Name**	**Infested Acres by Location[1]**						**# of sites[7]**	**Potential Infested Acres[2]**	**10-year Expansion no Treatment[3]**	**Proposed Treatment**				**Acres Treated Annually**	
			Airfield	**Wildlife Exclusion Zone**	**Grazing Management Areas**	**Vernal Pool Conservation Areas**	**Riparian conservation Area**	**Total Mapped**				**Manual/ Mechanical**	**Herbicide**	**Burning**	**Grazing**	**Current Management[5]**	**Proposed Action[9]**
Eradication Stage	black locust	*Robinia pseudoacacia*	0	8	5	0.6	0.6	10.5	15	18	65	5	10	--	--	**0**	**15**
	bull thistle[4]	*Cirsium vulgare*	0	110	110	0	0	110	14	190	681	50	50	--	50	**0-100**	**150**
	edible fig	*Ficus carica*	0	20	17	0.6	11	48	20	83	297	5	50	--	--	**0**	**55**
	giant reed	*Arundo donax*	0	0	0	0	11	11	16	19	68	5	15	--	--	**5**	**20**
	stinkwort[4]	*Dittrichia graveolens*	0	19	19	11	0	19	5	33	118	10	10	19	--	**0**	**20**
	tree-of-heaven	*Ailanthus altissima*	0.6	8	0.6	0	4.3	13	20	22	80	--	15	--	--	**0**	**15**
	Total Eradication Stage[6]		0.6	90	74	4	24	136	90	235	842	100	175	19	50	**0-120**	**325**
Containment Stage	barbed goatgrass	*Aegilops triuncialis*	129	302	290	12	7	502	203	867	3108	100	250	250	200	**0-25**	**800**
	blessed milkthistle	*Silybum marianum*	10	237	36	5	157	405	218	700	2508	100	50	--	--	**0**	**150**

	Common Name	Scientific Name	Infested Acres by Location[1]						# of sites[7]	Potential Infested Acres[2]	10-year Expansion no Treatment[3]	Proposed Treatment				Acres Treated Annually	
			Airfield	Wildlife Exclusion Zone	Grazing Management Areas	Vernal Pool Conservation Areas	Riparian conservation Area	Total Mapped				Manual/ Mechanical	Herbicide	Burning	Grazing	Current Management[5]	Proposed Action[9]
	St. John's wort	*Hypericum perforatum*	29	318	317	0	46	824	630	1424	5102	100	200	--	--	**0**	**300**
	Rush skeletonweed	*Chondrilla juncea*	14	117	221	0	57	570	402	985	3529	50	25	--	50	**0**	**125**
	Vervain[4]	*Verbena* spp.	0	355	47	0	76	452	12	781	2799	100	50	--	--	**0-175**	**150**
	Total Containment Stage[6]		182	987	846	11.4	287	2146	1465	3708	13287	450	575	250	250	**0-200**	**1,525**
Asset-Based Protection Stage	Black mustard	*Brassica nigra*	24	400	72	16	248	863	420	1491	5343	20	50	100	100	**0**	**270**
	Himalayan blackberry	*Rubus armeniacus*	0.6	154	120	4	261	596	198	1030	3690	20	100	25	--	**13**	**120**
	Italian thistle	*Carduus pycnocephalus*	150	1145	223	12	335	2611	857	4512	16167	15	300	100	225	**0**	**640**
	Yellow star thistle	*Centaurea solstitialis*	606	4823	2416	281	579	6815	904	11776	20767	300	300	2500	2500	**75-300**	**5,600**
	Medusahead	*Elymus caput-medusae*	1543	12,340	12471	911	539	20453	many	20767	20767[8]	1300	500	6000	16000	**0-600**	**20,767**

	Common Name	Scientific Name	Infested Acres by Location[1]						# of sites[7]	Potential Infested Acres[2]	10-year Expansion no Treatment[3]	Proposed Treatment				Acres Treated Annually	
			Airfield	Wildlife Exclusion Zone	Grazing Management Areas	Vernal Pool Conservation Areas	Riparian conservation Area	Total Mapped				Manual/ Mechanical	Herbicide	Burning	Grazing	Current Management[5]	Proposed Action[9]
	Total Asset-Based Protection Stage[6]		1555	12419	12514	911	723	20755	2379	20767	20767	1655	1250	6000	16000	**89-988**	**20,767**
	Habitat Enhancement															**0-100**	**300**
	Total[6]		1557	12426	12518	911	723	20767	3934	20767	20767	2205	2000	6000	16000	**89-1,408**	**20,767**

[1] Infested acres were calculated using data from 2014-2016 weed mapping efforts on Beale AFB (H.T. Harvey & Associates 2015; CEMML 2017). No data is available for LRS. Weed data were collected as percent cover classes in 50x50 meter (0.6 acre) quadrats. For purposes of calculating infested acres, the entire 50mx50m quadrat was included in the acreage estimate if a weed was present.
[2] Acreage calculated based on an annual expansion rate of 20% over the three years since weeds were mapped in 2016. The 20% expansion rate is the same used in the El Dorado National Forest Environmental Assessment of Eradication and Control of Invasive Plants (United States Department of Agriculture (USDA) 2013) based on Asher and Dewey (2005) who documented rates of noxious weed spread varying from 10 to 24 percent for many of the species proposed for treatment.
[3] Acreage calculated based on an annual expansion rate of 20% over ten years since weeds were mapped in 2016.
[4] Acreage reflects infestations mapped for treatment in 2017 (H.T. Harvey & Associates 2017).
[5] Excludes grazing.
[6] Total area is less than the sum of acres of all infestations because of overlapping infestations. Virtually all open space on Beale AFB is infested by some type of invasive plant.
[7] Infested quadrats directly adjacent to other infested quadrats were considered a single contiguous infestation and counted as one site.
[8] Medusahead is present in all mapped quadrats thus acres cannot expand further, though percent cover will increase, having detrimental impacts to the grazing program, native species, and floral and faunal diversity.
[9] Includes grazing because grazing prescriptions can be tailored to meet specific invasive species control goals.

2.1 Invasive Plant Species Treatment Methods

2.1.1 Herbicide Application

Targeted herbicide application will be used for base-wide invasive species management efforts. Table 2-3 lists all herbicides that are proposed for use on Beale AFB. Proposed application methods include pre-emergent, broadcast and target foliar, basal stem, cut-stump, stem injection, and frill and squirt. Application would be both selective (targeting individual plants or species) and non-selective (targeting all vegetation in a specific treatment area). These application methods are described below. Table 2-4 provides an overview of target species and application methods for each herbicide active ingredient. The majority of herbicide treatment would be by hand using backpack application equipment. The remaining treatments would consist of broadcast spraying, basal bark, selective application, or target application using a hose or hand wand from an ATV or truck. Herbicides will always be applied in accordance with the Air Force Pest Management Program, General National Pollutant Discharge Elimination System Permit for Residual Aquatic Pesticide Discharges and all applicable federal, USAF, Department of Defense (DoD), State of California, and local directives and regulations. All herbicide use will follow California Department of Pesticide Regulation (DPR) requirements and manufacturer label guidelines. Herbicide formulations used will be selected based on efficacy against the target species, potential interactions with special status species, and environmental constraints. An ecological risk assessment of all proposed herbicides has been created and is included as an appendix (Appendix A). Additionally, labels for all herbicide products proposed for use are included as an appendix (Appendix B) See Section 2.4.1 for species-specific minimization measures related to herbicide use, Table 2-5 for the physical properties of each active ingredient, and Tables 2-6 and 2-7 for ecological toxicity of proposed active ingredients and adjuvants. If chemicals not included in this BA are proposed for use in the future, a pre-notification will be sent to the USFWS addressing any differences from herbicides analyzed in this BA in relation to impacts to T&E species.

Table 2-3. Herbicides proposed for use on Beale AFB.

Product Name	Active Ingredient	Type	USEPA Regulation Number
Milestone	Triisopropanolammonium salt of aminopyralid	Liquid	62719-519
Capstone	Triisopropanolammonium salt of aminopyralid	Liquid	62719-572
Telar XP	Chlorosulfuron	Dry flowable	432-1561
Roundup Pro	Isopropylamine salt of glysophosate	Liquid	524-475
Rodeo/Roundup Custom*	Isopropylamine salt of glysophosate	Liquid	62719-324/ 524-475
Clearcast*	Ammonium salt of imazamox	Liquid	241-437-67690
Arsenal*	Isopropylamine salt of imazapyr	Liquid	241-346
Habitat*	Isopropylamine salt of imazapyr	Liquid	241-426
Oust XP	Sulfometuron methyl	Dispersible granules	432-1552
Garlon 4 Ultra	Triclopyr butoxyethyl ester (BEE)	Liquid	62719-527
Garlon 3*	Tricolpyr triethylamine salt (TEA)	Liquid	62719-37

*Aquatic approved formula

Table 2-4. Herbicide methods, target species, and application rates.

Herbicide	Application Methods	Target Species	Maximum Pounds Active Ingredient or Acid Equivalent per acre per year (label max)	Maximum # of Treatments per year	Maximum Acres/Year[1,2]
Aminopyralid	Target Spray	bull thistle, blessed milk thistle, skeletonweed, St. John's wort, Italian thistle, yellow starthistle, Indian toothcup, artichoke thistle, Canada thistle, Russian knapweed, spotted knapweed	0.11 (0.22 spot treatment)[3]	1	925
	Broadcast Spray	St. John's wort, yellow starthistle, medusahead	0.11	1	1,000
	Pre-emergent	Italian thistle, medusahead, spotted knapweed	0.11	1	525
Aminopyralid + Triclopyr	Target Spray	black locust, tree-of-heaven, Himalayan blackberry	0.11 + 1.12	1	125
Chlorsulfuron	Target Spray	bull thistle, blessed milk thistle, black mustard, yellow starthistle, perennial pepperweed, Canada thistle, Russian knapweed	0.122 (0.062 rangeland)	1	475
	Pre-emergent	black mustard		1	50
Chlorsulfuron + Sulfometuron Methyl	Pre-emergent	barbed goatgrass	0.062 + 0.375	1	250

Herbicide	Application Methods	Target Species	Maximum Pounds Active Ingredient or Acid Equivalent per acre per year (label max)	Maximum # of Treatments per year	Maximum Acres/Year[1,2]
Glyphosate	Target Spray	black locust, tree-of-heaven, giant reed, stinkwort, edible fig, barbed goatgrass, skeletonweed, St. John's wort, black mustard, Italian thistle, yellow starthistle, medusahead, perennial pepperweed, Canada thistle, cheatgrass, purple loosestrife, red sesbania, spotted knapweed, vervain, Himalayan blackberry	8.0	2	1,900
	Broadcast Spray	barbed goatgrass, medusahead, cheatgrass	8.0	2	775
	Cut Stump	black locust, giant reed	8.0	1	2.5
Glyphosate + Imazapyr	Target Spray	giant reed	8.0 + 1.5	1	15
Imazamox	Direct aquatic	parrotfeather, water primrose, alligator weed, hydrilla, smallflower tamarisk, South American Spongeplant, water hyacinth	1.0	1	25
Imazapyr	Target Spray	bull thistle, skeletonweed, yellow starthistle, black locust, edible fig, tree-of-heaven, giant reed, vervain, perennial	1.5	1	540

Herbicide	Application Methods	Target Species	Maximum Pounds Active Ingredient or Acid Equivalent per acre per year (label max)	Maximum # of Treatments per year	Maximum Acres/Year[1,2]
		pepperweed, pokeweed, artichoke thistle, water primrose, parrotfeather, alligator weed, Canada thistle, cheatgrass, purple loosestrife, red sesbania, Russian knapweed, smallflower tamarisk, spotted knapweed, water hyacinth			
	Pre-emergent	skeletonweed		1	25
Sulfometuron Methyl	Target Spray	Himalayan blackberry, barbed goatgrass, pokeweed, vervain	0.375	1	375
	Broadcast Spray	medusahead, barbed goatgrass		1	750
	Pre-emergent	barbed goatgrass, black mustard, medusahead, perennial pepperweed, cheatgrass		1	825
Triclopyr	Target Foliar	Himalayan blackberry, barbed goatgrass, bull thistle, yellow starthistle, black locust, edible fig, black mustard, Italian thistle, stinkwort, perennial pepperweed, water-primrose, Indian toothcup, artichoke thistle, Canada thistle,	8.0 (2.0 rangeland)	1	895

Herbicide	Application Methods	Target Species	Maximum Pounds Active Ingredient or Acid Equivalent per acre per year (label max)	Maximum # of Treatments per year	Maximum Acres/Year[1,2]
		pennyroyal, purple loosestrife, red sesbania, smallflower tamarisk			
	Cut stump or basal bark	tree-of-heaven, edible fig		1	6.5

[1] Total acres per year that would be treated if the maximum proposed acreage for all species listed are treated using a single herbicide and single application method. This is not a likely scenario as a number of herbicides and methods are proposed for use, and the herbicide and method selected will depend on the plant species, location of infestation, and USAF herbicide use approval. More than one herbicide, or more than one application method would not be used for the same species in the same treatment area within a single year.
[2] Acres represent infested acres, so actual acres sprayed for target treatments is estimated to be 10-50% of the total.
[3]Cannot spot-treat more than 50% of an acre at this concentration

Table 2-5. Physical properties of active ingredients selected for use in the Proposed Action. Log Kow refers to the log-value of the octanol-water partition coefficient, Kd refers to the soil adsorption coefficient, and Koc refers to the soil adsorption coefficient accounting for organic carbon content of the soil.

Herbicide						
Active Ingredient	Trade Names	log K_{ow}	K_d	K_{oc}	Soil Half Time (days, unless otherwise specified)	Water Half Time (days, unless otherwise specified)
Aminopyralid[1]	Milestone, Capstone[a]	at 19°C: pH 5: -1.75 pH 7: -2.87 pH 9: -2.96 unbuffered: 0.201	mean: 0.22 median: 0.13 range: 0 - 39	Clay: 0.81, 0.87, 6.2 Silty clay: 7.96 Clay loam: 23.69, 27.24 Silt: 4.52 Silty loam: 5.31, 5.51 Loam: 11.62 Loamy sand: 28	Not specified: 130.4 Field dissipation: 6- 74, 8 - 35, 25 - 35 Aerobic Clay: 5 Clay loam: 266, 341, 343 Silty loam: 46, 48, 59, 60 Sandy loam: 14, 21 Loam: 25, 34, 45 Anaerobic: Stable Soil photolysis: 61	Not specified:477 Water photolysis: 0.6
Chlorsulfuron[2]	Telar XP	pH 5: 0.33, 2.13 pH 7: -1.0 pH 9: -1.4, 0.0387		unspecified soil type: 1.02, 14 - 60, 36, 40 Silty loam: 17 - 20 Sandy loam: 13	Field dissipation: 10 - 185, 28 - 56 Aerobic 13 - 88 Clay: 168 Sand: 47 Loam: 37	Not specified: 69, 198, 203 Water photolysis: 80 Field dissipation: 4 - 6 weeks (growing season conditions)
Glyphosate[3]	Roundup Pro, Rodeo[b], Roundup Custom[b]	< - 3.5, < -3.2 pH 1.77: -3.39 pH 4.61: -4.38 pH 6.86: -4.85 pH 9: -4.14	Averages Sand: 170 Sandy loam: 18, 230 Silty clay loam: 680, 1000	Averages Sand: 58000 Sandy loam: 3100, 13000 Silty clay loam: 33000, 47000	Not specified: 2 - 174, 18 - 41, 20 - 40, 29 - 40, 30 - 40, 45 - 60, 47, 85.6 - 103.5 Field dissipation: 1 - 130, 2.8 - 30, 21 - 180, 44, 1.7 - 142 Aerobic Unspecified: 96.4 Lab: 4 - 180 Silty loam: 2.6 Sandy loam: 1.8, 5.4 Anaerobic: 0.6 - 1.1, 22.1	Not specified: 14, 42 - 70, >35, 50 - 70 Pond: <1 Aquatic mesocosm: 5.8 - 7.4 Water photolysis: 33 (pH 5), 69 (pH 7), 77 (pH 9) Field dissipation: 7.5

Herbicide						
Imazamox[4]	Clearcast	pH 5 & 6: 0.73	Clay: 0.3 Silty clay: 0.42 Silty loam: 0.19 Sandy loam: 0.26, 0.28, 0.33 Loam: 0.26	Clay: 13.4 Silty clay: 30.9 Silty loam: 13.6 Sandy loam: 10.5, 25.5, 34.7 Loam: 23.6	Field dissipation: 21.1 - 34.7 Aerobic Unspecified: 28, 30 Anaerobic: Stable	Water photolysis: 6.8 h (pH 5, 7, 9)
Imazapyr[5]	Arsenal[b], Habitat[b]	<0.01, 1.29, 1.3, 1.31, 1.66	Clay loam: 0.84 Sand: 0.11 Silty loam: 0.64, 0.86, 2.4 Loamy sand: 0.04, 0.52 Sandy loam: 0.07, 1.9 Loam: 0.23 Pond sediment: 3.4	Clay loam: 18 Sand: 31 Silty loam: 53, 82, 100 Loamy sand: 15, 100 Sandy loam: 8.2, 110 Loam: 17 Pond sediment: 150	Not specified: 25 - 58, 210, 313, 2150, stable Anaerobic: Stable Soil photolysis: 30.9, 149	Water photolysis: 2.5 - 5.3, 3.7 (pH 7), 79.1, 19.9
Sulfometuron Methyl[6]	Oust XP	pH 5: 1.01, -1.07 pH 7: -0.46 pH 9: -1.86, -1.87		16 - 50, 61 - 122	Clay: 10 Loam: 30 Sand: 100	Not specified: 113
Triclopyr[7c]	Garlon 4 Ultra, Garlon 3A[b]	pH 5: -0.42 pH 7: -0.45 pH 9: -0.96	0.08 - 38.12, increases with humic acid content and descreases with pH Clay loam: 0.733 Sand: 0.975 Sandy loam: 0.571 Silty loam: 0.165	11.4 - 84 Clay loam: 53 Sand: 134 Sandy loam: 25 Silty loam: 25	Not specified: 1.4, 3.9, 10 (TEA), 40, 45, 46 (TEA and BEE) Field dissipation: 1.1, 10.6, 2 wk, 7.6 - 10.6 (TEA), 10 (BEE turf), 100 (BEE soil), 39 - 60 (forest floor) Aerobic Unspecified: 28.39, 42, 130 Silty loam: 1.4 h (BEE), 13.7 (TEA), 18 (TEA) Silty clay loam: 8 (TEA) Sandy loam: 0.9 h (BEE), 5.6 (TEA)	Not specified: 2.8 - 14.1 h (TEA), 16.7 - 83.4 h (BEE) Field dissipation: Unspecified: 14.9 - 26.4 h, 3.7 - 4.7, 6 BEE: 0.6, 1, 3.8 - 4.3 TEA: 6.9 h (river), 0.5 - 3.4, 0.5 - 3.5, 0.8 - 7.5, 3.6 TCP: <1, 0.5 - 10, 4 - 8.8 TMP: 4 - 10 Triclopyr: 0.5 - 3.6, 5.9 - 7.5 (pond), 9, 27

[a]Aminopyralid + Triclopyr
[b]aquatic approved formulations
[c]BEE = triclopyr formulated as butoxyethyl ester, TEA = triclopyr formulated as triethylamine salt, TCP = a triclopyr metabolite: 3,5,6-trichloropyridinol, TMP = a triclopyr metabolite: 3,5,6-trichloro-2-methoxypyridine
1. Syracuse Environmental Research Associates, Inc. (SERA) 2007b. 2. SERA 2004a. 3. SERA 2011a. 4. SERA 2010. 5. SERA 2011c. 6. SERA 2004b. 7. SERA 2011b

Table 2-6. Toxicity of active ingredients in proposed herbicides towards various taxonomic groups. Species listed in parentheses indicate potentially affected species at Beale AFB which are listed as federally-threatened, endangered, or are under status review.

Herbicide						
Active Ingredient	Trade Names	Amphibians & Reptiles (GGS)	Birds (WYBC)	Fish (Steelhead)	Aquatic Invertebrates (VPFS, VPTS)	Terrestrial Invertebrates (VELB, Monarch, Bee)
Triisopropanolammonium salt of aminopyralid	Milestone, Capstone[a]	practically non-toxic to aquatic-phase amphibians[1]	practically non-toxic[2]	practically non-toxic[2]	practically non-toxic[2]	practically non-toxic[2]
Chlorsulfuron	Telar XP	no data available[3d]	practically non-toxic[4]	practically non-toxic[4]	practically non-toxic[4]	practically non-toxic[4]
Isopropylamine salt of glyphosate	Roundup Pro	practically non-toxic[5], aquatic: practically non-toxic - moderately toxic[17e], terrestrial: see birds[17]	slightly toxic[6,17]	practically non-toxic[6], slightly toxic - highly toxic[17]	may be slightly toxic[6,7], practically non-toxic - moderately toxic[17e]	non-toxic[6]
Isopropylamine salt of glyphosate	Rodeo[b], Roundup Custom[b]	na, but see above	na, but see above	practically non-toxic - slightly toxic[17]	na, but see above	na, but see above
Ammonium salt of imazamox	Clearcast	no data available[8]	practically non-toxic[9]	practically non-toxic[9]	practically non-toxic[9]	practically non-toxic[9]
Isopropylamine salt of imazapyr	Arsenal[b], Habitat[b]	practically non-toxic[10]	practically non-toxic[11], no risk of concern[19]	practically non-toxic[11],no risk of concern[19]	practically non-toxic[11], no risk of concern[19]	practically non-toxic[11], no risk of concern[19]
Sulfometuron Methyl[c]	Oust XP	practically non-toxic[12d]	practically non-toxic[12]	practically non-toxic[12]	practically non-toxic[12]	practically non-toxic[12]
Triclopyr butoxyethyl ester (BEE)	Garlon 4 Ultra	moderately - highly toxic[13]	slightly toxic[18]	moderately - highly toxic[18]	slightly - moderately toxic[18]	na
Triclopyr triethylamine salt (TEA)	Garlon 3A[b]	likely practically non-toxic[13]	practically non-toxic[14,18]	practically non-toxic[18]	practically non-toxic - moderately toxic[14,15,18]	practically non-toxic[14,18]

[a]Aminopyralid + Triclopyr, a.k.a. Milestone VM Plus; [b]aquatic approved formulations; [c]toxicity 'levels' are based primarily on acute testing methods, chronic effects are extrapolated; [d]aquatic phase-amphibian toxicity is based on fish assessments, terrestrial phase are based on bird assessments; supplemental data exist for chlorsulfuron; [e]toxicity varies with specific formulation and species, etc.

1. SERA 2007. 2. US Office of Prevention, Pesticides, Environmental Protection and Toxic Substances 2005. 3. SERA 2016. 4. Oregon State University and Intertox 2006. 5. Vincent and Davidson 2015. 6. University of California Davis 1996. 7. No toxicity is expected from labeled use of glyphosate, toxicity is from

the surfactant (Monsanto 2002). 8. SERA 2010. 9. US EPA 1997. 10. Trumbo and Waligora 2009. 11. SERA 2011b. 12. US EPA 2008. 13. Berrill et al. 1994, Edington et al. 2003, Yahnke et al. 2017. 14. National Pesticide Information Center 2005. 15. Toxicity varies by formulation of finished product and species tested. 16. Garlon 4 formulation is highly toxic to salmonids (Wan et al. 1987). 17. US EPA 2015. 18. US EPA 1998. 19. US EPA 2006

Table 2-7. Toxicity of adjuvants proposed for use towards various taxonomic groups. Species listed in parentheses indicate potentially affected species at Beale Air Force Base which are listed as federally-threatened, endangered, or are under status review.

Adjuvant Name	Approved for Aquatic Use in CA	Surfactant Type	Action	Amphibians & Reptiles (GGS)	Birds (WYBC)	Fish (Steelhead)	Aquatic Invertebrates (VPFS, VPTS)	Terrestrial Invertebrates (VELB, Monarch, Bee)
AGRI-DEX	Yes	Crop oil concentrate	increase pesticide penetration	practically non-toxic in formulation with glyphosate IPA[1]	na	practically non-toxic[2], practically non-toxic in formulation with Arsenal[3]	practically non-toxic[2]	no toxicity observed[4]
Competitor	Yes	Modified vegetable oil	increase pesticide penetration	practically non-toxic in formulation with glyphosate IPA1	na	slightly toxic[2]	practically non-toxic[2]	na
Hasten-EA	Yes	Modified vegetable oil concentrate	increase pesticide penetration	na	na	practically non-toxic[3] (Hasten) in formulation with Arsenal - slightly toxic[5]	na	na
Dyne-Amic	Yes	Modified vegetable oil surfactant blend	increase pesticide penetration	no significant increase in mortality at environmentally-relevant concentrations and in formulation with glyphosate[6]	na	slightly toxic[2,7]	slightly toxic[2]	learning impairment following oral ingestion of 20µg[4]
Induce	Yes	Nonionic low foam wetter/spreader	increase pesticide penetration	na	na	moderately toxic[7]	na	no toxicity observed[4]
Grounded W	No	Deposition aid (sticker)	promotes even, uniform spray deposition	na	na	na	na	na

1. Vincent and Davidson 2015. 2. Washington State Department of Agriculture 2012. 3. Fisher et al. 2003. 4. Ciarlo et al. 2012. 5. Smith et al. 2004. 6. Johnson 2017. 7. Haller and Stocker 2003

2.1.1.1 Herbicide Application Techniques

The following herbicide application techniques will be used to control non-native plant species on Beale AFB and are summarized in Table 2-8.

- Broadcast Spray (Boom): Spraying herbicide to an entire infested area, rather than to individual target plants, using a regulated nozzle. This method uses a truck- or all-terrain vehicle (ATV)-mounted boom sprayer and is limited to areas with moderate terrain. Broadcast methods are used for denser infestations where application to individual plants will not be feasible.

- Targeted Spray: Spraying herbicide onto the foliage of individual target plants. This is done using a regulated nozzle, which helps to concentrate application towards target plants. This method uses a backpack-mounted wand sprayer or a truck- or ATV-mounted hose sprayer. This is used for small infestations or in areas not accessible by vehicle.

- Pre-emergent Spray: Herbicide is applied directly to the soil in areas with known infestations to prevent seed germination or otherwise inhibit development. Herbicide may be applied using backpack-mounted wand sprayer or a truck- or ATV-mounted hose sprayer. This method is best for large infestations and difficult to control species.

- Basal Bark: Basal bark herbicides are mixed with an oil carrier to penetrate the bark of the target plant. Herbicide is sprayed around the circumference of the base of the stem. This is used to control thin-barked plants less than 6 inches in basal diameter.

- Selective Application: Touching individual target plants with applicators containing herbicide. Because these methods involve direct application, there is a very low likelihood of drift, run-off, or accidental non-target exposure. Specific methods include:
    - Hack and squirt–A cut is made into the sapwood of a target plant and herbicide is applied to the cut surface or injected into the trunk from the tool if using a specialized hatchet. This method eliminates or greatly reduces re-sprouts. This is used on individual target woody plants.
    - Cut Stump–The target plant is cut down and herbicide is applied directly to the stump using a low-pressure nozzle, wick, or brush. This is used for individual woody plants.
    - Wick, wipe, drizzle–Target plants by touching with a wipe or wick containing herbicide. This may be used on individual or groups of target plants.

- Aquatic Applications: Herbicide is either applied directly to foliage growing at or above the water's surface, or to the water column itself if plants are fully submerged. Only an herbicide labelled for aquatic use may be applied for the project using the following methods:

- Foliar Application–herbicide is applied to foliage at or above the water's surface using a regulated nozzle or boom. This method can be done using a backpack-mounted wand sprayer, truck- or boat-mounted hose sprayers, or boat-mounted boom sprayers. This is used for emergent and floating-leaved aquatic plants.
- Subsurface and deep water injection–Herbicide is fed into the water through hoses spaced at intervals along a bow- or stern-mounted boom. The nozzle body contains a disk that meters the flow into the water. Hoses length is adjusted so that the nozzles are at or just below the water surface for subsurface injection. For deep water injection, weighted hoses long enough to reach submerged weed mats are used. This method is used for fully-submerged aquatic plants.

Table 2-8. Comparison of herbicide active ingredients and application method.

Active Ingredient(s)	**Broadcast Spray**	**Target Spray**	**Pre-emergent Spray**	**Basal Bark**	**Hack and Squirt**	**Cut Stump**	**Wick, Wipe, Drizzle**	**Aquatic Foliar Application**	**Water Injection**
Aminopyralid	x	x	x		x	x	x		
Aminopyralid + Triclopyr		x		x			x		
Chlorosulfuron		x	x				x		
Chlorsulfuron + Sulfometuron Methyl		x	x				x		
Glyphosate	x	x			x	x	x		
Glyphosate + Imazapyr		x			x	x	x		
Imazamox		x					x	x	x
Imazapyr		x	x				x		
Sulfometuron Methyl	x	x	x				x		
Triclopyr		x		x	x	x	x		

2.1.1.2 Herbicide Descriptions

Chemical Properties

Chemical properties used to characterize herbicide's environmental fate and transport are described below. Properties of herbicides proposed for use on Beale AFB are included in Table 2-5.

Soil Adsorption Coefficient (K_d/K_{oc}) (EPA 1999)

The soil adsorption coefficient (K_d) describes the mobility and partitioning of a chemical between soil and water is as follows:

$$K_d = \frac{concentration\ of\ chemical\ adsorbed\ in\ soil}{concentration\ of\ chemcial\ adsorbed\ in\ water}$$

K_d values vary greatly because the organic content of soil is not accounted for. Because adsorption in soil occurs predominantly to organic matter, it is more useful to express the distribution coefficient as K_{oc}, the organic carbon-water partition coefficient:

$$K_{oc} = \frac{K_d \times 100}{\%\ organic\ carbon}$$

K_d or K_{oc} measures the mobility of a chemical substance in soil. A very high value means it is strongly adsorbed onto soil and organic matter and does not move throughout the soil. A very low value means it is highly mobile in soil. K_{oc} is a very important input parameter for estimating environmental distribution and environmental exposure level of a chemical substance.

For pesticides, higher K_{oc} or K_d is better in the sense that such pesticides are less likely to leach out or enter surface runoff and contaminate ground water or other water bodies. However, if the K_{oc} of a substance is very high (for example, log K_{oc} >4.5), there is the potential for adverse effects of the substance on terrestrial organisms such as earthworms.

General Thresholds for logK_{oc} (Ney 1995):

>4 = High, sorbs well to soil
3-4 = Moderate, moderate sorption to soil
<3 = Low, does not sorb well to soil

Octanol/Water Partition Coefficient (K_{ow}/logK_{ow}) (ECHA 2017)

The octanol/water partition coefficient (K_{ow}) is defined as the ratio of the concentration of a chemical in octanol and water at equilibrium at a specified temperature:

$$K_{ow} = \frac{concentration\ of\ chemical\ in\ octanol}{concentration\ of\ chemical\ in\ water}$$

Values of K_{ow} are unitless and usually expressed as logK_{ow}, a relative indicator of the tendency of an organic compound to adsorb to soil and living organism. LogK_{ow} are generally inversely related to water solubility and directly proportional to molecular weight of a substance.

$LogK_{ow}$ is a very important parameter for predicting the distribution of a substance in various environmental compartments (water, soil, air, biota, etc). Substances with high $logK_{ow}$ values tend to adsorb more readily to organic matter in soils or sediments because of their low affinity for water. Chemicals with very high $logK_{ow}$ values (i.e, >4.5) are of greater concern because they may have the potential to bio-concentrate in living organisms.

General thresholds:

< 2.7 = Low bioaccumulation
2.7 – 3 = Moderate
> 3.0 = High

Henry's Law Constant (Kerle et al. 2007)

Henry's Law Constants characterize the equilibrium distribution of dilute concentrations of volatile, soluble chemicals between gas and liquid. Henry's Law Constant, as calculated below, is defined as the ratio of solute partial pressure in the air to the equilibrium water concentration.

Henry's Law Constant = (Vapor Pressure x Molecular Weight) / (760 x Water Solubility) atmosphere molecule cubed/ mole (atm m^3/mol)

Henry's law constant is used to characterize the tendency for a pesticide to move between the air and the "soil water." The higher the Henry's law constant, the more likely that a pesticide will volatilize from moist soil. Since sorption will affect the amount of pesticide in the soil water, the tendency to volatilize from moist soil depends on both the Henry's law constant and the distribution coefficient (K_d). The equation here is for other units used for Henry's law constant are atmospheres or two dimensionless values. Note that Henry's Law Constants, and thus chemical volatility, are temperature dependent, such that chemicals are more likely to volatize at higher temperatures.

Aminopyralid

Chemical Description (SERA 2007)

Aminopyralid is the common name for 4-amino-3,6-dichloro-pyridinecarboxylic acid. Aminopyralid is a pyridine carboxylic acid, a class of herbicides that includes clopyralid, picloram, and triclopyr..

Mode of Action (SERA 2007)

Aminopyralid is a selective systemic herbicide that has been developed for the control of broadleaf weeds in rangeland, non-crop areas, and grazed areas. It can be used as both a pre- and post-emergent herbicide. It is absorbed by the foliage and roots of actively growing plants and translocated to the meristematic areas, including the roots. Aminopyralid is a systemic auxin herbicide possessing auxinlike (plant growth regulator) qualities. Aminopyralid moves systemically throughout the plant and deregulates plant growth metabolic pathways affecting the growth process of the plant. This disruption of plant growth processes, by binding of aminopyralid at receptor sites normally used by the plant's natural growth hormones, results in death of susceptible plant species.

Environmental Fate and Transport (USEPA 2014a)

Aminopyralid is relatively soluble (203 – 212 grams/Litre at 20°C) and is classified as mobile to highly mobile based on measured K_{oc} values (Table 2-5). It has the potential to reach groundwater, especially in vulnerable soils with low organic-carbon content and/or the presence of shallow groundwater. Based on log K_{OW}'s ranging from -2.96 to 0.201, aminopyralid is not likely to bioconcentrate in organisms. Aminopyralid is classified as non-volatile from water, dry non-adsorbing surfaces, and moist soil. Fate study results indicate that aminopyralid may range from non-persistent to very persistent in the environment. Aminopyralid is stable to hydrolysis at pH 5, 7, and 9 and essentially stable to anaerobic aquatic metabolism. Aminopyralid is degraded by aerobic metabolism in soils.

Chlorsulfuron

Chemical Description (SERA 2004a)

Chlorsulfuron is the common name for 2-chloro-N-[(4-methoxy-6-methyl-1,3,5-triazin-2-yl)aminocarbonyl]benzenesulfonamide. It is essentially a chlorobenzene ring linked to a methyl (-CH3) and methoxy (-0CH3) substituted triazine ring by a sulfonyl urea bridge.

Mode of Action (SERA 2004a)

Chlorsulfuron is recommended for preemergent and early postemergent control of many annual, biennial, and perennial broadleaf weeds. Chlorsulfuron acts by inhibiting the enzyme acetolactate synthetase resulting in the decreased synthesis of the branched-chain amino acids valine, leucine, and isoleucine, which are essential for plant growth.

Environmental Fate and Transport (USEPA 2012a)

Chlorsulfuron has a log dissociation constant (pK_a) of 3.4 and is a weak acid indicating it will primarily exist as a negatively charged ion (anion) in the natural environment. Its solubility increases with pH. Chlorsulfuron is considered non-volatile from dry non-adsorbing surfaces, water, and moist soil. Chlorsulfuron has relatively low $\log K_{ow}$ values (Table 2-5), so is not likely to bioconcentrate in aquatic or terrestrial organisms. Chlorsulfuron does not break down well in water. This property is associated with long-term persistence if the chemical reaches groundwater.

The range of half-lives for chlorsulfuron in soil and water indicates that it is persistent to very persistent (Toxic Release Inventory Classification). Hydrolysis is the primary mechanism of degradation at low pH. However, in neutral and alkaline environments, biodegradation is expected to dominate as pH increases and chlorsulfuron becomes less susceptible to hydrolysis.

Glyphosate

Chemical Description (SERA 2011a)

Glyphosate is the common name for N-(phosphonomethyl) glycine. At ambient temperatures, glyphosate is a white crystalline substance. In the crystalline form, glyphosate has both positive and negative regions of charge. Such dipolar ion species are sometimes referred to as zwitterions. In aqueous solutions, the hydrogen atoms of the carboxylic acid (COOH) and phosphonate (C-PO_2H_2) groups may be associated (e.g., -COOH) or dissociated (e.g., -COO- + H^+) depending on the pH of the solution.

Mode of Action (SERA 2011a)

Glyphosate is a broad-spectrum, non-selective, post-emergence systemic herbicide. Glyphosate inhibits the shikimic acid pathway in plants, which is involved in the production of essential aromatic amino acids. This inhibition leads to an inhibition or cessation of growth, cellular disruption, and, at sufficiently high levels of exposure, plant death. The time course for these effects can be relatively slow, depending on the plant species, growth rate, climate, and application rate.

Environmental Fate and Transport (USEPA 2009)

The potential for volatilization of glyphosate from soil and water is expected to be low due to the low vapor pressure and low Henry's Law constant. It is also unlikely to bioaccumulate in fish given the low $LogK_{ow}$ value (Table 2-5). The major route of transformation of glyphosate identified in laboratory studies is microbial degradation. In soils incubated under aerobic conditions, the half-life of glyphosate is relatively short. However, anaerobic conditions limit the metabolism of glyphosate. In laboratory studies, glyphosate was not observed to break down by abiotic processes, such as hydrolysis, direct photolysis in soil, or photolysis in water. Glyphosate dissipation appeared to correlate with climate, being more persistent in cold than in warm climates. Along with significant mineralization to carbon dioxide, the major metabolite of glyphosate is aminomethylphosphonic acid (AMPA).

The available field and laboratory data indicate that both glyphosate and AMPA adsorb strongly to soil. Soil partitioning coefficients (K_d) measured in batch equilibrium studies ranged from 18 to 1000 mL/g, with corresponding organic carbon partitioning coefficients (K_{oc}) of 3100 to 58000 mL/g_{oc}· The coefficient of variation for K_{oc} is less than the coefficient of variation for K_d, indicating that pesticide binding to the organic matter fraction of the soil explains some of the variability among the adsorption coefficients, and that K_{oc} is therefore the appropriate parameter to use in determining the soil mobility of the compound. Based on measured K_{oc} values, glyphosate is classified as slightly mobile to hardly mobile according to the Food and Agriculture Organization (FAO) classification scheme and would not be expected to leach to groundwater or to move to surface water at high levels through dissolved runoff. However, glyphosate does have the potential to contaminate surface water from spray drift or transport of residues adsorbed to soil particles suspended in runoff.

Glyphosate Surfactant Toxicity (reference SERA 2011a, all references as cited in SERA 2011a)

The surfactants used in many glyphosate formulations may be of equal or greater concern than the toxicity of glyphosate itself. While a number of surfactants may be used in conjunction with glyphosate, the most important class of surfactants is the POEA (polyoxyethyleneamine) group. A specific POEA surfactant, designated as MON 0818, was originally used with glyphosate in Roundup formulations at a concentration of 15% (Wan et al. 1989). The surfactant was a complex mixture consisting of a tallow amine surfactant at a concentration of 75% and other unidentified components. The toxicity of the original Roundup and similar formulations containing POEA surfactants is far greater than the toxicity of technical grade glyphosate, Rodeo, or other formulations that do not contain surfactants.

The general structure of a tallowamine surfactant is relatively simple. A polyethoxylated tallow amine consists of three hydrocarbon moieties linked via a nitrogen atom (i.e., the amine). The hydrocarbon group (i.e., the CH3-(CH2)a—structure on the left side is derived from tallow. Tallow is a general term for the harder or denser fat of cattle or sheep. Tallow contains a variety of fatty acids including oleic (37–43%), palmitic (24–32%), stearic (20–25%), myristic (3–6%), and linoleic (2–3%) acids as well as small amounts of cholesterol, arachidonic, elaidic, and vaccenic acids (Budavari 1989). The tallow moiety consists of a number of methylene (CH2) groups. Meaning this moiety is a polymer of varying lengths in different tallow amines. The other two groups in tallow amine linked to the nitrogen atom consist of a series of ethoxy groups (i.e., CH2-CH2-O-). Ethoxy groups can be linked together by ether (-C-O-C-) bonds.

Because animal fat is a complex mixture and tallow amine is made from animal fat, tallow amines are complex mixtures. Because animal fat can be rendered in different ways and ethoxylation can be conducted under different conditions, POAE surfactants may differ substantially. As discussed by Brausch and Smith (2007), the properties of POEA surfactants vary, depending on differences in the length of the three groups attached to the nitrogen atom.

The differences among POEA surfactants are critical to risk assessments. The toxicity of glyphosate formulations which contain surfactants is greater than the toxicity of formulations which do not contain surfactants. This is especially true for aquatic species. For this reason, higher toxicity glyphosate formulations that contain surfactants (Roundup Pro, Ranger Pro, Razor Pro, Glyphos Pro) are considered separately from lower toxicity formulations that do not contain surfactants (Rodeo, Roundup Custom).

Low Toxicity: This group consists of Rodeo (a 53.8% isopropylamine salt [IPA] formulation), Accord (a 41.5% IPA formulation), and other 41.5% or 53.8% IPA formulations which do not appear to have a surfactant – i.e., they are essentially equivalent to either Rodeo or Accord. Both Rodeo and Accord are known to consist primarily of the IPA salt of glyphosate and water. NCAP (2010) notes that Rodeo and Accord also contain FD&C Blue No. 1 (CAS #3844-45-9), an approved Food Additive (Clydesdale 1997). Dow AgroSciences, however, has indicated that FD&C Blue No. 1 is not used in Rodeo (Fonseca 2010a). In addition, ample toxicity and some field data are available on both Rodeo and Accord. Of the glyphosate formulations, the formulations in this group are the least toxic and have been extensively studied.

High Toxicity/High Confidence: Roundup Pro Concentrate and Roundup UltraMax (52.2% IPA). NCAP (2010) has identified inerts in Roundup Ultra as a phosphate ester neutralized polyethoxylated tallow amine mixture (no CAS number given), a silicone emulsion (no CAS number given), and FD&C Blue No. 1. NCAP (2010) has also identified a polyoxyethylene alkylamine (CAS #61791-26-2) and FD&C Blue No. 1 as inerts in Roundup Original Herbicide.

Imazamox

Chemical Description (SERA 2010)

Imazamox is the common name for (±)-2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5-oxo-1H-23 imidazol-2-yl]-5-(methoxymethyl)-3-pyridinecarboxylic acid. Imazamox is an herbicide which belongs to the imidazolinone class of pesticides which also includes imazapic, imazapyr, imazethapyr, imazamethabenz, and imazaquin.

Mode of Action (USEPA 2014b)

The imidazolinone herbicides share a common mechanism of action that involves the inhibition of the acetolactate synthase (ALS) enzyme, also referred to as acetohydroxyacid synthase (AHAS) inhibitor. ALS is an enzyme found in plants and is required for the synthesis of essential branched-chain amino acids (i.e., valine, leucine, and isoleucine), all of which are important for plant growth.

Environmental Fate and Transport (USEPA 2014b)

Imazamox is a relatively moderately persistent and mobile herbicide. Laboratory studies indicate that imazamox does not readily hydrolyze nor volatilize at pH's 5, 7, and 9. The herbicide is very mobile as indicated by low K_d and K_{oc} values (Table 2-5). Microbially mediated metabolism is the primary degradation mechanism in soils. Imazamox photolytically degrades more slowly in soils. Imazamox quickly degrades via aqueous photolysis in clear water however, it is stable in the dark control system. Thus, if not photolytically degraded, imazamox is stable and persistent in anaerobic aquatic sediments. Aerobic aquatic degradation rates are unknown at this time. As indicated by the low $\log K_{ow}$ value (Table 2-5), imazamox is not likely to bioaccumulate.

Imazapyr

Chemical Description (SERA 2011b)

Imazapyr is the common name for 2-[4,5-dihydro-4-methyl-4-(1-methylethyl)-5oxo-1H-31 imidazol-2-yl]-3-pyridinecarboxylic acid. Imazapyr is a member of the imidazolinone class of herbicides which also includes imazapic, imazamox, imazethapyr, imazamethabenz, and imazaquin. It is formulated both as an acid (imazapyr) and as an isopropylamine salt (imazapyr IPA).

Mode of Action (USEPA 2014c)

The active ingredient imazapyr is a systemic imidazolinone herbicide that is used for control of most annual and perennial broadleaf weeds and grasses, woody species, and riparian and emergent aquatic weeds species. The mode of action of imazapyr is to inhibit acetohydroxyacid synthase (ALS) which interferes with plant cell growth and DNA synthesis.

Environmental Fate and Transport (USEPA 2014c)

Imazapyr is an anionic, organic acid (pKa of about 3.8) that is non-volatile, degrades through photolysis in clear shallow waters, and is both persistent and mobile in soil. Imazapyr is mainly present in anionic form at typical environmental pHs, and the behavior of the acid and salt forms are expected to be similar. Most environmental fate data available for imazapyr are based on dissociation of the isopropylamine salt in water. Imazapyr was essentially stable to aerobic and anaerobic soil metabolism, and no major transformation products were identified during the course of laboratory studies. Field study observations are consistent with imazapyr's intrinsic ability to persist in soils and move via runoff in surface water and leach to groundwater. Imazapyr did not bioconcentrate in submitted laboratory studies. The relatively high solubility in water and low n-octanol to water partitioning ratio of imazapyr is also consistent with lowlikelihood of bioconcentration.

Although imazapyr is stable to hydrolysis and microbial metabolism, photodegradation in water is an important route of dissipation. Major photodegradation products of imazapyr (>10% of applied radiation) are CL11960 and CL9140. The degradation product CL252974 was a minor transformation product (<6.9% of applied radiation) in hydrolysis and aerobic soil metabolism studies. The transformation products CL11960 and CL9140 are prone to degrade through oxidative mineralization to CO_2.

Sulfometuron Methyl

Chemical Description (SERA 2004b)

Sulfometuron methyl is the common name for 2-[[[[(4,6-dimethyl-2-pyrimidinyl)- amino] carbonyl] amino] sulfonyl] benzoic acid methyl ester and is essentially a methyl ester of a benzoate ring linked to a dimethyl substituted pyrimidine ring by a sulfonyl urea bridge.

Mode of Action (USEPA 2008)

Sulfometuron methyl is a sulfonylurea herbicide that provides broad spectrum pre- and post-emergence control of annual and perennial grasses and broad-leaf weeds in forestry and non-crop situations, including vegetative management and rights of way and railroad. Similar to other sulfonylurea herbicides, sulfometuron's mode of action involves inhibiting the activity of the enzyme acetolactate synthase, which inhibits the production of amino acids required for cell growth in plants.

Environmental Fate and Transport (USEPA 2012b)

Sulfometuron methyl is mobile (all measured Koc values < 100) and persistent (degradation half-lives from a few weeks to several months in various laboratory and field studies) in the environment. Sulfometuron methyl is more soluble in neutral and alkaline water than in acidic water. The major route of dissipation for sulfometuron methyl is aerobic and anaerobic degradation / metabolism in soil and water, with hydrolysis potentially dominant under acidic conditions. However, sulfometuron methyl degradation rate and mobility in the environment can be characterized as highly variable – significantly affected by soil and water properties such as pH and organic matter and with often significantly increased resistance to degradation in soil over time. The lK_{OW} values for sulfometuron methyl are ≤1.07 and therefore, bioconcentration of the chemical in aquatic animal tissue is not expected.

The sulfometuron methyl environmental fate data show some unusual characteristics of sulfometuron methyl in that some field dissipation rates at some sites are slower than the degradation rates measured in aerobic soil metabolism studies. Furthermore, both measured laboratory degradation and field dissipation rates are in some cases slower than the hydrolysis rate measured in the laboratory (particularly under acidic conditions) for sulfometuron methyl. These data indicate that the fate of sulfometuron methyl may be highly site dependent.

Sulfometuron-methyl persistence in water indicates that if, either via spray drift or any runoff event, sulfometuron methyl reaches surface water, it may persist for a few weeks to several months and present some concern to surface water resources. The toxicity of sulfometuron methyl to certain plant species at very low levels (i.e., at only a small fraction of the already low application rates) means that there is a risk for exposure at toxic levels at far distances from the application site via spray drift.

The most commonly formed and persistent environmental degradates are the sulfometuron sulfonamide, the sulfometuron pyrimidine amine, and saccharin; other degradates occur less commonly. Deesterification from sulfometuron methyl to the free acid occurs, but this degradate does not appear to accumulate substantially.

Triclopyr

Chemical Description (SERA 2011c)

Triclopyr is the common name for [(3,5,6-trichloro-2-pyridinly)oxy]acetic acid. Triclopyr is the pyridine analogue of 2,4,5-T (2,4,5-trichlorophenoxyacetic acid) and differs from 2,4,5-T only by the presence of a nitrogen (N) atom in the ring structure. Like 2,4,5-T, triclopyr mimics auxin, a plant growth hormone, thus disrupting the normal growth and viability of plants.

Two forms of triclopyr are used commercially as herbicides: the triethylamine salt (TEA, e.g. Garlon 3A) and the butoxyethyl ester (BEE, e.g. Garlon 4). A major environmental metabolite of triclopyr (3,5,6-Trichloro-2-pyridinol [TCP]) is a concern when assessing the risk of triclopyr application. TCP is formed in all relevant environmental media, as a metabolite in plants, soil, and water. While there is little indication that TCP poses a substantial risk to humans, this metabolite is more toxic than triclopyr is to some aquatic organisms.

Mode of Action (EPA 2014d)

Triclopyr acid penetrates exposed foliage and is also readily absorbed from soils through plant roots. Triclopyr is believed to acidify the cell wall by stimulating the activity of a membrane-bound ATPase proton pump. In low concentrations, triclopyr and other synthetic auxin type herbicides cause uncontrolled cell division and growth resulting in vascular tissue destruction. In contrast, with higher concentrations, they may inhibit cell division and growth. Also, auxin type herbicides may cause chlorosis (yellowing of leaves due to lack of chlorophyll), and curling or bending of leaves (known as epinasty).

Environmental Fate and Transport (USEPA 2014d)

Triclopyr acid has a low vapor pressure and is highly soluble. Triclopyr TEA is a non-volatile, very soluble salt. Triclopyr BEE is non-volatile and shows relatively low solubility. Triclopyr acid is a weak acid which will dissociate completely to the triclopyr anion at pHs > 5 (dissociation constant pK_a 3). Therefore, triclopyr anion will be the dominant moiety present in the environment when products containing either triclopyr acid or triclopyr TEA are used. However, triclopyr BEE is anticipated to persist longer in the environment than triclopyr TEA. Due to its high log K_{ow} and low water solubility, Triclopyr BEE is expected to bioaccumulate in fish.

Triclopyr Acid

Based on laboratory studies, triclopyr acid is stable to hydrolysis and anaerobic aquatic metabolism, and it degrades slowly under aerobic aquatic conditions. Triclopyr acid is a weak acid which will dissociate completely to the triclopyr anion at pHs > 5 (dissociation constant pK_a 3). Therefore, the triclopyr anion will be the predominant moiety present in the environment. The very low K_{OW} for triclopyr acid indicates that it will not be bioaccumulated in fish tissue. Based on the preliminary review of a fish bioaccumulation study, this is confirmed experimentally. It appears that aqueous photolysis is a predominant degradation mechanism in aquatic media. Photodegradation of triclopyr acid was less than 1 day in sterile solutions (either exposed to mercury lamp or natural sunlight) and approximately 1 day in natural water (exposed to natural sunlight). The major photodegradation products observed were 5-chloro-3,6-dihydroxy-2-pyridinoloxyacetic acid in sterile solutions and oxamic acid in sterile natural river water and buffer solutions.

In soil, the predominant degradation mechanism for triclopyr acid is biotic metabolism. Triclopyr acid degraded in aerobic soil with half-lives of 8 to 18 days to intermediate degradates 3,5,6-trichloro-2-pyridinol (TCP) and 3,5,6-trichloro-2-methoxypyridine (TMP); the ultimate degradate is carbon dioxide. TCP was also observed as a minor degradate in the aerobic aquatic metabolism study. Based on adsorption/desorption studies, triclopyr acid and its major degradate TCP, both chemicals are expected to be very mobile in soils.

Triclopyr TEA

Triclopyr TEA is a salt which is expected to dissociate rapidly in water to the triclopyr acid/anion. In measurements of conductance of a solution of triclopyr TEA in water as a function of time, triclopyr TEA was found to be dissolved and dissociated completely to the acid within one minute. Although the triethylamine portion of the triclopyr molecule was not monitored, it is reasonable to believe the other hydrolytic product (triethylamine) is formed at the same time. As indicated previously, triclopyr acid is expected to dissociate completely at environmentally relevant pH values and exist as the triclopyr anion.

The primary degradation pathway for triclopyr TEA is dissociation to triclopyr acid and presumably to triethylamine, because the latter degradate was not monitored in all available fate studies. Triethylamine is then degraded by aerobic microbial processes to CO_2. It is stable in aquatic conditions in the first 14-18 days and then proceeds to rapid degradation. Triethylamine is stable to degradation under anaerobic aquatic conditions (half-life > 2 years). Because of the rapid microbial degradation under aerobic conditions, it is not expected that volatilization, photodegradation, or bioaccumulation in fish will contribute significantly to the dissipation of triethylamine. Triclopyr TEA degraded with half-live of 2.2-7.6 days in the water at two study sites in AR and LA and half-lives of 2.9-7.6 days in the soil in rice field dissipation studies. TCP was detected up to 36 weeks after treatment in vegetated soil; it represented a considerable amount (0.131 ppm) at 63 weeks (last test interval) in bare soil.

Triclopyr BEE

Triclopyr BEE will persist to varying degrees in the environment depending on environmental conditions and type of study, with persistence in laboratory studies being shorter than that observed in field studies. In the laboratory, the primary degradation pathway for triclopyr BEE is hydrolysis to triclopyr acid, with hydrolysis occurring more rapidly at higher pHs. Triclopyr BEE hydrolyzed quickly to triclopyr acid in non-sterile natural waters (pH 6.7; half-life of 0.5 days), but somewhat slower at pH 7 in sterile pure water (half-life of 9 days). It appears that hydrolysis occurred more rapidly at higher pH values (half-life of 84.0, 9.0 and 0.3 days at pH 5, 7, and 9, respectively) in sterile pure water. Supplemental information indicates that triclopyr BEE degrades to triclopyr acid with a half-life of about three hours when applied to silty clay loam, silt loam, and sandy loam soils.

In the field dissipation studies using triclopyr BEE, triclopyr BEE dissipated much faster in North Carolina (NC) than in California (CA) (with half-lives of 1.1 days and 39 days, respectively). The variation in half lives could be related to the difference in soil pH (NC site has a soil pH of 6.3 whereas CA site has a pH of 4.7-5.7). In these studies, concentrations of triclopyr acid, TCP, and TMP were not found in soil depths below 15 cm or below 30 cm. TCP was generally limited to the upper 30 cm of the soil, with sporadic detections in deeper soil depths. These observations appear to indicate that TCP is very persistent and mobile in the field and that triclopyr BEE may persist under some environmental conditions.

TCP and Other Transformation Products

The major organic degradates of triclopyr acid, TEA and BEE in submitted environmental fate studies were triclopyr acid, TCP, TMP, 5-chloro-3,6-dihydroxy-2-pyridinyloxyacetic acid, oxamic acid, and (5/6)-chloro-3-hydroxy-s-pyridinone. In the field dissipation studies for triclopyr TEA and BEE, three degradates (acid, TCP and TMP) were monitored. Since the fate of the triethylamine part of the triclopyr TEA molecule and the butoxyethanol of the triclopyr BEE molecule were not monitored in all fate studies, the formation of triethylamine and 2-butoxyethanol could not be confirmed; however, it is expected to occur.

TCP is relatively mobile and persistent and has the potential to reach groundwater. Triclopyr and TCP do not adsorb to soil and sediment particles, and may be transported in surface waters;

information from two field dissipation studies conducted on rice fields indicate that following application of triclopyr TEA, TCP can persist in flood waters.

Since the butoxyethanol part of triclopyr BEE in all fate studies was not monitored, the formation and decline of 2-butoxyethanol in the environment remains unknown. According to the fate studies of 2,4-D ester salt, 2-butoxyethanol (the test substance) degrades rapidly by microbial processes (aerobic soil and aerobic/anaerobic aquatic systems) to 2-butoxyacetic acid (half-lives of 0.9–1.4 hours in soil; half-life of 0.6-3.4 days in a sediment/water mixture). The degradate (2-butoxyacetic acid) is more persistent under anaerobic aquatic conditions than aerobic aquatic conditions (half-lives of 73.3 and 1.4 days, respectively). It is not expected that volatilization will contribute significantly to the dissipation of 2-butoxyethanol. Because of the rapid microbial degradation, it is not expected that photodegradation or bioaccumulation in fish will contribute significantly to the dissipation of butoxyethanol.

2.1.2 Mowing

Mowing may be used to control or suppress certain invasive species, particularly annual species. For treatments of annual invasive species, mowing will be carefully timed to coincide with the vulnerable stage of target species' phenology. Mowing may also be used for perennial invasive species when removal of biomass is required (e.g., reduction of BASH hazards, preparation or maintenance of habitat enhancement sites). Regular mowing performed for fuels control and grounds maintenance in this sense does not apply as an effective invasive species control technique. However, mowing may also be used in conjunction with prescribed fire in order to prepare the site for wet fire-lines. This is ideal for locations where ground disturbance is restricted (e.g., vernal pools). Mowing can present a biosecurity threat from equipment used off-base that may transport invasive plant species onto Beale AFB or between locations on base. Appropriate cleaning best management practices (BMPs) will be used for equipment traveling between sites (Beale 2017a). Table 2-9 provides relative benefits and downsides to mowing when compared to other manual/mechanical control methods.

Table 2-9. Manual and mechanical control method descriptions and impacts.

Type	Tool/Method	Description of Technique	General Benefit	General Cons	BRC	PGD	LSI	ID	TS	DoA	T
Manual (Conducted by hand or with non-mechanized hand tools)	Cut Stump with Hand Saws	Used to kill tree or shrub species unlikely to resprout or in conjunction with herbicide application	No herbicides, species specific	Limited to few a species, generates biomass that may need to be removed	Low	Low	Small	Diffuse	High	High	Flat to mod
	Trim with Hand Sheers, Loppers, or Similar Tools	Used to remove portions of trees and shrubs without killing them	No herbicides, species specific	No kill, generates biomass that may need to be removed	Low	None	Small	Diffuse	High	High	Flat to mod
	Pull by Hand or Weed Wrenches	Used to remove small trees/shrubs and small or intermixed infestations of plants	No herbicides, species specific	Limited to a few species, generates biomass that needs to be removed, very labor/time intensive	Low	Low	Small	Diffuse	High	Mod	Flat to mod
	Excavate with Shovels or similar Tools	Used to Dig up small patches of plants that are too difficult to pull by hand	No herbicides, species specific	Limited to a few species, minor soil disturbances, generates biomass that may need to be removed, very labor/time intensive	Low	Mod	Small	Diffuse	High	Mod	Flat to mod
	Mulch	Organic material (wood chips) used to suppress germination of invasive species	No herbicides, can be used in conjunction with restoration activities	Non-selective, only useful against seedlings, physically disruptive, labor intensive	None	None	Mod	Diffuse	Low	High	Flat
Mechanical	Cut Stump with Chain Saw or Similar Tool	Used to kill tree or shrub species unlikely to resprout	No herbicides, species specific	No kill, generates biomass that may need to be removed	Low	Low	Large	Dense	High	High	Flat to mod
	Trim with Chain Saws, Brush-cutters, or Similar Tools	Used to remove portions of trees and shrubs without killing them or in conjunction with herbicide application	No herbicides, species specific	Limited to few a species, generates biomass that may need to be removed	Low	None	Large	Dense	Mod	High	Flat to mod
	Remove Using Excavator or Back Hoe	Used to remove large rhizomatous species like Himalayan blackberry and Arundo	No herbicides, species specific	Limited to a few species, highly disruptive to soil	Low	High	Mod	Diffuse	High	High	Flat
Mowing	Mow using weed-whackers, riding mowers or similar equipment	Used to mow small infestations of annual invasive species or reduce biomass of perennial species	No herbicides, can cover significant areas	Limited to few species, non-selective, equipment must be cleaned to prevent spread of invasive species	Mod	Low	Large	Dense	Low	High	Flat
BRC=Biomass Reduction Capability, PGD= Potential for Ground Disturbance, LSI= Landscape Scale of Infestation, ID= Infestation Density, TS= Target Specificity, DoA= Detection of Application, T= Terrain.											

2.1.3 Manual and Mechanical Removal

Manual and mechanical treatments using, hand-pulling, small hand-powered tools, and handheld equipment (e.g., weed whackers, chainsaws, and brush cutters) will be used for removing small or new infestations of invasive plants. Heavy equipment (including mowing tractors large and small, tracked and wheeled, and masticators) may be used to remove large infestations and Arundo and Himalayan blackberry. This would be relegated to the use of mowing-attachments to reduce blackberry biomass and the targeted removal of Arundo from areas where the stands are too dense or too massive to remove by hand. Depending on the target species and environmental constraints (see Section 2.4), manual and mechanized removal will used independently or in concert with herbicide application. Methods such as hand pulling would be used for small infestations or in areas where herbicide cannot be safely used due to proximity to T&E species. Cutting of trees would be paired with a cut-stump herbicide application in cases where the target species is capable of re-sprouting from the base (e.g., tree of heaven). Any biomass will be removed and disposed of to avoid spread of invasive species. Disturbance to soil will be minimized to reduce areas that invasive plants can spread into as they often prefer disturbed soil and can more quickly establish themselves than native plant species. Table 2-9 lists manual and mechanical treatments proposed for use and their relative effects. Refer to the IPSMG for more information on manual control techniques.

2.1.4 Controlled Burns

Prescribed fire will be utilized to control certain non-native plant species at Beale AFB and the LRS. Prescribed burns may not be feasible in some areas due to conflicts with mission-critical operations or sensitive habitats (e.g., VELB habitat).

Prescribed burns require careful planning, coordination, and implementation to be successful. A prescribed fire plan is developed for prescribed burn to address site-specific conditions. All prescribed fire plans will be reviewed by the NRM to ensure that no T&E species will be adversely affected by prescribed fire activities and that all AMMs and the Biological Opinion (BO) are followed. Beale AFB has an existing robust prescribed fire program that serves to maintain and enhance habitat to support a multitude of grassland and woodland species. All prescribed burns are managed in accordance with the IPSMG, in addition to the WFMP, which provides guidance for the suppression and prevention of wildfires as well as the implementation of ecosystem management and fuels reduction on Beale AFB. The WFMP addresses Beale AFB INRMP management goals and objectives, and complies with all applicable laws and regulations. It lays out responsibilities and procedures for prescribed fire management in a manner that is safe, efficient, effective, and highly professional. The WFMP addresses, among other things, prescribed fire planning, project implementation, operations, public notification, smoke management, management protocol, reporting requirements, asset protection, training and qualifications, and monitoring and evaluation.

According to the WFMP, the locations and plans for all prescribed fires in support of the goals and objectives of the INRMP will be approved by the Beale AFB NRM. The NRM alone will set prescribed fire priorities on the installation for the purpose of meeting Natural Resources

Program goals and will be consulted on all planned prescribed fire actions. Prescribed fires that meet other purposes, for instance fuels reduction, would also be planned but reviewed by the NRM.

The WFMP suggests that the existing prescribed fire program could be enhanced by introducing prescribed fire to more areas of the installation to improve floral and faunal diversity, improve rangeland habitat quality, control certain non-native species, and reduce hazardous fuels that could increase wildfire intensity. This would be done by implementing controlled burns timed to mimic historic mean fire return intervals (MFRI) or specifically timed and repeated for invasive species control. According to the current WFMP, the historic MFRI for the dominant grassland areas on Beale AFB is about four years. The historic MFRI for the oak woodland is about 12 years. Because increased native plant biodiversity has been documented to last greater than three years when prescribed fire is applied to vernal pools, the WFMP recommends that vernal pool habitat management follows the MFRI prescribed for surrounding grassland areas. The WFMP includes a table of prescribed fire recommendations for the control of selected non-native species on Beale AFB, which is reproduced here in Table 2-10. Annual prescribed fire application on the installation would need to average 3,434 to 5,723 acres to achieve the goals identified in the WFMP. As with other weed control methods, timing of treatment is critical.

Table 2-10. Prescribed fire recommendations for selected non-native plant species.

Potential Objective	Prescribed Fire Recommendation
Control barbed goatgrass (*Aegilops triuncialis*)	Early summer or late spring prescribed fire in 2 consecutive years*
Control yellow starthistle (*Centaurea solstitialis*)	Early summer or late spring prescribed fire in 3 consecutive years. Repeat treatments may be necessary every 2-4 years*
Control Himalayan blackberry (*Rubus armeniacus*)	Prescribed fire at any time of the year with follow-up herbicide treatment of resprouts*
Control medusahead (*Elymus caput-medusae*)	Late spring (after seed head dispersal but before the seed moisture drops below 30%) prescribed fire followed by fall application of lmazapic. Repeat treatments may be necessary every 2-4 years*
*Recommendations follow those found in the 2017 Invasive Plant Species Management Guidelines for Beale Air Force Base, California.	

2.1.5 Grazing

Grazing by domestic livestock, including cattle, sheep, goats, and horses, will be implemented as a method for controlling some non-native plant species and can be used to move plant community composition in a desired direction and maintain habitat for listed species. While grazing alone does not eradicate non-native plant species, it can be effective in reducing infestation levels and slowing the spread of some undesirable species. Grazing is also useful for controlling invasive species in locations where other methods such as herbicide applications and controlled burns are not available due to the presence of sensitive resources. Additionally, the reduction of non-native plant species and their thatch from vernal pools via grazing has been shown to increase inundation periods (pools both fill earlier and stay wet longer), which benefits a wide range of species that rely on these unique habitats, including large branchiopods (USFWS 2005). Grazing typically helps to remove the thatch from within the vernal pool and reduces total RDM in surrounding upland areas (Marty 2015).

The duration, intensity, and frequency of seasonal grazing on Beale AFB are designed to improve habitat for listed species occurring on Beale AFB, promote native species, minimize soil erosion, reduce wildfire risk and prevent the spread of undesirable plant species (Beale AFB 2019). For these reasons, Beale AFB considers seasonal grazing management to have beneficial effects on the listed species covered in this document. The upland habitat surrounding the vernal pools on Beale AFB is dominated by non-native annual grass and forb species. Based on weed surveys at Beale AFB, the principal invasive species include medusahead (*Elymus caput-medusae*), yellow starthistle (*Centaurea solstitialis*), and barbed goatgrass (*aegilops triuncialis*) (Beale AFB 2017b).

Currently, Beale AFB accommodates agricultural outleasing as a major land use. Grazing currently occurs within designated fields, or Grazing Management Units (GMUs), located throughout Beale AFB (Figure 2-1). Cattle grazing occurs within these areas from approximately November to May, depending on the year and weather, and year-round for horses. Adaptive management principles are essential to the grazing management program to maximize potential benefits of the program while precipitation and temperature vary. As of August 2019, cattle grazing currently covers 11,866 acres and horse grazing covers 302 acres (Beale AFB 2019). Activities associated with the agricultural outleasing program on Beale AFB include cattle grazing; fence installation, maintenance and replacement; access road maintenance; and installation and maintenance of water wells and troughs as specified in the Grazing Management Guidelines (GMG) (Beale AFB 2017b).

Under the Proposed Action, grazing would be continued and expanded on Beale AFB. In addition to the pastures currently being grazed on Beale AFB, the USAF proposes to graze up to 3,332 additional acres on Beale AFB and 210 acres of land on LRS in areas that are either unmanaged or mowed and where grazing has not occurred recently and where habitat degradation has been observed (Figures 2-1 and 2-2). Most of these areas do not have infrastructure currently to support livestock grazing, so improvements to fencing and development of water sources as described above would be required for grazing to be initiated. Approximately 66,000 feet of linear fencing are proposed to be completed to enclose proposed grazing areas. All permanent grazing infrastructure (e.g. wooden corner posts, troughs, corrals) will be placed at a minimum of 50 feet from T&E species habitat. No new access roads will be installed within the new grazing units; however, existing access roads will be maintained. Construction zones, including staging areas, egress, and ingress routes, will avoid T&E species and all construction will occur during the dry season (1 May-1 Nov). All permanent grazing pastures may be grazed by cattle, horses, goats, and sheep. Additionally, grazing using goats and sheep would also be incorporated into new areas to control invasive species where permanent enclosures and cattle grazing are impractical (e.g., small areas near facilities, road banks, and manmade impoundment structures). All fencing and infrastructure for goats and sheep outside of cattle pastures will be temporary (i.e., electrified fencing) and will be removed at the end of the grazing treatment. Site-specific management and monitoring plans are included in the GMG.

The grazing program at Beale AFB and the LRS will be maintained in accordance with the Beale AFB GMG, which help guide livestock grazing management activities to meet INRMP natural resource management goals. While the GMG does not currently include LRS, all management prescriptions, goals, objectives, and BMPs in it apply to the LRS. The LRS is composed of the same habitat types (e.g., annual grassland, oak woodland, vernal pool grasslands) as Beale AFB with the same special status resources, which results in identical management decisions and thus identical environmental effects. Stocking rate calculations will need to be done for LRS but will follow the established methodology of the GMG. The GMG helps to ensure that the grazing program on Beale AFB and the LRS is implemented in the safest and most efficient and beneficial manner possible. The GMG addresses goals and mission support functions of the grazing program, conditions affecting grazing, grazing leases, land use rules, grazing management recommendations including recommended actions and timelines, monitoring, and adaptive management. The GMG is updated periodically to meet changing conditions, natural resource and conservation goals, and mission requirements.

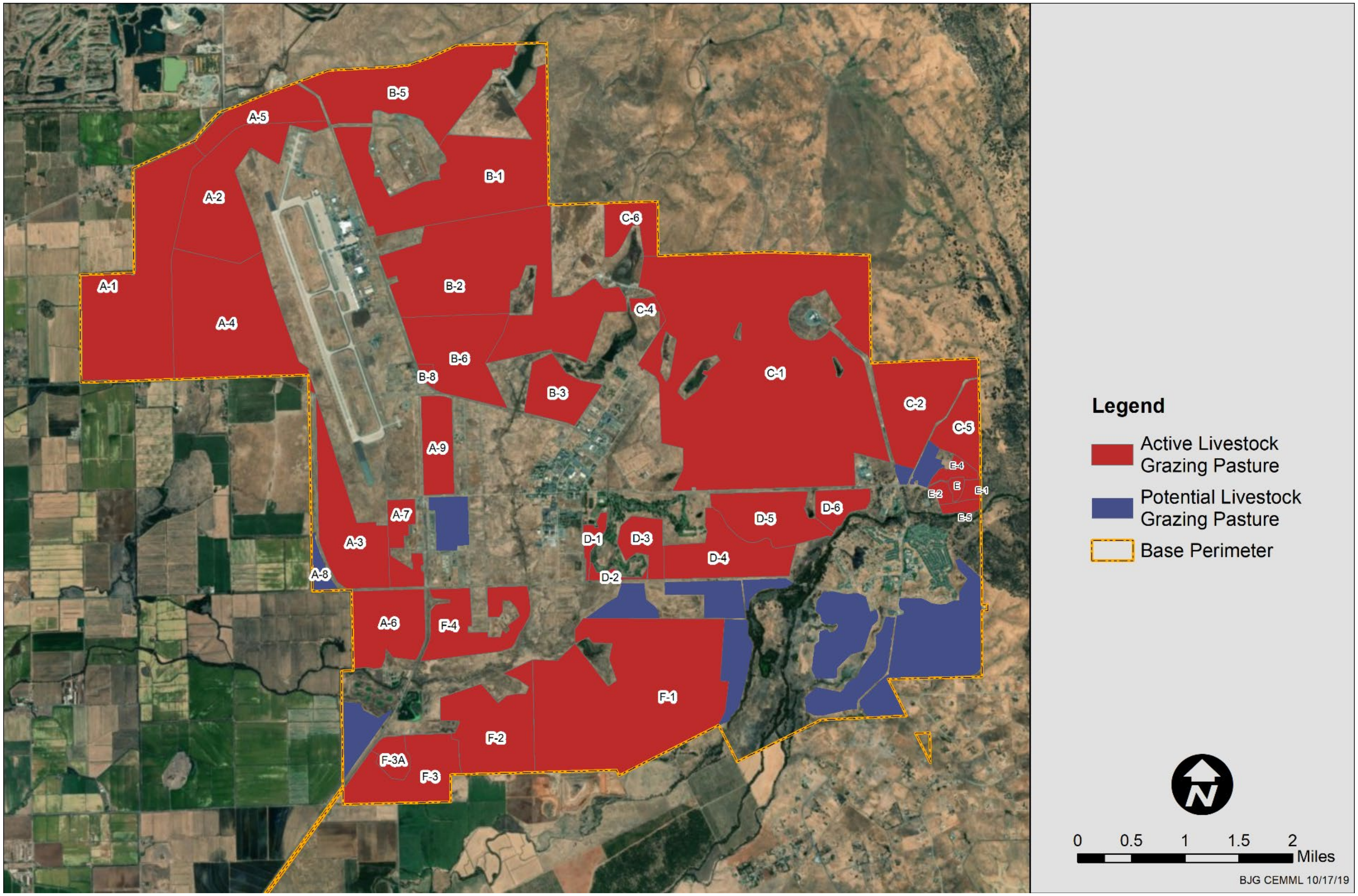

Figure 2-1. Current and proposed permanent grazing pastures on Beale AFB.

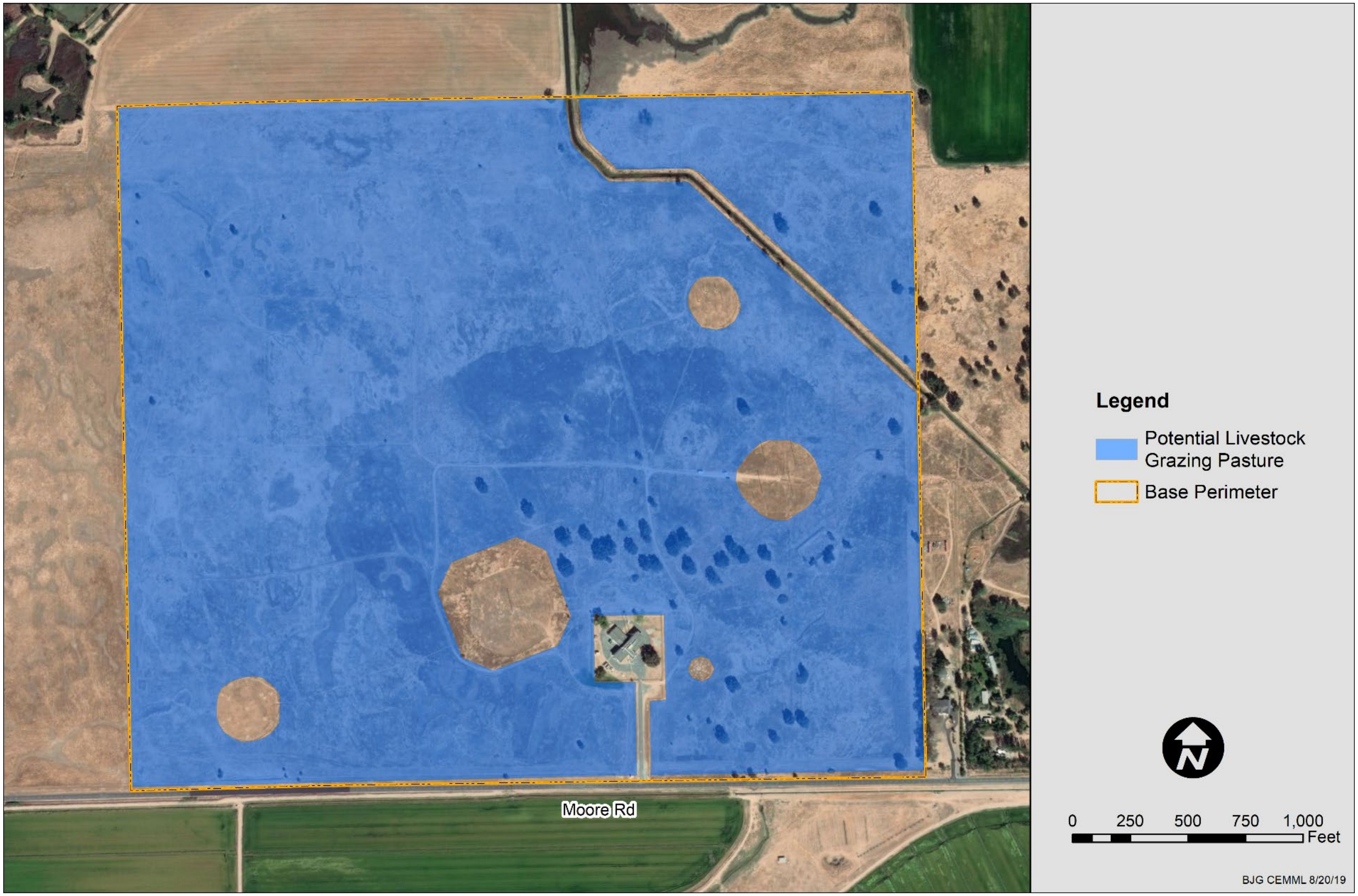

Figure 2-2. Proposed grazing pasture at the LRS.

The IPSMG provides several BMPs to minimize potential transfer of invasive species through grazing actions (Beale AFB 2017b). These will be incorporated into grazing practices: (1) Pastures will be grazed according to the Beale AFB GMG and monitoring data collected, (2) any supplemental feed will be certified weed-free, and (3) grazing lessees will be informed about biosecurity and early detection efforts to prevent establishment of new invasive species.

2.1.6 Habitat Enhancement Treatments

Habitat restoration and enhancement treatments such as replanting or reseeding will be used at Beale AFB and the LRS to promote desirable species and habitat conditions in conjunction with weed control treatments. Revegetation with desirable native species will be used to enhance ecosystem function, provide habitat to wildlife, suppress non-native plant regrowth, and reduce the number of follow-up treatments (Cal-IPC 2015). If Beale AFB determines that restoration treatments are required due to invasion by problematic weed species or significant degradation of habitat value, reseeding or replanting using native species will be used. Revegetating non-native plant treatment sites may be accomplished using a mixture of native grasses and forbs, and may include trees and shrubs if appropriate (e.g., riparian and oak woodland habitats). Revegetating decisions will be compatible with future uses and management actions, and will consider suitability and cost of available options as well as the suitability of the site itself. Plant species that would be used include purple needlegrass (*Stipa pulchra*), blue wildrye (*Elymus glaucus*), California brome (*Bromus carinatus*), creeping wildrye (*Elymus triticoides*), Pacific fescue (*Festuca microstachys*), meadow barley (*Hordeum brachyantherum*), miniature lupine (*Lupinus bicolor*), tomcat clover *(Trifolium wildenovii*), purple clarkia (*Clarkia purpea*), fiddleneck (*Amsinckia menziesii*) and California goldfields (*Lasthenia californica*). Table 2-11 gives an example of an appropriate seed mix for grassland revegetation. Additionally, native perennial plants that provide resources to pollinators, especially monarchs, will be included whenever possible and include species such as milkweed (*Asclepias* spp), buckwheats (*Eriogonum* spp), coyote bush (*Baccharis pilularis*) blue dicks (*Dichelostemma capitatum*), and great valley gumplant (*Grindelia camporum*). All restoration plant mixes must be approved by the NRM before installation and will include only California native species. Table 2-12 provides an example of a native plant mix appropriate for upland habitat enhancement aimed at benefitting pollinators. Additional habitat enhancement guidance is provided in the IPSMG and the *U.S. Air Force Pollinator Conservation Strategy Guide* (USFWS 2017a).

Site preparation is not likely to include disking but might, depending on project goals and location, and would occur after herbicide treatment, manual removal, or prescribed burning has been conducted. The most common restoration methods that may be used at Beale AFB include:

- Hand seeding: In very small (under 1/10th acre) upland disturbed areas, hand seeding with a base-approved native seed mix may be used to encourage recolonization by native vegetation.
- Drill seeding: A drill seeder with a row of small disks mounted on the front will be used to plant seeds. The seeder digs a 0.75 to 1-inch groove in which the seed is planted, and

then the grove is closed behind the machine. Thatch reduction using grazing, prescribed burning, or mowing will be conducted prior to seeding to break up thatch to improve seed germination.

- Plug planting: A dibble tool will be used to poke a hole in the ground to a depth of about two to three inches. A small container plant will be placed in the hole and the top of the soil is closed around it to seal it in. Typically, these plugs will be planted every 1-3 feet. Thatch reduction using grazing, prescribed burning, or mowing will be conducted prior to seeding to break up thatch to improve plant survival.

- Container Planting: Hand tools or a tractor with auger will be used to dig holes in the ground for the installation of regionally native plants. Generally, container planting will be conducted using methods from the *Restoration Plan for the Dry Creek Riparian Area* (River Partners 2011).

All plug and container planting sites will be maintained and monitored for five years to ensure survival and establishment. Additionally, the sites will be monitored for use by target wildlife species including pollinators, monarch, and migratory birds.

Table 2-11. Example native seed mix for grassland habitat enhancement on Beale AFB.

Scientific Name	**Common Name**	**Pounds (Lbs) Pure Live Seed PLS Per Acre**
Stipa pulchra	Purple needlegrass	6.0
Stipa cernua	Nodding needlegrass	1.5
Bromus carinitus	California brome	3.5
Poa secunda spp. *secunda*	One-sided blue grass	1.5
Elymus gluacus	Blue wildrye	4.0
Festuca microstachys	Pacific fescue	3.0
Lupinus bicolor	Miniature lupine	2.5
Trifolium wildernovii	Tomcat clover	2.0
Lasthenia fremontii	Fremont’s goldfields	0.5
Lasthenia glabrata	Yellow ray goldfields	0.5
		Total: 25.0 Lbs

Table 2-12. Example plant mix for upland and pollinator specific habitat enhancement on Beale AFB.

Scientific Name	Common Name	Form	Planting Method
Aesculus californica	California buckeye	Tree	1 gallon
Acmispon glaber	Deerweed	Perennial	Seed, plug
*Asclepias eriocarpa**	Woolypod milkweed	Perennial	Seed, plug
*Asclepias fascicularis**	Narrow-leaf milkweed	Perennial	Seed, plug
Arctostaphylos manzanita	Common manzanita	Shrub	1 gallon
Baccharis pilularis	Coyote bush	Shrub	Seed, plug, 1 gallon
Eriogonum nudum	Naked buckwheat	Perennial	Seed, plug
Eriogonum fasciculatum	California buckwheat	Shrub	Seed, plug, 1 gallon
Ericameria nauseosa	Rubber rabbitbush	Shrub	1 gallon
Eriodycton californica	Yerba Santa	Shrub	1 gallon
Heteromeles arbutifolia	Toyon	Shrub/tree	1 gallon
Lupinus albifrons	Silverbush lupine	Shrub	1 gallon
Monardella villosa	Coyote mint	Perennial	Plug, 1 gallon
Phacelia californica	California phacelia	Perennial	Seed, plug
Grindelia camporum	Great valley gumplant	Perennial	Seed, plug
Salvia sonomensis	Sonoma sage	Shrub	plug

* Host plant of monarch butterfly

2.2 Project Area Access

Many of the treatment areas are in undeveloped portions of Beale AFB and the LRS and lack established access roads. In such cases, personnel may use ATVs and/or kayaks to reach project sites. When driving off-road or using an ATV, Beale AFB Natural Resources staff will ensure routes avoid all sensitive habitat or species (e.g., vernal pools). Additionally, no off-road vehicle use will be conducted during rainy periods or when the ground is saturated to prevent rutting or other damage to habitats. If vehicles cannot avoid sensitive habitat, then the location will be accessed on foot. Kayaks would be used to transport personnel and equipment across water in areas where water depth prevents foot access.

Table 2-13. Access methods to reach project areas in Beale AFB. "PGD" refers to potential for ground disturbance, "T" refers to terrain, and "mod" refers to moderate.

Access Method	Description	General Benefit	Cons	PGD	T
ATV	Used to transport workers to remote areas	fast	may damage native habitats, limited to dry soil conditions	mod	flat to mod
Truck	Used to transport workers to developed areas	moderately fast	may damage native habitats, limited to dry soil conditions	mod	flat to mod
Kayak	Used to access inundated areas or edges of riparian areas.	water access	slow: inefficient over long distances	low	flat to mod
Foot	Used to access remote areas when vehicular access is not feasible	moderately fast	slow: inefficient over long distances	none	flat to mod

2.3 Effects Monitoring

To determine treatment efficacy and impacts, monitoring will be required within treatment areas. Monitoring efforts may include visual surveys of treatment sites, ground photography, and RDM sampling. Targeted special status species surveys may be conducted including VPFS/VPTS wet and dry season sampling, monarch larvae and flight surveys, and WYBC surveys. Additionally monitoring of milkweed and elderberry shrubs would be conducted at treatment sites to document survival and changes in density following weed control treatments (e.g. does controlled burning increase milkweed abundance).

At locations where revisitation of the exact locations is required, monument installation may occur in upland areas. These monuments would consist of flagged or painted t-posts or similar material pounded into the ground at photo-monitoring locations, survey center points, and transect start and end points.

2.4 Avoidance and Minimization Measures

The following measures are intended to avoid and minimize any potential adverse effects to listed species during implementation of the project activities. The general AMMs (Section 2.4.1) would be fully implemented as part of the project activities and species-specific AMMs (Section 2.4.2 through2.4.8) would be implemented based on the potential for the presence of a specific T&E species.

2.4.1 General Avoidance and Minimization Measures

2.4.1.1 General

1. A USFWS-approved biologist will brief all project personnel prior to participating in project activities. At a minimum, the briefing will include a summary of the proposed actions, a description of the federally-listed species that may occur in the project area, and a summary of the measures that the USAF will implement to avoid or minimize the adverse effects to the federally-listed species within a projects' footprint.

2. A natural resources monitor will conduct spot compliance checks during control activities in or adjacent to sensitive habitats as required. The natural resources monitor will ensure compliance with all applicable AMMs required to protect federally-listed species and their habitats. Full-time on-site monitoring may occur if activity is particularly sensitive, if personnel conducting control activities are not well trained or experienced with T&E species, or if personnel have a history of non-compliance.

3. A USFWS-approved biologist will conduct environmental awareness training for all field personnel working within and near sensitive habitat on Beale AFB. Training will be provided at the start of work and all new workers will be provided with training before conducting project activities. The program will consist of a briefing on environmental issues relative to the proposed project. The training program will include an overview of the legal status, biology, distribution, habitat needs, and compliance requirements for each federally-listed species that may occur in the project area. The presentation will also include a discussion of the legal protection for endangered species under the ESA, including penalties for violations. A fact sheet conveying this information will be distributed to all personnel who enter the project site. Upon completion of the orientation, employees will sign a form stating that they attended the program and understand all avoidance and minimization measures. These forms will be maintained at Beale AFB and will be accessible to the appropriate resource agencies.

4. The fueling of vehicles and equipment will occur on impervious surfaces to the maximum extent practicable. Spill containment equipment will be present at all project sites where fuels or other hazardous substances, including herbicides, are brought to the site. In addition, qualified personnel will conduct daily inspections of the equipment and the staging and maintenance areas for leaks of hazardous substances.

5. Prior to initiation of weed control or restoration activities, sensitive areas, such as vernal pools, wetlands, riparian areas, and potential habitat for federally-listed species (i.e., VPFS, VPTS, VELB, WYBC, or Monarch), will be identified. If work will be conducted by contractors or other personnel not familiar with applicable T&E species and their habitat, sensitive areas will be staked and flagged as exclusion zones where control activities cannot take place. Orange construction barrier fencing (or an appropriate alternative method) will designate exclusion zones where control activities cannot occur. The flagging and fencing will be clearly marked as an environmentally sensitive area. The contractor will remove all fencing, stakes and flagging within 60 calendar days of project completion.

If work is conducted by in-house personnel, familiar with applicable T&E species and their habitat, sensitive areas will be flagged or marked as needed.

6. Plants propagated for habitat enhancement planting would be inspected and ensured to be free of invasive species (e.g., Argentine ants, *Linepithema humile*).

7. All livestock forage, seed, and erosion control materials will be weed free to prevent the spread of invasive species.

8. All equipment used to control invasive plants will be cleaned before being moved from one location on the installation to another.

9. All plant debris potentially containing reproductive parts (i.e., seeds or plant fragments for species that reproduce vegetatively) will be disposed of at an off-site landfill or green waste facility. It will be transported in a manner that prevents the spread of invasive plants to other locations. This action may require, but is not limited to, bagging the material before it is transported off-site.

10. During project activities, all trash that may attract animals will be properly contained, removed from the work site daily, and disposed of properly. Following construction, all refuse and construction debris will be removed from work areas. All garbage and project construction-related materials in construction areas will be removed immediately following project completion.

11. Any worker that inadvertently kills or injures a federally-listed species, or finds one injured or trapped, will immediately report the incident to the on-site biologist. The biologist will inform the Beale NRM immediately (9 CES/CEIE). The Beale NRM will verbally notify the Sacramento Fish and Wildlife Office within one calendar day and will provide written notification of the incident within five calendar days.

12. A USFWS-approved biologist or natural resources monitor will inspect heavy equipment being brought from off-base for cleanliness to minimize spread of invasive and noxious weeds onto and around Beale AFB. The designated biologist or monitor may reject equipment that has visible clumps of mud when arriving on site. The biologist or monitor will also identify any listed noxious weed found on the project site, and will hand-pull noxious weeds where practical.

2.4.1.2 Site Access

13. Established roads, both paved and unpaved, would be used to the maximum extent practicable. In areas where this is not possible, preexisting disturbed areas will be used to the maximum extent practicable.

14. No work requiring vehicles/equipment will be done when the ground is soft enough that travel will cause depressions as determined by a Natural Resources monitor.

15. When it is not practical to stage or operate project vehicles or equipment on paved or existing roadways and trails, the USAF will stage and operate vehicles and equipment in an area

designated by a USFWS-approved biologist, where activities are least likely to impact native vegetation.

16. The number of access routes, number and size of staging areas, and the total area of the activity will be limited to the minimum necessary to achieve the project goal. Routes and boundaries will be clearly demarcated, and these areas will avoid wetlands/drainage areas whenever feasible. All access routes will be restored to normal grade and revegetated with a certified weed free seed mix approved by 9 CES/CEIE at project completion (see Table 2-11).

17. In the event that a new vehicle access route is required in special status species habitat, the route would be pre-surveyed by a USFWS-approved biologist to minimize impacts, and the NRM and the Service will be notified to determine actions required to minimize impacts. If routes will be reused over multiple years, they would be assessed annually to ensure that they are clear of special status species.

18. All vehicle operators will follow the posted speed limit on paved roads and a 15-miles per hour speed limit on unpaved roads. Per the Fugitive Dust Emissions Rule, a person shall take every reasonable precaution to not cause or allow the emissions of fugitive dust from being airborne past the action area especially near threatened or endangered species or their habitats.

2.4.1.3 Herbicide Application

19. Herbicide will only be administered by current Qualified Applicator Certificate holders (minimum qualification) from the California Department of Pesticide Regulation. If the applicator will be using herbicides within jurisdictional wetlands or waters of the U.S., the applicator must also have passed the Aquatic Category of the California Qualified Applicator Test. The Installation Pest Management Coordinator will receive qualifications from applicators within 30 calendar days of contract award. These applicators must know and be able to recognize sensitive resources including listed wildlife, plants, vernal pools, and nesting birds. If not, they will receive Environmental Awareness Training (AMM-4).

20. All herbicides will be applied in accordance with the IPSMG; the Beale AFB IPMP; the Air Force Pest Management Program; a General NPDES Permit for Residual Aquatic Pesticide Discharges; all applicable federal, DoD, USAF, State of California, and local directives and regulations; and label instructions. All pesticides applied must be USAF-approved.

21. Hazardous materials storage and equipment staging and storage would occur at least 150 feet away from sensitive habitats.

22. Herbicide will not be applied during rain nor immediately following rain when soil is saturated or runoff or standing water is present. Application will only occur under favorable weather conditions, defined as:
    - 50% or less chance of precipitation on the day of application based on National Oceanic and Atmospheric Administration weather forecasting, and
    - If rain, showers or light rains are predicted within 48 hours, the amount of rain predicted shall be no more than ¼ inch of rain, and
    - Rain does not appear likely at the time of application

23. Drift of herbicides will be limited by not spraying when wind speeds exceed 10 miles per hour or as indicated by label instruction to protect nearby non-target vegetation by minimizing drift. The applicator will ensure that only the necessary amount of herbicide to effectively treat the target plants is used and that all herbicides are used within their given heat tolerances to avoid volatilization.

24. Herbicide applicators will prescribe and use only non-ionic surfactants near open water. These surfactants are readily biodegradable and low in aquatic toxicity.

25. In areas with sensitive resources, low-volume applications and reduced application rates will be used. Spot applications rather than broadcast applications will be used when feasible to limit the effects of contamination of small mammals' insect-based diets (Cal-IPC 2015).

26. All herbicide application will follow the minimum buffers in Table 2-14 when applying herbicide near aquatic features. Note that these buffers do not apply to imazamox (Clearcast), which is an aquatic herbicide that will not be used near vernal pools. A USFWS-approved biologist or NRM who is supervising or conducting treatment may, on a case by case basis, reduce buffers. Under no circumstances will herbicide be applied directly into a vernal pool or vernal swale (see Section 2.4.2).

27. Only an herbicide labelled for aquatic use may be applied (e.g. non-POEA glyphosate formulations) near aquatic resources, even when dry.

28. Spray Drift near suitable T&E species habitat: For sprayable or dust formulations: when the air is calm or moving away from habitat, commence applications on the side nearest the habitat and proceed away from the habitat. When air currents are moving toward habitat, do not make applications within 120 feet upwind from occupied habitat. The county agricultural commissioner may reduce or waive buffer zones following a site inspection, if there is an adequate hedgerow, windbreak, riparian corridor or other physical barrier that substantially reduces the probability of drift (CA Department of Pesticide Regulations [DPR] 2019).

29. Soil Active Herbicides (chlorsulfuron and imazapyr) near suitable T&E species habitat: Do not apply within 30 yards upslope of habitat unless a suitable method is used to contain or divert runoff waters (CA DPR 2019).

Table 2-14. Minimum buffers for various herbicide application methods.

Active Ingredient	Application Method	Dry Aquatic Features[1] (ft)	Streams[1] or Ditches with Water (ft)	Special Aquatic Features (vernal swales & pools)[2] (ft)
Aminopyralid	Spot & directed foliar spray	25	25	100
	wiping	15	15	15
Chlorsulfuron	directed foliar spray	25	100	100
	wiping	15	15	15
Glyphosate	directed foliar spray or drizzle	0	25	25[3]
	cut stump or wiping	0	15	15[3]
Imazamox	direct application	0	0[5]	n/a
Imazapyr	Directed foliar spray	25	75[4]	75
Sulfometuron methyl	Spot and preemergent	50	100	100
Triclopyr (TEA)	directed foliar	25	75	75
	wiping or cut stump	15	15	15
Triclopyr (BEE)	Spot & directed foliar spray	75	250	250
	cut stump	75	75	75

[1] As measured from the edge of the stream channel. If a defined channel is not present (draws do not have defined channels), measurement is from the bottom of the feature.
[2] As measured from the edge of the wet area surrounding the special aquatic feature, or the vernal pool vegetation, whichever is greater.
[3] Only non-POEA containing formulations may be used.
[4] With the exception of giant reed treatment in Dry Creek and Best Slough
[5] Imazamox will not be applied directly to flowing water, water where the outflow cannot be controlled, to Dry Creek, Best Slough, or their tributaries.

2.4.2 Vernal Pool Fairy Shrimp

Note: Project-specific requirements may be added as necessary by NRM staff to meet requirements under the ESA and INRMP.

All projects that occur within 250 feet of known or potential VPFS habitat, will implement the following measures to avoid or minimize disturbances and adverse effects to the species:

1. With the exception of manual removal (i.e. hand-pulling), no work will be conducted in the vicinity of suitable vernal pool species' habitat between 1 Nov and May 1. Permission to work outdoors outside of the 1 Nov and 1 May timeframe may be granted from the Natural Resource Manager (NRM) in coordination with the USFWS, if weather continues to be fair. Work continuation is dependent on prevailing conditions, forecasted weather, and whether or not activities will damage soil or vegetative cover. The only outdoor work allowed 12 hours before or after a storm event is the inspection, installation, and/or maintenance of erosions control BMPs. The NRM must be contacted to obtain permission to work after each storm event. Permission to work after 1 November will not be granted once wetlands are activated (standing water present).

2. If mowing occurs in or near vernal pools, it will occur only when the soil is no longer saturated to ensure tracks are not left in or near wetlands. The mower height must be set to avoid the flowering heads of sensitive vernal pool plant species.

3. No hand-lines will be cut within 50 feet of wetlands during a prescribed fire conducted near or within potential VPFS habitat. Only black lining (back burning a perimeter) and wet lining (mowing and then wetting an area to prevent combustion) will be used to create fire lines within 50 feet of wetlands.

4. Projects that occur on road surfaces and along road shoulders will avoid direct impacts to wetland habitats, including roadside ditches that act as seasonal wetlands.

    a. Roadside herbicide application would avoid ditches and other potential VPFS habitat.

    b. Roadside mechanical or hand removal would avoid leaving biomass in ditches or other VPFS habitat.

5. If access routes crossing vernal pool habitats cannot be avoided, ground protection mats will be used to disperse the weight of vehicles and equipment so as to not harm any existing cysts. This method cannot be used while vernal pools are wet.

6. Upon approval from the NRM in coordination with the Service, a Service-approved biologist will flag vernal pool species' habitat to be avoided. The area will be protected by placing construction fencing or other appropriate protective fencing around the pools, including a buffer. Fencing will be used in locations where project equipment and/or personnel will be situated adjacent to or in the vicinity of suitable vernal pool species' habitat.

7. If herbicide spraying is required near vernal pool species' habitat, only herbicides and adjuvants approved for use in aquatic environments will be used. Buffer distances in Table 2-14 will be followed. A USFWS-approved biologist who is supervising or conducting treatment may, on a case by case scenario, reduce these buffers after approval from the NRM and coordination with Cathy Johnson of the Service's Sacramento Fish and Wildlife Office.

8. No herbicide will be sprayed within vernal pools at any time (inundated or dry).

9. If necessary, to meet conservation goals, non-POEA glyphosate may be applied up to the boundary of a vernal pool when the pools and surrounding habitat is dry. All applications must be conducted by a USFWS-approved biologist after approval from the NRM and coordination with Cathy Johnson of the Service's Sacramento Fish and Wildlife Office.

10. If invasive species removal is required within a vernal pool (e.g., *Glyceria* infestations), only hand-pulling or hand tools will be used, with the minimum amount of soil disturbance required to remove target invasive species. All non-native biomass removed will be disposed of in a landfill. All soil will be replaced/left in the vernal pool it came from.

11. All equipment used in projects requiring access to sites within vernal pool species' habitat will be staged outside of vernal pool habitat and will be on paved or gravel surfaces wherever possible. If paved or gravel surfaces are not available, construction mats and or drip pans will be placed under vehicles to minimize impacts. To further minimize adverse effects, the following measures will be implemented at project sites near vernal pools:

    a. No work shall occur within vernal pool habitat when water is present.

    b. As necessary, a USFWS-approved biologist will be present during access and project work within vernal pool habitat to monitor activities.

    c. For projects adjacent to (within 30 feet) vernal pool species' habitat or hydrologically connected to the habitat, silt fencing or other appropriate best management BMPs to prevent siltation shall be implemented prior to work within that area. A USFWS-approved biologist will flag areas where silt fencing or BMPs shall be implemented. BMPs may include sand bags and weed-free straw bales or straw wattles.

    d. Spill containment kits will be present at all sites where petroleum-fueled equipment is used.

12. If project activities encroach within the perimeter of a pool, the following measures will be implemented:

    a. Protective mats should be used as a first resort, if not possible, equipment with pneumatic tires should be used over tracked equipment.

b. Non-wetlands present within adjacent habitat will be used as an equipment-parking platform. Alternately, ground protection mats, boards, or plates will be used to distribute the weight of construction equipment for access. Drip pans will also be placed under vehicles parked on non-wetland vegetation.

c. Project will be implemented during the dry season only, when the pool is dry.

13. Pre- and post-project surveys will be conducted to record habitat condition before the start of a project and after completion of the project for tracking purposes. This may include photos and/or species surveys and will be used to better manage for the species.

2.4.3 Vernal Pool Tadpole Shrimp

Note: Project-specific requirements may be added as necessary by NRM staff to meet requirements under the ESA and INRMP.

All projects that occur within 250 feet of known or potential VPTS habitat will implement the following measures to avoid or minimize disturbances and adverse effects to the species:

See Avoidance and Minimization Measures 1 through 11 in Section 2.4.2 for applicable measures.

2.4.4 Valley Elderberry Longhorn Beetle

Note: Project-specific requirements may be added as necessary by NRM staff to meet requirements under the ESA and INRMP. Conservation measures are in accordance with the USFWS Framework for Assessing Impacts to the Valley Elderberry Longhorn Beetle (Desmocerus californicus dimorphus)-March 2017.

All projects that occur within 100 feet of elderberry shrubs (*Sambucus* spp.) with stems of 1-inch diameter or more will implement the following measures to avoid or minimize disturbances and adverse effects to the species:

1. Prior to start of construction activities in known VELB habitat, a USFWS-approved biologist will conduct surveys to determine the presence of elderberry shrubs within a buffer of 100 feet of the project footprint to determine areas to be avoided.
2. All areas to be avoided during construction will be fenced and flagged by a USFWS-approved biologist.
3. A USFWS-approved biologist will monitor the work area at project-appropriate intervals to assure that all avoidance and minimization measures are implemented. The amount and duration of monitoring required will depend on the project specifics and should be discussed with the USFWS-approved biologist.*
4. If encroachment of the 100-foot buffer cannot be avoided, a 20-foot buffer from the dripline of the plant will be established, fenced and flagged.
5. As much as feasible, all activities that could occur within 100 feet of an elderberry shrub, will

be conducted outside of the flight season of the VELB (March–July).*

6. Generally no herbicides, or other chemicals that might harm the beetle or its host plant will be used within 100 feet of any elderberry plant. All herbicides used within 250 feet of an elderberry plant will be applied using a backpack sprayer or similar direct application method.* Herbicide may be applied up to 20 feet from the drip line of elderberry shrubs, but only under the direction of a USFWS-approved biologist.
7. No pre-emergent or persistent herbicides will be used within 100 feet of elderberry shrubs.
8. Mechanical weed removal such as mowing and weed-whacking, within the dripline of the shrub will be limited to the season when adult VELB are not active (August–February). When weed removal needs to occur during the active season, weeds will be removed by hand or using non-electric hand tools only. Site would be accessed by foot only. No chemicals or electric tools (mowers, weed-whackers) would be used.*
9. As necessary, a USFWS-approved biologist will be present during access and project work within VELB habitat to ensure that no damage to elderberry shrubs occurs.
10. Erosion control will be implemented, and the affected area will be re-vegetated with appropriate native plants.*
11. If prescribed burns are conducted in an area with elderberry shrubs present, a minimum 100-foot buffer will be maintained around each shrub.
12. Any shrubs within grazed areas will be fenced and adequately protected. A natural resources monitor will periodically check protected shrubs to maintain fences etc.
13. Pre- and post-project surveys will be conducted to record habitat condition before the start of a project and after completion of the project for tracking purposes. This may include photos and/or species surveys and will be used to better manage for the species.*

2.4.5 Western Yellow-billed Cuckoo

Note: Project-specific requirements may be added as necessary by NRS staff to meet requirements under the ESA and INRMP.

If projects will be conducted within 1,000 feet of suitable WYBC breeding habitat (e.g. “Poor” habitat quality or greater as identified in Halterman 2019), during the breeding season (June 1–August 31) a USFWS-approved biologist will make an initial site visit to verify the habitat suitability and determine the need for implementation of any of the below AMMs or whether additional surveys are needed. Beale AFB may (depending on survey results) implement the following measures to avoid or minimize disturbances and adverse effects to the species (unless otherwise noted in the Project Effects Analysis):

1. Any projects that involve excessive noise (81 dB or more) or other disturbance within suitable WYBC habitat, commencing between June 1 and August 31 (migration and breeding season), will require a minimum of three pre-construction surveys to be conducted by a USFWS-approved biologist.
   a. Surveys will follow *Western Yellow-billed Cuckoo Natural History Summary and*

Survey Methodology (Halterman et al. 2015).

b. A minimum of three pre-project surveys will be conducted within a 1,000-foot buffer of the project footprint and shall take place within 30 calendar days before the onset of construction or vegetation removal activities. The final survey will be within three days of commencement of activities.

2. If nests are detected, Beale AFB Environmental staff will establish buffers around nests that are sufficient to ensure that breeding is not likely to be disrupted or adversely impacted by construction. No-disturbance buffers around active nests will be a minimum of 1,000 feet, unless a qualified biologist determines that smaller buffers would be sufficient to avoid impacts to nesting birds. Factors to be considered for determining buffer size will include: the presence of natural buffers provided by vegetation or topography, nest height, locations of foraging territory, and baseline levels of noise and human activity. Buffers will be maintained until a qualified biologist has determined that young have fledged and are no longer reliant upon the nest or parental care for survival.
3. No riparian vegetation alterations will occur in confirmed WYBC breeding habitat area during the WYBC nesting season, June 1 – August 31. This includes mechanical removal and herbicide spray treatment.
4. If vegetation removal cannot be avoided, a qualified biologist will conduct a minimum of five surveys in the 30 calendar days leading up to the commencement of the project, with the final survey conducted within the three days of commencement of the project.
5. Herbicide treatments will be applied without motorized equipment during the nesting season (June 1 – August 31) unless otherwise approved by 9 CES/CEIE NRM staff. If a need for this is determined, surveys will be conducted first to ensure no nests are present.
6. Conservation measures will be adjusted if additional guidelines are released by the USFWS, and the USFWS will be notified at that time.
7. Pre- and post-project surveys will be conducted to record habitat condition before the start of a project and after completion of the project for tracking purposes. This may include photos and/or species surveys and will be used to better manage for the species.
8. Prescribed burns will be limited to non-breeding season (September 1 through May 31) within 500 feet of suitable WYBC breeding habitat.
9. No high-intensity grazing will occur within the Dry Creek and Best Slough riparian corridor or other suitable WYBC breeding habitat. Targeted grazing for invasive plant and vegetation control may occur.

2.4.6 Monarch

Note: These AMMs will not be fully implemented unless the species is listed under the ESA. Project-specific requirements may be added or amended as necessary by NRM staff to meet requirements under the ESA and INRMP. Conservation measures are in accordance with the Monarch Conservation on Department of Defense Lands in the West: Best Management Practices-2018.

Note: For habitat enhancement projects with specific conservation goals benefitting monarchs, not all the listed AMMs may be adhered to.

All projects that occur within 100 feet of milkweed plants or 250 feet from occupied habitat (roosting and breeding sites), will implement the following measures to avoid or minimize disturbances and adverse effects to the species. Where surveys for milkweed haven't been conducted, either pre-project surveys or during-project surveys will identify milkweed stands. Additionally, if milkweeds are identified within the project area, then surveys for adult and larval monarchs will be conducted both before and after the project.

1. Actively unoccupied growing milkweed will be avoided by a minimum of two feet during the application of herbicides. Herbicide application within 50 feet of a milkweed plant would be conducted with a low-pressure backpack sprayer to reduce the risk of drift.

2. All individuals conducting weed control activities within the buffer area (100 or 250 feet as defined above) will receive training on the identification of milkweed plants and a description of both adult and larval monarchs in order to identify and avoid milkweed and monarchs during all activities.

3. No herbicide application will take place within 100 feet of occupied monarch habitat when monarchs are present (adults or larvae), generally 15 March through 31 October (Pelton et al. 2018). If herbicide application must occur within 100 feet of occupied monarch habitat, then application will only be conducted using targeted spraying, cut stump, and wiping by a USFWS-approved biologist and will be no closer than 2 feet

4. No broad-spectrum herbicide application would take place within 100 feet of occupied monarch habitat when wind speeds exceed 10 mph, or temperatures exceed 85°F to minimize potential for drift and volatilization.

5. No persistent or pre-emergent herbicides would be used within 100 feet of milkweed or other occupied monarch habitats (e.g., roosting sites).

6. Milkweed numbers and species would be assessed in project areas where impacts to milkweed may occur due to activities such as ATV access and herbicide application.

    a. The impacts of milkweed removal in known monarch breeding areas would be minimized by planting equivalent milkweed species at a 3:1 ratio. The impacts of milkweed removal in habitat not known to be used by monarchs will be minimized by planting milkweed at a 2:1 ratio.

    b. Areas within or adjacent to occupied habitat (within 250 feet of a documented monarch breeding or roosting location), lacking extensive milkweed, where successful control of invasive species has been achieved, will be prioritized for planting.

    c. All newly planted milkweed will be regionally native and preferably of the same species removed. Milkweed species selection and replanting location will be at the discretion of the NRM.

7. A 2-foot buffer would be maintained around extant milkweed plants during off-road vehicle access, restoration and habitat enhancement planting, and other ground-disturbing activities to protect breeding habitat.

8. Willows and other trees known to or with the potential to be (within occupied habitat) used as roosting sites will be preserved.

    a. Except for cut stump and wiping of target species, no herbicide application will occur during the active season of monarchs (15 March through 31 October) within 50 feet of known or potential roosting sites.

    b. No trimming of trees used by monarchs as roosting sites will occur during the active season (15 March through 31 October).

9. Heavy cattle or horse grazing in areas with low residual dry matter (below approximately 1000-1200 pounds per acre (lbs./ac)) or grazing with sheep and goats would not occur in locations known to be occupied by monarchs during the active season (15 March through 31 November) to prevent soil compaction and trampling of milkweeds.

10. Riparian areas and drainages with known habitat used by monarchs (e.g., milkweed stands and roosting sites along Dry Creek, Hutchinson Creek) will be excluded from grazing.

11. Any enhancement projects occurring in or adjacent to known monarch breeding locations will incorporate native plants important for monarchs (e.g., milkweeds, late-season flowering shrubs).

12. No prescribed fire treatment will occur within 100 feet of habitat occupied by monarchs during the active monarch season (15 March through 31 October).

13. Any areas within 250 feet of known monarch breeding habitat requiring reseeding will include species beneficial to monarchs, including native milkweed. All seed mixes must be approved by the NRM.

14. Mowing projects during the summer will be conducted during the morning to avoid injuring resting monarchs.

15. Generally, mowing will not be conducted within 100 feet of areas with suitable monarch habitat during the active season (15 March through 31 October).

    a. If mowing must be conducted (i.e. for habitat restoration projects benefiting Monarchs or other listed species) and vehicle access must be allowed, all milkweed plants would be identified and avoided.

    b. Additionally, if mowing occurs from March to June near areas where breeding occurs, mowing height would be set to a minimum of 10-12 inches to avoid cutting newly emerged plants.

16. Conservation measures will be adjusted if additional guidelines are released by the

USFWS, and the USFWS will be notified at that time.

3.0 Affected Environment

3.1 Description of Vegetation Types

Characterization of the terrestrial habitat types found in the undeveloped areas on Beale AFB was completed in 1996 by Jones & Stokes (Jones & Stokes 1996). Subsequent studies have been conducted to refine these habitat types. Beale AFB used remote sensing to map vernal pools, other seasonal wetlands, and riparian habitat as part of preliminary jurisdictional delineation for consultation with the U.S. Army Corps of Engineers (USACE) and USFWS (Lichvar et al. 2006a; Lichvar et al. 2006b). Figure 3-1 shows different habitat types at Beale AFB. Terrestrial habitats include annual grassland, riparian and oak woodlands. Numerous studies have specifically focused on seasonal wetland habitats found on Beale AFB properties. Aquatic habitats include vernal pools, seasonal and perennial marshes, seeps, riparian wetlands, and several drainage features.

Figure 3-1. Overview of habitats on Beale AFB.

3.1.1 Terrestrial Habitats

Terrestrial habitats include undeveloped areas on Beale AFB properties that support natural vegetation communities (Figures 3-1 and 3-2). While the seasonal wetlands on Beale AFB provide habitat for some of the listed species, the surrounding grassland and riparian areas provide habitat for other listed species. The following descriptions summarize the terrestrial habitats on Beale AFB which includes: (1) Annual Grassland, (2) Riparian, (3) Oak Woodlands.

Annual Grassland

The most common plant community on the Beale AFB properties is annual grassland (e2M 2004; Beale AFB 2008d). Grasslands cover approximately 18,835 acres of Beale AFB, approximately 80% of the Base's area. The LRS contains 202 acres of annual grasslands and forbs. Typical grassland species on Beale AFB properties are non-native grasses such as ripgut brome (*Bromus diandrus*), Italian ryegrass (*Lolium multiflorum*), soft chess (*Bromus hordeaceus*), medusahead, and foxtail barley (*Hordeum marinum*). A few native perennial bunchgrasses such as purple needlegrass and California melic (*Melica californica*) still persist in some areas. One native annual grass, Oldfield three-awn (*Aristida oligantha*), also occurs on Beale AFB. Intermixed with the grasses is an assemblage of introduced and native herbs and forbs including doveweed (*Croton setiger*), sheep sorrel (*Rumex acetosella),* clover (*Trifolium* spp.), blue-eyed grass (*Sisyrinchium bellum*), filaree (*Erodium* spp), field mustard (*Brassica rapa*), lupine (*Lupinus* spp.), and Mariposa lilies (*Calochortus* spp.) (e2M 2004).

In areas highly disturbed by grazing and other frequent disturbance, ruderal vegetation such as yellow star-thistle (*Centaurea solstitialis*), milk thistle (*Silybum marianum*), field bindweed (*Convolvulus arvensis*), cheeseweed (*Malva parviflora*), and chicory (*Cichorium intybus*) are common. These areas are characterized by limited plant cover and low wildlife values (e2M 2004).

Riparian

The highest quality riparian area at Beale AFB is found along Dry Creek and Best Slough. This area consists of a continuous corridor of well-developed riparian forest. Along other drainages, riparian vegetation is patchy and sparse, such as along Hutchinson Creek, or nonexistent, such as along Reeds Creek. Hutchison Creek is deeply incised/downcut below its natural streambed and may contribute to low amounts of riparian vegetation. Portions of Dry Creek are also downcut, but periodic beaver dams' aid in watering the adjacent floodplain riparian vegetation.

Types of riparian vegetation on Beale AFB include riparian scrub, composed primarily of dense growths of various willow species, and riparian forest, composed of a multilayered complex of cottonwoods (*Populus freemontii*) with occasional valley oaks, gray pine (*Pinus sabiniana*), California sycamore (*Platanus racemose*), Oregon ash (*Fraxinus latifolia)*, box elder (*Acer negundo*), and willows (*Salix* spp.). Wild grape vines (*Vitis californica*) and California pipevine (*Aristolochia californica*) are typically found draping the overstory and midstory trees of the riparian forest. Thickets of wild rose (*Rosa californica*), non-native Himalayan blackberry, and other shrubs can also be found in the understory. Groundcover is usually dense and composed of grasses and herbs. Three specific types of riparian forest have been identified at Beale AFB: cottonwood-willow riparian forest, valley oak riparian forest, and mixed riparian forest (Jones & Stokes Associates 1995).

Oak Woodlands

Oak woodlands cover approximately 481 acres on Beale AFB. Oak woodlands occur in small, isolated groves scattered throughout the dominant grassland community, as well as in larger areas on the hilly terrain around the family housing area, in the foothills east of the family housing area, and as a component of the Dry Creek/Best Slough bottomlands.

Oak woodlands are typically dominated by an overstory of one or more species of oak with a total cover of at least 50% and an herbaceous understory that is composed of species commonly occurring in annual grasslands. Shrubs such as poison oak (*Toxicodendron diversilobum*), manzanita (*Arctostaphylos* spp), and buckbrush (*Ceanothus cuneatus*), may also be present in the understory. In the eastern portion of Beale AFB, grey pine is found growing in the blue oak woodland (Beale AFB 2019).

Lack of oak regeneration is an ecosystem management issue in California. One factor limiting recruitment is lack of protection of oaks from wildlife and cattle in their sapling growth phase. Beale AFB will weigh impacts to oak regeneration when making decisions for areas of grazing expansion.

3.1.2 Aquatic Habitats

Beale AFB properties include about 43 miles of major streams and drainages, approximately 885 acres of wetlands, and some of the largest contiguous tracts of vernal pools in the Sacramento Valley (approximately 1,380 acres), which are known to support federally-listed species. The LRS is bisected by several shallow intermittent drainages and strings of seasonally ponded depressions that support vernal pool vegetation. A total of 36 acres of vernal pools, distributed throughout the 231 acres of the LRS, were identified and mapped during surveys conducted in 2013 (AESOM 2013). Species composition is variable among wetlands, depending on the soil type, basin topography, level of disturbance, and duration of saturation or ponding. The seasonal wetlands at Beale AFB are generally classified into five different plant community types determined primarily by their floristic components. These wetland types include (1) Vernal Pools, (2) Seasonal and Perennial Marches, (3) Seeps, (4) Riparian Wetlands, and (5) Drainage Features.

Vernal Pools

Vernal pools on Beale AFB properties are Northern Hard Pan Vernal Pools (Sawyer and Keeler-Wolf 1995). These vernal pools are defined as, “A low, amphibious, herbaceous community dominated by annual herbs and grasses. Germination and growth begin with winter rains, often continuing even when inundated. Rising spring temperatures evaporate the pools, leaving concentric bands of vegetation that colorfully encircle the drying pool” (Holland 1986).

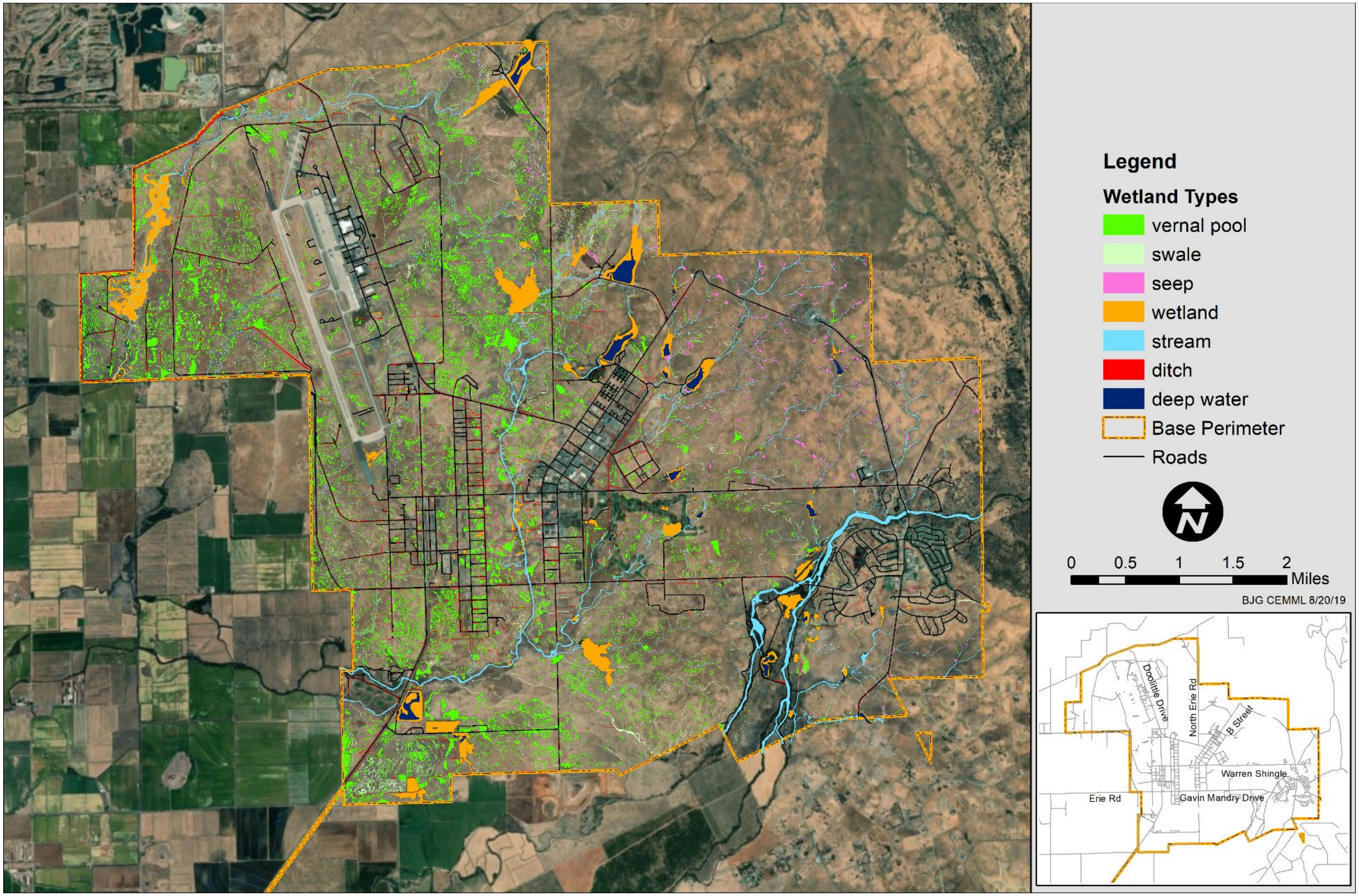

Figure 3-2. Overview of wetlands on Beale AFB.

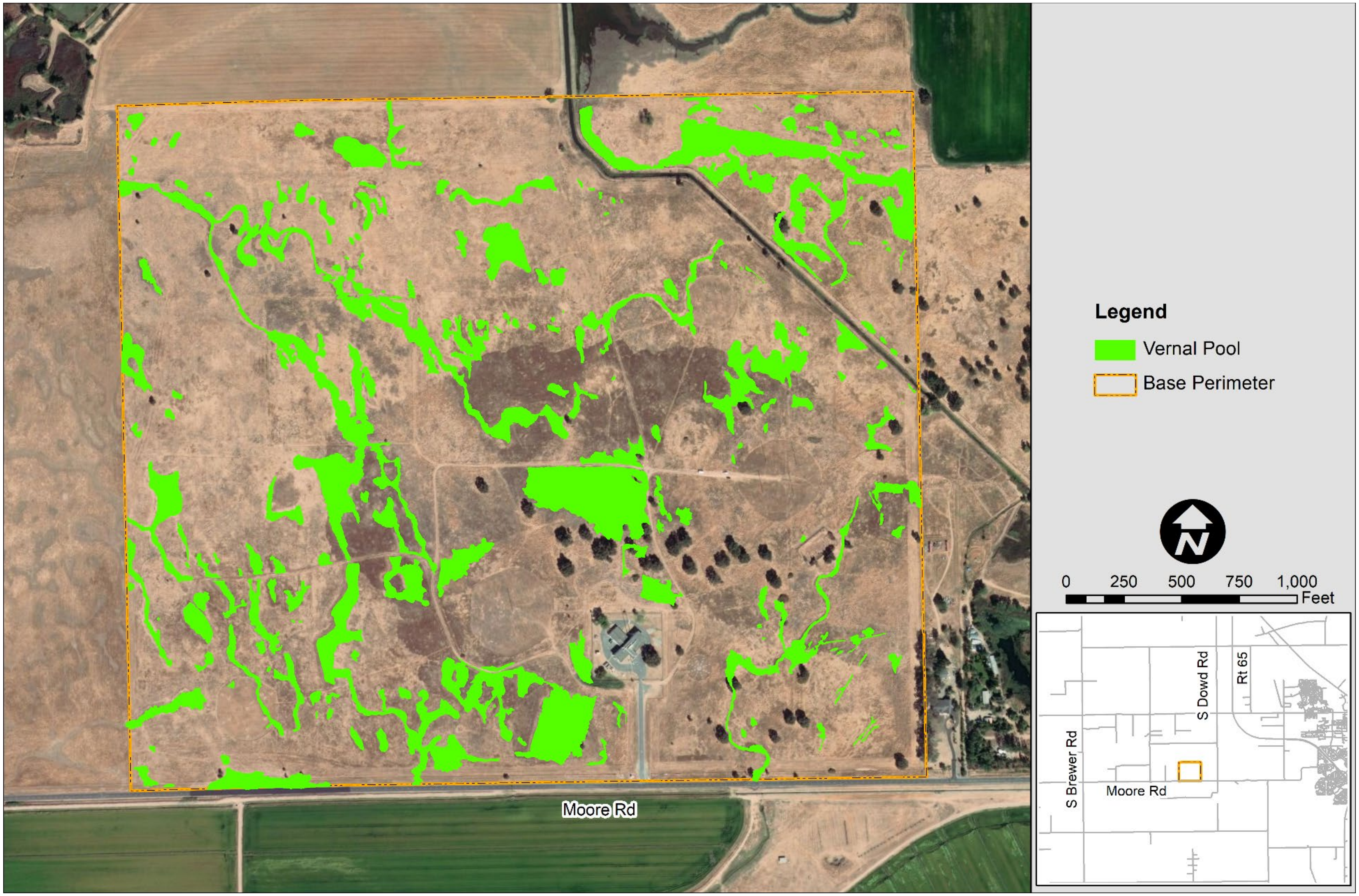

Figure 3-3. Overview of wetlands at the Lincoln Receiver Site.

Northern Hard Pan Vernal Pools occur on, "Old, very acidic, Fe-Si cemented hardpan soils (Redding, San Joaquin, and similar series). The microrelief on these soils typically is hummocky, with mounds intervening between localized depressions. Winter rainfall perches on the hardpan, forming pools in the depressions. Evaporation (not runoff) empties the pools in spring" (Holland 1986).

Vernal pools are extensive in the western, central and southern portions of the base, covering approximately 1,380 acres. At the LRS, 36 acres of vernal pools have been identified and mapped during surveys (AECOM 2013). Vernal pool plants on Beale AFB include coyote thistle (*Eryngium vaseyi*), Fremont goldfields (*Lasthenia fremontii*), white-flowered navarettia (*Navarettia leucocephala*), vernal butter cup (*Ranunculus bonariensis* var. *trisepalus*), annual hairgrass (*Deschampsia danthonioides*), ornate downingia (*Downingia ornatissima*), Sacramento mesa mint (*Pogogyne zizyphoroides*) and dwarf wooly marbles (*Psilocarphus brevissimus* var. *brevissimus*) (e2M 2004).

Vernal pools provide habitat for a highly diverse assortment of copepods, amphipods, crustaceans and insects and their larvae. These species include the VPFS and the VPTS that are regulated under the Federal ESA.

Seasonal and Perennial Marshes

Seasonal and perennial marshes are found mostly at the edges of the lakes throughout Beale AFB. Smaller marshes are found along seasonal drainages and swales. Freshwater marsh vegetation also intermingles with riparian woodland vegetation along drainages, such as Hutchinson Creek and Dry Creek.

Marshes support species such as cattails, tules (*Scirpus* spp.), sedges (*Carex* spp.), rushes (*Juncus* spp.), mints (*Pogogyne* spp), arrowhead (*Sagittaria* spp.), and warm-season wetland grasses such as dallis grass (*Paspalum dilatatum*) and Bermuda grass (*Cynodon dactylon*). Depending on soil type and water availability, marsh habitat may support such woody species such as willows (*Salix* spp.) and cottonwoods (*Populus* spp.) on the wetland margin (e2M 2004).

Seeps

Seeps are scattered throughout Beale AFB. Seeps represent areas where groundwater intersects with the soil surface. The vegetation in seeps includes species commonly associated with seasonal and perennial marshes. When seeps only flow for short periods in the warm season, species like mint, sedges, and rushes dominate. But for those seeps that flow for longer periods, such species as cattail are also common (e2M 2004).

Riparian Wetlands

Occasionally an area will have the appropriate conditions (e.g., soils, hydrology) to support a willow/cottonwood scrub or forest community that also meets the three-parameter criteria for wetlands. Note that this wetland type is distinct from the typical woody riparian plant community that is located in an upland setting along stream courses, pond edges, etc. (e2M 2004). Riparian wetlands occur mostly on the northwestern area of Beale AFB.

Drainage Features

The USACE recognizes three distinct types of drainage features which are scattered throughout Beale AFB:

1. Ephemeral drainages: Fed primarily by storm water. They convey flows during and immediately after storm events, but they may stop flowing or begin to dry if the interval between storms is long enough.
2. Intermittent drainages: Fed primarily by groundwater and supplemented by storm water. After the onset of rains, they should have persistent flows through and past the end of the rainy season. Eventually, depending on the availability of groundwater, these features become dry.
3. Perennial drainages: Fed predominantly by groundwater and supplemented by storm water. Flows in these systems persist throughout the year (e2M 2004). At Beale AFB, perennial drainages include Reeds Creek, Hutchinson Creek, and Dry Creek.

Impoundment Lakes

There are a few large impoundment lakes throughout Beale AFB, mostly located along Hutchinson Creek.

Irrigation and Water Conveyance Canals

Irrigation and water conveyance canals may represent a realignment of a previously existing natural drainage feature. Some irrigation and water conveyance canals are excavated in uplands and carry surface water supplies to and from agricultural fields (e2M 2004).

Roadside Ditches

Roadside ditches constitute man-made features excavated in uplands whose primary function is flood control. Roadside ditches may be excavated in uplands to convey storm water (e2M 2004). If roadside ditches are found to be functioning as vernal pools due to lack of maintenance of flow, these will be surveyed first for species before receiving maintenance to allow flow.

3.2 Soils

There are 14 soil map units of soil series or soil complexes on Beale AFB (Table 3-1; Figure 3-4 NRCS 2016) that can be grouped into two main categories: Central Valley Terraces and Sierra Nevada Foothill. The main Base and flight line are on the valley soils. Family housing is on foothill soils. The subsoil consists of primarily sandy clay and gravel. The high clay content and underlying hardpan result in soils with slow permeability and a shallow rooting depth, which favor annual grasses and forbs. The depth of foothill soils is highly variable as are slopes (3-75%). These soils favor native oaks, shrubs, forbs and annual grasses.

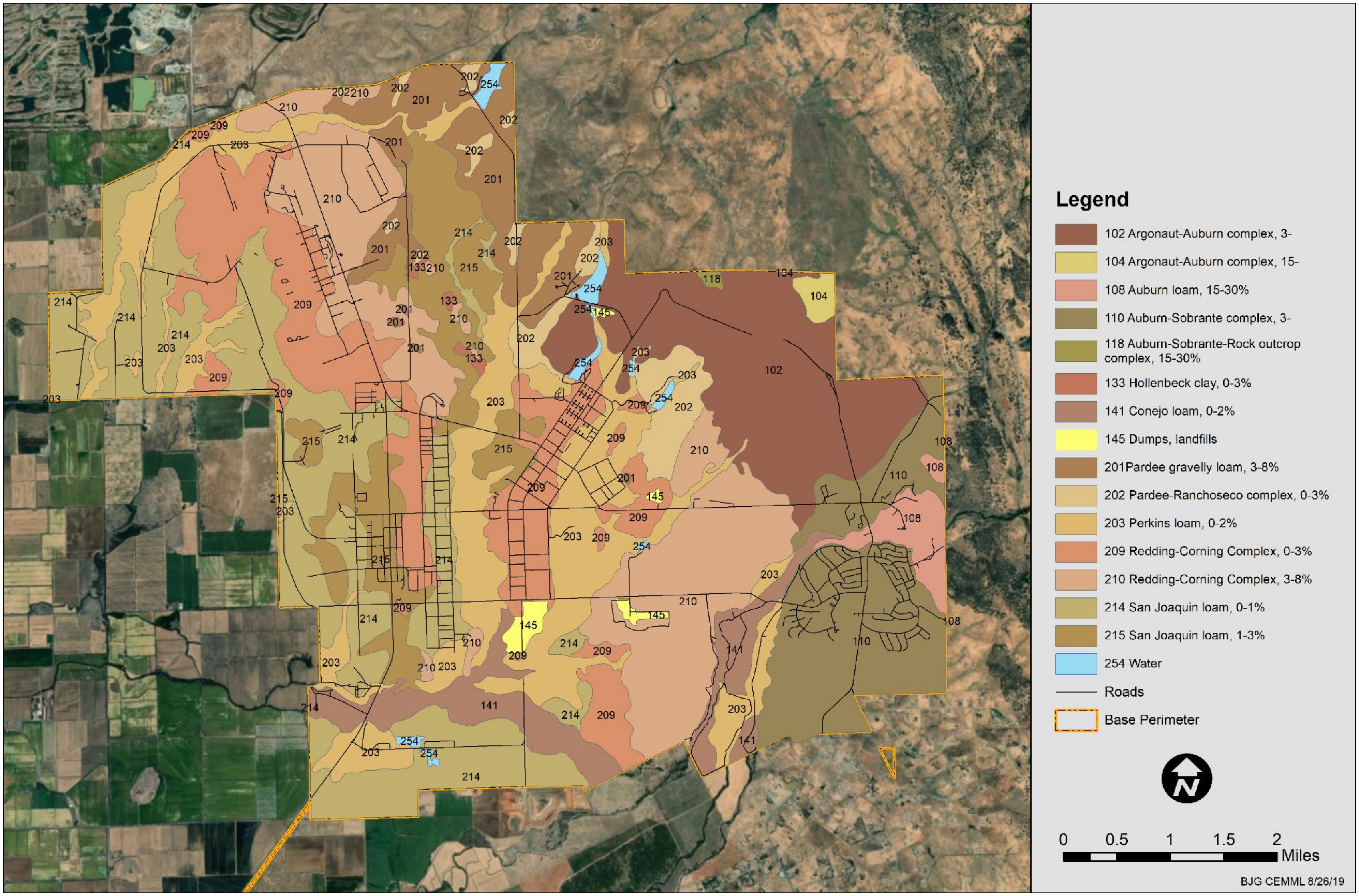

Figure 3-4. Soils map of Beale AFB.

Soils at LRS are predominantly sandy loams in the San Joaquin series. This series consists of well-drained, clay-pan soils underlain by indurated granitic alluvium. The Cometa series is also a well-drained, clay-pan soil underlain by compacted (but not indurated) alluvium (USDA 1980). The indurated layer of the San Joaquin soils creates the impermeable bottom of vernal pools.

Names of soils underlying LRS:

- 142 Cometa-Ramona sandy loam, 1-5%
- 181 San Joaquin sandy loam, 1-5%
- San Joaquin-Cometa sandy loam, 1-5%

Table 3-1. Soil map units within the Beale AFB pasture units, with acreage and water erosion hazard rating.

Soil Series/Map Unit, with Percent Slope Class	Map symbol	Acreage	Water Erosion Hazard
Argonaut-Auburn complex, 3-8%	102	2,154.0	slight
Argonaut-Auburn complex, 15-30%	104	86.2	severe
Auburn loam, 15-30%	108	100.5	severe
Auburn-Sobrante complex, 3-8%	110	319.0	slight
Auburn-Sobrante-Rock outcrop complex, 15-30%	118	18.7	severe
Hollenbeck clay, 0-3%	133	37.4	slight
Conejo loam, 0-2%	141	294.8	slight
Pardee gravelly loam, 3-8%	201	804.3	slight
Pardee-Ranchoseco complex, 0-3%	202	536.3	slight
Perkins loam, 0-2%	203	1,526.2[2]	slight
Redding-Corning complex, 0-3%	209	1,080.5	slight
Redding-Corning complex, 3-8%	210	2,127.1	moderate
San Joaquin loam, 0-1%	214	2,617.5	slight
San Joaquin loam, 1-3%	215	1,068.8	slight
Dumps, landfills	145	8.5	
Water	254	10.0	
Source: Table 4-3 in the 2017 GMG (Hopkinson 2017b)			

4.0 BIOLOGICAL INFORMATION

4.1 Listed Species Affected

Five federally-listed species will potentially be affected by the proposed action. Additionally, one species currently under review for listing, the monarch (*Danaus plexippus*), was included due to the species' reliance on native plants for breeding and food sources and its current review status under the ESA. Table 4-1 below provides a summary of the species analyzed in this document.

Table 4-1. Summary of species analyzed in this Biological Assessment.

Species	Status*	Peak Sensitivity	
		Season	Dates
Vernal pool fairy shrimp	FT	Wet	01 Nov - 01 May
Vernal pool tadpole shrimp	FE	Wet	01 Nov - 01 May
Valley elderberry longhorn beetle	FT	Flight	01 Mar - 01 Sep
Giant garter snake	FT	Dry	01 May - 01 Nov
Western yellow-billed cuckoo	FT	Breeding	01 May - 01 Oct
Monarch	SR	Breeding	01 Apr - 01 Nov

4.1.1 Vernal Pool Fairy Shrimp (Federally-Threatened Species)

4.1.1.1 Listing Status

The vernal pool fairy shrimp (*Branchinecta lynchi*) was listed as threatened by the USFWS in 1994 (Federal Register (FR) 59:80 and updated in FR 68:151). Critical habitat was designated on August 6, 2003 (68 CFR 46683) and was subsequently revised with critical habitat unit designations on February 10, 2006 (71 CFR 7117). The USFWS published a recovery plan that included this species entitled Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (USFWS 2005).

4.1.1.2 Life History

The VPFS occupies a variety of different vernal pool habitats from small, clear, sandstone rock pools to large, turbid, alkaline, grassland valley floor pools. Other kinds of depressions that hold sufficient water volume, depth and area for sufficient duration and seasonality may also constitute potential habitat. These other depressions are often artificial habitats such as roadside ditches, ruts left by heavy construction vehicles, and depressions in fire breaks (Eng et al. 1990; Rogers and Fugate 2001). Although the species has been collected from large vernal pools, including one exceeding 25 acres, it tends to occur in small swales or vernal pools in unplowed grasslands (Eriksen and Belk 1999). It is most frequently found in pools measuring less than 0.05 acre. Depth of the pool is more important as it relates to inundation time (King et al. 1996). Although it is fairly widely distributed throughout the Central Valley, the VPFS is not common on the western side of the Sacramento Valley.

VPFS require cold winter water temperatures to hatch and grow and typically appear after the first frosts. Pools must dry completely during the summer months to prevent fungus from destroying cysts. Helm (1998) determined that VPFS reach sexual maturity on average in 41 days, but may be as few as 18 days at optimal conditions. Life cycles are reported to range from 63 to 147 days, demonstrating that growth rates are dependent on water temperature. VPFS may have three distinct hatches in one season when pools dry out and refill for a long enough period (Gallagher 1996). Hatching begins shortly after temporary pools have been inundated by runoff from fall and winter rains. Newly hatched larvae develop through a juvenile stage and eventually become sexually mature adults. A sexually mature female can be identified by the presence of one or more eggs in her ovisac (Eriksen and Belk 1999). After males and females mate, the female releases her eggs, which remain in the bottom of the dry pool through the summer.

This species is rather widely distributed through the grasslands of California, from Shasta County south to Riverside County but is seldom abundant anywhere (Erikson and Belk 1999). Populations of VPFS are often small, and this species tends to be outnumbered by other co-occurring species.

4.1.1.3 Occurrence within Action Area

The VPFS is known to occur on Beale AFB properties (Figures 4-1 and 4-2). The presence of suitable habitat for the species and documented occurrences suggests that the species is likely to persist on the Beale AFB properties given current conditions. On Beale AFB, the documented occurrences and presumably most of the suitable habitat is concentrated within the western portion of Beale AFB that is designated as a Conservation Area in the Installation Development Plan (IDP). This area is also part of the Vernal Pool Recovery Plan as the Beale Core Recovery Area (BCRA) (Figure 4-1). A number of other occurrences are scattered throughout the center of Beale AFB and in the southwest portion of Beale AFB. On the LRS, there is currently one documented occurrence in the central western portion of the site. The majority of the Lincoln Receiver Site is also part of the BCRA, as designated in the Vernal Pool Ecosystem Recovery Plan (Figure 4-2). Although there is likely suitable habitat for this species throughout the Beale AFB properties, large-scale sampling efforts are lacking on the LRS.

The species was detected in survey efforts at Beale AFB (Figure 4-1). In 1992/1993, vernal pool surveys detected VPFS in 20 of 116 vernal pools surveyed. In 1996, the species was recorded in 29 of 1,000 vernal pools surveyed (see Jones & Stokes 1996 in Beale AFB 2005a). In 2006, VPFS cysts were detected at five sample sites during a dry season survey by EM Assist (EM

Assist 2006). The species was not detected during vernal pool restoration monitoring in 2006 in either reference pools or restored pools (SRS 2006). In 2007, the VPFS cysts were detected during dry-season surveys, although adults were not detected during subsequent wet-season surveys in 2007/2008 (EDAW 2008) and dry-season surveys in 2008 (Helm 2008). In 2008, the species was detected in three vernal pools during two phases of vernal pool restoration monitoring in the west flight line area of Beale AFB (Foothill and Associates 2008; ECORP 2008). In 2012, 229 vernal pools were surveyed, and VPFS were recorded in eight pools (H. T. Harvey 2013). Ten VPFS occurrences were recorded out of 130 pools surveyed in 2015 by HDR (Bhate 2016), and, in 2016, there were nine records of occurrence for the species out of 114 pools surveyed. Dry-season surveys for the same year recorded VPFS in 13 out of 121 basins (AuxiliALL JV 2017).

The 2016 90-Day Report for branchiopod surveys conducted by H. T. Harvey recorded observations of VPFS in the area west of the flight line and in the area between the flight line and the Munitions Training Area (MUNS). In 2019, two observations of VPFS were recorded during wet-season sampling in the central portion of Beale AFB (Marty 2019).

There was one recorded occurrence of VPFS on the LRS from 2013 (Figure 4-2). The species was not detected during a survey effort of the Lincoln Receiver Site conducted in 1997 (KEA Environmental 1997). There were several occurrences of VPFS reported in 2010 by Helm Biological Consulting and by H. T. Harvey in 2013 (Figure 4-2).

In 2016, a vernal pool California Rapid Assessment Method (CRAM) assessment was conducted for six vernal pools chosen to reflect the typical range of pool depths, sizes, landscape features and similar ecological factors found in the assessment area (AuxiliALL JV 2017). The results of the assessment found that Beale AFB's vernal pools were in moderate to good condition overall. It also identified factors that could improve ecological conditions, such as increasing vernal pool and swale density, removal of invasive species, and improving grazing practices (AuxiliALL JV 2017). The CRAM assessment does not address specific habitat attributes for vernal crustaceans but assesses the overall quality of the habitat.

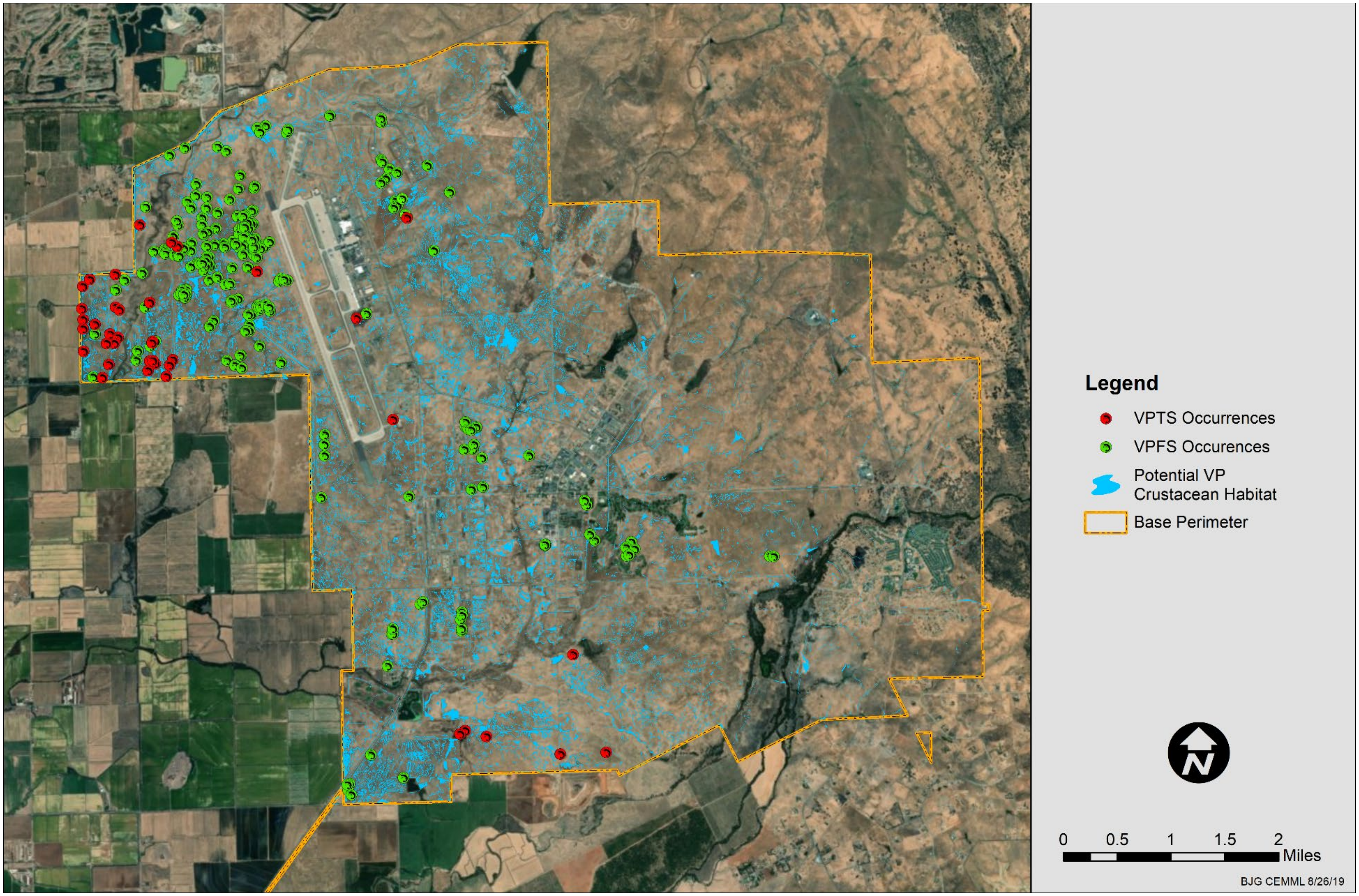

Figure 4-1. Potential vernal pool crustacean habitat and known occurrences of vernal pool fairy shrimp and tadpole shrimp at Beale AFB.

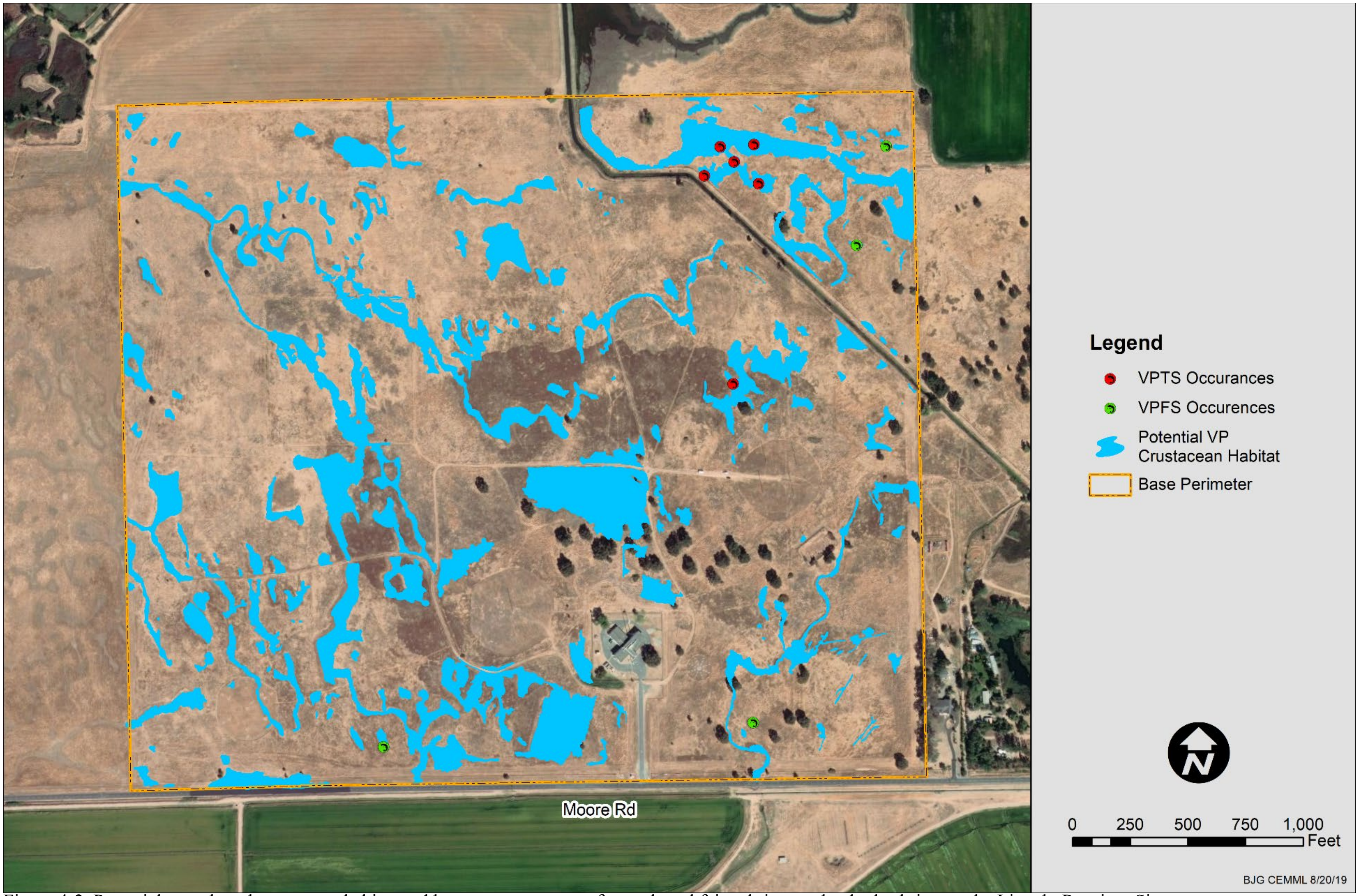

Figure 4-2. Potential vernal pool crustacean habitat and known occurrences of vernal pool fairy shrimp and tadpole shrimp at the Lincoln Receiver Site.

4.1.2 Vernal Pool Tadpole Shrimp (Federally-Endangered Species)

4.1.2.1 Listing Status

The vernal pool tadpole shrimp (VPTS; *Lepidurus packardi*) was listed as threatened by the USFWS in 1994 (FR 59:80 and updated in FR 68:151). Critical habitat was designated on August 6, 2003 (68 CFR 46683) and was subsequently revised with critical habitat unit designations on February 10, 2006 (71 CFR 7117). The USFWS published a recovery plan that included this species entitled the Recovery Plan for Vernal Pool Ecosystems of California and Southern Oregon (USFWS 2005).

4.1.2.2 Life History

The VPTS is a small crustacean in the Triopsidae family. VPTS are aquatic species in the order Notostraca and are known as "living fossils" because of their morphological continuity in the fossil record over the past two hundred and fifty million years (Longhurst 1955). VPTS are distinguished by a large, shield-like carapace that covers the anterior side of the body. The adult form of this species measures 0.6 to 3.3 inches long.

The VPTS occurs in a wide variety of vernal pool habitats including vernal pools, clay flats, ephemeral stock ponds, and roadside ditches (Helm 1998). The life history of the VPTS is linked to the phenology of its vernal pool habitat. After winter rainwater fills the pools, the populations are reestablished from diapaused eggs, which lie dormant in the dry pool sediments (Ahl 1991; Langford 1974). Helm (1998) found that VPTS took a minimum of 25 days to mature and the mean age at first reproduction was 54 days. Other researchers have observed VPTS generally take between three and four weeks to mature (Ahl 1991). A portion of the eggs hatch immediately, and the rest enter diapause and remain in the soil to hatch during later rainy seasons (Ahl 1991). The VPTS matures slowly and is a relatively long-lived species (Ahl 1991). Adults are often present and reproductive until the pools dry up in the spring (Ahl 1991; Simovich et al. 1992). VPTS were not found to have more than one hatch in a season even if pools dried and refilled (Gallagher 1996). This is likely because of their requirements for both temperature and inundation which are less likely to be satisfied later in the season.

VPTS, as well as other vernal pool crustaceans, are an important food source for a number of aquatic and terrestrial species. Aquatic predators include insects such as backswimmers, predaceous diving beetles and their larvae, and dragonflies and damselfly larvae. VPTS are also a significant predator of VPFS both in adult and egg or cyst forms (Croel 2014).

4.1.2.3 Occurrence within Action Area

Much of the vernal pool habitat on the Beale AFB properties provides suitable habitat for the VPTS (Figures 4-1 and 4-2). At Beale AFB, vernal pools are associated with four geologic formations: Laguna, Riverbank, Modesto, and Mehrten formations (Smith and Verrill 1998). These formations are primarily located in the western two-thirds of Beale AFB.

Numerous data sources, including the California Natural Diversity Database (CNDDB) and Beale AFB, have reported the occurrence of the VPTS on Beale AFB properties. There are five CNDDB recorded occurrences of VPTS on Beale AFB, two of which are observations from 1991 and 1992 respectively, one from 2008, and two from 2012 (CNDDB 2017). The species was also detected in other survey efforts conducted between 1992 and 2019 (Figure 4-2). In the 1992/1993 surveys, VPTS were detected in three of 116 vernal pools surveyed on Beale AFB. In 1996, the species was recorded in 37 of 1,000 vernal pools surveyed on Beale AFB (see Jones & Stokes 1996 in Bhate 2016). In 2006, VPTS were detected in approximately half of sampled restored pools and all of the vernal pool reference pools on Beale AFB (SRS 2006). In 2007/2008 wet-season surveys, VPTS were detected in two vernal pools surveyed (EDAW 2008). In addition, VPTS cysts were detected during the dry-season surveys in a single location on Beale AFB in 2008 (Helm 2008). In 2008, the species was also detected in two vernal pools during two phases of vernal pool restoration monitoring in the west flight line area of Beale AFB (Foothill and Associates 2008; ECORP 2008). Helm Biological detected the VPTS in eight out of 216 pools surveyed (Helm 2010). In 2012, 14 out of 229 vernal pools surveyed recorded VPTS. Surveys of 15 pools in 2013 did not detect any VPTS, and HDR recorded only two occurrences out of 130 pools surveyed in 2015. In 2016, 14 occurrences were recorded out of 114 pools surveyed, 25 of which were observed during the wet season, while 18 were discovered from dry-season surveys conducted by H. T. Harvey (AuxilALL 2017). In 2019 two new records for VPTS were recorded during wet-season surveys in the central portion of Beale AFB (Marty 2019). The closest recorded occurrences off Beale AFB include one that is 0.39 miles to the north at the Western Aggregates Mine and another that is 5.6 miles to the southwest on the Reeds Creek Vernal Pool Preserve (CNDDB 2017).

At the LRS, there are six recorded locations for VPTS, all situated in the northeast corner of the property (Figure 4-2). CNDDB records shows a record of occurrence in 2013 in the same area as well as just north of the property on a vernal pool preserve managed by Wildlands Inc. The next closest CNDDB records for the LRS is 5.7 miles to the southeast and 7.4 miles to the southwest.

4.1.3 Valley Elderberry Longhorn Beetle (Federally-Threatened Species)

4.1.3.1 Listing Status

The valley elderberry longhorn beetle (VELB; *Desmocerus californicus dimorphus*) was listed as a threatened species under the Federal ESA on August 8, 1980. However, on October 2, 2006, the USFWS released a *5-Year Review: Summary and Evaluation Report* that recommended delisting the VELB from the ESA. This recommendation was based on USFWS data collected that indicate the species has recovered (USFWS 2006). In October 2012, the USFWS proposed to remove VELB as a federally-threatened species. However, as of September 17, 2014, the USFWS withdrew the proposed rule to remove the VELB from the Federal List of Endangered and Threatened Wildlife because the best available information was not used. The best available information indicates that "the threats to the species and its habitat have not been reduced to the point where the species no longer meets the statutory definition of an endangered or threatened species."

4.1.3.2 Life History

The VELB has a long tube-like body with long antennae that are more than 2/3 its body length. Adult males are around 2 centimeters long and have red wing coverings (elytra) with four elongate black spots and antennae that are about as long as their bodies. Adult females are broader than the males with shorter antennae and dark elytra. VELB have only been found in association with their host plants, elderberry (*Sambucus mexicanus*) shrubs as VELB are dependent on elderberry shrubs throughout their entire life cycle (Biosystems Analysis, Inc. 1994). Elderberry shrubs are often found within or close to riparian zones along Central Valley rivers and their tributaries. Due to the widespread reduction of riparian habitat throughout the state, supporting habitat for this species has been drastically reduced from historical levels (Katibah 1984).

Evidence of use of the elderberry by the beetle is rarely apparent. Beetles remain hidden within the stems and trunks of elderberry shrubs as larvae then pupae for one to two years. VELBs spend most of their life in the larval stage within the elderberry shrub (USFWS 2017b). Adults emerge from the shrub between late March and June, or about the same time the elderberry produces flowers. Elderberry shrubs often occur in clumps that consist of several stems attached to a main trunk. Stems and trunks must be equal to or greater than 1 inch in diameter to provide suitable habitat for beetles. Generally, the VELB occurs in low densities and is difficult to observe. Therefore, the USFWS requires compensation for effects to any elderberry shrubs located within the range of the beetle (USFWS 2017b).

4.1.3.3 Occurrence within Action Area

There is suitable elderberry shrub habitat for VELB within the Dry Creek/Best Slough riparian area, which contains elderberry shrubs. Located on the southeastern side of Beale AFB, this area is on Best Slough and designated for preservation (EDAW 2005). Hutchinson Creek riparian corridor, in the center of Beale AFB, and the Reeds Creek riparian corridor, west of the flight line (Figure 4-3), are the only other areas on the Beale AFB properties that contain elderberry shrub habitat; however, the Dry Creek/Best Slough riparian corridor support a far greater density of the shrubs. There are 853 mapped elderberry shrubs located on Beale AFB.

Multiple sources have recorded the presence (via exit holes) of the VELB on Beale AFB property and in the vicinity. The nearest documented CNDDB occurrence of the VELB is approximately 1.2 miles north of the northwest corner of Beale AFB (CNDDB 2017). This record is from 1998 and indicates that an elderberry shrub was found near a transmission line. There are 17 additional CNDDB documented occurrences, consisting of species and exit-hole observations, within a 10-mile radius of the action area (CNDDB 2017). Figure 4-3 shows the location of all potential VELB habitat (elderberry shrubs) on Beale AFB. In addition, a 2005 survey of elderberry shrubs on the southeast corner of Beale AFB performed by EDAW found that 13 of 51 elderberry shrubs surveyed contained VELB exit holes (EDAW 2005). Surveys conducted in 2012 by H T Harvey and Associates reported only one shrub in 50 with an exit hole (H T. Harvey 2013). The 2016 survey report found evidence of VELB in five of 50 shrubs surveyed (AuxiliALL 2017).

There is no suitable elderberry shrub habitat for the VELB at the LRS. The unnamed canal in the northeast corner of the LRS is unvegetated and contains no elderberry shrubs along its banks. The remaining area of the site is largely vernal pool habitat that would not support elderberry shrubs (Beale AFB 2008a). Numerous data sources, including CNDDB and Beale AFB surveys, have not identified the occurrence of the VELB or elderberry shrubs at the LRS. The closest documented occurrence is a CNDDB recorded occurrence from 2003 approximately seven miles north of the Lincoln Receiver Site (CNDDB 2017). There is a total of five documented occurrences within a 10-mile radius of the LRS (CNDDB 2017).

The VELB has the potential to and does occur on Beale AFB in the Dry Creek/Best Slough High Integrity Area Conservation Planning Category (CPC), in the southwest corner of Beale AFB, in the riparian corridors of Hutchinson Creek, in the middle of Beale AFB, and at Reeds Creek, west of the flight line, where elderberry shrubs exist. These three locations are the only locations on the Beale AFB properties where the VELB has the potential to occur. However, if other elderberry shrubs are detected on the Beale AFB properties, this statement should be reevaluated, and the USFWS will be notified. The presence of the elderberry shrubs in these areas and documented evidence of the species suggests that the species is likely to persist on the Beale AFB given current conditions, although to date no adult beetles have been observed on Beale AFB properties.

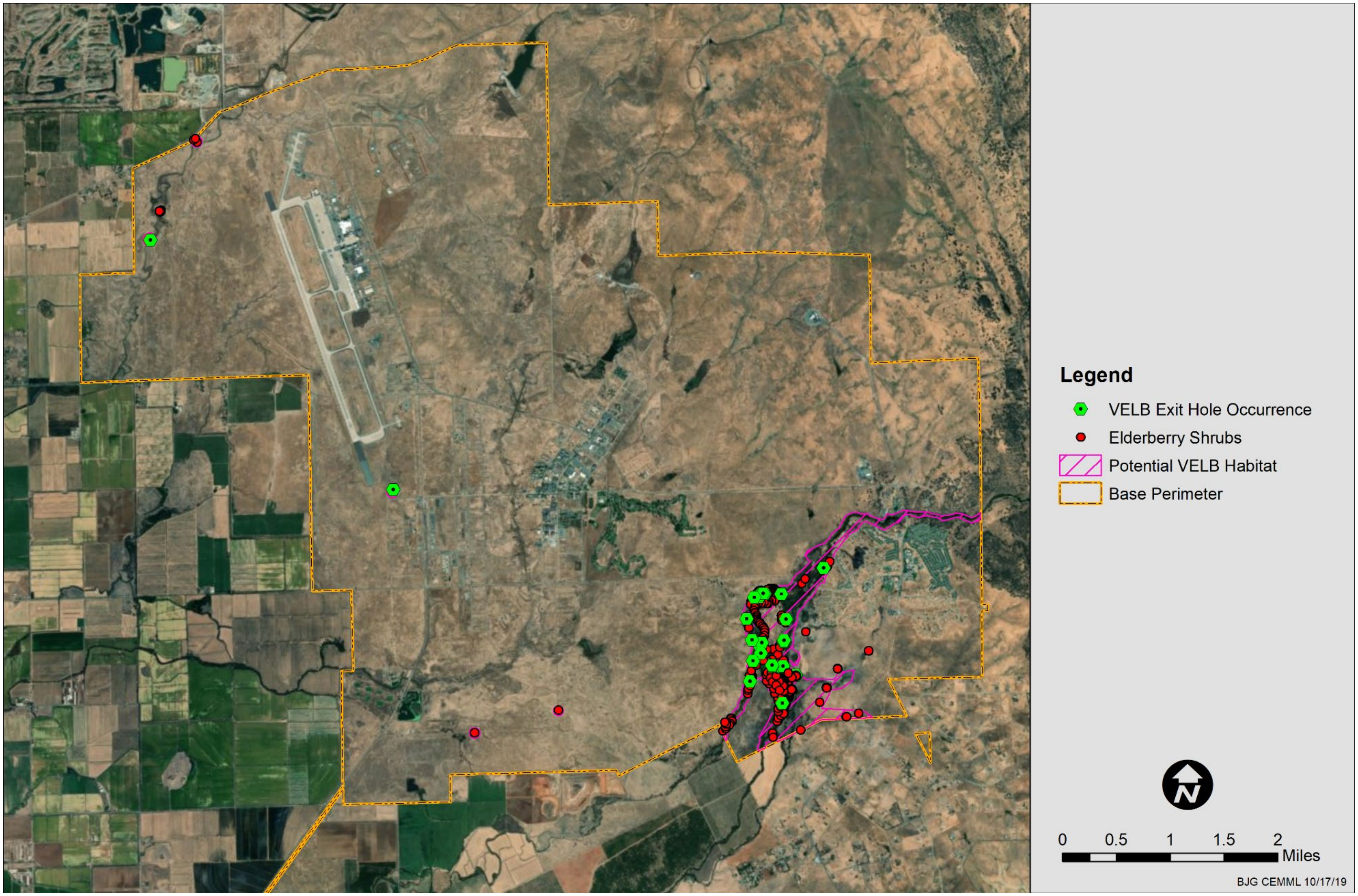

Figure 4-3. Locations of elderberry shrubs, known occurrences of valley elderberry longhorn beetle exit holes, and potential habitat at Beale AFB.

4.1.4 Giant Garter Snake (Federally-Threatened Species)

4.1.4.1 Listing Status

The giant garter snake (GGS; *Thamnophis gigas*) was listed as threatened under the ESA in 1993. A revised recovery plan for GGS was released in 2017 and recognized nine distinct populations (USFWS 2017c).

4.1.4.2 Life History

The GGS is one of the largest garter snakes and it can reach lengths in excess of 5 feet. Females tend to be slightly longer and stouter than males. The weight of adult female giant garter snakes is typically 1.1 to 1.5 pounds. Dorsal background coloration varies from brownish to olive with a checkered pattern of black spots, separated by a yellow dorsal stripe and two light colored lateral stripes. Background coloration and prominence of black checkered pattern and the three yellow stripes are geographically and individually variable (Hansen 1980). The ventral surface is cream to olive or brown and sometimes infused with orange, especially in northern populations.

Endemic to wetlands in the Sacramento and San Joaquin valleys, the giant garter snake inhabits marshes, sloughs, ponds, small lakes, low gradient streams, and other waterways and agricultural wetlands, such as irrigation and drainage canals and rice fields. GGS feed on small fishes, tadpoles, and frogs (Hansen 1980). Habitat requisites consist of (1) adequate water during the snake's active season (early-spring through mid-fall) to provide food and cover; (2) emergent, herbaceous wetland vegetation, such as cattails and bulrushes, for escape cover and foraging habitat during the active season; (3) grassy banks and openings in waterside vegetation for basking; and (4) higher elevation uplands for cover and refuge from flood waters during the snake's dormant season in the winter (Hansen 1980). GGS are typically absent from larger rivers and other water bodies that support introduced populations of large, predatory fish, and from wetlands with sand, gravel, or rock substrates (Hansen 1980). Riparian woodlands do not provide suitable habitat because of excessive shade, lack of basking sites, and absence of prey populations (Hansen 1980).

The GGS inhabits small mammal burrows and other soil crevices above prevailing flood elevations throughout its winter dormancy period (i.e., November to mid-March). GGS typically select burrows with sunny exposure along south and west facing slopes. GGS also use burrows as refuge from extreme heat during their active period. The Biological Resources Division (BRD) of the USGS (Wylie et al. 1997) has documented GGS using burrows in the summer as much as 165 feet away from the marsh edge.

Overwintering snakes have been documented using burrows as far as 820 feet from the edge of marsh habitat. During radio-telemetry studies conducted by the BRD, GGS typically moved little from day to day. However, total activity varied widely between individuals. GGS have been documented moving up to five miles over the period of a few days (Wylie et al. 1997).

The breeding season extends through March and April, and females give birth to live young from late July through early September (Hansen and Hansen 1990). Brood size is variable, ranging from 10 to 46 young, with a mean of 23 (Hansen and Hansen 1990). Young immediately scatter into dense cover and absorb their yolk sacs, after which they begin feeding on their own.

Although growth rates are variable, young typically more than double in size by one year of age. Sexual maturity averages 3 years in males and 5 years for females.

4.1.4.3 Occurrence within Action Area

Suitable habitat for the GGS exists at Beale AFB along Reeds Creek in the western portion of the base (Figure 4-4). This area is part of the American Basin Recovery Unit as described in the Recovery Plan for the Giant Garter Snake (USFWS 2017d). It contains permanent features such as sufficient water during the active summer season to supply cover and food such as small fish and amphibians; and emergent, herbaceous aquatic vegetation accompanied by vegetated banks to provide basking and foraging habitat (Hansen 2005).

GGS are also known to utilize rice fields, which are present adjacent to Beale AFB, west of the flight line near the southern border of Beale AFB (USFWS 1999a; Hansen 2005).

There have been no confirmed occurrences recorded of the GGS at Beale AFB despite several surveys. The nearest CNDDB recorded occurrence is approximately eight miles to the north of Beale AFB and was recorded in 2010 (CNDDB 2017). Prior to 1986, the species was observed nine miles from the southwestern-most corner boundary of Beale AFB (CNDDB 2017) (Figure 4-4). There are two more records just over 10 miles from Beale AFB to the west and northwest. These were recorded in 2012 and 2013 respectively. There was a sighting of a giant garter snake reported to the USFWS by John Little in 1998 which was allegedly found in the Dry Creek watershed south of Beale AFB. However, this occurrence has not been confirmed (Beale AFB 2008b). In addition, a trapping effort in selected suitable giant garter snake habitat on Beale AFB by Eric Hansen in 2005, 2014, 2015, and 2016 did not detect the presence of GGS (Hansen 2005, 2014, 2015, 2016). The failure to detect GGS during these surveys was likely due to the fact that the location of Beale AFB is in the easternmost portion of the species' range, and the fact that if GGS does occur at Beale AFB, it occurs in low densities (Hansen 2005). In 2018 an environmental DNA (eDNA) survey was conducted on Beale AFB on Reeds Creek to determine if the species was present within the Reeds Creek drainage. No evidence of eDNA from GGS was found, suggesting GGS does not occur within Reeds Creek. Furthermore, soil and habitat characteristics (presence of existing or historic tule marsh stands) associated with GGS occupancy are lacking on Beale AFB (Hansen 2019). The combined surveys and new information on habitat preference suggest that GGS do not currently occur at Beale AFB and likely have never been present on the Installation.

There is suitable habitat for the GGS at the LRS (Figure 4-4). The suitable habitat is located along the unnamed canal in the northeastern portion of the LRS, although GGS was not observed during surveys conducted in July 2005 (EDAW 2006). The closest documented CNDDB occurrence of the GGS was observed in 1986 and is approximately 8 miles southwest of the LRS

(California Department of Fish and Wildlife (CDFW) 2009b). More recent reports are from 2003 and 2004 approximately nine miles to the west of the site (CNDDB 2017).

4.1.5 Western Yellow-billed Cuckoo (Federally-Threatened Species)

4.1.5.1 Listing Status

In 1998, the western Distinct Population Segment (DPS) of the Yellow-billed Cuckoo (WYBC; *Coccyzus americanus occidentalis*) was petitioned to be listed as federally-endangered (USFWS 2001). In 2002, higher priority species precluded federal action even though the petition was determined to have merit. A proposed rule to list this DPS was recorded in the FR (78 FR 61621) on October 3, 2013, and the final listing rule was published on October 3, 2014 (79 FR 59992). The listing designation went into effect on November 3, 2014 (Halterman et al. 2015). However, in 2017, a petition was submitted requesting that the western DPS of the WYBC be de-listed due to an error in DPS analysis, and utilization of additional habitat by the species, in 2018 the petition was found substantial (USFWS 2018).

4.1.5.2 Life History

The WYBC winters in South America and breeds in riparian systems of western North American. The WYBC is an obligate breeder in riparian forests, utilizing dense riparian woodlands and native broadleaf trees and shrubs of approximately 50 acres or more in extent. In California, they are most often associated with willow/Fremont cottonwood dominated forests. They have been recorded using newly restored stands of riparian saplings of one to two years of age (post-planting) on the Sacramento River in California (Halterman et al. 2015).

Little is known about the WYBC migration routes, but small patches of suitable habitat may provide crucial stopover sites during migration in which birds may rest and feed before continuing migration (Halterman et al. 2015)

The WYBC breeds in riparian habitat with dense cover and nearby water. This includes woodlands with low scrubby vegetation, overgrown orchards, abandoned farmland and dense thickets along streams and marshes. Girvetz and Greco (2009) found that cottonwoods were the most important factor in determining suitable nesting habitat because cottonwoods tended to support their preferred prey species. Willows are also important nesting substrate for the western subspecies, although they appear to prefer utilizing dense riparian woodlands and native broadleaf trees and shrubs of approximately 50 acres.

4.1.5.3 Occurrence within Action Area

There have been three possible observations of WYBC in the past five years on Beale AFB. Each observation was considered tentative due to the difficulty to obtain clear visual confirmation. All observations were located in the southeastern portion of Beale AFB in or near the Dry Creek/Best Slough area by qualified biologists working in the area. The most recent audible observation of the WYBC was on June 3, 2016 (AuxiliALL JV 2016). It was heard at the Monitoring Avian Productivity and Survivorship (MAPS) bird banding station on Best Slough.

Surveys and a baseline habitat assessment in 2018 found no evidence of WYBC on Beale AFB, and only three small patches of poor-quality breeding habitat were identified, with the likelihood of use for breeding extremely low (Halterman 2019). Additional areas were identified that have marginal WYBC habitat that would not support breeding, but could be used during migration (Halterman 2019). CNDDB has two reports of WYBC within a 10-mile radius of Beale AFB (Figure 4-4). One is seven miles to the west at the confluence of the Yuba and Feather rivers and the other is 9.4 miles northwest on the Feather River (CNDDB 2017). There is no habitat for WYBC at the LRS and no CNDDB occurrences within a 10-mile radius of the site.

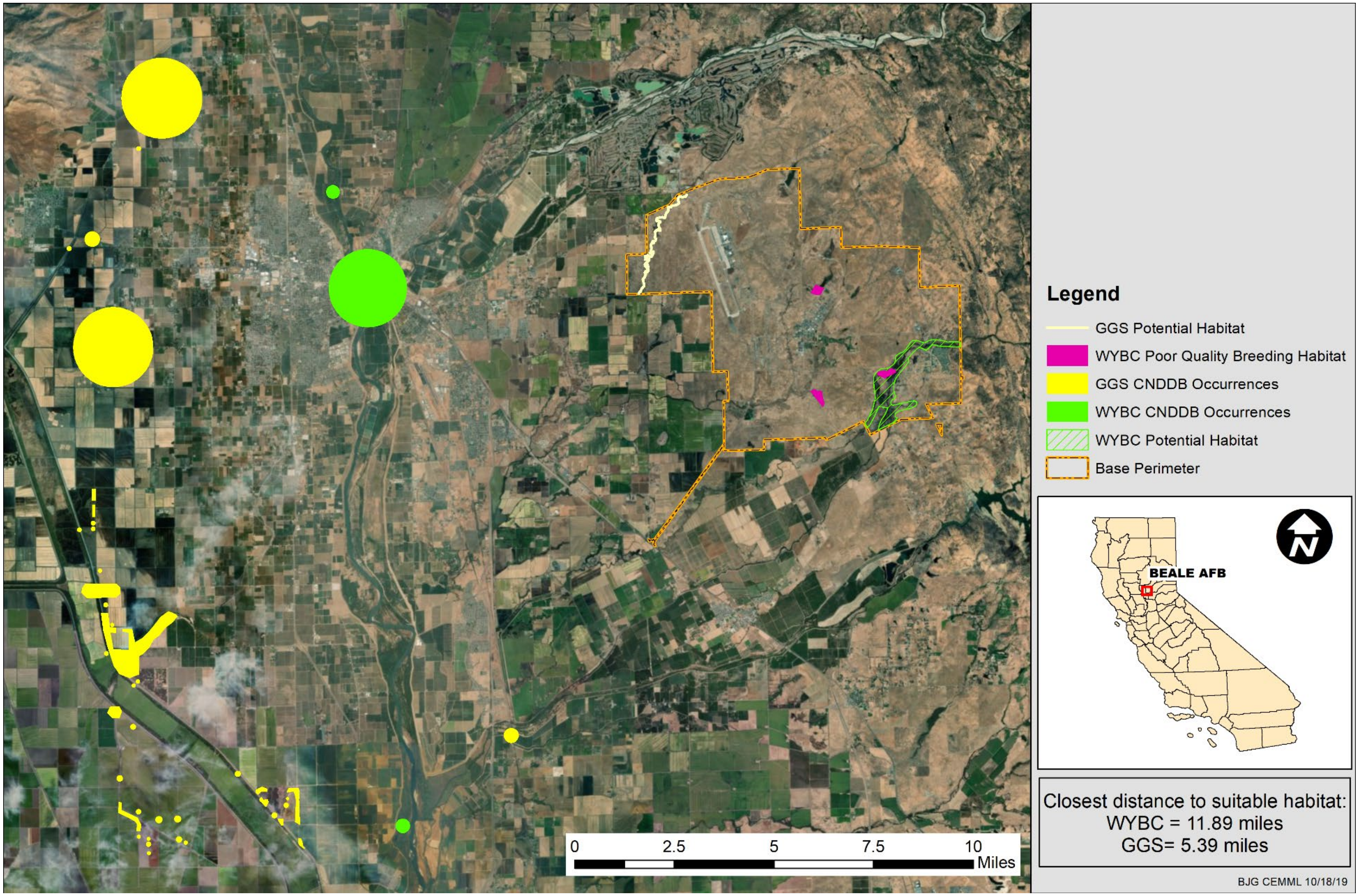

Figure 4-4. Known occurrences of western yellow-billed cuckoo and giant garter snake near Beale AFB from the CNDDB, and suitable habitat for each species on Beale AFB.

4.1.6 Monarch (Candidate Species)

4.1.6.1 Listing Status

The monarch butterfly (monarch; *Danaus plexippus*) was petitioned for listing under the ESA in 2013, and is currently under review. In December 2014, the USFWS submitted a 90-day finding that the petition for listing warrants a full status review (USFWS 2014b). The 12-month finding in for this species is scheduled for fiscal year 2021. Monarchs have experienced dramatic declines across North America with the western monarch (a geographically distinct population from the more well-known eastern population) having the greatest population reductions, with a population decrease of approximately 99% from its historic populations and may be at risk of quasi-extinction (Pelton et al 2019). A final listing determination is slated for 15 December, 2020 (USFWS 2019).

4.2.6.2 Life History

Monarch butterflies are unique in that they are the only insects that embark on a multi-generational migration to and from breeding and overwintering areas that span thousands of miles. In early spring, the western population of monarchs travels from overwintering sites along the California coast to breeding ranges in California, Nevada, Oregon, Washington, Arizona and Idaho, where they lay eggs on newly emerging milkweed plants (*Asclepias* spp.), which serves as the host plant for monarch caterpillars. With the onset of fall, the newest generations of monarchs make the journey back to their overwintering sites. Adult monarchs are generalists and feed on a variety of flowering plants. Spring and summer monarch generations typically have an adult lifespan of two to five weeks, while overwintering adults live six to nine months (Pelton et al. 2019).

Little is known about western monarch migration routes and breeding phenology, but small, scattered patches of suitable habitat (e.g., trees for roosting, milkweed stands, native nectar sources) may provide crucial stopover sites during migration in which monarchs may rest and feed before continuing migration (Pelton et al. 2019). While some monarchs are known overwinter in interior areas, this has not been recorded yet at Beale AFB.

4.2.6.3 Occurrence within Action Area

Monarchs can be found throughout Beale AFB during the breeding season (approximately March–October), and multiple breeding locations have been observed and recorded by Beale AFB environmental staff. No formal surveys have been conducted for monarchs on Beale AFB. All current occurrences represent locations reported by Beale AFB Natural Resources personnel. On Beale AFB, monarchs are typically observed near milkweed stands with nearby water sources and roosting sites. Anecdotally, monarchs tend to be dispersed in the early parts of the dry season and gradually retreat to riparian corridors, lakes, and seasonal drainages as the dry season progresses (C. McCready per observation). Typical locations include the Dry Creek riparian corridor, various ephemeral drainages, and open upland areas with native milkweeds and flowering shrubs. Nectar sources that monarchs have been observed using on Beale AFB include narrow-leaf milkweed (*Asclepias fascicularis*), wooly-pod milkweed (*A. eriocarpa*), buckwheats (*Eriogonum* spp.), buttonwillow (*Cephalanthus occidentalis*), and coyote bush (*Baccharis pilularis*). There is suitable breeding habitat at the LRS, and monarchs have been observed foraging on milkweed and roosting in oak trees on the GSU (C. McCready per obs.). No breeding has been observed at the LRS, but the sightings of adult butterflies and the presence of suitable habitat suggests that breeding is likely to occur on the LRS. No known overwintering occurs on Beale AFB, however, suitable overwintering sites (i.e. *Eucalyptus* groves) exist on Base (Shultz per communication).

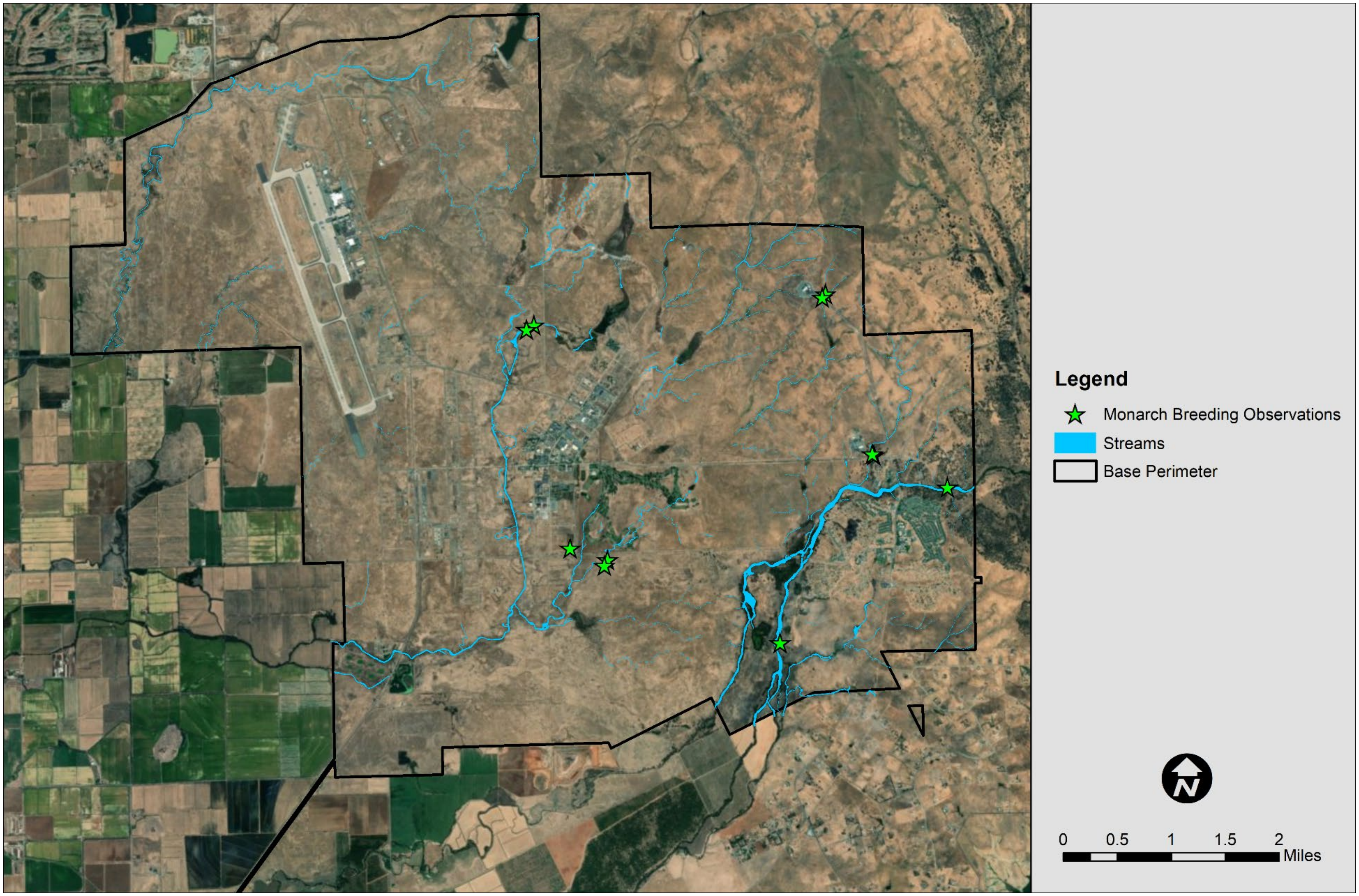

Figure 4-5. Observations of monarch breeding activity at Beale AFB.

4.2 Other Listed Species Considered

Effects on the following species were also considered but discontinued due to the unlikelihood of occurrence:

- **California red-legged frog (CRLF, *Rana draytonii* [Federally-Threatened]):** Marginal suitable habitat exists on Beale AFB. An amphibian habitat assessment was conducted at Beale AFB in March 2008 that found predators of the CRLF to be present in habitats that were potentially suitable for CRLF. The presence of these predators would not allow CRLF to be found in that habitat. There are no occurrences recorded in CNDDB within a 10-mile radius of BAFB. Listed by the USFWS with potential to occur in all of the 12 USGS 7.5 minute quadrangles that contain or border Beale AFB boundaries. No potential to occur at the LRS. No suitable habitat present and there are no documented occurrences of the species.

- **California tiger salamander (*Ambystoma californiense* [Federally-Threatened]):** The Beale AFB properties are located outside of this species' known range. Yolo County is the northernmost boundary of this species' range, but the properties are located in Yuba and Placer counties. Although the properties have vernal pools which could supports California tiger salamander, it is not likely that this species is present. In addition, there are no recorded CNDDB occurrences of this species within a 10-mile radius of the properties.

- **Conservancy Fairy Shrimp (*Branchinecta conservation* [Federally-Endangered]):** Beale AFB properties contain large areas with vernal pools and seasonal swales. There are no CNDDB recorded occurrences within a 10- mile radius of either Beale AFB property. Additionally, no surveys conducted for vernal pool crustaceans have observed any individuals on Beale AFB.

- **Hartweg's Golden Sunburst (*Psuedobahia bahiifolia* [Federally-Endangered]):** There is a CNDDB recorded historic occurrence within a 10-mile radius of Beale AFB. However, this plant was last observed in 1848. In addition, it only occurs in two general locations; one in Madera County and one in Stanislaus County (FR 62:25). The Beale AFB properties are not within these areas.

- **Layne's Butterweed (*Senecio laynea* [Federally-Threatened]):** The Beale AFB properties do not contain suitable habitat to support this plant species, such as chaparral communities. In addition, there are no CNDDB recorded occurrences within a 10-mile radius of the Beale AFB properties.

5.0 ANALYSIS OF POTENTIAL EFFECTS

Activities associated with the implementation of invasive plant control activities have the potential to result in short-term, temporary, adverse effects to VPFS, VPTS, VELB, GGS, WYBC, and monarch. The activities that could directly or indirectly adversely affect these species include off road access, movement of workers and vehicles, herbicide exposure, contamination of waterways and soil from vehicular leaks or improper maintenance, injury or death from prescribed fires, and increased disturbance. Potential effects from herbicide application are listed in Tables 2-8 and 2-9.

Invasive plant control and habitat restoration activities are designed to result in long-term positive effects to VPFS, VPTS, VELB, GGS, WYBC, and monarchs. Positive effects will be achieved through the reduction of competitive pressures from invasive plants to monarch breeding habitat (milkweed species), improved ponding duration and water quality in VPFS and VPTS habitat, and improved productivity of WYBC, GGS, and VELB habitat.

The AMMs in Section 2.4 are designed to minimize the short-term and temporary adverse effects to listed species. However, some AMMs such as buffers, limit the efficacy of restoration activities aimed at improving listed species habitat. This is especially relevant in the case of VELB and monarch, which are dependent on host plants and native vegetation for survival. Some portions of invasive plant control may cause temporary impacts to some species in the short term, but will enable the USAF maximum flexibility to design restoration projects to provide beneficial affects to the species in the long-term. Habitat restoration and invasive plant control projects will be designed to be self-mitigating for any short-term project impacts by including high numbers of host plants for both species as well as companion plants (see Section 2.1.6) and monitoring of the sites for five years. If milkweed plants or elderberry shrubs are damaged, they will be replaced at the ratios specified in Section 2.4.

5.1 Vernal Pool Fairy Shrimp

Anticipated effects of the Proposed Action are outlined in Table 5-1. The effects of actions occurring in VPFS habitat are also discussed in greater detail in Sections 5.1.1 through 5.1.6.

Table 5-1. Effects of the proposed action on vernal pool fairy shrimp.

Vernal Pool Fairy Shrimp		
Action	**Effect**	**Rationale**
Herbicide application	May affect, not likely to adversely affect	Herbicides would not be applied to vernal pools at any time. Additionally, herbicide application would not occur within 15 feet of pools when soil is saturated or surface water is present, or 24-hour before or after a significant precipitation event. Only herbicide formulations practically non-toxic to aquatic invertebrates will be used in VPFS habitat.
Mowing	May affect, not likely to adversely affect	All mowing projects will follow the AMM necessary to prevent damage to VPFS habitat.
Manual/mechanical removal	May affect, not likely to adversely affect	Any manual removal of invasive species within VPFS habitat would occur during dry soil conditions when cysts are less vulnerable to damage. Removal of non-native plant species from VPFS habitat would improve water quality and therefore result in the long-term increase in habitat value.
Controlled Burns	May affect, not likely to adversely affect	Controlled burns are likely to reduce RDM levels and control non-native plants that may invade VPFS habitat. Cysts have been shown to be tolerant of periodic grassland fires.
Grazing	May affect, not likely to adversely affect	Carefully managed grazing is likely to reduce RDM levels, improve water quality, and increase the hydroperiod.
Habitat Enhancement	No effect	Habitat enhancement is not proposed for use within VPFS habitat with the exception of upland seeding with native plant species.
Project area access	May affect, not likely to adversely affect	All individuals entering VPFS habitat will follow the AMMs necessary to prevent damage to VPFS habitat.
Effects monitoring	May affect, not likely to adversely affect	All individuals entering VPFS habitat will follow the AMMs necessary to prevent damage to VPFS habitat. No markers or monuments will be installed into vernal pools.

5.1.1 Herbicide Application

Little is known about the effects of pesticides on vernal pool branchiopods. One study conducted on *B. sandiegonensis* found that glyphosate, the active ingredient in Roundup, could be lethal to this species depending on the concentration of this chemical in the pool water (Ripley et al. 2002/2003). No studies have measured glyphosate concentrations in Central Valley vernal pools, but a study in the northeastern United States found glyphosate levels in some vernal pools well above the range of the lethal dose levels indicated in the Ripley et al. study (Battaglin et al.

2009). These concentrations were found in a pool where the adjacent habitat had been sprayed for a noxious weed seven days before the sample collection.

Studies have found that the surfactants (also called adjuvants or “inert ingredients”) found in some formulations of commercial preparations of glyphosate can be toxic to aquatic life including amphibians (Battaglin et al. 2009; Reylea and Jones 2009), Daphnia spp. (Cuhra et al. 2013) and VPFS (Brausch and Smith 2007). In general, aquatic organisms are more negatively impacted by surfactants than terrestrial organisms due to surfactant sorption to biological membranes (skin, gills), which disrupts biological functions. A study on the branchiopod *Thamnocephalus platyurus* assessed the acute toxicity of polyethoxylated tallowamine (POEA) and found it to be extremely toxic at low concentrations (Brausch and Smith 2007). Because inert ingredients are not required to be specified on product labels by the manufacturer, it can be difficult to discern which or even whether an adjuvant is present in the formulation as well as whether or not it is harmful to wildlife (Cuhra et al. 2013).

Several precautionary actions will be taken in order to minimize any potential known or unknown effects of herbicide use on VPFS. Herbicides will not be applied directly to vernal pools, wet or dry, at any time. Only herbicide formulations which are practically non-toxic to aquatic invertebrates will be used around VPFS habitat. In general, herbicide will not be sprayed within 15 feet of any VPFS habitat. A USFWS-approved biologist with a Qualified Applicator License (QAL/C) may apply (or directly monitor) herbicide application spot treatments to plants within 3 feet of VPFS habitat, but only when soil conditions are dry and no precipitation is expected to occur within 24 hrs and only with herbicide formulations that do not contain POEA. Following these guidelines should sufficiently minimize the potential for impacts to VPFS from herbicide application to determine that it is not likely to adversely affect VPFS.

5.1.2 Mowing

Mowing during the dry season may help improve vernal pool function by reducing thatch within vernal pools. Mowing in and around VPFS habitat would only occur when the soil is no longer saturated to prevent damage to vernal pools and cysts. All mowing related to invasive species control will follow the established AMMs within this BA. Thus, mowing may affect, but is not likely to adversely affect, VPFS.

5.1.3 Manual and Mechanical Removal

Manual and mechanical removal of invasive plants in VPFS habitat may result in damage or destruction to cysts due to soil disturbance, but it is expected to improve habitat conditions for aquatic VPFS life stages. Species targeted for removal would include waxy mannagrass (*Glyceria declinata*), an invasive species known to invade vernal pools and wetlands (Ditomaso et al. 2013). To control waxy mannagrass, manual removal would be used to eliminate the plant from vernal pools during its terrestrial life stage. Manual removal is preferred for vernal pools because it would both kill the target species and remove plant biomass that would impact VPFS habitat as it decomposes. While hand tools (shovels) may be used, hand pulling will be the primary mode of removal, as hand pulling will cause the least amount of soil disturbance. All manual removal efforts will take care to avoid excessive disturbance to the soil. Weed whacking may also be used to reduce plant biomass. As a result, manual invasive plant removal under the Proposed Action may affect, but is not likely to adversely affect VPFS.

5.1.4 Controlled Burns

Damage to VPFS habitat from controlled burns would be avoided by using wet lines only or by using hand lines in areas at least 250 feet away from VPFS habitat. To avoid crushing cysts, no fire suppression equipment will be allowed to access VPFS habitat during controlled burns. Studies of wildland fire on vernal pool crustaceans have shown that fire does not pose a significant threat to cysts. In one study, cysts of the closely related *Branchinecta sandiegoensis* successfully hatched in the first rainy season following a fire event (Wells et al. 1997). Controlled burns are expected to improve VPFS habitat by removing thatch from the vernal pool and surrounding uplands, and therefore improving ecological function.

5.1.5 Grazing

VPFS may experience direct impacts due to grazing in the form of crushing or damage to cysts due to herbivore trampling (Hathaway et al. 1996). However, this effect would be expected to be offset by the positive effects of grazing on vernal pool ecosystems. In vernal pool systems in the Central Valley of California, continuous grazing was associated with 5 to 20 percent more native plant cover and 273 percent longer pooling durations (Marty 2015).

In addition, grazing would be expected to improve water quality issues by reducing RDM levels. RDM values in grazed pools were typically at least 50 percent lower than those in ungrazed pools (Marty 2015; Swiecki and Bernhardt 2008). If RDM levels are high, the breakdown of this material following inundation creates anoxic conditions incompatible with VPFS occupancy (SRS 2006). RDM build-up is also thought to create a positive feedback loop in which high RDM values decrease the inundation period, allowing increased grass encroachment, which further increases RDM build-up, which further reduces the hydroperiod. Left unchecked, the end result is vernal pools functionally incapable of supporting many species (Marty 2015).

Although branchiopod cysts are more vulnerable to breakage during the wet season (Hathaway et al. 1996), maximum positive impacts of grazing are achieved when grazing is allowed to occur during the wet season. During wet season grazing, animals avoid flooded pools and swales, focusing on upland vegetation before moving into the basins after water has receded and upland vegetation has dried. Allowing grazing to occur as water levels draw down in pools has effectively suppressed non-native grasses in pool basins in Central Valley sites while significantly increasing native cover and diversity (Swiecki and Bernhardt 2008).

Grazing conducted in the Central Valley of California for vernal pool management typically employs both cattle and sheep (Marty 2015; Swiecki and Bernhardt 2008). Livestock type may play a key role in habitat management due to different feeding preferences and grazing behaviors (Borgias 2004). Sheep may have less impact due to their decreased weight and behavior (sheep avoid vernal pools until they dry down, thereby reducing the impact of damage to cysts) and therefore may be more appropriate in areas with high densities of vernal pools (N. McCarten personal communication 2018). Studying the efficacy of different grazing animals on VPFS habitat would allow the selection of the most effective grazers for long-term habitat management on Beale AFB. Therefore, grazing may affect, but is not likely to adversely affect VPFS, and would likely result in long-term beneficial impacts on this species.

5.1.6 Project Area Access

All off-road access would be restricted to pre-cleared routes. To the degree practicable all vehicle fueling, maintenance, and repairs would be conducted outside of sensitive habitat. Appropriate spill containment measures including the employment of catch pans and protective mats would be used if it is necessary to fuel or service vehicles in the field. All vehicle operation in VPFS habitat would be restricted to the dry season. With these measures in place, degradation of VPFS habitat is not anticipated and would not have adverse impacts on this species.

5.1.7 Effects Monitoring

Effects monitoring will consist of a combination of protocol VPFS wet and dry season surveys. Quadrat transect sampling and RDM sampling will also occur. Monuments would be installed at photo-monitoring sites.

The AMMs in place would prevent adverse impacts to VPFS. Monitoring would provide a means of gauging treatment efficacy and be used to inform subsequent treatment efforts such that they could be further tailored to provide maximum benefit to VPFS. All surveys for VPFS would be conducted by permitted biologists.

5.1.8 Conclusion

Based on the analysis provided in this BA, the USAF has concluded that implementing portions (manual and mechanical removal) of the Proposed Action may have a short-term adverse effect on the federally-threatened VPFS. However, implementation of the Proposed Action would likely have long-term beneficial impacts on the species. The goal and expected outcome of the Proposed Action is improved functionality and integrity of VPFS habitat through the control and management of non-native plant species. Adverse impacts to VPFS would be prevented by implementing the AMMs outlined in Sections 2.4.1 and 2.4.2. Successful improvement in vernal pool function and invasive plant biomass reduction are expected to improve VPFS occupancy rates and frequency (i.e, pools that are managed for non-native plants are more likely to support VPFS in more years). As a result, the Proposed Action may affect, but is not likely to adversely affect, the VPFS.

5.2 Vernal Pool Tadpole Shrimp

Anticipated effects of the Proposed Action are outlined in Table 5-2. The effects of actions occurring in VPTS habitat are also discussed in greater detail in Sections 5.2.1 through 5.2.6.

Table 5-2. Effects of the Proposed Action on vernal pool tadpole shrimp.

Vernal Pool Tadpole Shrimp		
Action	**Effect**	**Rationale**
Herbicide application	May affect, not likely to adversely affect	Herbicides would not be applied to vernal pools at any time. Additionally, herbicide application would not occur within 15 feet of pools when soil is saturated or surface water is present, or 24-hour before or after a significant precipitation event. Only herbicide formulations practically non-toxic to aquatic invertebrates will be used in VPTS habitat.
Mowing	May affect, not likely to adversely affect	All mowing projects will follow the AMM necessary to prevent damage to VPTS habitat.
Manual/mechanical removal	May affect, not likely to adversely affect	Any manual removal of invasive species within VPTS habitat would occur during dry soil conditions when cysts are less vulnerable to damage. Removal of non-native plant species from VPTS habitat would improve water quality and therefore result in the long-term increase in habitat value.
Controlled Burns	May affect, not likely to adversely affect	Controlled burns are likely to reduce RDM levels and control non-native plants that may invade VPTS habitat. Cysts have been shown to be tolerant of periodic grassland fires.
Grazing	May affect, not likely to adversely affect	Carefully managed grazing is likely to reduce RDM levels, improve water quality, and increase the hydroperiod.
Habitat Enhancement	No effect	Habitat enhancement is not proposed for use within VPTS habitat.
Project area access	May affect, not likely to adversely affect	All individuals entering VPTS habitat will follow the AMMs necessary to prevent damage to VPTS habitat.
Effects monitoring	May affect, not likely to adversely affect	All individuals entering VPTS habitat will follow the AMMs necessary to prevent damage to VPTS habitat. No markers will be placed into vernal pools.

5.2.1 Herbicide Application

As with the VPFS, few studies have investigated the potential effects of herbicides on vernal pool branchiopods. There is some evidence that sufficiently elevated concentrations of glyphosate may cause lethality, (Ripley et al. 2002, 2003). While there are no known measurements of glyphosate concentrations in Central Valley California vernal pools, measurements in the northeastern U.S. indicate that there is a risk of shrimp death (Battalgin et al. 2009). These elevated concentrations were found in a pool where the adjacent habitat had been sprayed for a noxious weed seven days before the sample collection.

Adjuvants, as discussed in Section 5.1.1, may also be of concern for VPTS. This is particularly true for surfactants (e.g., POEA) which can facilitate absorption of active ingredients across plant and animal cuticles, and exhibits extreme toxicity (Brausch and Smith 2007). However, because inert ingredients are not required to be listed on product labels, knowledge of an adjuvant's present in an herbicide formulation or its effects on wildlife are poorly understood.

Several precautionary actions will be taken in order to minimize any potential known or unknown effects of herbicide use on VPTS. Herbicides will not be applied directly to vernal pools, wet or dry, at any time. Only herbicide formulations which are practically non-toxic to aquatic invertebrates will be used around VPTS habitat. In general, herbicide will not be sprayed within 15 feet of any VPTS habitat. A USFWS-approved biologist with a QAL/C may apply (or directly monitor) herbicide application spot treatments to plants within 3 feet of VPTS habitat, but only when soil conditions are dry and no precipitation is expected to occur within 24 hours and only with herbicide formulations that do not contain POEA. Following these guidelines should sufficiently minimize the potential for impacts to VPTS from herbicide application to determine that it is not likely to adversely affect VPTS.

5.2.2 Mowing

As with the VPFS, mowing in and around VPTS habitat would only occur when the soil is no longer saturated to prevent damage to vernal pools and cysts. Mowing during the dry season may help improve vernal pool function by reducing thatch within vernal pools. Thus, mowing may affect, but is not expected to adversely affect this species.

5.2.3 Manual and Mechanical Removal

Manual and mechanical removal of invasive plants in VPTS habitat may result in damage or destruction to cysts due to soil disturbance but is expected to improve habitat conditions for aquatic VPTS life stages. Species targeted for removal would include waxy mannagrass (*Glyceria declinata*), an invasive species known to invade vernal pools and wetlands (Ditomaso et al. 2013). To control waxy mannagrass, manual removal would be used to eliminate the plant from vernal pools during its terrestrial life stage. Manual removal is preferred for vernal pools because it would both kill the target species and remove plant biomass that would impact VPTS habitat as it decomposes. While hand tools (shovels) may be used, hand pulling will be the primary mode of removal, as hand pulling will cause the least amount of soil disturbance. All manual removal efforts will take care to avoid excessive disturbance to the soil. Weed whacking may also be used to reduce plant biomass. As a result, manual invasive plant removal may affect, but is not likely to adversely affect VPTS, but it is also expected to have a long-term beneficial effect on the species.

5.2.4 Controlled Burns

Controlled burns would avoid damaging VPTS habitat by using wet lines only or by using hand lines in areas greater than 250 feet from VPTS habitat. To avoid crushing cysts, no fire suppression equipment will be allowed to access VPTS habitat during controlled burns. Studies of wildland fire on vernal pool crustaceans have shown that fire does not pose a significant threat to cysts. In one study, cysts of the closely related *Branchinecta sandiegoensis* successfully hatch in the first rainy season following a fire event (Wells et al. 1997). Controlled burns are expected to improve VPTS habitat by removing thatch from the vernal pool and surrounding uplands, and therefore improving ecological function.

5.2.5 Grazing

VPTS may experience direct impacts due to grazing in the form of crushing or damage to cysts due to herbivore trampling (Hathaway et al. 1996). However, this effect would be expected to be offset by the positive effects of grazing on vernal pool ecosystems. In vernal pool systems in the Central Valley of California, continuous grazing was associated with 5 to 20 percent more native plant cover, and 273 percent longer pooling durations (Marty 2015).

In addition, grazing would be expected to improve water quality issues by reducing RDM levels. RDM values in grazed pools were typically at least 50 percent lower than those in ungrazed pools (Marty 2015; Swiecki and Bernhardt 2008). If RDM levels are high, the breakdown of this material following inundation creates anoxic conditions incompatible with VPTS occupancy (SRS 2006). RDM build-up is also thought to create a positive feedback loop in which high RDM values decrease the inundation period, allowing increased grass encroachment, which further increases RDM build-up, which further reduces the hydroperiod. Left unchecked, the end result is vernal pools functionally incapable of supporting many species (Marty 2015).

Although branchiopod cysts are more vulnerable to breakage during the wet season (Hathaway et al. 1996), maximum positive impacts of grazing are achieved when grazing is allowed to occur during the wet season. During wet season grazing, animals avoid flooded pools and swales, focusing on upland vegetation before moving into the basins after water has receded and upland vegetation has dried. Allowing grazing to occur as water levels draw down in pools has effectively suppressed non-native grasses in pool basins in Central Valley sites while significantly increasing native cover and diversity (Swiecki and Bernhardt 2008).

Grazing conducted in the Central Valley of California for vernal pool management, typically employs both cattle and sheep (Marty 2015; Swiecki and Bernhardt 2008). Livestock type may play a key role in habitat management due to different feeding preferences and grazing behaviors (Borgias 2004). Sheep may have less impact due to their decreased weight and behavior (sheep avoid vernal pools until they dry down, thereby reducing the impact of damage to cysts) and therefore may be more appropriate in areas with high densities of vernal pools (N. McCarten personal communication 2018). Studying the efficacy of different grazing animals on VPTS habitat would allow the selection of the most effective grazers for long-term habitat management on Beale AFB. Therefore, grazing may affect, but is not likely to adversely affect VPTS and would likely result in long-term beneficial impacts on this species.

5.2.6 Project Area Access

All off-road access would be restricted to pre-cleared routes. To the degree practicable all vehicle fueling, maintenance, and repairs would be conducted outside of sensitive habitat. Appropriate spill containment measures including the employment of catch pans and protective mats would be used if it is necessary to fuel or service vehicles in the field. All vehicle operation in VPTS habitat would be restricted to the dry season. With these measures in place, degradation of VPTS habitat is not anticipated and would not have adverse impacts on this species.

5.2.7 Effects Monitoring

Effects monitoring will consist of a combination of protocol VPTS dry and wet season surveys. Quadrat transect sampling and RDM sampling would also be conducted. Monuments would be installed at photo-monitoring sites.

The AMMs in place would prevent adverse impacts to VPTS. Monitoring would provide a means of gauging treatment efficacy and be used to inform subsequent treatment efforts such that they could be further tailored to provide maximum benefit to VPTS. All surveys for VPFS would be conducted by permitted biologists.

5.2.8 Conclusion

Based on the analysis provided in this BA, the USAF has concluded that implementing portions (manual and mechanical removal) of the Proposed Action will have a short-term adverse effect on the federally-threatened VPTS. However, implementation of the Proposed Action would be likely to have long-term beneficial impacts on the species. The goal and expected outcome of the Proposed Action is improved functionality and integrity of VPTS habitat through the control and management of non-native plant species. Adverse impacts to VPTS would be prevented or minimized by implementing the AMMs outlined in Sections 2.4.1 and 2.4.2. Successful improvement in vernal pool function and reduction of invasive plant biomass are expected to improve VPTS occupancy rates and frequency (i.e, pools that are managed for non-native plants support VPTS for more years). As a result, the Proposed Action may affect, but is not likely to adversely affect VPTS.

5.3 Valley Elderberry Longhorn Beetle

Anticipated effects of the Proposed Action are outlined in Table 5-3. The effects of actions occurring in VELB habitat are also discussed in greater detail in Sections 5.3.1 through 5.3.6.

Table 5-3. Effects of the Proposed Action on valley elderberry longhorn beetle.

Valley Elderberry Longhorn Beetle		
Action	**Effect**	**Rationale**
Herbicide application	May affect, not likely to adversely affect	Most elderberry stands on Beale AFB exist within active restoration areas and replanting is ongoing. Herbicide applied within the 20 feet disturbance area will follow established AMMs and shrubs will be monitored for survival by a USFWS- approved biologist.
Mowing	May affect, not likely to adversely affect	All elderberry shrubs would be flagged for avoidance by a USFWS-approved biologist. Mowing projects will follow the AMM necessary to prevent damage to VELB habitat.
Manual/mechanical removal	May affect, not likely to adversely affect	Removal of non-native plants is likely to improve habitat conditions for VELB by reducing competition with elderberry shrubs. All manual control within the dripline of a shrub will be conducted by hand to avoid damaging shrubs or injuring VELB.
Controlled Burns	May affect, not likely to adversely affect	Controlled burns will not be conducted within 100 feet of elderberry shrubs. If controlled burns are proposed within the buffer trees will be wetted to prevent burning and monitored for survival.
Grazing	May affect, not likely to adversely affect	Elderberry shrubs will be avoided by constructing new pastures that do not include shrubs or by fencing off shrubs to avoid damage from livestock.
Habitat Enhancement	May affect, not likely to adversely affect	Habitat enhancement in riparian areas will improve habitat conditions for VELB by reducing competition from non-native plants and adding additional elderberry shrubs.
Project area access	May affect, not likely to adversely affect	All individuals entering VELB habitat will follow the AMMs necessary to prevent damage to VELB habitat.
Effects Monitoring	May affect, not likely to adversely affect	All individuals entering VELB habitat will follow the AMMS necessary to prevent damage to VELB habitat.

5.3.1 Herbicide Application

There are no known studies of the potential effects of herbicide use on VELB. However, studies using honey bees found that some herbicides and surfactants can be toxic to terrestrial invertebrates (Table 2-5 and 2-6). Most herbicides are toxic to elderberry shrubs, the VELB host plant. To reduce the chance of non-target drift harming elderberry shrubs, herbicide will not be applied within 20 feet of any shrubs. Persistent and pre-emergent herbicides will not be used within 150 feet of VELB habitat. Herbicides applied within 250 feet of an elderberry shrub will be sprayed with a backpack sprayer or other direct method. If herbicide is applied near elderberry shrubs it will be in low wind conditions in accordance with applicable AMMs. The implementation of these AMMs will minimize adverse effects to VELB, but the action may cause temporary impacts to VELB or their habitat in the short term. In the long-term invasive plant control using herbicide is anticipated to benefit this species. If any shrubs were determined to be damaged or killed by controlled burns, then Beale AFB would initiate consultation on mitigation of elderberry shrubs through riparian habitat restoration planting and long-term maintenance and monitoring in accordance with the 2017 USFWS's *Framework for Assessing Impacts to the Valley Elderberry Longhorn Beetle*.

5.3.2 Mowing

Prior to any mowing activity, all elderberry plants will be flagged for avoidance. Any mowing treatment that must occur within the dripline of an elderberry plant will be conducted outside of the VELB active season (i.e., August-February). If weed removal within the dripline must occur during the active season due to phenological restrictions of the target non-native species, it will be by hand only and without electric or gas-powered tools. Thus, mowing may affect, but is not likely to adversely affect the VELB.

5.3.3 Manual and Mechanical Removal

Like with mowing, all elderberry plants will be flagged for avoidance before any activities are performed. Manual or mechanical removal actions within the dripline of elderberry plants will occur outside of the VELB active season (i.e., will occur August-February). In extreme cases where manual or mechanical removal activities must occur during the VELB active season, it will only be performed with hand tools. As such, manual and mechanical removal may affect, but is not likely to adversely affect the VELB.

5.3.4 Controlled Burns

In cases where prescribed burns must be conducted in an area with elderberry shrubs, a 100-foot minimum buffer will be maintained around each shrub. If burns are conducted during the active period of the adult VELB (March-July), a minimum 100-foot buffer will be maintained around each shrub. Thus, prescribed burns may affect, but are not likely to adversely affect the VELB. If a location is proposed to be burned that includes elderberry shrubs, the shrubs would be wetted to prevent ignition. Monitoring would be conducted into the subsequent growing season to ensure shrub survival. If any shrubs were determined to be damaged or killed by controlled burns, then Beale AFB would initiate consultation on mitigation of elderberry shrubs through riparian habitat restoration planting and long-term maintenance and monitoring in accordance with the 2017 USFWS's *Framework for Assessing Impacts to the Valley Elderberry Longhorn Beetle*.

5.3.5 Grazing

Grazing will be limited within areas containing elderberry shrubs (ie the Dry Creek riparian corridor), and any shrubs within grazed areas will be fenced and adequately protected to prevent livestock from grazing them. A natural resources monitor will periodically check protected shrubs to maintain fences and ensure that grazing of elderberry shrubs has not occurred. With these protections in place, grazing may affect, but is not likely to adversely affect the VELB.

5.3.6 Project Area Access

All off-road ATV access would be restricted to routes that have been pre-cleared for special status species. To the degree practicable all vehicle fueling, maintenance, and repairs would be conducted outside of sensitive habitat. Appropriate spill containment measures including the employment of catch pans and protective mats would be used if it is necessary to fuel or service vehicles in the field. All elderberry shrubs would be flagged for avoidance in accordance with the AMMs. With these measures in place, degradation of VELB habitat or take of VELB is not anticipated.

5.3.7 Effects Monitoring

Effects monitoring may consist of visual surveys, RDM sampling, and ground-based photography. Monuments would be installed at photo-monitoring and transect sites. Monuments would ensure that the same locations are re-visited during successive monitoring events so that long-term changes can be accurately assessed and that data are comparable between survey years.

Additionally, monitoring and mapping for elderberry shrub survival, restoration success, and VELB presence would be conducted within treatment areas. All personnel performing monitoring will be USFWS-approved biologist.

5.3.8 Conclusion

Based on the analysis provided in this BA, the USAF has concluded that the implementation of these activities may affect, but is not likely to adversely affect the VELB. While control of invasive species may impact shrubs in the riparian corridor, following the AMM's provided in this document should minimize impacts. Some temporary impacts may arise from mechanical treatment and herbicide application. Implementation of the Proposed Action is intended to maintain and enhance habitat for VELB by controlling invasive species within existing restoration sites and proposed riparian restoration locations, and is likely to have long-term beneficial impacts on the species by improving the functionality and integrity of VELB habitat through the enhancement of riparian habitat and overall increase in elderberry shrub health and abundance. The goal and expected outcome of the Proposed Action is that adverse impacts to VELB would be prevented by implementing the AMMs outlined in Sections 2.4.1 and 2.4.4.

5.4 Giant Garter Snake

Anticipated effects of the Proposed Action are outlined in Table 5-4. The effects of actions occurring in GGS habitat are also discussed in greater detail in Sections 5.4.1 through 5.4.6.

Table 5-4. Effects of the Proposed Action on giant garter snake.

Giant Garter Snake		
Action	**Effect**	**Rationale**
Herbicide application	May affect, not likely to adversely affect	Only aquatic-safe herbicide would be used near GGS habitat.
Mowing	May affect, not likely to adversely affect	Mowing in suitable would occur during the GGS active season (1 May to 1 Oct) to minimize potential for direct mortality
Manual/mechanical removal	May affect, not likely to adversely affect	Removal in suitable habitat would occur during the GGS active season (1 May to 1 Oct) to minimize potential for direct mortality
Controlled Burns	No effect	Controlled burns are not expected to be conducted within potential GGS habitat.
Grazing	May affect, not likely to adversely affect	Grazing is expected to improve GGS habitat by reducing non-native plant biomass.
Habitat Enhancement	May affect, not likely to adversely affect	Habitat enhancement in wetland areas will improve habitat conditions for GGS by enhancing habitat.
Project Area Access	No Effect	Project access is not expect to occur in occupied GGS habitat.
Effects Monitoring	No Effect	Effects monitoring is not expected to be conducted in GGS-occupied habitat.

5.4.1 Herbicide Application

Herbicide may have the potential to adversely affect GGS if improperly applied; however, Beale AFB would only apply aquatic-safe, non-POEA herbicide near potential GGS habitat.

5.4.2 Mowing

Mowing has the potential to affect GGS by disrupting behavior and injuring snakes. However, mowing is proposed for upland areas during the active season of GGS (1 May through 1 Oct), when snakes are typically within aquatic habitats instead of upland refugia. Therefore, mowing is not expected to adversely affect GGS.

5.4.3 Manual and Mechanical Removal

Manual and mechanical removal has the potential to affect GGS by disrupting behavior and potentially harming snakes. However, potential impacts to GGS will be minimized through the use of the established AMMs. Additionally, the consistent negative results of protocol level surveys for GGS strongly suggests that the species is not present on Beale AFB. Manual and mechanical removal is not expected to adversely affect GGS.

5.4.4 Controlled Burns

Controlled burns would typically target upland habitats during the growing season, when GGS are located near water sources and not in overwintering sites. Additionally, only wet lines are proposed to be used near potential GGS habitat, and no ground disturbance would occur. Any disruptions caused by controlled burns would be short-term behavioral disruptions. Finally, the consistent negative results of protocol level surveys for GGS strongly suggests that the species is not present on Beale AFB. Therefore, controlled burns are not expected to affect GGS.

5.4.5 Grazing

The primary goal of livestock grazing is to reduce abundance of non-native plant biomass. As such, this will indirectly benefit GGS by improving the overall habitat. The presence of livestock (e.g., cattle, sheep, and goats) may cause temporary behavioral disruption to GGS. There is also the chance that livestock may step on individual GGS and cause harm or death. The likelihood of this happening, however, is very slim, and grazing, as a whole, may but is not likely to adversely affect GGS.

5.4.6 Project Area Access

All off-road ATV access would be restricted to routes that have been pre-cleared for special status species. To the degree practicable all vehicle fueling, maintenance, and repairs would be conducted outside of sensitive habitat. Appropriate spill containment measures including the employment of catch pans and protective mats would be used if it is necessary to fuel or service vehicles in the field. With these measures in place, degradation of GGS habitat is not anticipated.

5.4.7 Effects Monitoring

Effects monitoring may consist of visual surveys, RDM sampling, and ground-based photography. Monuments would be installed at photo-monitoring and transect sites. Monuments would ensure that the same locations are re-visited during successive monitoring events so that long-term changes can be accurately assessed and that data are comparable between survey years.

GGS are not presumed to occur at Beale AFB, and as such, effects monitoring is not expected to affect the species or its habitat.

5.4.8 Conclusion

Given the lack of GGS sightings on Beale AFB or the surrounding areas, and the negative results of eDNA surveys conducted along Reeds Creek, it is highly unlikely that GGS occur on or near Beale AFB.

5.5 Western Yellow-billed Cuckoo

Anticipated effects of the Proposed Action are outlined in Table 5-5. The effects of actions occurring in WYBC habitat are also discussed in greater detail in Sections 5.5.1 through 5.5.6.

Table 5-5. Effects of the Proposed Action on western yellow-billed cuckoo.

Western Yellow-billed Cuckoo		
Action	**Effect**	**Rationale**
Herbicide application	May affect, not likely to adversely affect	Herbicide use will follow WYBC-specific AMMs. There may be some temporary behavioral disruptions, but they are not expected to have an adverse impact.
Mowing	May affect, not likely to adversely affect	If WYBC are discovered during surveyed then all mowing projects within a 1000 feet buffer of the known occupied site will be halted until WYBC are no longer resent.
Manual/mechanical removal	May affect, not likely to adversely affect	Removal of non-native plants is likely to improve habitat conditions for WYBC by reducing competition with native riparian forest. All manual control will avoid disturbing WYBC when present by following the established AMMs
Controlled Burns	May affect, not likely to adversely affect	Controlled burns will not be conducted during the active nesting season within 1,000 feet of occupied habitat.
Grazing	May affect, not likely to adversely affect	Due to the transient nature of WYBC on Beale AFB, targeted grazing would have discountable and insignificant effects on the species.
Habitat Enhancement	May affect, not likely to adversely affect	Habitat enhancement in riparian areas will improve habitat conditions for WYBC by reducing competition from non-native plants and adding additional forage and nesting habitat.
Project area access	May affect, not likely to adversely affect	All individuals entering WYBC will follow the AMMs necessary to avoid impacts to WYBC.
Effects Monitoring	May affect, not likely to adversely affect	All individuals entering WYBC will follow the AMMs necessary to avoid impacts to WYBC

5.5.1 Herbicide Application

Herbicide may directly impact WYBC through toxicity and behavioral disruption via noise and indirectly affect the species by reducing vegetative cover used for breeding and foraging. In areas where WYBC are confirmed, herbicide use will follow the species-specific AMMs to avoid any adverse effects on the species.

5.5.2 Mowing

Mowing may directly affect WYBC by disturbing behavior through noise. Changes in ambient noise levels resulting from the implementation of projects within WYBC habitat and the surrounding area could result in direct or indirect effects if they cause a nesting bird to abandon its nest. If mowing was to occur near WYBC-occupied habitat, then the species-specific AMMs would be used to minimize the potential effects to the species.

5.5.3 Manual and Mechanical Removal

Manual and mechanical removal may occur in suitable WYBC habitat. This activity has the potential to directly and indirectly affect the species due to alterations of the ambient noise levels. If WYBC are known to be present in or near a manual or mechanical removal project, then the associated species-specific AMMs would be adhered to.

5.5.4 Controlled Burns

Controlled burns could directly affect WYBC by destroying breeding/foraging habitat and nests and indirectly by altering behavior due to smoke. However, controlled burns are not proposed within locations identified as suitable nesting habitat for WYBC. If controlled burns are proposed for a location within 1,000 feet of potential nesting habitat, then the WYBC-specific AMMs would be adhered to.

5.5.5 Grazing.

Sheep or goat grazing could be used to control invasive plants in riparian areas considered suitable WYBC habitat. The goal of targeted grazing in riparian areas is to reduce the prevalence of invasive plants and improve native plant diversity and overall riparian ecosystem health which would indirectly benefit WYBC. Grazing would primarily occur outside of the time period when WYBC would be present. Temporary electric fencing would be used to keep livestock within treatment areas and animals would be moved immediately if detrimental effects to native vegetation were observed. Therefore, grazing is not anticipated to have no effect or a beneficial effect on WYBC.

5.5.6 Project Area Access

All off-road access would be restricted to pre-cleared routes. To the degree practicable all vehicle fueling, maintenance, and repairs would be conducted outside of sensitive habitat. Appropriate spill containment measures including the employment of catch pans and protective mats would be used if it is necessary to fuel or service vehicles in the field. With these measures in place, degradation of WYBC habitat is not anticipated and would not have adverse impacts on this species.

5.5.7 Effects Monitoring

Effects monitoring will consist of protocol level WYBC surveys, invasive plant species surveys, riparian habitat restoration survival monitoring, and RDM sampling. Monuments would be installed at photo-monitoring sites. All protocol level surveys would be conducted by a permitted biologist

The AMMs in place would prevent adverse impacts to WYBC. Monitoring would provide a means of gauging treatment efficacy and be used to inform subsequent treatment efforts such that they could be further tailored to provide maximum benefit to WYBC.

5.5.8 Conclusion

While there is the potential for WYBC to occur on Beale AFB, the available suitable breeding habitat is limited to only three locations and is considered poor habitat (Halterman 2019). All invasive species control will follow the established general AMMs, as well as the WYBC-specific AMMs if WYBCs are confirmed to be present with the Action Area. Therefore, the proposed action may affect, but is not likely to adversely affect the WYBC.

5.6 Monarch

Anticipated effects of the Proposed Action are outlined in Table 5-6. The effects of actions occurring in monarch habitat are also discussed in greater detail in Sections 5.6.1 through 5.6.6.

5.6.1 Herbicide Application

Using the ecological risk assessment (Appendix A) and the toxicity determinations from Table 2-6, Beale AFB has determined that herbicide application may have direct impacts to monarchs by physically harming the insects during application, and cause indirect impacts by incidentally killing milkweeds. However, carefully timed herbicide application, with buffers and surveys to flag known milkweeds, will likely benefit monarch breeding habitat by reducing non-native plant infestations that directly compete with milkweeds and native nectar plants.

Beale AFB would prevent risks posed by drift or accidental overspray of broad-spectrum herbicides to milkweed and monarchs by avoiding use of these herbicides within 100 feet of occupied monarch habitat during the breeding season to the maximum degree feasible. If use of such herbicides is necessary, Beale AFB would employ special precautions as outlined in the herbicide and monarch-specific AMMs (Sections 2.4.1 and 2.4.7). Special precautions include placing temporary physical barriers around plants, using low pressure application techniques, and only applying herbicide during low wind conditions (see Section 2.4.7). Pre-emergent herbicides could potentially prevent germination and development of milkweed seedlings if applied where seed occurred. However, pre-emergent herbicides would not be used within 150 feet of milkweed localities. All individuals operating within monarch habitat during the growing season would be trained and be required to demonstrate proficiency in milkweed identification before working in monarch habitat. Based on these measures, Beale AFB believes the chance of drift or overspray damaging or killing milkweed is discountable.

If invasive plant infestations are left unchecked, these plants will continue to overrun milkweed habitat, leading to localized extirpations or significant population declines. Controlling invasive plant species with herbicides in occupied and suitable monarch habitat is expected to restore and enhance milkweed and increase the viability of known milkweed stands. Additionally, Beale AFB is actively conducting habitat enhancement for monarchs by conducting and monitoring plantings of native milkweeds and nectaring plants in areas near existing breeding sites. As a result, targeted herbicide application would have a long-term beneficial impact on this species.

Table 5-6. Effects of the Proposed Action on the monarch.

Monarch		
Action	**Effect**	**Rationale**
Herbicide application	May affect, likely to adversely affect	Herbicide use within areas supporting milkweed and monarchs may adversely affect the species by killing host plants and larval/adult monarchs. However, the goal of treatments within these areas is to reduce nonnative plant species and thereby enhancing monarch habitat by increasing milkweed numbers/density. All milkweed within the buffer area would be monitored for the subsequent growing period to ensure plant survival. Any milkweed lost to control would be mitigated at the rates provided in Section 2.4.6 A
Mowing	May affect, likely to adversely affect	Mowing in the early season has the potential to damage newly emerged milkweed. Generally Milkweeds would be flagged for avoidance by a USFWS-approved biologist. Monitoring of mowing treatments would be conducted to document effects of milkweed density. Removal of plant biomass is predicted to improve monarch habitat.
Manual/mechanical removal	May affect, not likely to adversely affect	Removal of non-native plants is likely to improve habitat conditions for monarchs by reducing competition. All mechanical control within 2 feet of a milkweed plant will be conducted outside of the monarch breeding season (15-Mar-31 Oct)
Controlled Burns	May affect, likely to adversely affect	Controlled burns in monarch breeding sites have the potential to directly impact the species by killing larvae and eggs. However, the goal of the Proposed Action is to enhance habitat by reducing invasive plant cover and increasing milkweed numbers and density. All areas where controlled burns will be conducted will be monitored for the effects on milkweed as well as use by monarchs. Roosting trees will be protected from prescribed fire.
Grazing	May affect, not likely to adversely affect.	Grazing would be excluded from those portions of drainages known to support breeding monarchs. Grazing animals typically avoid milkweed. Carefully timed and managed grazing is likely to improve monarch habitat by reducing nonnative grass RDM and suppressing non-native plant species.
Habitat Enhancement	May affect, not likely to adversely affect	Habitat enhancement is likely to improve habitat for monarchs by expanding existing milkweed stands, creating new breeding habitat, and providing native nectaring plants.
Project area access	May affect, not likely to adversely affect	All individuals entering monarch habitat will follow the AMMs necessary to avoid impacts to monarchs.
Effects Monitoring	May affect, not likely to adversely affect	All individuals entering monarch habitat will follow the AMMs necessary to prevent damage to monarch habitat. All monarch monitoring will be conducted by a USFWS-approved biologist.

5.6.2 Mowing

Mowing may occur in areas where milkweed is found. Mowing can have detrimental effects to monarchs during the breeding season by destroying larval food sources and killing caterpillars and eggs. Excessive mowing can also reduce native plant diversity and suppress milkweed abundance. However, carefully timed mowing can benefit milkweeds by reducing competition for resources with non-native plants and promoting growth (Xerces Society 2018). If mowing is conducted during the summer, a USFWS-approved biologist would survey the project area and flag milkweeds for avoidance. All mowers would receive training to identify milkweeds and important nectar plants in order to avoid plants during mowing. Early spring mowing in areas where milkweed has been recorded would set mower height to a minimum of 10-12 inches to avoid damage to newly emerging milkweeds whenever possible. Use of mowing to control non-native plants using the established AMMs is likely to adversely affect the species by killing eggs and larvae on newly emerged milkweeds, however mowing is expected to have a long-term benefit to the species by improving habitat for both adults and larvae.

5.6.3 Manual and Mechanical Removal

Manual and mechanical removal has the potential to cause adverse effects to monarchs by damaging or destroying milkweed and injuring the eggs or larvae of the monarch. However, damage to milkweed plants will be minimized by adhering to the AMMs within this BA. Furthermore, removal of non-native plant species is likely to improve habitat for the monarch over time by removing competition and allowing for the establishment of additional milkweed plants. All disturbed areas near monarch habitat would be reseeded with a base-approved seed mix that includes milkweed seeds. Thus, manual and mechanical removal may affect, but is not likely to adversely affect the monarch.

5.6.4 Controlled Burns

There is limited information available as to the potential effects of prescribed fire on monarch butterflies, and what information there is comes from the eastern population of monarchs in prairie habitat. However, in these habitats, monarchs have been shown to respond positively to prescribed fire, with more monarchs using areas that had previously burned areas. Milkweeds are a rhizomatous species, and both seeds and rhizomes are thought to sprout readily following fire (USDA 200). Furthermore, prescribed fire likely benefits milkweeds by reducing thatch and competition by non-native grasses and forbs, allowing plants to more readily establish, as native milkweeds typically germinate much later than other species and have trouble establishing in areas with high non-native plant pressures (Xerces 2018). Controlled burns could affect monarchs by destroying milkweed plants, killing monarchs (all life stages) and eliminating roosting sites and nectar resources. Smoke may also affect monarchs, but no studies have been conducted to ascertain the effects of smoke on monarchs (Xerces 2018). However, it is likely that the removal of thatch via burning may promote the germination of milkweed seeds and allow newly emerged milkweeds to be more readily accessed by monarchs (Stephanie McKnight personal communication 2019). Therefore, controlled burns in known monarch habitat will be conducted only when monarchs are not actively breeding on Beale AFB (15 Mar-31 Oct) to avoid take of monarchs and to stimulate flower production of spring-blooming nectar resources. All roosting trees will be avoided during burns. In prescribed-fire areas where monarchs are known to occur, when reseeding is required, Beale AFB will include seeds of plants known to be beneficial to monarchs. This will include native milkweed seed either collected from plants on the base or purchased from a local nursery. Following the established AMMs and buffers, prescribed fire is not expected to have any adverse effects on the species. However, controlled burns are proposed for use with the specific goal of habitat enhancement within areas known to support milkweed. Beale AFB has determined that controlled burns under these conditions would have a temporary negative impact to the species, but over the long term, a beneficial effect on the monarch.

5.6.5 Grazing

Livestock avoid foraging on milkweed due to its toxicity (Pfister et al. 2002). However, monarchs may experience direct impacts due to grazing in the form of cattle crushing milkweed plants, monarch eggs and larvae, as well as damage to upland nectar sources by foraging livestock. Milkweed and monarch butterflies have been documented within the current and proposed grazing pastures. Using BMPs, grazing is assumed to be beneficial to pollinator species by reducing RDM, controlling non-native species (Pelton et al. 2018), and improving diversity of flowering forbs (GMG 2017). Currently, grazing on base is conducted primarily during the dormant season (fall and winter) of local milkweed species, and, therefore, impacts to both the host plant and the species itself would be minimized, discountable, and insignificant. Furthermore, grazing would be excluded from breeding locations that provide roosting sites and water (i.e., ephemeral drainages and riparian corridors) where monarchs have been observed. Therefore, grazing may affect, but is not likely to adversely affect the monarch.

5.6.6 Project Area Access

All off-road ATV access would be restricted to routes that have been pre-cleared for special status species. To the degree practicable all vehicle fueling, maintenance, and repairs would be conducted outside of sensitive habitat. Appropriate spill containment measures including the employment of catch pans and protective mats would be used if it is necessary to fuel or service vehicles in the field. All milkweed plants would be flagged for avoidance in accordance with the AMMs. With these measures in place, degradation of monarch habitat or take of the species is not anticipated.

5.6.7 Effects Monitoring

Effects monitoring may consist of visual surveys, invasive plant species surveys, RDM sampling, and ground-based photography. Protocol level surveys for monarch eggs, larvae, and adults would also be conducted. Monuments would be installed at photo-monitoring and transect sites. Monuments would ensure that the same locations are re-visited during successive monitoring events so that long-term changes can be accurately assessed and that data are comparable between survey years. All monarch surveys would be conducted by a USFWS-approved biologist.

Additionally, monitoring for milkweed survival and spread would be conducted within treatment areas. All personnel performing monitoring will be USFWS-approved biologist.

5.6.8 Conclusion

Adverse impacts to the monarch would be avoided, if federally-listed under ESA, through implementing the AMMs outlined in Sections 2.4.1 and 2.4.7. Additionally, Beale AFB is actively conducting habitat creation and enhancement projects for monarch breeding sites on Beale AFB, and this, along with the milkweed compensation rates included in Section 2.4.7, would offset any impacts to the species from the Proposed Action. The goal and expected outcome of the Proposed Action is the control of nonnative plant species in occupied and suitable monarch habitat in order to enhance and protect the viability of breeding monarchs on Beale AFB. Locations where invasive plant control is conducted will be monitored for milkweed survival and monarch use, as well as for nonnative plant cover, RDM, and composition. Therefore, Beale AFB has determined that portions of the Proposed Action (herbicide applications, controlled burns, and mowing) may affect, and are likely to adversely affect, the monarch.

5.7 Cumulative Impacts

Under the ESA, cumulative effects are defined as those effects of future private, state, and tribal activities in addition to the current project effects, not involving federal activities under these projects, that are reasonably certain to occur in the Action Area of the federal action subject to consultation (50 CFR §402.02). Future Federal actions that are unrelated to the proposed action will require separate consultation pursuant to Section 7 of the ESA. Because Beale AFB is a federal installation, any actions of private, state, or tribal activities are not anticipated in the action area. Therefore, no cumulative effects as a result of private, state, or tribal activities are anticipated in the Action Area.

Cumulative effects are defined in 50 CFR §402.02 (Interagency Cooperation on the ESA of 1973, as amended): "…those effects of future State or private activities not involving Federal activities that are reasonably certain to occur within the action area of the Federal action subject to consultation." Reasonable foreseeable future federal actions and potential future federal actions that are unrelated to the Proposed Action are not considered in the analysis of cumulative effects because they would require separate consultation pursuant to Section 7 of the ESA.

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area. The Action Area is completely within Beale AFB and thus considered federal land. Future federal actions unrelated to the Proposed Action would require separate consultation under Section 7 of the ESA. Activities along the upstream portion of Dry Creek could impact the stream to an extent that effects are seen on Beale AFB within the action area, but those activities are not known to the USAF at this time. Additionally, there is potential for cumulative impacts in combination with herbicide sprayed on adjacent properties and for grounds maintenance purposes. Mowing and weed whacking for invasive species control will be in addition to grounds maintenance actions.

6.0 SUMMARY OF DETERMINATION

Beale AFB has determined that portions of the Proposed Action may affect, and is not likely to adversely affect, some of the federally-listed species that occur or have the potential to occur on the installation. Table 6-1 summarizes the determinations of the analysis of six species included in this BA.

Table 6-1. Summary of ESA Determinations.

Species	Endangered Species Act Determination of Effect on the Species
Vernal Pool Fairy Shrimp (*Branchinecta lynchi*)	**May Affect, Not Likely to Adversely Affect**
Vernal Pool Tadpole Shrimp (*Lepidurus packardi*)	**May Affect, Not Likely to Adversely Affect**
Western Yellow-billed Cuckoo (*Coccyzus americanus*)	**May Affect, Not Likely to Adversely Affect**
Valley Elderberry Longhorn Beetle (*Desmocerus californicus dimorphus*)	**May Affect, Not Likely to Adversely Affect**
Giant Garter Snake (*Thamnophis gigas*)	**No Effect**
Monarch (*Danaus plexippus*)	**May Affect, Likely to Adversely Affect**

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USFWS Concurrence Letter for Informal Consultation on the Biological Assessment for Non-Native and Noxious Plant Species Management at Beale Air Force Base

6 October 2020

United States Department of the Interior

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In Reply Refer to
08ESMF00 2020-I-1563

October 6, 2020

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Beale Air Force Base, California 95903-1708
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Subject: Informal Consultation on Non-Native and Noxious Plant Species Management Project, Beale Air Force Base, Yuba County, California

Dear Gwendolyn Vergara:

This letter is in response to the Beale Air Force Base's (Beale AFB) June 8, 2020 request for initiation of formal consultation with the U.S. Fish and Wildlife Service (Service) on the proposed Non-Native and Noxious Plant Species Management Project (proposed project) at Beale AFB in Yuba County, California. Your request was received by the Service on June 9, 2020. At issue are the proposed project's effects on the federally-listed as threatened valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (beetle), vernal pool fairy shrimp (*Branchinecta lynchi*) (fairy shrimp), western yellow-billed cuckoo (*Coccyzus americanus occidentalis*) (cuckoo), and the federally-listed as endangered vernal pool tadpole shrimp (*Lepidurus packardii)* (tadpole shrimp). This response is provided under the authority of the Endangered Species Act of 1973, as amended (16 U.S.C. 1531 *et seq*.) (Act), and in accordance with the implementing regulations pertaining to interagency cooperation (50 CFR 402).

The federal action on which we are consulting is the implementation of a non-native invasive plant species management plan on Beale AFB and the Lincoln Receiver Site (LRS) in order to reduce or eliminate noxious weed populations. Pursuant to 50 CFR 402.12(j), you submitted documents for our review and requested concurrence with the findings presented therein. These findings conclude that the proposed project may affect, but is not likely to adversely affect the beetle, the fairy shrimp, the tadpole shrimp and the cuckoo. The proposed project does not occur within designated or proposed critical habitat for any federally-listed species.

In considering your request, we based our evaluation on the following: (1) your June 9, 2020, letter initiating consultation; (2) the June 2020 *Biological Assessment for Non-Native and Noxious Plant Species Management at Beale Air Force Base*; (3) email and telephone correspondence between the Service and Beale AFB between October 18, 2019 and August 27, 2020; and (4) additional information available to the Service.

Project Description

Beale AFB is located within the Central Valley of California, approximately 40 miles north of Sacramento, and covers approximately 23,000 acres. The LRS is a 235-acre geographically separated unit (GSU) located in Placer County, approximately 15 miles south of Beale AFB and 5 miles west-southwest of the town of Lincoln, CA.

The proposed project is to manage non-native invasive plant species on Beale AFB and the LRS in order to reduce or eliminate their populations using an efficient, sustainable, and long-term strategy that incorporates an adaptive approach. Beale AFB proposes to implement a program to control and eradicate invasive plant species that may impact listed species and their habitat, mission operations, and natural resource conservation programs base-wide. If non-native and noxious invasive plant species continue to spread they will degrade remaining native habitat.

Methods used for the control and eradication of invasive species will include physical (hand/mechanical, and prescribed burning), chemical (herbicide), and biological (grazing and habitat enhancement) control (Beale AFB 2017a).

Herbicide Application

Targeted herbicide application will be used for base-wide invasive species management efforts. Proposed application methods include pre-emergent, broadcast and target foliar, basal stem, cut-stump, stem injection, and frill and squirt. Application will be both selective (targeting individual plants or species) and non-selective (targeting all vegetation in a specific treatment area). The majority of herbicide treatment will be by hand using backpack application equipment. The remaining treatments will consist of broadcast spraying, basal bark, selective application, or target application using a hose or hand wand from an ATV or truck. Herbicides will always be applied in accordance with the Air Force Pest Management Program, General National Pollutant Discharge Elimination System Permit for Residual Aquatic Pesticide Discharges, and all applicable federal, United States Air Force (USAF), Department of Defense (DoD), State of California, and local directives and regulations. All herbicide use will follow California Department of Pesticide Regulation (DPR) requirements and manufacturer label guidelines. Herbicide formulations used will be selected based on efficacy against the target species, potential interactions with special status species, and environmental constraints.

Herbicide Application Techniques

Several herbicide application techniques will be used to control non-native plant species for the proposed project.

Broadcast Spray (Boom) - Spraying herbicide to an entire infested area, rather than to individual target plants, using a regulated nozzle. This method uses a truck- or all-terrain vehicle (ATV)-mounted boom sprayer and is limited to areas with moderate terrain. Broadcast methods are used for denser infestations where application to individual plants will not be feasible.

Targeted Spray - Spraying herbicide onto the foliage of individual target plants. This is done using a regulated nozzle, which helps to concentrate application towards target plants. This method uses a backpack-mounted wand sprayer or a truck- or ATV-mounted hose sprayer. This is used for small infestations or in areas not accessible by vehicle.

Pre-emergent Spray - Herbicide is applied directly to the soil in areas with known infestations to prevent seed germination or otherwise inhibit development. Herbicide may be applied using backpack-mounted wand sprayer or a truck- or ATV-mounted hose sprayer. This method is best for large infestations and difficult to control species.

Basal Bark - Basal bark herbicides are mixed with an oil carrier to penetrate the bark of the target plant. Herbicide is sprayed around the circumference of the base of the stem. This is used to control thin-barked plants less than 6 inches in basal diameter.

Selective Application - Touching individual target plants with applicators containing herbicide. Because these methods involve direct application, there is a very low likelihood of drift, run-off, or accidental non-target exposure. Specific methods include:

- Hack and squirt - A cut is made into the sapwood of a target plant and herbicide is applied to the cut surface or injected into the trunk from the tool if using a specialized hatchet. This method eliminates or greatly reduces re-sprouts. This is used on individual target woody plants.

- Cut stump–The target plant is cut down and herbicide is applied directly to the stump using a low-pressure nozzle, wick, or brush. This is used for individual woody plants.

- Wick, wipe, drizzle - The target plants are touched with a wipe or wick containing herbicide. This may be used on individual or groups of target plants.

Aquatic Applications - Herbicide is either applied directly to foliage growing at or above the water's surface, or to the water column itself if plants are fully submerged. Only an herbicide labelled for aquatic use may be applied for the project using the following methods:

- Foliar Application - Herbicide is applied to foliage at or above the water's surface using a regulated nozzle or boom. This method can be done using a backpack-mounted wand sprayer, truck- or boat-mounted hose sprayers, or boat-mounted boom sprayers. This is used for emergent and floating-leaved aquatic plants.

- Subsurface and deep water injection - Herbicide is fed into the water through hoses spaced at intervals along a bow- or stern-mounted boom. The nozzle body contains a disk that meters the flow into the water. Hose length is adjusted so that the nozzles are at or just below the water surface for subsurface injection. For deep water injection, weighted hoses long enough to reach submerged weed mats are used. This method is used for fully-submerged aquatic plants.

<u>Mowing</u>

Mowing will be used to control or suppress certain invasive species, particularly annual species. For treatments of annual invasive species, mowing will be carefully timed to coincide with the vulnerable stage of target species' phenology. Mowing may also be used for perennial invasive species when removal of biomass is required (e.g., reduction of bird air strike hazard (BASH) hazards, preparation or maintenance of habitat enhancement sites). Regular mowing performed for fuels control and grounds maintenance in this sense does not apply as an effective invasive species control technique. However, mowing may also be used in conjunction with prescribed fire in order to prepare the site for wet fire-lines. This is ideal for locations where ground disturbance is restricted (e.g., vernal pools). Mowing can present a biosecurity threat from equipment used off-base that may transport invasive plant species onto Beale AFB or between locations on base. Appropriate cleaning and best management practices (BMPs) will be used for equipment traveling between sites.

Manual and Mechanical Removal

Manual and mechanical treatments using hand-pulling, small hand-powered tools, and handheld equipment (e.g., weed whackers, chainsaws, and brush cutters) will be used for removing small or new infestations of invasive plants. Heavy equipment (including mowing tractors large and small, tracked and wheeled, and masticators) may be used to remove large infestations and Arundo (*Arundo donax)* and Himalayan blackberry (*Rubus armeniacus*). This will be relegated to the use of mowing-attachments to reduce blackberry biomass and the targeted removal of Arundo from areas where the stands are too dense or too massive to remove by hand. Depending on the target species and environmental constraints, manual and mechanized removal will be used independently or in concert with herbicide application. Methods such as hand pulling will be used for small infestations or in areas where herbicide cannot be safely used due to proximity to listed species. Cutting of trees will be paired with a cut-stump herbicide application in cases where the target species is capable of re-sprouting from the base (e.g., tree of heaven). Any biomass will be removed and disposed of to avoid spread of invasive species. Disturbance to soil will be minimized to reduce areas that invasive plants can spread into as they often prefer disturbed soil and can more quickly establish themselves compared to native plant species.

Controlled Burns

Prescribed fire will be utilized to control certain non-native plant species at Beale AFB and the LRS. Prescribed burns may not be feasible in some areas due to conflicts with mission-critical operations or sensitive habitats. Prescribed burns require careful planning, coordination, and implementation to be successful. A prescribed fire plan is developed for prescribed burns to address site-specific conditions. All prescribed fire plans will be reviewed by the Natural Resource Manager (NRM) to ensure that no listed species will be adversely affected by prescribed fire activities and that all conservation measures are followed.

Beale AFB has an existing robust prescribed fire program that serves to maintain and enhance habitat to support a multitude of grassland and woodland species. All prescribed burns are managed in accordance with the Invasive Plant Species Management Guidelines (IPSMG), in addition to the Wildland Fire Management Plan (WFMP), which provides guidance for the suppression and prevention of wildfires as well as the implementation of ecosystem management and fuels reduction on Beale AFB. The WFMP addresses Beale AFB Integrated Natural Resource Management Plan (INRMP) management goals and objectives, and complies with all applicable laws and regulations. It lays out responsibilities and procedures for prescribed fire management in a manner that is safe, efficient, effective, and highly professional. The WFMP addresses, among other things, prescribed fire planning, project implementation, operations, public notification, smoke management, management protocol, reporting requirements, asset protection, training and qualifications, and monitoring and evaluation.

Grazing

Grazing by domestic livestock, including cattle, sheep, goats, and horses, will be implemented as a method for controlling some non-native plant species and can be used to move plant community composition in a desired direction and maintain habitat for listed species. While grazing alone does not eradicate non-native plant species, it can be effective in reducing infestation levels and slowing the spread of some undesirable species. Grazing is also useful for controlling invasive species in locations where other methods such as herbicide applications and controlled burns are not available due to the presence of sensitive resources. Additionally, the reduction of non-native plant species and their thatch from vernal pools via grazing has been shown to increase inundation periods (pools both fill earlier and stay wet longer), which benefits a wide range of species that rely on these unique habitats, including large branchiopods (USFWS 2005). Grazing typically helps to remove the thatch from within the vernal pool and reduces total residual dry mass (RDM) in surrounding upland areas (Marty 2015).

The duration, intensity, and frequency of seasonal grazing on Beale AFB are designed to improve habitat for listed species occurring on Beale AFB, promote native species, minimize soil erosion, reduce wildfire risk, and prevent the spread of undesirable plant species (Beale AFB 2019). The upland habitat surrounding the vernal pools on Beale AFB is dominated by non-native annual grass and forb species. Based on weed surveys at Beale AFB, the principal invasive species include medusahead (*Elymus caput-medusae*), yellow starthistle (*Centaurea solstitialis*), and barbed goatgrass (*aegilops triuncialis*) (Beale AFB 2017b).

Currently, Beale AFB accommodates agricultural outleasing as a major land use. Grazing currently occurs within designated fields, or Grazing Management Units (GMUs), located throughout Beale AFB. Cattle grazing occurs within these areas from approximately November to May, depending on the year and weather, and year-round for horses. Adaptive management principles are essential to the grazing management program to maximize potential benefits of the program while precipitation and temperature vary. As of August 2019, cattle grazing currently covers 11,866 acres and horse grazing covers 302 acres (Beale AFB 2019). Activities associated with the agricultural outleasing program on Beale AFB include cattle grazing; fence installation, maintenance and replacement; access road maintenance; and installation and maintenance of water wells and troughs as specified in the Grazing Management Guidelines (GMG) (Beale AFB 2017b).

Under the proposed project, grazing will be continued and expanded on Beale AFB. In addition to the pastures currently being grazed on Beale AFB, Beale AFB proposes to graze up to 3,332 additional acres on Beale AFB and 210 acres of land on LRS in areas that are either unmanaged or mowed, and where grazing has not occurred recently and habitat degradation has been observed. Most of these areas do not have infrastructure currently to support livestock grazing, so improvements to fencing and development of water sources as described above will be required for grazing to be initiated. Approximately 66,000 feet of linear fencing are proposed to be completed to enclose proposed grazing areas. All permanent grazing infrastructure (e.g. wooden corner posts, troughs, corrals) will be placed at a minimum of 50 feet from listed species habitat. No new access roads will be installed within the new grazing units; however, existing access roads will be maintained. Construction zones, including staging areas, egress, and ingress routes, will avoid listed species and all construction will occur during the dry season (1 May-1 Nov). All permanent grazing pastures may be grazed by cattle, horses, goats, and sheep. Additionally, grazing using goats and sheep will also be incorporated into new areas to control invasive species where permanent enclosures and cattle grazing are impractical (e.g., small areas near facilities, road banks, and manmade impoundment structures). All fencing and infrastructure for goats and sheep outside of cattle pastures will be temporary (i.e., electrified fencing) and will be removed at the end of the grazing treatment. Site-specific management and monitoring plans are included in the GMG.

The grazing program at Beale AFB and the LRS will be maintained in accordance with the Beale AFB GMG, which help guide livestock grazing management activities to meet INRMP natural resource management goals. While the GMG does not currently include the LRS, all management prescriptions, goals, objectives, and BMPs in it apply to the LRS. The LRS is composed of the same habitat types (e.g., annual grassland, oak woodland, vernal pool grasslands) as Beale AFB with the same special status resources, which results in identical management decisions and thus identical environmental effects. Stocking rate calculations will need to be done for the LRS but will follow the established methodology of the GMG. The GMG helps to ensure that the grazing program on Beale AFB and the LRS is implemented in the safest and most efficient and beneficial manner possible. The GMG addresses goals and mission support functions of the grazing program, conditions affecting grazing, grazing leases, land use rules, and grazing management recommendations including recommended actions and timelines, monitoring, and adaptive management. The GMG is updated periodically to meet changing conditions, natural resource and conservation goals, and mission requirements.

The IPSMG provides several BMPs to minimize potential transfer of invasive species through grazing actions (Beale AFB 2017b). These will be incorporated into grazing practices: (1) pastures will be grazed according to the Beale AFB GMG and monitoring data collected, (2) any supplemental feed will be certified weed-free, and (3) grazing lessees will be informed about biosecurity and early detection efforts to prevent establishment of new invasive species.

<u>Habitat Enhancement Treatments</u>

Habitat restoration and enhancement treatments such as replanting or reseeding will be used at Beale AFB and the LRS to promote desirable species and habitat conditions in conjunction with weed control treatments. Revegetation with desirable native species will be used to enhance ecosystem function, provide habitat to wildlife, suppress non-native plant regrowth, and reduce the number of follow-up treatments (Cal-IPC 2015). If Beale AFB determines that restoration treatments are required due to invasion by problematic weed species or significant degradation of habitat value, reseeding or replanting using native species will be used. Revegetating non-native plant treatment sites may be accomplished using a mixture of native grasses and forbs, and may include trees and shrubs if appropriate (e.g., riparian and oak woodland habitats). Revegetating decisions will be compatible with future uses and management actions, and will consider suitability and cost of available options as well as the suitability of the site itself. Plant species that will be used include purple needlegrass (*Stipa pulchra*), blue wildrye (*Elymus glaucus*), California brome (*Bromus carinatus*), creeping wildrye (*Elymus triticoides*), Pacific fescue (*Festuca microstachys*), meadow barley (*Hordeum brachyantherum*), miniature lupine (*Lupinus bicolor*), tomcat clover *(Trifolium wildenovii*), purple clarkia (*Clarkia purpea*), fiddleneck (*Amsinckia menziesii*) and California goldfields (*Lasthenia californica*). Additionally, native perennial plants that provide resources to pollinators, especially monarchs, will be included whenever possible and include species such as milkweed (*Asclepias* spp), buckwheats (*Eriogonum* spp), coyote bush (*Baccharis pilularis*) blue dicks (*Dichelostemma capitatum*), and great valley gumplant (*Grindelia camporum*). All restoration plant mixes must be approved by the NRM before installation and will include only California native species appropriate for upland habitat enhancement aimed at benefitting pollinators. Additional habitat enhancement guidance is provided in the IPSMG and the *U.S. Air Force Pollinator Conservation Strategy Guide* (USFWS 2017a).

Conservation Measures

The following is a summary of Beale AFB proposed conservation measures to be implemented as outlined in the biological assessment, to minimize effects on the fairy shrimp, the tadpole shrimp, the cuckoo, and the beetle. The conservation measures proposed below are considered part of the proposed action.

General

1. A Service-approved biologist will brief all project personnel prior to participating in project activities. At a minimum, the briefing will include a summary of the proposed actions, a description of the federally protected species that may occur in the project area, and a summary of the measures that Beale AFB will implement to avoid or minimize the adverse effects to the federally protected species within a projects' footprint.

2. A natural resources monitor will conduct spot compliance checks during control activities in or adjacent to sensitive habitats as required. The natural resources monitor will ensure compliance with all applicable conservation measures required to protect federally protected species and their habitats. Full-time on-site monitoring may occur if the activity is particularly sensitive, if personnel conducting control activities are not well trained or experienced with listed species, or if personnel have a history of non-compliance.

3. A Service-approved biologist will conduct environmental awareness training for all field personnel working within and near sensitive habitat on Beale AFB. Training will be provided at the start of work and all new workers will be provided with training before conducting project activities. The program will consist of a briefing on environmental issues relative to the proposed project. The training program will include an overview of the legal status, biology, distribution, habitat needs, and compliance requirements for each federally protected species that may occur in the project area. The presentation will also include a discussion of the legal protection for endangered species under the ESA, including penalties for violations. A fact sheet conveying this information will be distributed to all personnel who enter the project site. Upon completion of the orientation, employees will sign a form stating that they attended the program and understand all avoidance and minimization measures. These forms will be maintained at Beale AFB and will be accessible to the appropriate resource agencies.

4. The fueling of vehicles and equipment will occur on impervious surfaces to the maximum extent practicable. Spill containment equipment will be present at all project sites where fuels or other hazardous substances, including herbicides, are brought to the site. In addition, qualified personnel will conduct daily inspections of the equipment and the staging and maintenance areas for leaks of hazardous substances.

5. Prior to initiation of weed control or restoration activities, sensitive areas, such as vernal pools, wetlands, riparian areas, and potential habitat for listed species, will be identified. If work will be conducted by contractors or other personnel not familiar with applicable listed species and their habitat, sensitive areas will be staked and flagged as exclusion zones where control activities cannot take place. Orange construction barrier fencing (or an appropriate alternative method) will designate exclusion zones where control activities cannot occur. The flagging and fencing will be clearly marked as an environmentally sensitive area. The contractor will remove all fencing, stakes and flagging within 60 calendar days of project

completion. If work is conducted by in-house personnel, familiar with applicable listed species and their habitat, sensitive areas will be flagged or marked as needed.

6. Plants propagated for habitat enhancement planting will be inspected and ensured to be free of invasive species.

7. All livestock forage, seed, and erosion control materials will be weed free to prevent the spread of invasive species.

8. All equipment used to control invasive plants will be cleaned before being moved from one location on the installation to another.

9. All plant debris potentially containing reproductive parts (i.e., seeds or plant fragments for species that reproduce vegetatively) will be disposed of at an off-site landfill or green waste facility. It will be transported in a manner that prevents the spread of invasive plants to other locations. This action may require, but is not limited to, bagging the material before it is transported off-site.

10. During project activities, all trash that may attract animals will be properly contained, removed from the work site daily, and disposed of properly. Following construction, all refuse and construction debris will be removed from work areas. All garbage and project construction-related materials in construction areas will be removed immediately following project completion.

11. Any worker that kills or injures a federally protected species, or finds one injured or trapped, will immediately report the incident to the on-site biologist and stop activities. The biologist will inform the Beale NRM immediately. The Beale NRM will verbally notify Cathy Johnson of the Service's Sacramento Fish and Wildlife Office immediately and will provide written notification of the incident within five calendar days.

12. A Service-approved biologist or natural resources monitor will inspect heavy equipment being brought from off-base for cleanliness to minimize spread of invasive and noxious weeds onto and around Beale AFB. The designated biologist or monitor may reject equipment that has visible clumps of mud when arriving on site. The biologist or monitor will also identify any listed noxious weed found on the project site, and will hand-pull noxious weeds where practical.

<u>*Site Access*</u>

1. Established roads, both paved and unpaved, will be used to the maximum extent practicable. In areas where this is not possible, preexisting disturbed areas will be used to the maximum extent practicable.

2. No work requiring vehicles/equipment will be done when the ground is soft enough that travel will cause depressions as determined by a natural resources monitor.

3. When it is not practical to stage or operate project vehicles or equipment on paved or existing roadways and trails, Beale AFB will stage and operate vehicles and equipment in an area designated by a Service-approved biologist, where activities are least likely to impact native vegetation.

4. The number of access routes, number and size of staging areas, and the total area of the activity will be limited to the minimum necessary to achieve the proposed project goal. Routes and boundaries will be clearly demarcated, and these areas will avoid wetlands/drainage areas whenever feasible. All access routes will be restored to normal grade and revegetated with a certified weed free seed mix approved by 9 CES/CEIE at project completion.

5. In the event that a new vehicle access route is required in special status species habitat, the NRM and the Service will be notified to determine actions required to minimize impacts. If routes will be reused over multiple years, they will be assessed annually to ensure that they are clear of special status species.

6. All vehicle operators will follow the posted speed limit on paved roads and a 15-miles per hour speed limit on unpaved roads. Per the Fugitive Dust Emissions Rule, a person shall take every reasonable precaution to not cause or allow the emissions of fugitive dust from being airborne past the action area especially near federally protected species or their habitats.

Herbicide Application

1. Herbicide will only be administered by current Qualified Applicator Certificate holders (minimum qualification) from the California Department of Pesticide Regulation. If the applicator will be using herbicides within jurisdictional wetlands or waters of the U.S., the applicator must also have passed the Aquatic Category of the California Qualified Applicator Test. The Installation Pest Management Coordinator will receive qualifications from applicators within 30 calendar days of contract award. These applicators must know and be able to recognize sensitive resources including listed wildlife, plants, vernal pools, and nesting birds. If not, they will receive environmental awareness training.

2. All herbicides will be applied in accordance with the IPSMG; the Beale AFB Installation Pest Management Plan; the Air Force Pest Management Program; a General National Pollutant Discharge Elimination System (NPDES) Permit for Residual Aquatic Pesticide Discharges; all applicable federal, DoD, USAF, State of California, and local directives and regulations; and label instructions. All pesticides applied must be USAF-approved.

3. Hazardous materials storage and equipment staging and storage will occur at least 150 feet away from sensitive habitats.

4. Herbicide will not be applied during rain nor immediately following rain when soil is saturated or runoff or standing water is present. Application will only occur under favorable weather conditions, defined as:
    a. 50% or less chance of precipitation on the day of application based on National Oceanic and Atmospheric Administration weather forecasting, and
    b. If rain, showers or light rains are predicted within 48 hours, the amount of rain predicted shall be no more than ¼ inch of rain, and
    c. Rain does not appear likely at the time of application

5. Drift of herbicides will be limited by not spraying when wind speeds exceed 10 miles per hour or as indicated by label instruction to protect nearby non-target vegetation by minimizing drift. The applicator will ensure that only the necessary amount of herbicide to effectively

treat the target plants is used and that all herbicides are used within their given heat tolerances to avoid volatilization.

6. Herbicide applicators will prescribe and use only non-ionic surfactants near open water. These surfactants are readily biodegradable and low in aquatic toxicity.

7. In areas with sensitive resources, low-volume applications and reduced application rates will be used. Spot applications rather than broadcast applications will be used when feasible to limit the effects of contamination of small mammals' insect-based diets (Cal-IPC 2015).

8. All herbicide application will follow the minimum buffers outlined in Table 2 when applying herbicide near aquatic features. These buffers do not apply to imazamox (Clearcast), which is an aquatic herbicide that will not be used near vernal pools. A Service -approved biologist or NRM who is supervising or conducting treatment may, on a case by case basis, reduce buffers after getting verbal (followed by email) agreement from Cathy Johnson of the Service's Sacramento Fish and Wildlife Office. Herbicide will not be applied directly into a vernal pool or vernal swale.

9. Only an herbicide labelled for aquatic use may be applied near aquatic resources, even when dry.

10. When using sprayable or dust formulations and the air is calm or moving away from habitat, commence applications on the side nearest the habitat and proceed away from the habitat for spray drift near suitable listed species habitat.

11. When air currents are moving toward habitat, do not make applications within 120 feet upwind from occupied habitat for spray drift near suitable listed species habitat for sprayable or dust formulations

12. The county agricultural commissioner may reduce or waive buffer zones following a site inspection, if there is an adequate hedgerow, windbreak, riparian corridor or other physical barrier that substantially reduces the probability of drift (CA Department of Pesticide Regulations [DPR] 2019).

13. Soil Active Herbicides (chlorsulfuron and imazapyr) will not be applied within 30 yards upslope of suitable listed species habitat unless a suitable method is used to contain or divert runoff waters (CA DPR 2019).

Table 1. Minimum buffers for various herbicide applications.

Active Ingredient	**Application Method**	**Dry Aquatic Features[1] (ft)**	**Streams[1] or Ditches with Water (ft)**	**Special Aquatic Features (vernal swales & pools)[2] (ft)**
Aminopyralid	Spot & directed foliar spray	25	25	100
	wiping	15	15	15
Chlorsulfuron	directed foliar spray	25	100	100
	Wiping	15	15	15
Glyphosate	directed foliar spray or drizzle	0	25	25[3]
	cut stump or wiping	0	15	15[3]
Imazamox	direct application	0	0[5]	n/a
Imazapyr	Directed foliar spray	25	75[4]	75
Sulfometuron methyl	Spot and pre-emergent	50	100	100
Triclopyr (TEA)	directed foliar	25	75	75
	wiping or cut stump	15	15	15
Triclopyr (BEE)	Spot & directed foliar spray	75	250	250
	cut stump	75	75	75

[1] As measured from the edge of the stream channel. If a defined channel is not present (draws do not have defined channels), measurement is from the bottom of the feature.
[2] As measured from the edge of the wet area surrounding the special aquatic feature, or the vernal pool vegetation, whichever is greater.
[3] Only non-POEA containing formulations may be used.
[4] With the exception of giant reed treatment in Dry Creek and Best Slough.
[5] Imazamox will not be applied directly to flowing water, water where the outflow cannot be controlled, to Dry Creek, Best Slough, or their tributaries.

Fairy Shrimp and Tadpole Shrimp

All projects that occur within 250 feet of known or potential fairy shrimp and tadpole shrimp habitat, will implement the following measures to avoid or minimize disturbances and adverse effects to the species:

1. With the exception of manual removal (i.e. hand-pulling), no work will be conducted in the vicinity of suitable vernal pool species' habitat between 1 November and May 1. Permission to work outside of the 1 November and 1 May timeframe may be granted from the NRM in coordination with the Service, in certain weather conditions. Work continuation is dependent on prevailing conditions, forecasted weather, and whether or not activities will damage soil or vegetative cover. The only work allowed 12 hours before or after a storm event is the inspection, installation, and/or maintenance of erosion control BMPs. The NRM must be contacted to obtain permission to work after each storm event. Permission to work after 1 November will not be granted once wetlands are activated (standing water present).

2. If mowing occurs in or near vernal pools, it will occur only when the soil is no longer saturated to ensure tracks are not left in or near wetlands. The mower height must be set to avoid the flowering heads of sensitive vernal pool plant species.

3. No hand-lines will be cut within 50 feet of wetlands during a prescribed fire conducted near or within potential fairy shrimp and tadpole shrimp habitat. Only black lining (back burning a perimeter) and wet lining (mowing and then wetting an area to prevent combustion) will be used to create fire lines within 50 feet of wetlands.

4. Projects that occur on road surfaces and along road shoulders will avoid direct impacts to wetland habitats, including roadside ditches that act as seasonal wetlands.

    a. Roadside herbicide application will avoid ditches and other potential fairy shrimp and tadpole shrimp habitat.

    b. Roadside mechanical or hand removal will avoid leaving biomass in ditches or other fairy shrimp and tadpole shrimp habitat.

5. If access routes crossing vernal pool habitats cannot be avoided, ground protection mats will be used on dry pools to disperse the weight of vehicles and equipment so as to not harm any existing cysts.

6. Upon approval from the NRM in coordination with the Service, a Service-approved biologist will flag vernal pool species' habitat to be avoided. The area will be protected by placing construction fencing or other appropriate protective fencing around the pools, including a buffer. Fencing will be used in locations where project equipment and/or personnel will be situated adjacent to or in the vicinity of suitable vernal pool species' habitat.

7. If herbicide spraying is required near vernal pool species' habitat, only herbicides and adjuvants approved for use in aquatic environments will be used. Buffer distances outlined in Table 1 will be followed. A Service-approved biologist who is supervising or conducting treatment may, on a case by case scenario, and after approval with the NRM and coordination with Cathy Johnson of the Service's Sacramento Fish and Wildlife Office, reduce these buffers.

8. No herbicide will be sprayed within vernal pools at any time.

9. If necessary to meet conservation goals, non-POEA glyphosate may be applied up to the boundary of a vernal pool when the pools and surrounding habitat is dry. All applications must be conducted by a Service-approved biologist, and after approval of the NRM and coordination with Cathy Johnson of the Service's Sacramento Fish and Wildlife Office.

10. If invasive species removal is required within a vernal pool (e.g., *Glyceria* infestations), only hand-pulling or hand tools will be used, with the minimum amount of soil disturbance required to remove target invasive species. All non-native biomass removed will be disposed of in a landfill. All soil will be replaced/left in the vernal pool it came from.

11. All equipment used in projects requiring access to sites within vernal pool species' habitat will be staged outside of vernal pool habitat and will be on paved or gravel surfaces wherever possible. If paved or gravel surfaces are not available, construction mats and or drip pans will be placed under vehicles to minimize impacts. To further minimize adverse effects, the following measures will be implemented at project sites near vernal pools:

    a. No work shall occur within vernal pool habitat when water is present.

    b. As necessary, a Service-approved biologist will be present during access and project work within vernal pool habitat to monitor activities.

    c. For projects adjacent to (within 30 feet) vernal pool species' habitat or hydrologically connected to the habitat, silt fencing or other appropriate best management BMPs to prevent siltation shall be implemented prior to work within that area. A Service-approved biologist will flag areas where silt fencing or BMPs shall be implemented. BMPs may include sand bags and weed-free straw bales or straw wattles.

    d. Spill containment kits will be present at all sites where petroleum-fueled equipment is used.

12. If project activities encroach within the perimeter of a pool, the following measures will be implemented:

    a. Protective mats will be used as a first resort, if not possible, equipment with pneumatic tires should be used over tracked equipment.

    b. Non-wetlands present within adjacent habitat will be used as an equipment-parking platform. Alternately, ground protection mats, boards, or plates will be used to distribute the weight of construction equipment for access. Drip pans will also be placed under vehicles parked on non-wetland vegetation.

    c. Projects will be implemented during the dry season only, when the pool is dry.

13. Pre- and post-project surveys will be conducted to record habitat condition before the start of a project and after completion of the project for tracking purposes. This may include photos and/or species surveys and will be used to better manage for the species.

Valley Elderberry Longhorn Beetle

All projects that occur within 100 feet of elderberry shrubs with stems of 1-inch diameter or more will implement the following measures to avoid or minimize disturbances and adverse effects to the species:

1. Prior to start of construction activities in known beetle habitat, a Service-approved biologist will conduct surveys to determine the presence of elderberry shrubs within a buffer of 100 feet of the project footprint to determine areas to be avoided.

2. All areas to be avoided during construction will be fenced and flagged by a Service-approved biologist.

3. A Service-approved biologist will monitor the work area at project-appropriate intervals to assure that all avoidance and minimization measures are implemented. The amount and duration of monitoring required will depend on the project specifics and will be discussed with the Service-approved biologist.

4. If encroachment of the 100-foot buffer cannot be avoided, a 20-foot buffer from the dripline of the plant will be established, fenced and flagged.

5. As much as feasible, all activities that could occur within 100 feet of an elderberry shrub, will be conducted outside of the flight season of the beetle (March–July).

6. No herbicides, or other chemicals that might harm the beetle or its host plant will be used within 100 feet of any elderberry plant. All herbicides used within 250 feet of an elderberry plant will be applied using a backpack sprayer or similar direct application method. Herbicide may be applied up to 20 feet from the drip line of elderberry shrubs, but only under the direction of a Service-approved biologist.

7. No pre-emergent or persistent herbicides will be used within 100 feet of elderberry shrubs.

8. Mechanical weed removal such as mowing and weed-whacking, within the dripline of the shrub will be limited to the season when adult beetles are not active (August–February). When weed removal needs to occur during the active season, weeds will be removed by hand or using non-electric hand tools only. Project site will be accessed by foot only. No chemicals or electric tools (mowers, weed-whackers) will be used.

9. As necessary, a Service-approved biologist will be present during access and project work within beetle habitat to ensure that no damage to elderberry shrubs occurs.

10. Erosion control will be implemented, and the affected area will be re-vegetated with appropriate native plants.

11. If prescribed burns are conducted in an area with elderberry shrubs present, a minimum 100-foot buffer will be maintained around each shrub.

12. Any shrubs within grazed areas will be fenced and adequately protected. A natural resources monitor will periodically check protected shrubs to maintain fences etc.
13. Pre- and post-project surveys will be conducted to record habitat condition before the start of a project and after completion of the project for tracking purposes. This may include photos and/or species surveys and will be used to better manage for the species.

Western Yellow-Billed Cuckoo

If projects will be conducted within 1,000 feet of suitable cuckoo breeding habitat during the breeding season (June 1–August 31), a Service-approved biologist will make an initial site visit to verify the habitat suitability and determine the need for implementation of any conservation measures, or whether additional surveys are needed. Beale AFB may (depending on survey results) implement the following measures to avoid or minimize disturbances and adverse effects to the species:

1. Any projects that involve excessive noise (81 dB or more) or other disturbance within suitable cuckoo habitat, commencing between June 1 and August 31 (migration and breeding season), will require a minimum of three pre-construction surveys to be conducted by a Service-approved biologist.
   a. Surveys will follow *Western Yellow-billed Cuckoo Natural History Summary and Survey Methodology* (Halterman et al. 2015).
   b. A minimum of three pre-project surveys will be conducted within a 1,000-foot buffer of the proposed project footprint and will take place within 30 calendar days before the onset of construction or vegetation removal activities. The final survey will be within three days of commencement of activities.
2. If nests are detected, Beale AFB Environmental staff will establish buffers around nests that are sufficient to ensure that breeding is not likely to be disrupted or adversely impacted by the proposed project.
   a. No-disturbance buffers around active nests will be a minimum of 1,000 feet, unless a Service-approved biologist determines that smaller buffers will be sufficient to avoid impacts to nesting cuckoos.
   b. Factors to be considered for determining buffer size will include: the presence of natural buffers provided by vegetation or topography, nest height, locations of foraging territory, and baseline levels of noise and human activity.
   c. Buffers will be maintained until a Service-approved biologist has determined that young have fledged and are no longer reliant upon the nest or parental care for survival.
3. No riparian vegetation alterations will occur in potential cuckoo breeding habitat areas during the cuckoo nesting season, June 1 – August 31. This includes mechanical removal and herbicide spray treatment.
   a. If vegetation removal cannot be avoided during this time period, a Service-approved biologist will conduct a minimum of five surveys in the 30 calendar days leading up to the commencement of the project, with the final survey conducted within three days of commencement of the project.
4. Herbicide treatments will be applied without motorized equipment during the nesting

season (June 1 – August 31) unless otherwise approved by NRM staff. If a need for this is determined, surveys will be conducted first to ensure no nests are present.

5. Conservation measures will be adjusted if additional guidelines are released by the Service.
6. Pre- and post-project surveys will be conducted to record habitat condition before the start of a project and after completion of the project for tracking purposes. This may include photos and/or species surveys and will be used to better manage for the species.
7. Prescribed burns will be limited to non-breeding season (September 1 through May 31) within 500 feet of suitable cuckoo breeding habitat.
8. No high-intensity grazing will occur within the Dry Creek and Best Slough riparian corridor or other suitable cuckoo breeding habitat. Targeted grazing for invasive plant and vegetation control may occur.

Monarch Butterflies

Although monarch butterflies are not a listed species, Beale AFB proposes avoidance and minimization measures to conserve created and actively occupied monarch habitat. All projects that occur within 100 feet of milkweed plants or 250 feet from occupied habitat (roosting and breeding sites), will implement the following measures to avoid or minimize disturbances and impacts to the species. Where surveys for milkweed have not been conducted, either pre-project surveys or during-project surveys will identify milkweed stands. Additionally, if milkweeds are identified within the project area, then surveys for adult and larval monarchs will be conducted both before and after the project.

1. All individuals conducting weed control activities within the buffer area (100 or 250 feet as defined above) will receive training by a Service-approved biologist on the identification of milkweed plants and a description of both adult and larval monarchs in order to identify and avoid milkweed and monarchs during all activities.

2. No herbicide application will take place within 100 feet of occupied monarch habitat (including milkweed) when monarchs are present (adults or larvae), generally 15 March through 31 October. If herbicide application must occur within 100 feet of occupied monarch habitat, then application will only be conducted using targeted spraying, cut stump, and wiping by a Service-approved biologist and will be no closer than 2 feet.

3. Actively unoccupied growing milkweed will be avoided by a minimum of 2 feet during the application of herbicides (target spray, cut stump, wiping and wicking). Herbicide application within 50 feet of a milkweed plant will be conducted with a low-pressure backpack sprayer to reduce the risk of drift.

4. No broad-spectrum herbicide application will take place within 100 feet of occupied monarch habitat when wind speeds exceed 10 mph, or temperatures exceed 85°F to minimize potential for drift and volatilization.

5. No persistent or pre-emergent herbicides will be used within 100 feet of milkweed or other occupied monarch habitats (e.g., roosting sites).

6. Milkweed numbers and species will be assessed in project areas where impacts to milkweed may occur due to activities such as ATV access and herbicide application.

7. The impacts of milkweed removal in known monarch breeding areas will be minimized by planting equivalent milkweed species at a 3:1 ratio. The impacts of milkweed removal in habitat not known to be used by monarchs will be minimized by planting milkweed at a 2:1 ratio.

8. Areas within or adjacent to occupied habitat (within 250 feet of a documented monarch breeding or roosting location), lacking extensive milkweed, where successful control of invasive species has been achieved, will be prioritized for planting.

9. All newly planted milkweed will be regionally native and preferably of the same species removed. Milkweed species selection and replanting location will be at the discretion of the NRM.

10. A 2-foot buffer will be maintained around extant milkweed plants during off-road vehicle access, restoration and habitat enhancement planting, and other ground-disturbing activities to protect breeding habitat.

11. Willows and other trees known to be or with the potential to be used as roosting sites (within occupied habitat) will be preserved.

    a. Except for cut stump and wiping of target species, no herbicide application will occur during the active season of monarchs (15 March through 31 October) within 50 feet of known or potential roosting sites.

    b. No trimming of trees used by monarchs as roosting sites will occur during the active season (15 March through 31 October).

12. Heavy cattle or horse grazing in areas with low RDM (below approximately 1000-1200 pounds per acre (lbs./ac)) or grazing with sheep and goats will not occur in locations known to be occupied by monarchs during the active season (15 March through 31 November) to prevent soil compaction and trampling of milkweeds.

13. Riparian areas and drainages with known habitat used by monarchs (e.g., milkweed stands and roosting sites along Dry Creek, Hutchinson Creek) will be excluded from grazing.

14. Any enhancement projects occurring in or adjacent to known monarch breeding locations will incorporate native plants important for monarchs (e.g., milkweeds, late-season flowering shrubs).

15. No prescribed fire treatment will occur within 100 feet of habitat occupied by monarchs during the active monarch season (15 March through 31 October).

16. Any areas within 250 feet of known monarch breeding habitat requiring reseeding will include species beneficial to monarchs, including native milkweed. All seed mixes must be approved by the NRM.

17. Mowing projects during the summer will be conducted during the morning to avoid injuring resting monarchs.

18. Generally, mowing will not be conducted within 100 feet of areas with suitable monarch habitat during the active season (15 March through 31 October).

    a. If mowing must be conducted (i.e. for habitat restoration projects benefiting monarchs or other listed species) and vehicle access must be allowed, all milkweed plants will be identified and avoided.

    b. Additionally, if mowing occurs from March to June near areas where breeding occurs, mowing height will be set to a minimum of 10-12 inches to avoid cutting newly emerged plants.

19. Conservation measures will be adjusted if additional guidelines are released by the Service.

Fairy Shrimp and Tadpole Shrimp

The proposed project is located within the range of the fairy shrimp and the tadpole shrimp and they are known to occur on Beale AFB properties. The proposed project, as outlined by Beale AFB, may have short-term effects on the fairy shrimp and tadpole shrimp; however, implementation of the proposed project will have long-term beneficial impacts to the fairy shrimp and tadpole shrimp. The objective and expected outcome of the proposed project is improved functionality and integrity of vernal pool habitat through the control and management of non-native plant species. Successful improvement in vernal pool function and invasive plant biomass reduction are expected to improve fairy shrimp and tadpole shrimp occupancy rates and frequency. Due to the avoidance and minimization measures proposed by Beale AFB and the future benefits of the proposed project, the Service believes the proposed projects benefits outweigh the short- term effects.

After reviewing all the available information, the Service concurs with your determination that the proposed project may affect, but is not likely to adversely affect the fairy shrimp and the tadpole shrimp. Given the proposed conservation measures outlined above, and the expected benefits to vernal pool habitat, proposed project effects are likely to be discountable.

Valley Elderberry Longhorn Beetle

The proposed project occurs within the known historical range of the beetle and there is suitable elderberry shrub habitat for the beetle within the Dry Creek/Best Slough riparian area, which contains elderberry shrubs. Located on the southeastern side of Beale AFB, this area is on Best Slough and designated for preservation (EDAW 2005). Hutchinson Creek riparian corridor, in the center of Beale AFB, and the Reeds Creek riparian corridor, west of the flight line, are the only other areas on the Beale AFB properties that contain elderberry shrub habitat; however, the Dry Creek/Best Slough riparian corridor support a far greater density of the shrubs. There are 853 mapped elderberry shrubs located on Beale AFB.

The nearest documented CNDDB occurrence of the VELB is approximately 1.2 miles north of the northwest corner of Beale AFB (CNDDB 2019). This record is from 1998 and indicates that an elderberry shrub was found near a transmission line. There are 17 additional CNDDB documented occurrences, consisting of species and exit-hole observations, within a 10-mile radius of the action area (CNDDB 2019). A 2005 survey of elderberry shrubs on the southeast corner of Beale AFB performed by EDAW found that 13 of 51 elderberry shrubs surveyed contained beetle exit holes (EDAW 2005). Surveys conducted in 2012 by H T Harvey and Associates reported only one shrub in 50 with an exit hole (H T. Harvey 2013). The 2016 survey report found evidence of beetle in five of 50 shrubs surveyed (AuxiliALL 2017).

There is no suitable elderberry shrub habitat for the beetle at the LRS. The unnamed canal in the northeast corner of the LRS is unvegetated and contains no elderberry shrubs along its banks. The remaining area of the site is largely vernal pool habitat that would not support elderberry shrubs (Beale AFB 2008a). Numerous data sources, including CNDDB and Beale AFB surveys, have not identified the occurrence of the beetle or elderberry shrubs at the LRS. The closest documented occurrence is a CNDDB recorded occurrence from 2003 approximately seven miles north of the Lincoln Receiver Site (CNDDB 2019). There is a total of five documented occurrences within a 10-mile radius of the LRS (CNDDB 2019).

The beetle has the potential to and does occur on Beale AFB in the Dry Creek/Best Slough High Integrity Area Conservation Planning Category (CPC), in the southwest corner of Beale AFB, in the riparian corridors of Hutchinson Creek, in the middle of Beale AFB, and at Reeds Creek, west of the flight line, where elderberry shrubs exist. These three locations are the only locations on the Beale AFB properties where the beetle has the potential to occur. However, if other elderberry shrubs are detected on the Beale AFB properties, this statement will be reevaluated, and the Service will be notified. The presence of the elderberry shrubs in these areas and documented evidence of the species suggests that the species is likely to persist on the Beale AFB given current conditions, although to date no adult beetles have been observed on Beale AFB properties.

After reviewing all the available information, the Service concurs with your determination that the proposed project may affect, but is not likely to adversely affect the beetle because the project effects are likely to be discountable based on implementation of the conservation measures, including buffers, and working outside of the beetle flight season.

Western Yellow-Billed Cuckoo

The proposed project is located within the range of the cuckoo and there have been three possible, but not confirmed, observations of the cuckoo in the past five years on Beale AFB. There were no visual observation confirmation in the southeastern portion of Beale AFB. On June 3, 2016 an audible observation occurred during a Monitoring Avian Productivity and Survivorship (MAPS) bird banding at a station on Best Slough (AuxiliALL 2016).

Surveys and a baseline habitat assessment in 2018 found no evidence of the cuckoo on Beale AFB, and only three small patches of poor quality breeding habitat were identified, with the likelihood of use for breeding extremely low (Halterman 2019). Additional areas were identified that have marginal habitat that will not support breeding, but could be used during migration (Halterman 2019). CNDDB (2019 and 2020) has two reports of the cuckoo within a 10-mile radius of Beale AFB. There is no habitat for the cuckoo at the LRS site and no CNDDB occurrences within a 10-mile radius (CNDDB 2020). The Service believes that it is highly unlikely the cuckoo will be present within the action area.

After reviewing all the available information, the Service concurs with your determination that the proposed project may affect, but is not likely to adversely affect the cuckoo. Given the proposed conservation measures outlined above, and that it is highly unlikely the cuckoo will be present within the action area, proposed project effects are likely to be discountable.

This concludes informal consultation on the Non-Native and Noxious Plant Species Management Project. Therefore, unless new information reveals effects of the proposed project that may affect listed species in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed project, no further action pursuant to the Act is necessary at this time. Please note, however, that this letter does not authorize take of listed species.

If you have any questions regarding the proposed Non-Native and Noxious Plant Species Management Project, please contact Cathy Johnson, Fish and Wildlife Biologist (cathy_s_johnson@fws.gov) at (916) 414-6596 or Jenn Hobbs, Acting Assistant Field Supervisor (jennifer_hobbs@fws.gov), (916) 414-6541 or by email.

Sincerely,

Jennifer Hobbs
Acting Assistant Field Supervisor

ec:
Tamara Gallentine, Department of the Air Force, Beale Air Force Base, California

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Correspondence Re: Informal Consultation with USFWS on the Biological Assessment for Non-Native and Noxious Plant Species Management at Beale Air Force Base

28 May 2020

Gmail **Maia Lipschutz <maia.lipschutz@gmail.com>**

RE: Non-Native and Noxious Plant Species Project

5 messages

MCCREADY, CHADWICK A CTR USAF ACC 9 CES/CEIER <chadwick.mccready.ctr@us.af.mil> Tue, Jun 2, 2020 at 5:13 PM

To: "GALLENTINE, TAMARA A GS-12 USAF ACC 9 CES/CEIEC" <tamara.gallentine.2@us.af.mil>, "McCready,Chadwick" <Chadwick.McCready@colostate.edu>
Cc: Maia Lipschutz <maia.lipschutz@gmail.com>

Thanks Tamara, I will adjust accordingly.

Respectfully,

Chadwick McCready, Biologist

Center for Environmental Management Military Lands 9th CES/CEIE

6425 B street

Beale AFB, CA 95903

(530) 634-4391

From: GALLENTINE, TAMARA A GS-12 USAF ACC 9 CES/CEIEC <tamara.gallentine.2@us.af.mil>
Sent: Tuesday, June 2, 2020 4:46 PM
To: MCCREADY, CHADWICK A CTR USAF ACC 9 CES/CEIER <chadwick.mccready.ctr@us.af.mil>
Subject: FW: Non-Native and Noxious Plant Species Project

FYI

From: Johnson, Cathy S <Cathy_S_Johnson@fws.gov>
Sent: Thursday, May 28, 2020 9:20 AM
To: GALLENTINE, TAMARA A GS-12 USAF ACC 9 CES/CEIEC <tamara.gallentine.2@us.af.mil>
Subject: [Non-DoD Source] Non-Native and Noxious Plant Species Project

Hi Tamara - just a follow up on our conversation on Monday regarding the change in determination for VELB for the Non-Native and Noxious Plant Species Management Project and additions to conservation measures.

As discussed I added the following *"after approval with the NRM and coordination with Cathy Johnson of the Service's Sacramento Fish and Wildlife Offce"* to conservation measures VP7 and VP9.

We also agreed the February 2020 BA did not include the information needed to proceed with your determination of LAA for VELB. No compensation for habitat acreage or shrubs were mentioned in the BA. To proceed with this consultation with the LAA determination we would need more information on acres of habitat that would be effected; and/or shrubs replaced/transplanted and compensation for these effects to VELB. In the BA, it states up to 21,000 acres will be treated annually and that there are 853 shrubs on Beale with no reference of how many acres (or shrubs) of VELB habitat will be compensated for or potentially damaged. We further discussed Beale's ability to avoid VELB habitat and Beale changing its determination of LAA to NLAA. We recommend that Beale re-evaluates the proposed project effects on VELB and submit to the Service a revised letter and BA addressing the issues discussed on our phone conversation.

Due to COVID-19 and our full-time telework policy, please submit revised and or supplemental information to me electronically.

Please give me call if you would like to discuss further. Thank you!

All the best, Cathy

~~~~~~

Cathy Johnson

U.S. Fish and Wildlife Service

2800 Cottage Way W-2605

Sacramento, CA 95825

cathy_s_johnson@fws.gov

"In an effort to slow the spread of the coronavirus (COVID-19), the Sacramento Fish and Wildlife Office has implemented a full-time telework schedule. At this time, we are responding to requests for information via email or phone as often as possible as we do not have the in-office capacity to support regular mail service. We appreciate your understanding."

Maia Lipschutz <maia.lipschutz@gmail.com> Wed, Jun 3, 2020 at 8:14 AM
To: "MCCREADY, CHADWICK A CTR USAF ACC 9 CES/CEIER" <chadwick.mccready.ctr@us.af.mil>

This will affect what is in the EA. I was almost done with the draft. Do you have time to change this, or do you want me to take a stab at it?
[Quoted text hidden]

2 attachments

image001.png
1K
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Informal Consultation Concurrence from USFWS on the Proposed Invasive Weed Control on Reeds Creek

at Beale Air Force Base

8 October 2015

United States Department of the Interior

FISH AND WILDLIFE SERVICE
Sacramento Fish and Wildlife Office
2800 Cottage Way, Suite W-2605
Sacramento, California 95825-1846

In Reply Refer to:
08ESMF00-
2016-I-0006

OCT 0 8 2015

Gregory S. Capra
Deputy Base Civil Engineer
9 CES/CD
6601 B Street
Beale AFB, California 95903-1708

Subject: Informal Consultation on the Proposed Invasive Weed Control on Reeds Creek at Beale Air Force Base, Yuba County, California

Dear Mr. Capra:

This letter is in response to Beale Air Force Base's (Beale AFB/base), September 24, 2015, request for initiation of informal consultation with the U.S. Fish and Wildlife Service (Service) on the proposed Invasive Weed Control on Reeds Creek (proposed project), in Yuba County, California. Your request, which included the September 2015, *Invasive Weed Control on Reeds Creek at Beale Air Force Base - Informal Consultation* (biological assessment), was received by the Service on September 29, 2015. The biological assessment presents an evaluation of the proposed project's effects on species federally-listed under the Endangered Species Act of 1973, as amended (16 U.S.C. §1531 *et seq.*) (Act).

The federal action we are consulting on is the application of herbicide to Himalayan blackberry along Reeds Creek at Beale AFB. This response is provided under the authority of the Act, and in accordance with the implementing regulations pertaining to interagency cooperation (50 CFR 402).

The findings presented in the project information conclude that the proposed project may affect, but is not likely to adversely affect the federally-listed as threatened giant garter snake (*Thamnophis gigas*) (snake), valley elderberry longhorn beetle (*Desmocerus californicus dimorphus*) (beetle), vernal pool fairy shrimp (*Branchinecta lynchi*) (fairy shrimp), and the federally-listed as endangered vernal pool tadpole shrimp (*Lepidurus packardi*) (tadpole shrimp). You came to this determination by analyzing the effects of the proposed project using the October 2, 2012, *Programmatic Biological Opinion for Actions Associated with the Special Area Management Plan for Beale Air Force Base, Yuba County, California* (Service 2012b) (SAMP programmatic) and through discussions with the Service prior to initiating informal consulation. The SAMP programmatic was created to provide a framework to help Beale AFB personnel determine the effects of future proposed projects on federally-listed species within the base.

The findings and recommendations in this consultation are based on: (1) your September 29, 2015, letter initiating consultation; (2) the September 2015 biological assessment, prepared by Beale AFB; (3) the October 2, 2012, SAMP programmatic (File# 81420-2009-F-1118-1); (4) email and telephone correspondence between the Service and Beale AFB; and (5) other information available to the Service.

Project Description

Beale AFB is home to an active runway and flight line, and the 9th Reconnaissance Wing requires the base to follow a Bird/Wildlife Aircraft Strike Hazard (BASH) Plan designed to minimize bird strikes, which create a severe threat to human life in addition to aircraft damage. Some key requirements found in the BASH plan include minimizing and reducing conditions that are attractive to birds around the flight line. Beale AFB is proposing to reduce the base's flight hazard by eliminating invasive Himalayan blackberry bushes along Reeds Creek that provide habitat to various blackbird species. Beale AFB's active runway and flight line are located less than 1.5 miles away Reeds Creek and in early June 2015, flight operations were halted due to increased activity from blackbirds nesting along Reeds Creek.

Proposed project work will be confined to 13.1 acres of invasive Himalayan blackberry that were mowed/masticated in June 2015 after flight operations were halted (see Appendix, Figure 1). Project activities will consist of applying herbicide on new growth of invasive Himalayan blackberry stands. Under the Invasive Species Management Program, as part of Beale AFB's Pest Management Plan and BASH Management Techniques, herbicide application is a standard method to eliminate avian congregation sites near the flight line.

The proposed project locations (see Appendix, Figures 2 through 5) encompass the maximum area of impacts and include the locations of the herbicide application and access routes to reach the various locations. The application of up to 5 upland acres will be completed fall 2015 and the treatment for the remaining acres will be completed in 2016. The contractor will comply with all the proposed Avoidance and Minimization Measures to prevent any environmental impacts.

Ground disturbance associated with herbicide application will be temporary and limited to access routes needed to reach project areas. Proposed staging or laydown areas are not required to complete the work. Small equipment such as a 4 x 4 ATV or tractor with a tank attachment or a backpack sprayer will be required to apply the herbicide. Any herbicides will be mixed off-base in an appropriate location to prevent spills and/or contamination concerns.

Per the SAMP programmatic (Service 2012b), the proposed project is located within a High Integrity/Conservation Area that indicates a location with aquatic resource features and associated watersheds with higher habitat integrity, aquatic habitats with wildlife connectivity value, or areas that have been previously designated for conservation by Beale AFB. These areas are more likely to provide higher quality habitat suitable to support any of the listed species identified in the SAMP programmatic, especially habitat for the fairy shrimp, tadpole shrimp and giant garter snake (Service 2012b). Although the proposed project activities take place immediately adjacent to Reeds Creek, there will be no ground disturbing activities within listed species habitat. All trucks and equipment will be staged and stored away from Reeds Creek, and no equipment will be left at the project site overnight.

Project activities are covered under the SAMP programmatic as *Vegetation Management* under Other Activities (Service 2012b). The proposed project will minimize access routes and limit overall temporary ground disturbance associated with access routes that allow for completion of the required work. Fall is the optimal time to spray herbicides on the Himalayan blackberry bushes because they are already in a stressed state from low water availability. Additionally, the plants are pulling carbohydrates to the roots for winter storage, which allows herbicide to affect the roots better and thus increase the percentage of eradication. Further mechanical removal was considered, but it will likely result in potentially greater impacts on the environment than the proposed herbicide application. Furthermore, mechanical removal will not solve the problem as the Himalayan blackberry will likely return. Distances from the access routes to wetland features were maximized during the planning process. See the Appendix, Figures 2 through 5 for further details on access routes.

Avoidance and Minimization Measures

The avoidance and minimization measures below are included as part of the proposed project to fulfill the criteria in the SAMP programmatic for a "not likely to adversely affect" determination. These measures include the *Species Specific Avoidance and Minimization Measures* described in the SAMP programmatic and are further described below.

1. A Service-approved biologist will conduct pre-implementation surveys of all treatment areas within sensitive habitats to determine if any listed species may be present prior to the start of herbicide application. If any listed species are encountered during pre-implementation surveys, the Service will be contacted to determine how to proceed.

2. Best Management Practices will be implemented to prevent herbicide application from entering vernal pools that are within 100 feet of, or have a hydrologic connection to, the project site. This includes but is not limited to, the use of silt fencing, straw bales, and straw wattles.

3. A Service-approved biologist will monitor project activities to ensure compliance with the avoidance and minimization components of the proposed project. The biological monitor will also ensure construction personnel are in compliance with all avoidance and minimization measures. The biologist will have the authority to stop any aspect of the project and if they exercise this authority, they will notify the Service within 1 working day.

4. A Service-approved biologist will conduct environmental awareness training for herbicide crews before project implementation. The education program will briefly cover the listed species and their habitats that might be encountered during project implementation. The awareness training will cover all of the restrictions and guidelines that must be followed to avoid or minimize impacts on listed species and their habitat. The training will also include the penalties for violating the provisions of the Act. Environmental awareness training will be conducted prior to construction, when crews are about to enter potentially sensitive areas and/or when new personnel join the construction crews.

5. Current state pesticide applicator licenses and necessary training will be maintained by the contractor or in house personnel performing the work. All herbicide application instructions will be followed. Approved herbicide will be applied in waters of the United States, but herbicides will not be applied during wet weather or 12 hours before or after a rain event.

Herbicides will only be applied when winds are less than 5 miles/hour. Herbicides will be mixed at an approved location outside of Beale AFB.

6. Beale AFB will track the area of impact resulting from projects covered under the SAMP programmatic and will submit an annual report to the Service summarizing these acreages on a project by project basis.

7. If needed, all road areas will be watered during project activities to avoid excessive dust.

8. All areas of ground disturbance will be re-seeded with a native "weed free" seed mix.

9. No work will be conducted within 100 feet of vernal pools and streams between November 1st and May 1st, unless specifically approved by the Beale AFB environmental office.

10. Prior to initiation of herbicide activities, sensitive areas (i.e., vernal pools, elderberry shrubs, and emergent wetlands) will be staked, flagged, and fenced off as exclusionary zones where herbicide application cannot take place. Access routes will be maintained outside of fenced off areas. Flagging and fencing will be clearly marked as an environmentally sensitive area. The Service-approved biologist or monitor will be responsible for directing the placement of all fences, stakes, flags, and barriers protecting sensitive resources.

11. Off-road travel outside of the demarcated construction boundaries will be prohibited.

12. Motor vehicles and equipment will only be fueled and serviced in designated service areas, at least 250 feet away from any wetland feature. Prior to the onset of construction activities, Beale AFB will prepare a plan to allow a prompt and effective response to any accidental spills. All workers will be informed of the importance of preventing spills and of the appropriate measures to take should a spill occur.

13. The number of access routes, number and size of staging areas, and the total area of the activity will be limited to the minimum necessary to achieve the project goal. Routes and boundaries will be clearly demarcated, and these areas will be outside of wetlands and drainages.

Habitat within Reeds Creek includes emergent, herbaceous native wetland vegetation along with large clumps of Himalayan blackberry. Surrounding the project site, the area is dominated by grasslands with an extensive wetland complex dispersed throughout. Project work will occur within 100 feet of 59 wetland features (see Appendix, Table 1 and Figures 2 through 5) but the proposed action does not involve any work in wetlands or vernal pools. In the Appendix, Table 1 contains a description of the wetland features within 100 feet of the proposed project and the justification for why each feature will not be impacted by project activities. The proposed project will only result in temporary minimal impacts from access routes due to driving to each project location. The application method for the herbicide will follow the guidance on herbicide labels, will target just the Himalayan blackberry bushes, and will avoid other wetland vegetation growing along Reeds Creek.

The Reeds Creek area provides suitable habitat for the giant garter snake. The proposed project is located in the Mid-Valley recovery unit designated for the species (Service 1999) and is located in the

American Basin watershed, which is recognized as a giant garter snake population unit in the 5-year review (Service 2012a). Historically, Reeds Creek provided adequate water, vegetation, food and cover with adjacent upland habitat for the giant garter snake (Hansen 2005). Due to the current drought in California, there has not been consistent water flow in the channel. In addition, beaver activity has impounded water in certain sections of the creek, preventing it from flowing throughout its entirety. Trapping surveys conducted in 2005, 2014, and 2015 did not detect the species along Reeds Creek. Giant garter snakes have never been confirmed to occur on base property (Hansen 2005 and 2014), although a habitat assessment indicated that this area is suitable habitat for this species (Hansen 2005). The closest California Natural Diversity Database (CNDDB) occurrence for the giant garter snake is over 8 miles north of the project area (CNDDB 2015).

A single elderberry shrub, the sole host plant for the beetle, occurs 17 feet northeast from the project sites. The elderberry shrub is well established and has 35 stems greater than 1 inch in diameter, which is suitable habitat to support the beetle. Beaver use of the shrub was apparent with several stems having been chewed off near the base. No exit holes were observed but holes have been found on elderberry shrubs in the vicinity. The elderberry shrub in the project area will be marked to avoid herbicide application near the shrub. Herbicide treatment will be conducted 15 feet away from any elderberry shrub and no physical contact will be made with the elderberry shrub throughout the project area with herbicides or through accessing the areas to be treated. The nearest CNDDB recorded occurrence for the beetle is 1.3 miles northwest from the project area (CNDDB 2015).

The proposed project is located in the Beale core area, which is within the Southeastern Sacramento Valley vernal pool region (Service 2005). Vernal pool crustacean surveys have not been completed for this specific project; however, both protocol and non-protocol surveys for the vernal pool crustaceans have been completed in numerous locations at the base. The nearest recorded fairy shrimp specimen was located approximately 646 feet from the project area (Beale AFB, undated) and the closest documented occurrence of the tadpole shrimp is approximately 870 feet from the project areas (Beale AFB, undated). There are numerous recorded occurrences of the fairy shrimp and the tadpole shrimp in the vernal pool complexes surrounding Reeds Creek (CNDDB 2015).

The Service concurs with your determination that the proposed project may affect, but is not likely to adversely affect the snake. The proposed project reached the 'may affect' level, and the subsequent requirement for a biological assessment, due to the fact that the proposed project occurs within the known range of the giant garter snake and there is potential habitat present within the project area. Due to the lack of ground disturbance within Reeds Creek, the recent trapping surveys that did not detect the giant garter snake, and the implementation of avoidance and minimization measures, the Service believes that any potential adverse effects to the giant garter snake from implementation of the proposed project will be discountable.

The Service concurs with your determination that the proposed project may affect, but is not likely to adversely affect the beetle. The proposed project reached the 'may affect' level, and the subsequent requirement for a biological assessment, due to the fact that the proposed project occurs within the known range of the beetle and there is an elderberry shrub within the project area. Due to the lack of ground disturbance near the elderberry shrub, the targeted application of herbicides to only Himalayan blackberry, and the implementation of avoidance and minimization measures, the Service believes that any potential adverse effects to the beetle from implementation of the proposed project will be discountable.

The Service also concurs with your determination that the proposed project may affect, but is not likely to adversely affect the fairy and tadpole shrimp. The proposed project reached the 'may affect' level, and the subsequent requirement for a biological assessment, due to the fact that the proposed project occurs within the known range of both species and there is known habitat present for both species within 250 feet of project activities. Due to the lack of ground disturbance within mapped wetland areas, project activities taking place during the dry season, and the implementation of avoidance and minimization measures, the Service believes that any potential adverse effects to the fairy and tadpole shrimp from implementation of the proposed project will be discountable.

Therefore, unless new information reveals effects of the proposed project that may affect listed species in a manner or to an extent not considered, or a new species or critical habitat is designated that may be affected by the proposed project, no further action pursuant to the Act is necessary.

If you have any questions regarding the proposed Invasive Weed Control on Reeds Creek at Beale Air Force Base, please contact Amber Aguilera, Fish and Wildlife Biologist, at (916) 414-6577, or myself at (916) 414-6563.

Sincerely,

Doug Weinrich

Doug Weinrich
Assistant Field Supervisor

Enclosure

LITERATURE CITED

Beale Air Force Base (Beale AFB). Undated. Geospatial database of federally-listed branchiopod survey results for Beale AFB. Accessed September 2015.

_______. 2011. Beale AFB Final Integrated Natural Resources Management Plan. October 2011.

Hansen, E.C. 2005. Giant Garter Snake (Thamnophis gigas) Surveys at Beale Air Force Base: Yuba County, California. Prepared for Beale Air Force Base. November 20, 2005. Unpublished. 12pp.

_______. 2014. Giant Garter Snake (Thamnophis gigas) Surveys at Beale Air Force Base: Yuba County, California. Prepared for Beale Air Force Base. 11pp.

U.S. Fish and Wildlife Service (Service). 1999. Draft Recovery Plan for the Giant Garter Snake (Thamnophis gigas). U.S. Fish and Wildlife Service, Portland, Oregon. ix.+ 192pp.

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_______. 2012a. Giant Garter Snake (*Thamnophis gigas*) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Sacramento, California. June 2012.

_______. 2012b. Programmatic Biological Opinion for Actions Associated with the Special Area Management Plan for Beale Air Force Base, Yuba County, California. October 2, 2012. 81420-2009-F-1118-1.

Appendix

Figures 1-5
Table 1

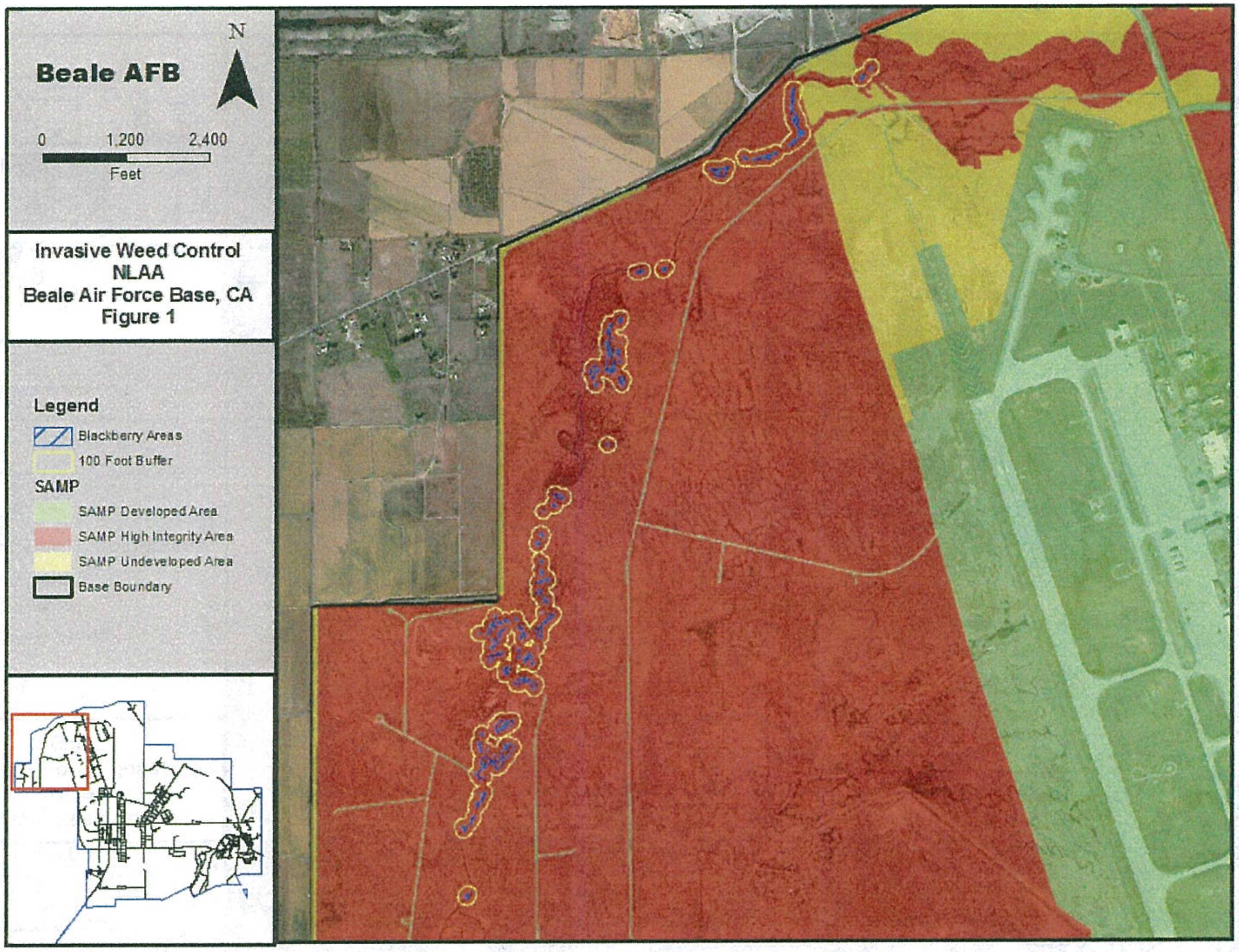

Figure 1. Project Area with Special Area Management Plan (Beale GIS data sourced 22 Sept 15)

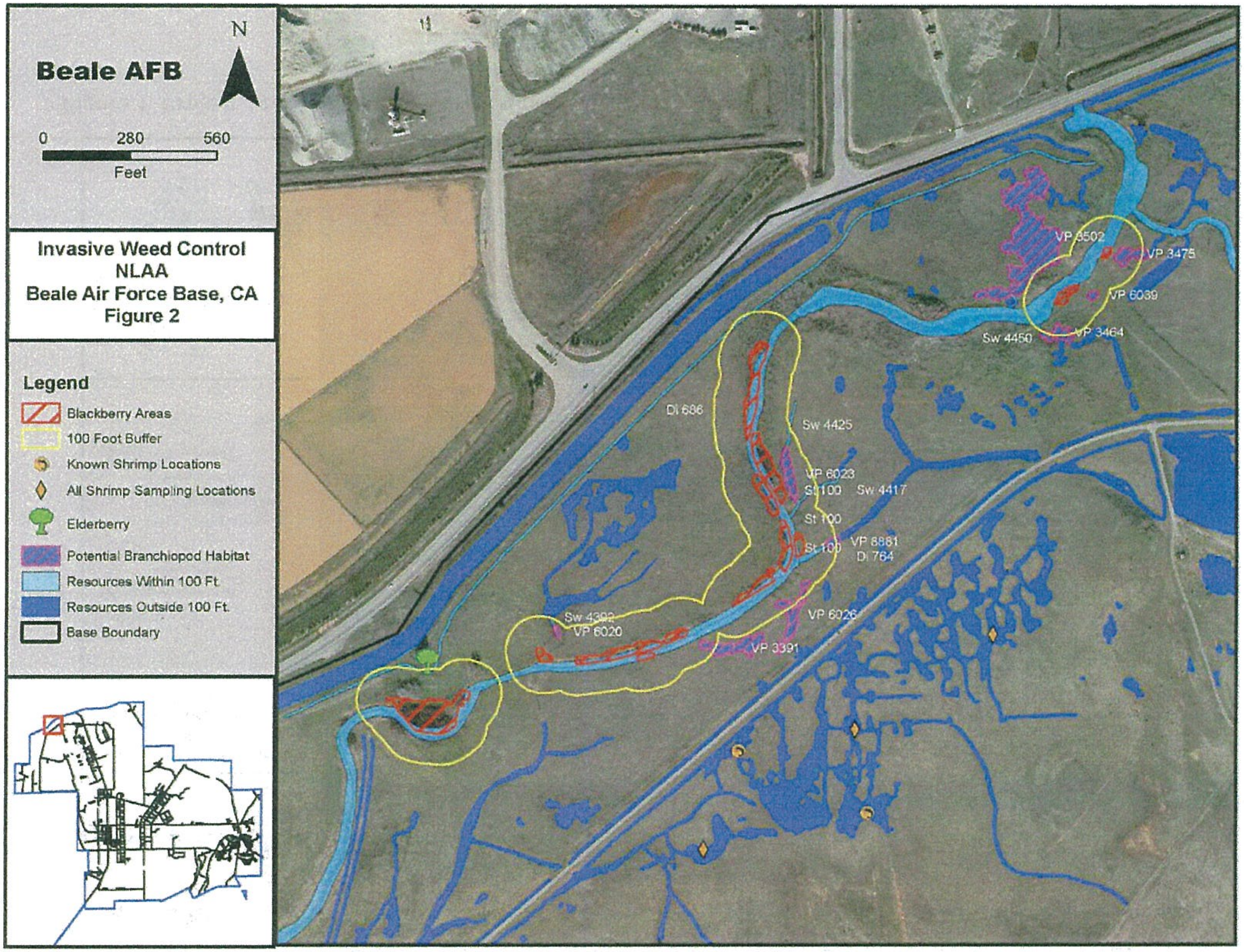

Figure 2. Project Area North, Northern Portion (Beale AFB, September 2015)

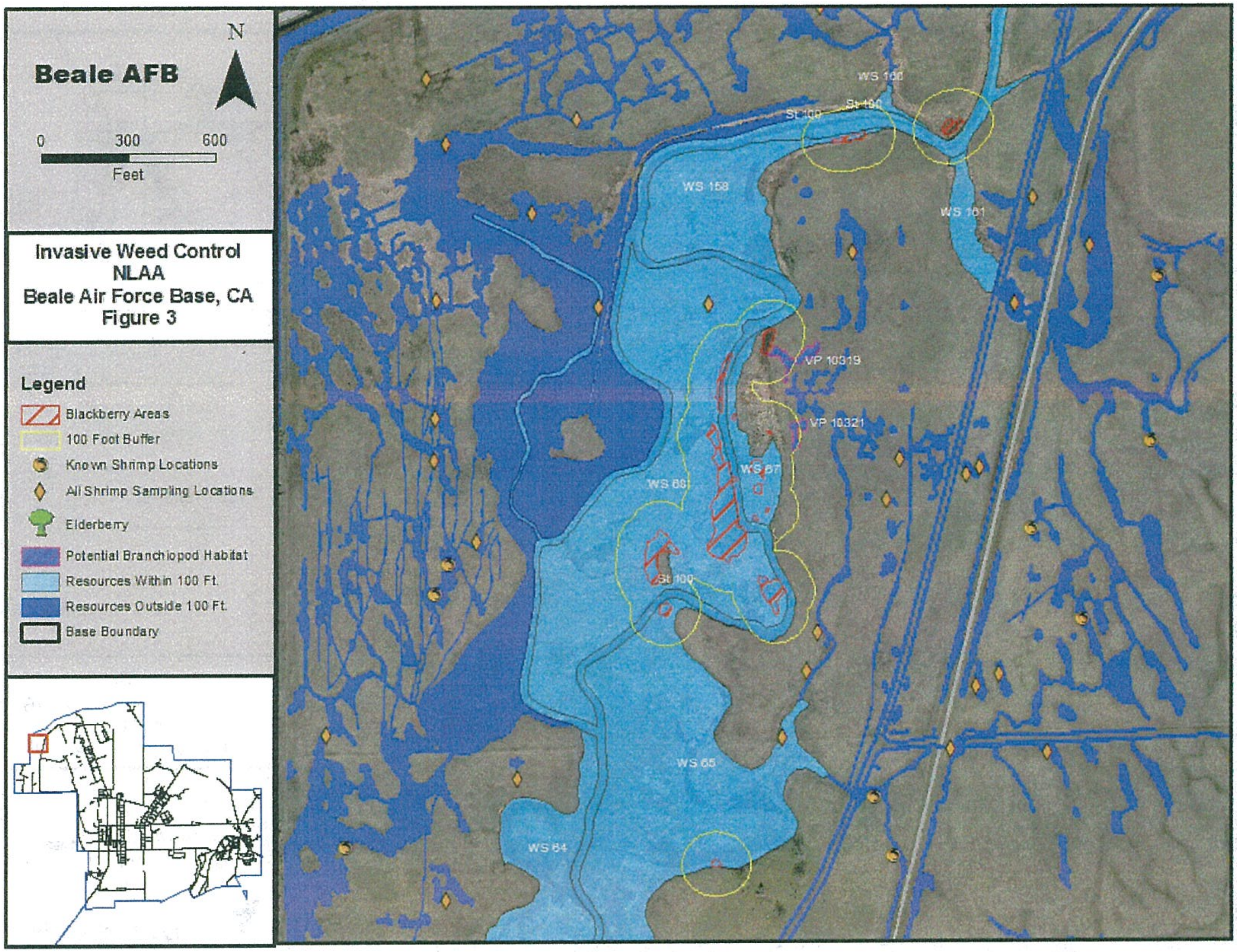

Figure 3. Project Area North, Central Portion (Beale AFB, September 2015)

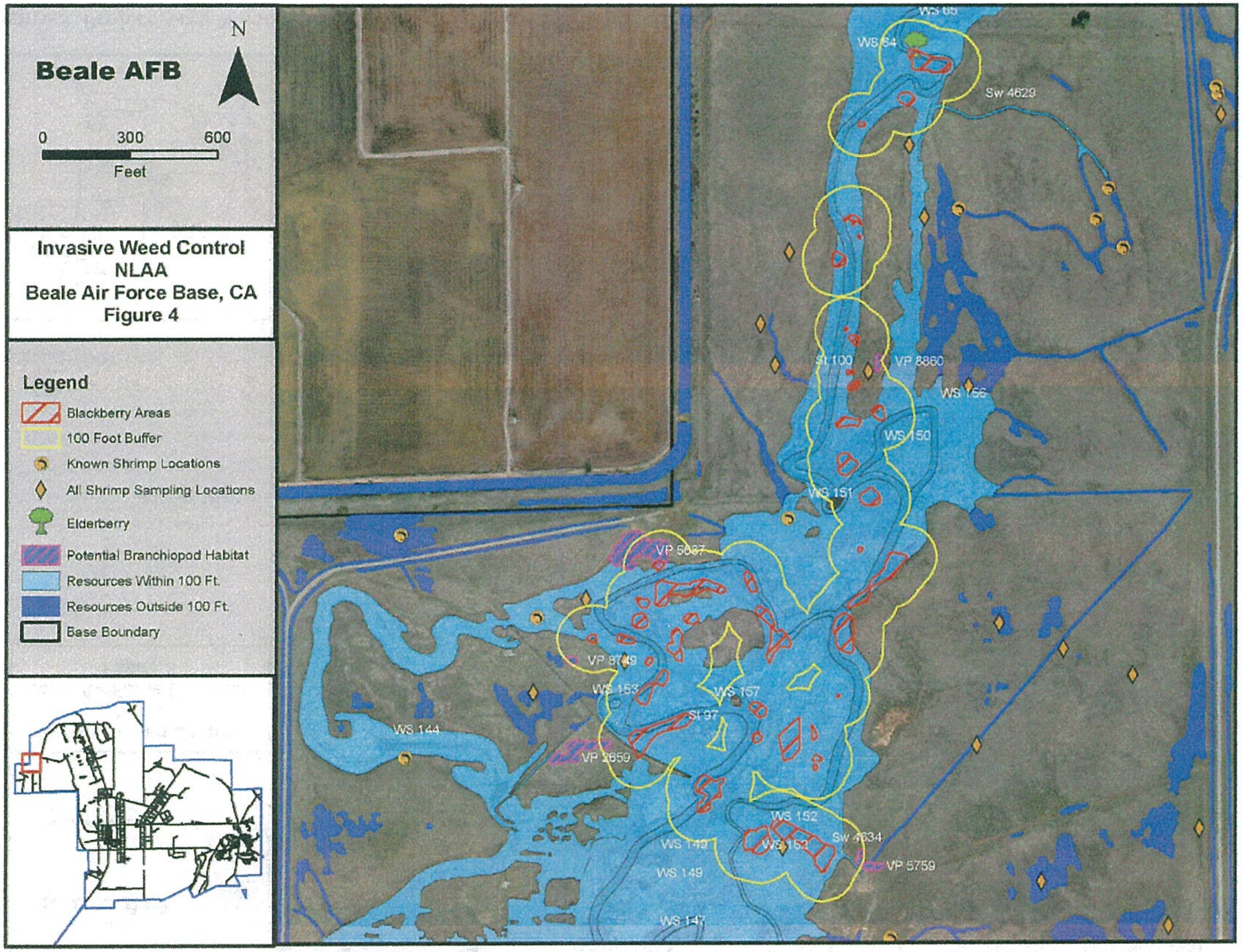

Figure 4. Project Area South, Central Portion (Beale AFB, September 2015)

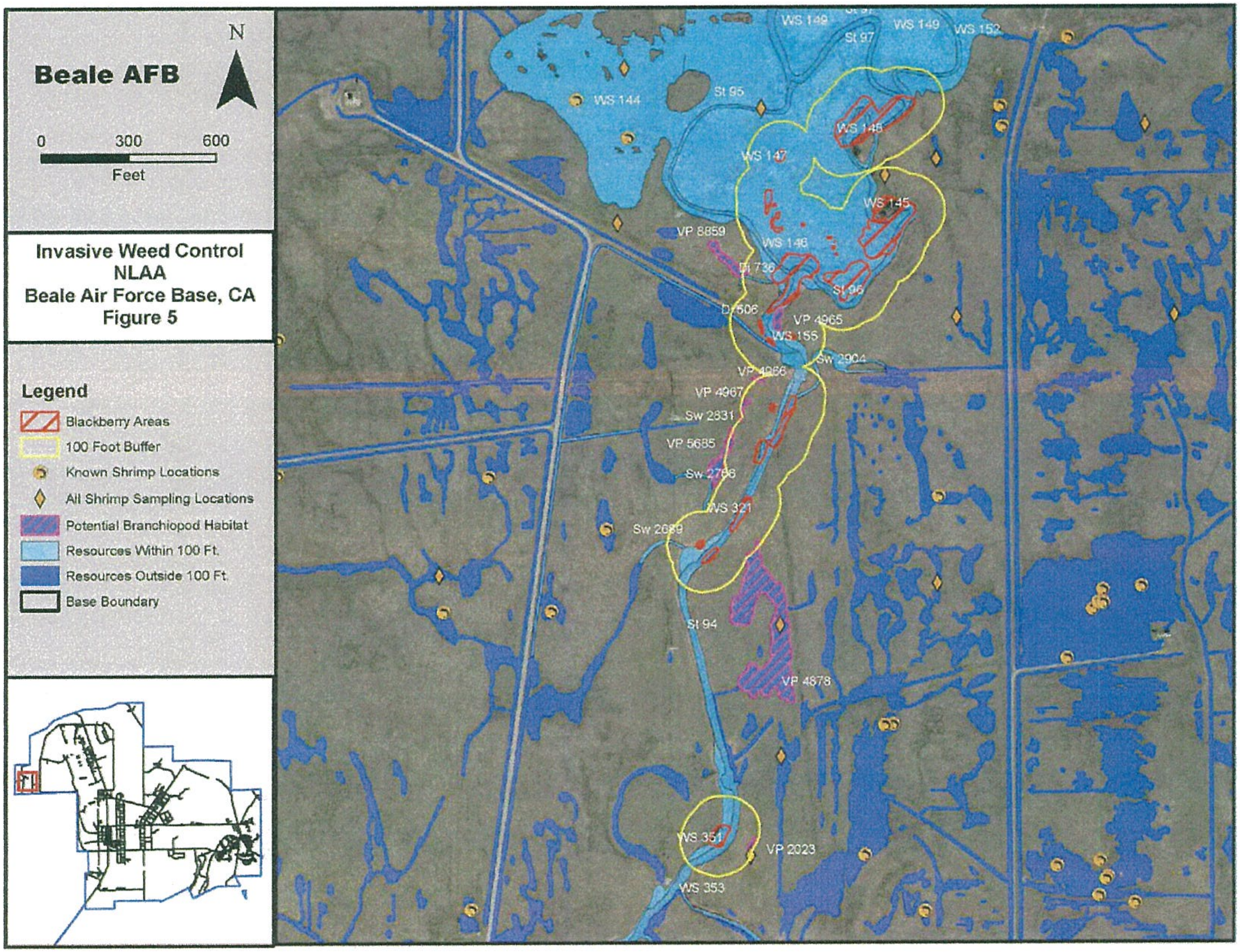

Figure 5. Project Area South, Southern Portion (Beale AFB, September 2015)

Table 1. Wetland features within 100 feet of the project area

ID Number	Wetland Type	Elevation Relative to Project Area	Hydrologically Connected? (Y/N)	Nearest Distance to Herbicide Application (ft.)	No Impact Justification
Figure 2					
3502 6026 3391	Vernal Pool (VP)	Equal	N	85 64 50	These features are physically separated from the project area by a stream. Herbicide treatment will occur on the opposite side of the stream. Potential impacts to these features will be eliminated with avoidance and minimation measures (AMMs).
3464 6039 3475 8881 6020	VP	Equal	N	63 43 19 69 62.5	These features are hydrologically and physically separated from the project area by a stream. Herbicide treatment will occur on the same side of the stream. The potential for impact will be eliminated with appropriate access routes and flagged features.
6023	VP	Equal	N	11.5	This feature is physically separated from the project area by a 4 ft tall soil berm. AMMs will ensure that no herbicide is sprayed within the feature and that access routes do not traverse the feature.
100	Stream (St)	Upslope	Y	0	The area will be sprayed in fall when the stream is dry and the potential for herbicide application to drift is reduced. This stream carries high flow during storm events and is not suitable to special status shrimp species habitat requirements.
4450 4392 4425 4417	Swale (Sw)	Equal	N	90 90 67 21	These features are not hydrologically connected to the project area. These features are shallow and do not pond with enough water for long enough time periods to provide adequate habitat for special status shrimp species.
764 686	Ditch (Di)	Equal	Y	0 0	These drainage ditches carry high water flow during storm events and do not meet special status shrimp species habitat requirements.
Figure 3					
10319 10321	VP	Upslope	N	11 65	These features are higher in elevation than the project area and are not hydrologically connected to the project area. AMMs will ensure that no herbicide is sprayed within the feature and that access routes do not traverse the feature.

Table 1. Wetland features within 100 feet of the project area

ID Number	Wetland Type	Elevation Relative to Project Area	Hydrologically Connected? (Y/N)	Nearest Distance to Herbicide Application (ft.)	No Impact Justification
Figure 3					
160 161	Shallow Wetland (WS)	Equal	N	48 79	These features are not hydrologically connected to the project area. Herbicide treatment will occur on the opposite side of the stream as WS 161. Potential impacts to these features will be eliminated with AMMs.
65 67 68 158	WS	Equal	Y	0 0 0 0	WS 68 was sampled for special status shrimp and none were found. The other features have not been sampled but they do not hold enough water for long enough to support sensitive shrimp species. Strict adherence to AMMs will ensure these features are not impacted and access routes will be designed by a Service-approved biologist to minimize impacts.
Figure 4					
64 65 144 149 152 156	WS	Equal	Y	0 0 0 0 0 0	These features are saturated with water during winter; however, they do not retain enough water for long enough to provide habitat for sensitive shrimp species. Strict adherence to AMMs will ensure these features are not impacted and access routes will be designed by a biologist to minimize impacts.
8860 2659	VP	Equal	N	71 59	These features will not be impacted by the herbicide application due to strict adherence to the AMMs. Additionally, these features are not hydrologically connected to the project area. Access routes will be strategically placed to avoid traversing through these features to prevent impacts.
8749 5759	VP	Upslope	N	70 75	These features are not hydrologically connected to the project area as they are upslope from the project area. AMMs will ensure that no herbicide is sprayed within the feature and that access routes do not traverse the feature.

Table 1. Wetland features within 100 feet of the project area

ID Number	Wetland Type	Elevation Relative to Project Area	Hydrologically Connected? (Y/N)	Nearest Distance to Herbicide Application (ft.)	No Impact Justification
Figure 4					
5687	VP	Equal	Y	1	This feature is shallow and poorly defined in a previously disturbed location adjacent to a power pole. There is scant wetland vegetation present at this location with most of the ground cover a crabgrass variety. This feature is unlikely to support special status shrimp species. These will be spot treated and the AMMs listed will prevent any impacts to the feature.
97	St	Equal	N	0	The area will be sprayed in fall when the stream is dry and the potential for herbicide application to drift is reduced. This stream carries high flow during storm events and is not suitable to special status shrimp species habitat requirements.
150 151 153 157	WS	Equal	N	30 79 56 33	These features are not hydrologically connected to the project area. They are all islands created out of turns in the stream. These features will not be traversed to reach any of the project areas. Any other potential impacts to these features will be eliminated with AMMs.
4634	Sw	Upslope	Y	34	This feature is hydrologically connected to the project area receiving herbicide treatment; however, this feature is upslope and will not be sprayed. Strict adherence to AMMs will ensure these features are not impacted and access routes will be designed by a biologist to minimize impacts.
4629	Sw	Equal	Y	59	This feature is hydrologically connected to the project area; however, there will be no application of spraying directly in the feature. Access routes will be strategically placed to avoid traversing through these features to prevent impacts.

Table 1. Wetland features within 100 feet of the project area

ID Number	Wetland Type	Elevation Relative to Project Area	Hydrologically Connected? (Y/N)	Nearest Distance to Herbicide Application (ft.)	No Impact Justification
Figure 5					
145 146 147 148 155 321 351	WS	Equal	Y	0 0 0 0 0 0 0	These features are saturated with water during winter; however, they do not retain enough water for long enough to provide habitat for sensitive shrimp species. Strict adherence to AMMs will ensure these features are not impacted and access routes will be designed by a biologist to minimize impacts.
4965 4966 4967 5685 8859	VP	Equal	N	29 86 71 88 84	These features will not be impacted by the herbicide application due to strict adherence to the AMMs. Additionally, these features are not hydrologically connected to the project area. Access routes will be strategically placed to avoid traversing through these features to prevent impacts.
2023 4878	VP	Upslope	N	83 91	These features will not be impacted by the herbicide application due to strict adherence to the AMMs. Additionally, these features are not hydrologically connected to the project area and they are upslope of the project area. Access routes will be strategically placed to avoid traversing through these features to prevent impacts.
2768 2831	Sw	Upslope	N	97 97	These features are not hydrologically connected to the project area. These features are shallow and do not pond. They would not provide adequate habitat for special status shrimp species. Additionally, these features are upslope of the project area.
2689 2904	Sw	Upslope Equal	Y	39 1	These features are hydrologically connected to the project area receiving herbicide treatment; however, this feature is upslope and will not be sprayed. Strict adherence to AMMs will ensure that these features are not impacted and access routes will be designed by a biologist to minimize impacts.

Table 1. Wetland features within 100 feet of the project area

ID Number	Wetland Type	Elevation Relative to Project Area	Hydrologically Connected? (Y/N)	Nearest Distance to Herbicide Application (ft.)	No Impact Justification
Figure 5					
94 96	St	Equal	Y	0 0	The area will be sprayed in fall when the stream is dry and the potential for herbicide application to drift is reduced. These streams carry high flow during storm events and are not suitable to special status shrimp species habitat requirements.
736 506	Di	Equal	Y	7.3 2	These drainage ditches carry high water flow during storm events and do not meet special status shrimp species habitat requirements.
353	WS	Upslope	Y	25	This feature is hydrologically connected but upslope of the project area. AAMs will ensure no impacts.

Informal Consultation Initiation Letter with NOAA Fisheries on Biological Assessment for Non-Native and Noxious Plant Species Management at Beale Air Force Base

27 August 2020

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 9TH RECONNAISSANCE WING (ACC)
BEALE AIR FORCE BASE, CALIFORNIA

AUG 2 7 2020

MEMORANDUM FOR NATIONAL MARINE FISHERIES SERVICE
ATTN: MARIA REA
650 Capitol Mall, Suite 5-100
Sacramento, CA 95814-4708

FROM: 9 CES/CEIE
6425 B Street, Bldg. 25390
Beale AFB, CA 95903-1708

SUBJECT: Informal Consultation – Biological Assessment for Non-Native and Noxious Plant Species Management at Beale Air Force Base, California

1. The intent of this letter is to submit a Biological Assessment (BA) to the National Marine Fisheries Service to initiate consultation and update the file pursuant to the Endangered Species Act regulations (50 CFR 402.02) for Non-Native and Noxious Plant Species Management (Proposed Action) at Beale Air Force Base (AFB), Yuba County, California. This BA evaluates the potential effects on federally-listed species and their habitat from non-native and noxious plant species management actions to be conducted on Beale AFB, located in Yuba County, California, and the Lincoln Receiver Site, a geographically separated unit managed by Beale AFB, in Placer County, California.

2. Beale AFB does not believe this Proposed Action will result in impacts to the California Central Valley steelhead (*Oncorhynchus mykiss*). Furthermore, Beale AFB does not believe that the Proposed Action is likely to adversely affect other federally-listed marine species that occur in the general region of Beale AFB. Beale AFB is consulting separately with the U.S. Fish and Wildlife Service on non-marine species.

3. Please review the enclosed documents, and contact Ms. Tamara Gallentine, Natural Resources Manager at (530) 634-2738 or tamara.gallentine.2@us.af.mil if you have comments or need additional information.

Gwendolyn E. Vergara
GWEDONLYN E. VERGARA, GS-13, USAF
Chief, Environmental Element
9th Civil Engineer Squadron

Attachment:
Informal Consultation – Biological Assessment for Non-Native and Noxious Plant Species Management at Beale Air Force Base, California

NMFS Response Re: Informal Consultation Initiation Letter with NOAA Fisheries on Biological Assessment for Non-Native and Noxious Plant Species Management at Beale Air Force Base

8 September 2020

From: ccvo consultationrequests - NOAA Service Account <ccvo.consultationrequests@noaa.gov>
Sent: Tuesday, September 8, 2020 6:19 PM
To: GALLENTINE, TAMARA A GS-12 USAF ACC 9 CES/CEIEC
Subject: [Non-DoD Source] NMFS California Central Valley Office thanks you for your email Re: Beale AFB Informal Consultation for NON-NATIVE AND NOXIOUS PLANT SPECIES MANAGEMENT

Thank you for your request for consultation or official notice. It will be reviewed by a NMFS staff member who will be in contact with you shortly. If you have questions about a specific consultation, please reach out to the NMFS biologist covering your consultation directly. If you are unsure of who your NMFS contact is or need immediate assistance, please call the NOAA Sacramento Central Valley Office at (916)930-3600.

Gmail **Maia Lipschutz <maia.lipschutz@gmail.com>**

FW: [Non-DoD Source] Re: Additional information/clarification re: Non-Native and Noxious Plant Species Management at Beale Air Force Base, California

1 message

GALLENTINE, TAMARA A GS-12 USAF ACC 9 CES/CEIEC <tamara.gallentine.2@us.af.mil> Fri, Sep 11, 2020 at 6:16 PM

To: Maia Lipschutz <maia.lipschutz@gmail.com>, "Lipschutz,Maia" <Maia.Lipschutz@colostate.edu>, "MCCREADY, CHADWICK A CTR USAF ACC 9 CES/CEIER" <chadwick.mccready.ctr@us.af.mil>

Hi!

Please see email from Evan with a list of deficiencies. We can discuss further on Monday if you want.

Thank you,

Tamara Gallentine

Natural & Cultural Resources Program Manager

9 CES/CEIEC

6425 B St

Beale AFB, CA 95903

From: Ellen McBride - NOAA Federal <ellen.mcbride@noaa.gov>
Sent: Friday, September 11, 2020 4:23 PM
To: Evan Sawyer - NOAA Federal <evan.sawyer@noaa.gov>
Cc: GALLENTINE, TAMARA A GS-12 USAF ACC 9 CES/CEIEC <tamara.gallentine.2@us.af.mil>; Jean Castillo - NOAA Federal <jean.castillo@noaa.gov>
Subject: [Non-DoD Source] Re: Additional information/clarification re: Non-Native and Noxious Plant Species Management at Beale Air Force Base, California

Thanks for sending this out, Evan. When we send out a list of questions, it is important to notify partners that these are insufficiencies that prevent us from initiating consultation at this time. We should also state that, if we do not receive the requested information within a 45-day period, we will close the consultation, until we receive another request for initiation. This helps our partners understand the timeline and expectations, so there are no misunderstandings.

Typical language we would include in a letter would be something like this:

"Until we receive this information, we cannot initiate formal ESA and EFH consultations. We are available to help you determine how best to develop and provide this information. If we do not receive a response from you within 45 days, we will consider this consultation request withdrawn, and will notify you by letter that we are closing out the consultation due to inactivity. If you are still interested in consulting after 45 days have lapsed, please provide us a new request for consultation with complete information."

You might just follow up your earlier email with an adapted version of the above statement.

Thanks and have a wonderful weekend,

Ellen

On Fri, Sep 11, 2020 at 4:09 PM Evan Sawyer - NOAA Federal <evan.sawyer@noaa.gov> wrote:

> Dear Ms. Gallentine,
>
> It was nice talking to you today. As I said on the phone, after reviewing the transmittal memo and Biological Assessment, I still have a few questions regarding the Proposed Action (PA): Non-Native and Noxious Plant Species Management at Beale Air Force Base, California. Specifically:
>
> - Is the PA part of a larger program? "*The Proposed Action is to control invasive plant species in order to reduce their prevalence using an efficient, sustainable, and long-term strategy that incorporates a programmatic, adaptive approach, maximizes opportunities for stewardship of sensitive resources, and utilizes a varied toolkit of control methods including manual, mechanical, and chemical treatments.*" (BA pg. 2)
>   - If the PA is part of a larger program it may be better to consult on the program to ensure that all activities with the potential to affect ESA listed species, and Essential Fish Habitat (EFH) are covered.
> - What is the project duration? Is the proposed action a single application/attempt to remove invasive species or is there an expectation that this would occur annually over a number of years? Again, if the PA is part of a larger and long-term program it would be best to consult on the larger program so that we might consider the cumulative impact of multiple years of implementation and reduce the need for future consultations.
> - Table 1 (BA pg. 3) identifies 16 invasive plant control species found within riparian areas, 4 of which are "*generally proximate to open water*." It is unclear whether the PA is intended to cover measures to remove all, or just some of the species listed in table 1?
> - What is the proposed work window?
>   - General AAM #7 "*The general construction season shall be from 15 June to 31 October.*" (BA pg. 15)
>   - Herbicide Application AAM #14 "*Aquatic herbicide applications are only allowed from May 2 to October 31*" (BA pg. 19)
> - Which herbicides will be used in the PA? Is herbicide use limited to: "*an aquatic-approved formulation of glyphosate such as Rodeo or Roundup Custom, combined with an aquatic-approved formulation of Imazapyr such as Habitat or Arsenal will be used.*" (BA pg. 6)
> - Is there an EFH determination? The PA will occur within EFH for Pacific Salmon but potential effects to EFH were not discussed.
> - The BA makes reference to the following related documents which would be useful in assessing effects of the PA and relation to the larger program:
>   - Beale AFB Integrated Natural Resource Management Plan (INRMP; Beale AFB 2019)
>   - The Invasive Plant Species Management Guidelines (IPSMG; Hopkinson 2017)
>   - Aquatic Pesticide Application Plan (APAP), prepared per Water Quality Order No. 2013-0002-DWQ (including appropriate appendices)
>
> Please call or email if you have any questions or concerns regarding this request for additional information. I'm happy to assist in any way that I can.

Thank you,

Evan Sawyer

--

Evan Bing Sawyer,

During the COVID-19 pandemic I am under mandatory telework. I may be working flexible hours to balance family and personal needs. I appreciate your patience if my response time is delayed. If you have a request, please specify important time-frames or deadlines. I will do my best to respond accordingly. Because I have limited ability to retrieve mail, please send any formal correspondence that would normally be sent through the physical mail to ccvo.consultationrequests@noaa.gov. Thank you.

Natural Resource Management Specialist

NOAA Fisheries West Coast Region
U.S. Department of Commerce
Office: (916) 930-3656
Evan.Sawyer@noaa.gov
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NOTE: **During the COVID-19 pandemic, I am under mandatory telework. I may be working flexible hours to balance family and personal needs. I appreciate your patience, if my response time is delayed. If you have a request, please specify important timeframes or deadlines. I will do my best to respond accordingly. Because I have limited ability to retrieve mail, please send any formal correspondence that would normally be sent through the physical mail to ccvo.consultationrequests@noaa.gov. My office phone will ring directly to my mobile phone. Thank you and be well!

****

Ellen Roots McBride, M.S.

Sacramento River Basin Branch Chief, California Central Valley Office

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Updated Draft: Informal Consultation with NOAA Fisheries on Biological Assessment for Non-Native and Noxious Plant Species Management at Beale Air Force Base

25 September 2020

NON-NATIVE AND NOXIOUS PLANT SPECIES MANAGEMENT

AT

BEALE AIR FORCE BASE, CALIFORNIA

Informal Consultation with NOAA Marine Fisheries

SEPTEMBER 2020

PREPARED BY:

BEALE AIR FORCE BASE
9 CES/CEIE
6601 B STREET
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Acronyms and Abbreviations

9 CES	9th Civil Engineer Squadron
9 CES/CEIE	9th Civil Engineer Squadron/Environmental Element
AFB	Air Force Base
AMM	avoidance and minimization measure
APAP	Aquatic Pesticide Application Plan
BEE	butoxyethyl ester
BMP	best management practice
CCV	California Central Valley
cfs	cubic feet per second
DoD	Department of Defense
DPS	Distinct Population Segment
EFH	Essential Fish Habitat
EFHA	EFH Areas Protected from Fishing
ESA	Endangered Species Act
GMG	Grazing Management Guidelines
HPAC	Habitat Areas of Particular Concern
INRMP	Integrated Natural Resources Management Plan
IPMP	Installation Pest Management Plan
IPSMG	Invasive Plant Species Management Guidelines
LiDAR	Light Detection and Ranging
LRS	Lincoln Receiver Site
MFH	Military Family Housing
MSA	Magnuson-Stevens Fishery Conservation and Management Act
NMFS	National Oceanic and Atmospheric Administration, National Marine Fisheries Service
NPDES	Statewide General National Pollutant Discharge Elimination System Permit for Residual Aquatic Pesticide Discharges to WoUS from Algae and Aquatic Weed Control Applications
POEA	polyoxyethylene tallow amine
PBO	Programmatic Biological Opinion
RM	River Mile
SRA	Shaded Riparian Aquatic Habitat
SWA	Spenceville Wildlife Area
TEA	triethylamine salt
USEPA	U.S. Environmental Protection Agency
USFWS	U.S. Fish and Wildlife Service
WFMP	Wildland Fire Management Plan
WoUS	Jurisdictional Waters of the United States

EXECUTIVE SUMMARY

The purpose of this informal consultation is to review the management of non-native and noxious plant species (Proposed Action) at Beale Air Force Base (AFB) and the Lincoln Receiver Site (LRS) in sufficient detail to determine to what extent the Proposed Action may affect threatened and endangered species, and designated or proposed critical habitats under the Endangered Species Act (ESA). This is also a request for consultation initiation with NOAA NMFS pursuant to the essential fish habitat (EFH) provisions of the Magnuson-Stevens Fishery Conservation and Management Act (MSA). Section 305(b)(2) of the MSA requires federal action agencies to consult with NMFS for any action they authorize, fund, or undertake that may adversely affect EFH. This informal consultation has been prepared in accordance with legal requirements set forth under regulations implementing Section 7 of the Endangered Species Act (50 Code of Federal Regulations (CFR) 402; 16 USC 1536 (c)) and section 305(b) of the MSA, implementing regulations at 50 CFR 600.920.

The Proposed Action area is within the boundary of Beale AFB, in Yuba County, California, on the Camp Far West 7.5-minute U.S. Geological Survey topographic quadrangle. The purpose of the Proposed Action is to manage invasive plant species on Beale AFB to reduce the prevalence of non-native vegetation in order to protect and preserve the military mission, ecosystem function, and valued resources and programs.

The following listed species may be affected by the Proposed Action and is addressed in this informal consultation:

- Steelhead (*Oncorhynchus mykiss*) – California Central Valley (CCV) Distinct Population Segment (DPS)

EFH for the following species may be affected by the Proposed Action and is addressed in this informal consultation:

- Chinook salmon (*O. tshawytscha)* – Chinook salmon (Pacific Fisheries Management Council 2014).

There are features in or within 250 feet of the Proposed Action Area considered potential habitat for federally listed anadromous fish species. CCV steelhead are assumed to be present in some years, having been observed upstream at Spenceville Wildlife Area. Beale AFB contains EFH for Chinook Salmon. No listed fish species habitat or EFH occur at the LRS.

Adherence to the Avoidance and Minimization Measures (AMMs) included in this document will prevent the Proposed Action from negatively impacting listed species, listed species habitat, or EFH. The AMMs in this document include measures previously approved in a Programmatic Biological Opinion for Beale AFB (United States Fish and Wildlife Service (USFWS) 2012; expired October 2, 2017), guidelines provided in the 2020 Biological Opinion for the Repair Four Bridges System Project (National Marine Fisheries Service [NMFS] 2020), and AMMs from the Beale AFB Statewide General National Pollutant Discharge Elimination System (NPDES) Permit for Residual Aquatic Pesticide Discharges to Waters of the U.S. (WoUS) from Algae and Aquatic Weed Control Applications. Ultimately, the Proposed Action would result in a net beneficial impact to EFH, as it would remove invasive plants obstructing stream flow and degrading riparian habitat. For this reason, Beale AFB believes the Proposed Action warrants a determination of May Affect, Not Likely to Adversely Affect CCV steelhead or EFH for Chinook salmon.

1.0 PURPOSE AND NEED

On Beale Air Force Base (AFB) and the Lincoln Receiver Site (LRS) (Figure 1), a long-standing and entrenched suite of non-native and noxious plant species (hereafter referred to as “invasive plants”) threatens sensitive resources, the accomplishment of military objectives and missions, and other environmental and human values. More than 50 species of invasive plants have been identified on the base, and an extensive watch list of species that have not been found but could spread to Beale AFB has been developed (Attachment 1). The purpose of the Proposed Action is to manage invasive plant species on Beale AFB to reduce the prevalence of non-native vegetation in order to protect and preserve the military mission, ecosystem function, and valued resources and programs.

The need for the Proposed Action is to address the threats of numerous non-native plant species on Beale AFB. There is a need for elimination or control of known priority infestations, and for prevention of the establishment of new infestations of invasive plants. If allowed to spread unchecked, non-native plant species will continue to degrade native habitat; interfere with management of sensitive resources, economic activities, and quality of life; and impede the military mission.

Legal drivers for federal invasive species control programs include the Federal Noxious Weed Act (PL 93-629; 7 USC §2801 et seq.; 88 Stat. 2148, amended 1990), and Executive Orders (EOs) that explicitly direct federal agencies to control invasive species, such as EO 13112, Invasive Species (1999) and EO 13751, Safeguarding the Nation from the Impacts of Invasive Species (2016). EO 13751 states that United States policy is “to prevent the introduction, establishment, and spread of invasive species, as well as to eradicate and control populations of invasive species that are established” and acknowledges the harm that invasive species cause to “the environment and natural resources, agriculture and food production systems, water resources, human, animal, and plant health, infrastructure, the economy, energy, cultural resources, and military readiness,” almost all of which are relevant to natural resources management at Beale AFB.

Air Force Instruction 32-7064, Integrated Natural Resources Management (USAF 2016), provides the following instruction regarding invasive species: “Develop and implement management strategies oriented toward the control of exotic and invasive species when practical and consistent with the military mission." The current Beale AFB Integrated Natural Resource Management Plan (INRMP; Beale AFB 2019; Attachment 2) includes goals, objectives, and projects to guide the management of invasive species on the installation.

A comprehensive, adaptive management plan is needed in order to implement a physically effective, cost effective, and efficient invasive plant management program. The plan should include elements to prevent new infestations, eradicate infestations when practicable, and control/contain existing infestations for which eradication is not practical or possible.

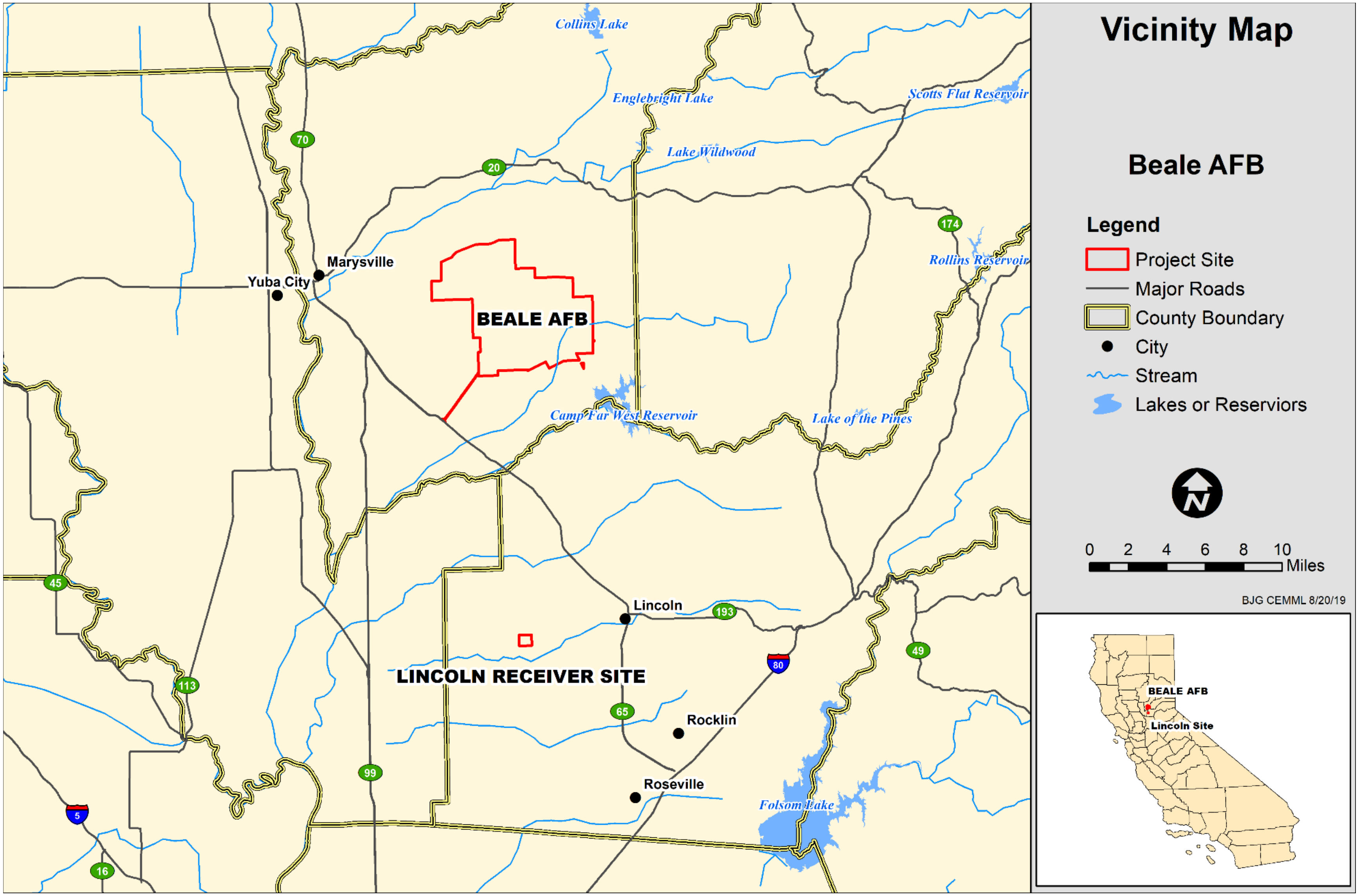

Figure 1. Location of Beale AFB and Lincoln Receiver Site.

2.0 DESCRIPTION OF PROPOSED ACTION

The Proposed Action is to control invasive plant species in order to reduce their prevalence using an efficient, sustainable, and long-term strategy that incorporates a programmatic, adaptive approach, maximizes opportunities for stewardship of sensitive resources, and utilizes a varied toolkit of control methods including manual, mechanical, and chemical treatments in addition to prescription fire and grazing. Invasive plant control actions could occur anywhere on the base, but only actions within the Dry Creek and Best Slough riparian corridor, where they may impact federally listed anadromous fish species are analyzed in detail (Figure 2). The Proposed Action is anticipated to have an overall beneficial impact on Essential Fish Habitat (EFH) (Figure 3).

The current Beale AFB INRMP contains several goals, objectives, and projects that provide explicit drivers for invasive species control. The Updated Invasive Plant Species Management Guidelines (IPSMG; Beale AFB 2017a; Attachment 3) and Grazing Management Guidelines (GMG; Beale AFB 2017b; Attachment 4) were developed to guide their achievement. The Wildland Fire Management Plan (WFMP; Beale AFB 2018a; Attachment 5) includes guidance for invasive plant control using prescribed burning.

The IPSMG is based on the current science, data, and recommendations, and designed to be reviewed and updated regularly as conditions, science, and drivers change. The IPSMG provides the foundation for this alternative. It is intended to be used by Beale AFB Natural Resources staff and contractors who manage vegetation on the installation. Beale AFB has managed both sensitive species and invasive species for many years, but a concerted effort to manage both together is more effective and is the approach adopted in the IPSMG.

Successful containment/control often requires multiple years of treatment, and sometimes requires multiple treatments per year involving a combination of methods. To increase the likelihood of successful long-term control, invasive plant management experts often recommend combining several management methods tailored to situation-specific goals, constraints, and opportunities. Treatments are tailored based upon:

- The target invasive plant species and its biology (e.g., mode of reproduction),
- Population size and density,
- Site type (e.g., disturbed roadside, riparian, upland), and
- Prior treatments and their efficacy.

The IPSMG includes protocols for preventing the spread of existing invasive plant species and the introduction of new species, methods for controlling specific invasive species, and general management strategies for the sensitive species and habitats on the installation. For certain species and situations, asset-based work plans are advantageous. Mechanical and manual methods, chemical treatments, grazing, and burning are all effective treatment methods for specific species in specific situations. For all control methods, timing treatment to coincide with the vulnerable phenological stage of the target species is an essential consideration (Beale AFB 2017). The IPSMG includes specific situational and species work plans.

While Proposed Action is designed to reduce overall invasive plant cover, it also simultaneously aims to improve forage quality for grazing animals, as grazing is the primary tool for controlling invasive species biomass. Improving forage quality equates to maintaining or increasing certain desirable non-native species, often referred to as naturalized species (normally annual grasses and forbs) that have been on the landscape for decades or centuries (e.g., Erodium sp.). Such species are too ubiquitous to warrant control, do not threaten the ecosystem like non-natives that are targeted for control, and provide a benefit, by supporting cattle grazing operations, which provide other invasive species control benefits.

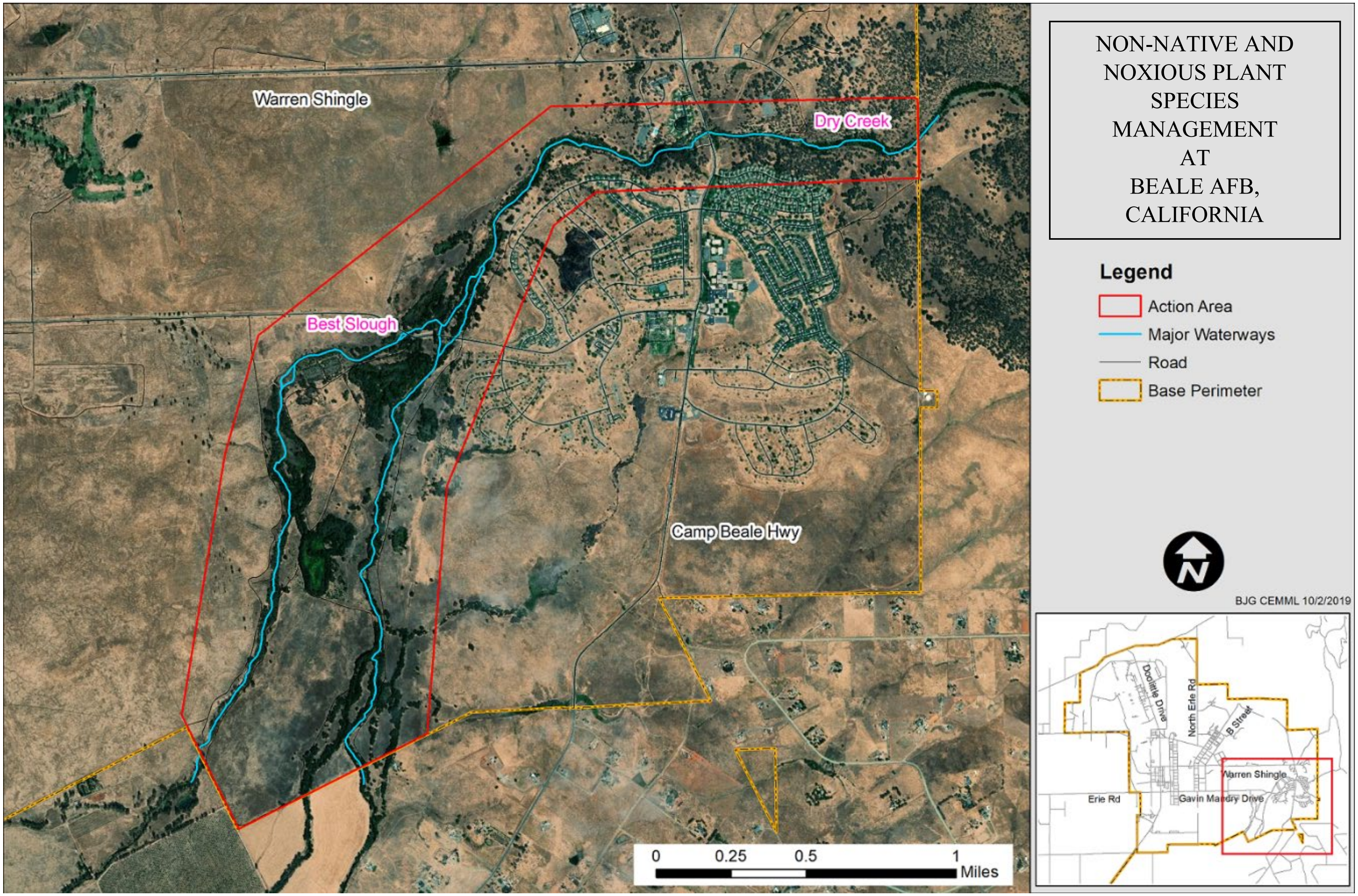

Figure 2. Proposed Action Area where control of invasive plant species may occur in or adjacent to habitat suitable for listed salmonids.

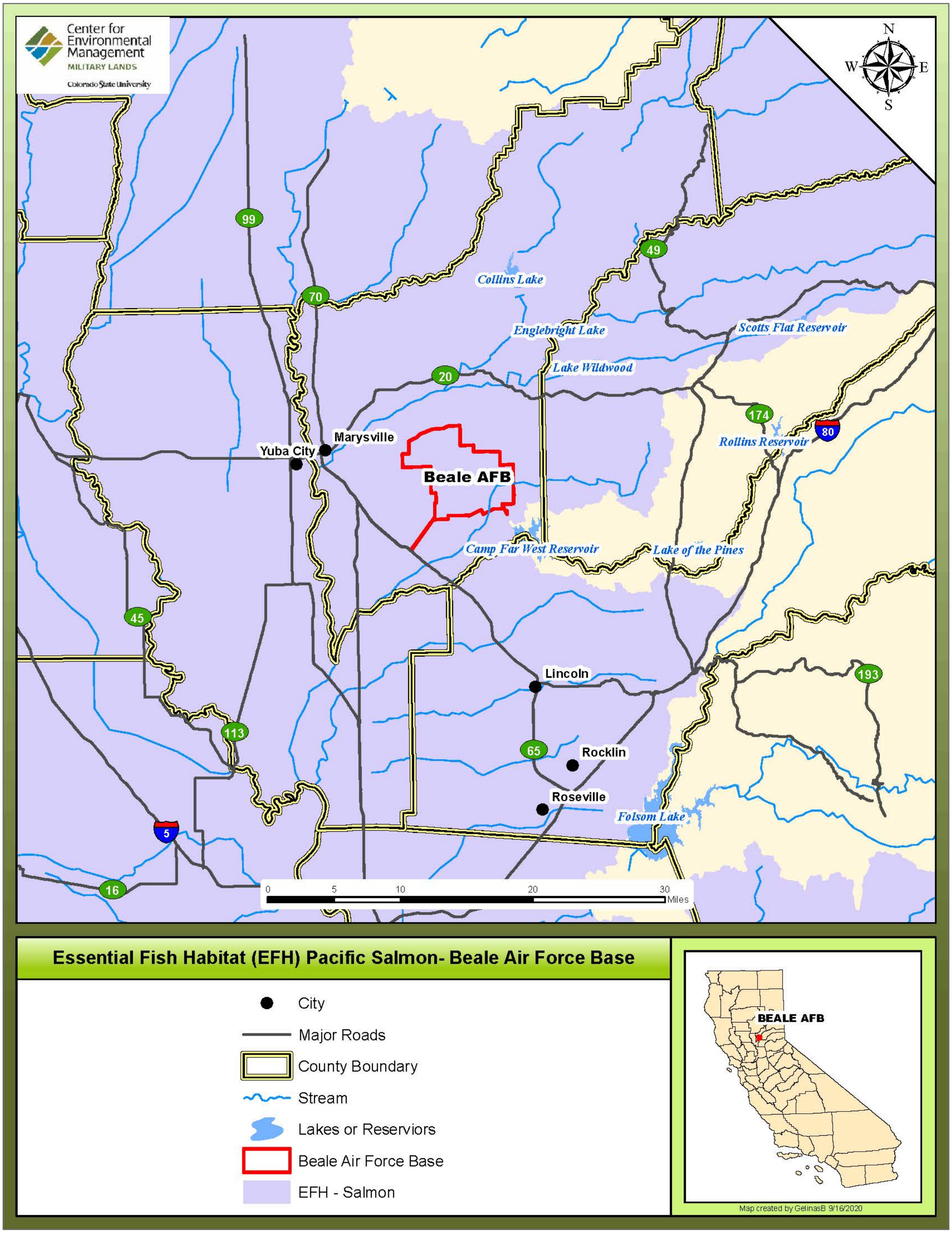

Figure 3. Essential Fish Habitat (EFH) for Chinook Salmon near Beale Air Force Base.

A USAF form 103, Work Clearance Permit would be required for activities conducted under Proposed Action. The USAF form 103 application is a work clearance coordination process. A USAF form 103 is required before beginning any type of work that may impact or alter an area, including interior work. This process allows different subject matter experts, shops, and sections of 9th Civil Engineer Squadron (9 CES) to screen the work site for potentially sensitive natural or cultural resources and/or health hazards (e.g., asbestos, lead-based paint). This review is done within 30 days of a project start, and ensures all involved parties have the most up to date project information. Implementation of additional project-specific protective best management practices (BMPs) may be required for permit approval.

2.1 Framework

The IPSMG recommends a programmatic approach to invasive plant species control that is structured around the invasion curve concept (Rodgers et al. 2015) and the Cal-IPC ranking system for invasive species, which ranks each species based on ecological impacts, invasive potential, and ecological distribution (Cal-IPC 2019). Both of these tools are described in the IPSMG. The combined use of these tools yields management information which prioritizes species to treat and identifies the most effective treatment methods. This analysis technique is repeatable and would be revisited to inform adaptive management practices over time. Non-native plant species on Beale AFB have been put into one of five categories: prevention/early detection rapid response (EDRR) stage, eradication stage, containment stage, asset-based protection stage, and no treatment stage.

2.1.1. Prevention/Early Detection Rapid Response (EDRR)

Finding and eradicating new species while they are in the early stage of the invasion curve is typically limited to small populations that have not had the opportunity to establish substantial widespread seedbanks or alter ecosystems. For successful management at this stage of the invasive curve, especially on an installation the size of Beale and with its numerous potential pathways and vectors, an EDRR program to find and eradicate incipient infestations of new invasive species is essential. This is the most cost-effective stage at which to manage invasive plants. There are 14 species that are top EDRR priorities for Beale AFB. New species could be added at any time due to the nature of invasion and introduction, especially if prevention measures fail. Current EDRR species are:

- Alligator weed (*Alternanthera philoxeroides)*
- Downy brome, cheatgrass (*Bromus tectorum*)
- Spotted knapweed (*Centaurea stoebe* ssp. *micranthos*)
- Canada thistle (*Cirsium arvense*)
- Artichoke thistle (*Cynara cardunculus*)
- Brazilian egeria (*Egeria densa*)
- Water hyacinth (*Eichhornia crassipes)*
- Hydrilla (*Hydrilla verticillata)*
- South American spongeplant (*Limnobium laevigatum)*
- Perennial pepperweed (*Lepidium latifolium*)
- Purple loosestrife (*Lythrum salicaria*)
- Pennyroyal (*Mentha pulegium*)
- Red sesbania, scarlet wisteria (*Sesbania punicea*)
- Smallflower tamarisk (*Tamarix parviflora*)

2.1.2. Eradication Stage

Species that are well-established in small populations that have not yet spread over a wide area may be targeted for eradication, as long as resources are set aside for long-term monitoring of sites where they have been removed. Nine plant species on Beale AFB fall into this category (Attachment 1); most of them have been definitively identified on the base but, based on the two recent invasive plant surveys, in a fairly limited number of locations and generally at low cover (H.T. Harvey & Associates 2015a, CEMML 2017). Two eradication stage species (water primrose and Russian knapweed) have potentially been observed on the base but were not definitively identified, so they are also included in the EDRR list.

Infestations of six eradication stage invasive plant species would be visited and treated each year until eradicated (Tables 1 and 2). The remaining three eradication stage species would be treated annually once positive identification and locations have been established. These species are documented as highly invasive with severe or substantial ecological impacts in California (Cal-IPC 2015a), and are currently limited in their distribution and abundance on Beale AFB making their eradication an achievable goal. Ninety known infestations, as well as newly discovered infestations of the species shown below would be treated and monitored annually to achieve the goal of eradication. In 2016 there were 212 acres mapped on the base that contained eradication stage plant infestations. Species from the EDRR stage would be added to this list if management actions fail to achieve the goals of the EDRR stage. Current eradication stage species are:

- Giant reed (*Arundo donax*)
- Tree-of-heaven (*Ailanthus altissima*)
- Bull thistle (*Cirsium vulgare*)
- Stinkwort (*Dittrichia graveolens*)
- Edible fig (*Ficus carica*)
- Black locust (*Robinia pseudoacacia*)
- Russian knapweed (*Acroptilon repens*) – positive identification and mapping needed
- Water primrose (*Ludwigia hexapetala* and *L. peploides*) – positive identification and mapping needed
- Indian toothcup (*Rotala indica*) – mapping needed
- Waxy mannagrass (*Glyceria declinata*) – mapping needed
- Common pokeweed (*Phytolacca americana*) – mapping needed

2.1.3. Containment Stage

Containment becomes the most cost-effective strategy once an invasive species establishes a viable population and begins to spread outward. At this stage, the focus would be on monitoring the original introduction site if known, curtailing spread from that site, and targeting any newly established satellite populations for immediate control. A portion of the mapped occurrences of five containment stage invasive plant species would be treated annually (Table 2), focusing first on eradicating or containing the most isolated, outlying occurrences and, over time, reducing the footprint of larger, less isolated occurrences. Treatment would also be focused on areas within the wildlife exclusion zone around the airfield and vernal pool and riparian conservation areas (Table 1).

Table 1. Current and Projected Future Acres Infested by Invasive Plants on Beale AFB.

	Common name	Scientific Name	Infested Acres by Location [1] Airfield	Wildlife Exclusion Zone	Grazing Management Areas	Vernal Pool Conservation Areas	Riparian Conservation Area	Total Acres Mapped	# of Sites Mapped [2]	Potential 10-year Expansion no Treatment [3]
Eradication Stage	Black locust	*Robinia pseudoacacia*	0	8	5	0.6	0.6	10.5	15	65
	Bull thistle [4]	*Cirsium vulgare*	0	110	110	0	0	110	14	681
	Edible fig	*Ficus carica*	0	20	17	0.6	11	48	20	297
	Giant reed	*Arundo donax*	0	0	0	0	11	11	16	68
	Stinkwort [4]	*Dittrichia graveolens*	0	19	19	11	0	19	5	118
	Tree-of-heaven	*Ailanthus altissima*	0.6	8	0.6	0	4.3	13	20	80
	Unmapped/ Early Detection Rapid Response		unk	unk	unk	unk	unk	NA	NA	unk
	Total Eradication Stage [5]		**0.6**	**165**	**152**	**12**	**27**	**212**	**90**	**1,310**
Containment Stage	Barbed goatgrass	*Aegilops triuncialis*	129	302	290	12	7	502	203	3,108
	Blessed milkthistle	*Silybum marianum*	10	237	36	5	157	405	218	2,508
	Common St. John's wort	*Hypericum perforatum*	29	318	317	0	46	824	630	5,102
	Rush skeletonweed	*Chondrilla juncea*	14	117	221	0	57	570	402	3,529
	Vervain [4]	*Verbena* spp.	0	355	47	0	76	452	12	2,799
	Total Containment Stage [5]		**182**	**1,329**	**911**	**17**	**343**	**2,753**	**1,465**	**17,046**
Asset-Based Protection Stage	Black mustard	*Brassica nigra*	24	400	72	16	248	863	420	5,343
	Himalayan blackberry	*Rubus armeniacus*	0.6	154	120	4	261	596	198	3,690
	Italian thistle	*Carduus pycnocephalus*	150	1,145	223	12	335	2,611	857	16,167
	Yellow starthistle [5]	*Centaurea solstitialis*	606	4,823	2,416	281	579	6,815	904	42,197
	Medusahead [5]	*Elymus caput-medusae*	1,543	12,340	12,471	911	539	20,453	many	126,640
	Total Asset-Based Protection Stage [5]		**2,324**	**18,862**	**15,302**	**1,224**	**1,962**	**31,338**	**2,379**	**194,037**
	Total All Stages [5]		**2,506**	**20,356**	**16,365**	**1,253**	**2,332**	**34,303**	**3,934**	**212,392**

[1] Infested acres calculated using data from 2014-2016 invasive plant species mapping efforts on Beale AFB (H.T. Harvey & Associates 2015a; CEMML 2017). No data is available for the LRS. Weed data were collected as percent cover classes in 50m x 50m (0.6 acre) quadrats. For purposes of calculating infested acres, the entire 50m x 50m quadrat was included in the acreage estimate if an invasive plant species was present in any density. [2] Infested quadrats directly adjacent to other infested quadrats were considered a single contiguous infestation and counted as one site. [3] Acreage calculated based on an annual expansion rate of 20% over ten years. The 20% expansion rate is from USDA (2013), based on Asher and Dewey (2005) who documented rates of invasive plant spread varying from 10-24% for many of the species proposed for treatment. [4] Acreage reflects infestations mapped for treatment in 2017 (H.T. Harvey & Associates 2017). [5] Actual infested area is less than the sum of acres of all infestations because of overlapping infestations. Total open space mapped in 2016 was 20,767 acres and is considered the maximum area that can realistically be infested, but percent cover can increase

Table 2. Maximum Acres that will be Treated under the Proposed Action.

Species/Stage	Infested Acres 2016 [1]	Max Acres Treated Proposed Action (Comprehensive Control)				
		Manual/ Mechanical	Herbicide	Burning	Grazing	Total
Unmapped/ EDRR [2]	NA	25	25	0	0	50
Black locust	10.5	5	10	0	0	15
Bull thistle [3]	110	50	50	0	50	150
Edible fig	48	5	50	0	0	55
Giant reed	11	5	15	0	0	20
Stinkwort [3]	19	5	5	9	0	19
Tree-of-heaven	13	5	15	0	0	20
Eradication	212	75	145	9	50	279
Barbed goatgrass	502	100	250	250	200	800
Blessed milkthistle	405	100	50	0	0	150
Common St. John's wort	824	100	200	0	0	300
Rush skeletonweed	570	50	25	0	50	125
Vervain [3]	452	100	50	0	0	150
Containment	2,753	450	575	250	250	1,525
Black mustard	863	20	50	100	100	270
Himalayan blackberry	596	20	100	25	0	145
Italian thistle	2,611	15	300	100	225	640
Yellow starthistle	6,815	300	300	2,500	2,500	5,600
Medusahead [4]	20,453	1,300	500	3,016	12,875	17,691
Asset-Based Protection [4]	31,338	1,655	1,250	5,741	15,700	24,346
Habitat Enhancement						300
Total [4]	**34,303**	**2,205**	**1,995**	**6,000**	**16,000**	**26,500**

[1] Infested acres calculated using data from 2014-2016 invasive plant species mapping efforts on Beale AFB (H.T. Harvey & Associates 2015a; CEMML 2017). No data is available for the LRS. Weed data were collected as percent cover classes in 50m x 50m (0.6 acre) quadrats. For purposes of calculating infested acres, the entire 50m x 50m quadrat was included in the acreage estimate if an invasive plant species was present in any density.
[2] EDRR = Early Detection Rapid Response.
[3] Acreage reflects infestations mapped for treatment in 2017 (H.T. Harvey & Associates 2017).
[4] Actual infested area is less than the sum of acres of all infestations because of overlapping infestations. Total open space mapped in 2016 was 20,767 acres, and is considered the maximum area that can realistically be infested, but percent cover can increase.

There are 1,465 containment stage infestations mapped occurring on 2,753 acres of the base (Table 1). Approximately 1,525 acres of containment stage infestations would be treated annually under the Proposed Action (Table 2). Current containment stage species are:

- Barbed goatgrass (*Aegilops triuncialis*)
- Rush skeletonweed (*Chondrilla juncea*)
- Klamathweed (*Hypericum perforatum*)
- Blessed milkthistle (*Silybum marianum*)
- Vervain (*Verbena litoralis* and/or *V. bonariensis*)
- Parrotfeather (*Myriophyllum aquaticum*) – control areas will be determined after mapping

2.1.4. Asset-Based Protection Stage

Asset-based protection-level species would be targeted for control when they directly threaten the base's resources, operation, or sensitive species, as they are very likely to continually reinvade any treatment site. These species would be controlled, if sufficient funds are available, when they occur in vernal pool or riparian conservation areas, or within the airfield fence and wildlife exclusion zone where they create an increased BASH risk. Other areas where these species threaten the base's assets and need to be controlled would be identified as needed. Medusahead has infested almost all open space on Beale AFB, and in most cases would not be targeted for individual treatment. It does, however, overlap infestations of many other species, meaning medusahead would be treated incidentally when other plants are controlled. Medusahead and yellow starthistle occur in most of the base's grazing management areas. Up to 12,900 acres of medusahead and 2,500 acres of yellow starthistle would be controlled via prescribed grazing (Table 2). Exact acreage would be determined through coordination between the Beale AFB Natural Resources Manager (NRM) and grazing lessees. There are 31,338 acres of asset-protection stage infestations mapped on the base (Table 1). Current asset-based protection stage species are:

- Yellow starthistle (Centaurea solstitialis)
- Medusahead (Elymus caput-medusae)
- Himalayan blackberry (Rubus armeniacus)
- Black mustard (Brassica nigra)
- Italian thistle (Carduus pycnocephalus)

2.1.5. No Treatment Proposed at this Time

An additional 28 invasive plant species have been documented on Beale AFB but would not be targeted for eradication or control at this time because they are too widespread to control and/or have limited ecological impact. Future analyses may target specific infestations where ecological or resource damage is observed. A list of these species is included in Attachment 1.

2.1.6. Riparian Habitats

A number of these invasive plants occur in riparian habitats on the base (Table 3). Individual species and infestations will be treated based upon infestation stage, physical location, and threats posed to the military mission and natural resources.

Table 3. Riparian Acres Infested by Priority Invasive Plant Control Species at Beale AFB (as of 2016).

Common Name	Scientific Name	Riparian Acres Infested	Generally Proximate to Open Water?
black locust	*Robinia pseudoacacia*	1	No
bull thistle	*Cirsium vulgare*	110	No
edible fig	*Ficus carica*	39	No
giant reed	*Arundo donax*	11	Yes
stinkwort	*Dittrichia graveolens*	0	No
tree-of-heaven	*Ailanthus altissima*	4	Yes
Early Detection, Rapid Response	*multiple new species*	Yes	Yes
barbed goatgrass	*Aegilops triuncialis*	7	No
blessed milkthistle	*Silybum marianum*	157	No
St. John's wort	*Hypericum perforatum*	46	No
rush skeletonweed	*Chondrilla juncea*	57	No
tall or seashore vervain	*Verbena spp.*	452	Yes
black mustard	*Brassica nigra*	248	No
Himalayan blackberry	*Rubus armeniacus*	596	Yes
Italian thistle	*Carduus pycnocephalus*	335	No
yellow starthistle	*Centaurea solstitialis*	579	No
medusahead	*Elymus caput-medusae*	539	No
Total		3,181	

2.2 Methodology

Employing invasive plant prevention measures such as implementing BMPs, enhancing education and awareness, and developing and maintaining an Invasive Plants Watch List would reduce the likelihood of new invasive plants being introduced onto Beale AFB.

The 2015 Cal-IPC report to Beale AFB recommended that the base develop an early detection-rapid response program (Cal-IPC 2015a). A work plan for such a program is included as an appendix to the IPSMG (Beale AFB 2017a; Attachment 3). The work plan includes a decision-making framework and guidance on action steps that should be implemented to respond to newly invading plant species. Associated activities include monitoring, communication, assessment, and development of a response plan for eradication.

Containment/control is the most cost-effective strategy once an invasive species establishes a viable population and is spreading outward. An asset-based protection spatial analysis and work plan for certain species and situations is often needed. Several work plans were developed and are included as appendices to the IPSMG; more may be developed as new threats emerge.

To increase the likelihood of successful long-term control, invasive plant management experts recommend combining several management methods, tailored to situation-specific goals, constraints, and opportunities. The following methods and activities for invasive plant species containment/control are considered under this alternative:

1. Continue and expand livestock grazing (cattle, sheep, goats, and horses), including prescribed grazing management strategies and techniques (e.g., continuous grazing, seasonal grazing, variable stocking rates, short duration high-intensity grazing methods), new grazing locations, and new infrastructure (e.g., permanent barbed wire fence, temporary or permanent electric fence, water troughs, solar wells, and trenched waterlines),
2. Burns (prescribed fires, torching/flaming, fire control lines),
3. Chemical treatments (herbicide application via broadcast, spot-spray, or cut-stump treatments),
4. Manual/mechanical treatments (e.g., mowing, hand-pulling, weed-whacking),
5. Habitat enhancement treatments (e.g., soil preparation, digging, planting, drill or broadcast seeding, hydroseeding, tilling, watering),
6. Monitoring for treatment efficacy, effects of invasive species, and other data important to the program,
7. Surveying (for new species and phenology tracking),
8. Tracking the invasive plant species control program,
9. Prevention measures (e.g., education, equipment cleaning, weed-free mulch and fill).

2.2.1. Livestock Grazing

Grazing by domestic livestock, including cattle, sheep, goats, and horses, would be implemented as a method for controlling some invasive plant species and would be used to move plant community composition in a desired direction. While grazing alone does not eradicate invasive plant species, it would be effective in reducing infestations, slowing the spread of some undesirable species, and would make some plants more susceptible to herbicide application.

Under Proposed Action, the grazing program at Beale AFB and the LRS would be maintained in accordance with the Beale AFB GMG (Beale AFB 2017b; Attachment 4), which helps guide livestock grazing management activities to meet INRMP goals. The GMG helps to ensure that the grazing program on Beale AFB and the LRS is implemented in the safest and most efficient and beneficial manner possible. The GMG addresses conditions affecting grazing, grazing leases, land use rules, grazing management recommendations including recommended actions and timelines, monitoring, and adaptive management, and the goals and mission support functions of the grazing program. The GMG is updated periodically to meet changing conditions, natural resource and conservation goals, and mission requirements.

The GMG includes the consideration of expanding the existing grazing program based on a study by H.T. Harvey & Associates (2015b) which describes a strategy to expand into areas of Beale AFB and the LRS that have not been grazed in recent years in order to meet management goals including maintaining firebreaks, controlling invasive plants, and protecting and enhancing resources. The strategy identifies approximately 3,332 acres on Beale AFB and 210 acres on the LRS of land that could potentially be utilized for grazing, and discusses associated infrastructure, livestock species considerations, and other particulars. Beale AFB has identified 1,668 acres for permanent cattle grazing pastures (Figure 4). Most of these areas do not currently have infrastructure to support livestock grazing, so improving fencing or adding fencing and developing water sources would be required before these areas could be grazed. All permanent grazing pastures may be grazed by cattle, horses, goats, and sheep. Additionally, grazing using goats and sheep would be used to control invasive plant species in areas where permanent enclosures and cattle grazing is impractical (e.g., small areas near facilities, road banks, and manmade impoundment structures). All fencing and infrastructure for goats and sheep outside of cattle pastures would be temporary (i.e., electrified fencing) and would be removed at the end of the grazing treatment.

Areas proposed for grazing expansion are ecologically identical to currently grazed lands. The areas are predominantly California annual grassland, interspersed with vernal pool complexes, seasonal swales and tributaries, and riparian and oak woodland habitat. Grazing will not occur within the Dry Creek Riparian corridor, and so will have no effect on listed California Central Valley (CCV) steelhead, their habitat, or EFH for Chinook salmon.

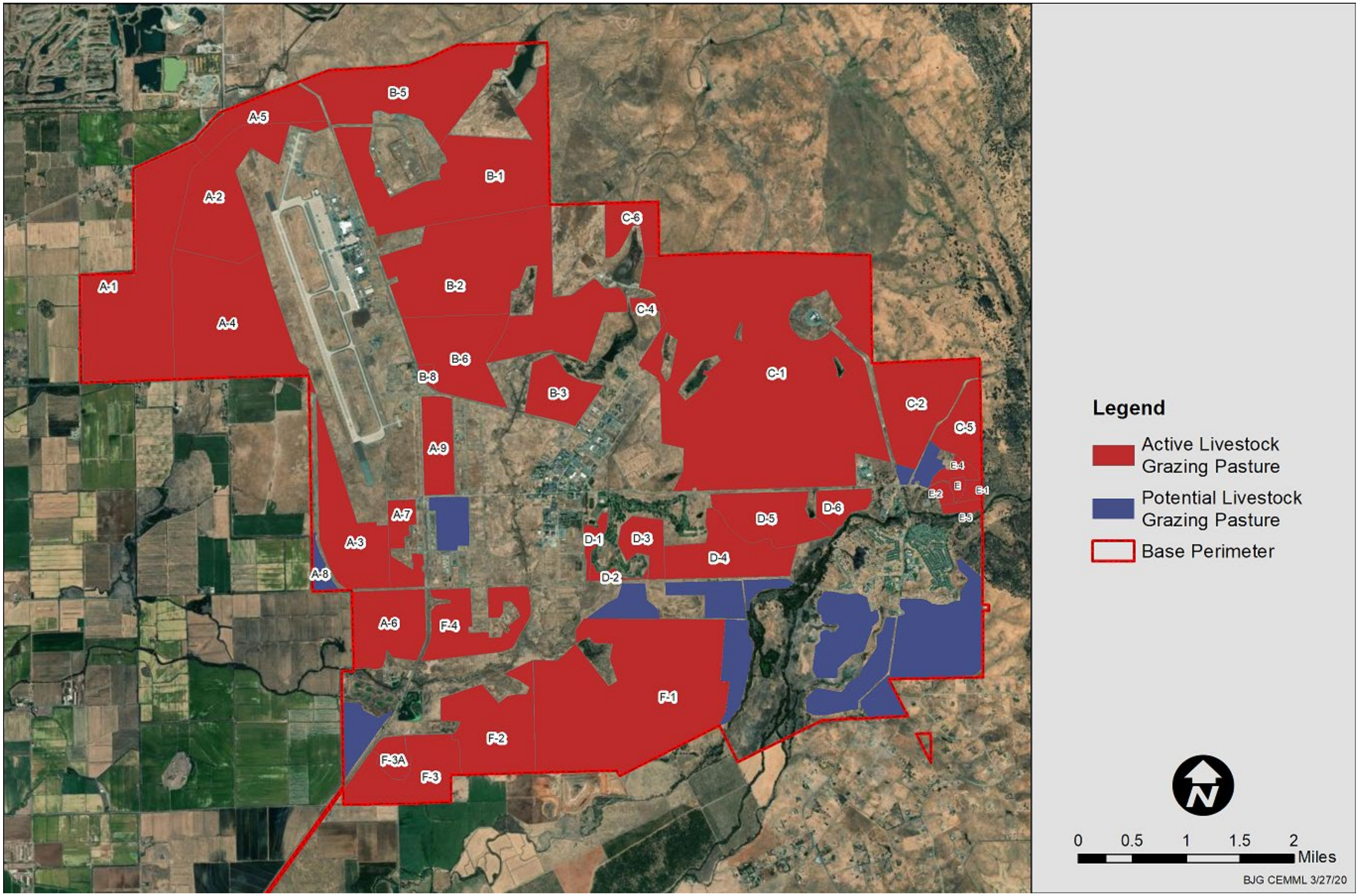

Figure 4. Current and Proposed Cattle Pastures on Beale AFB.

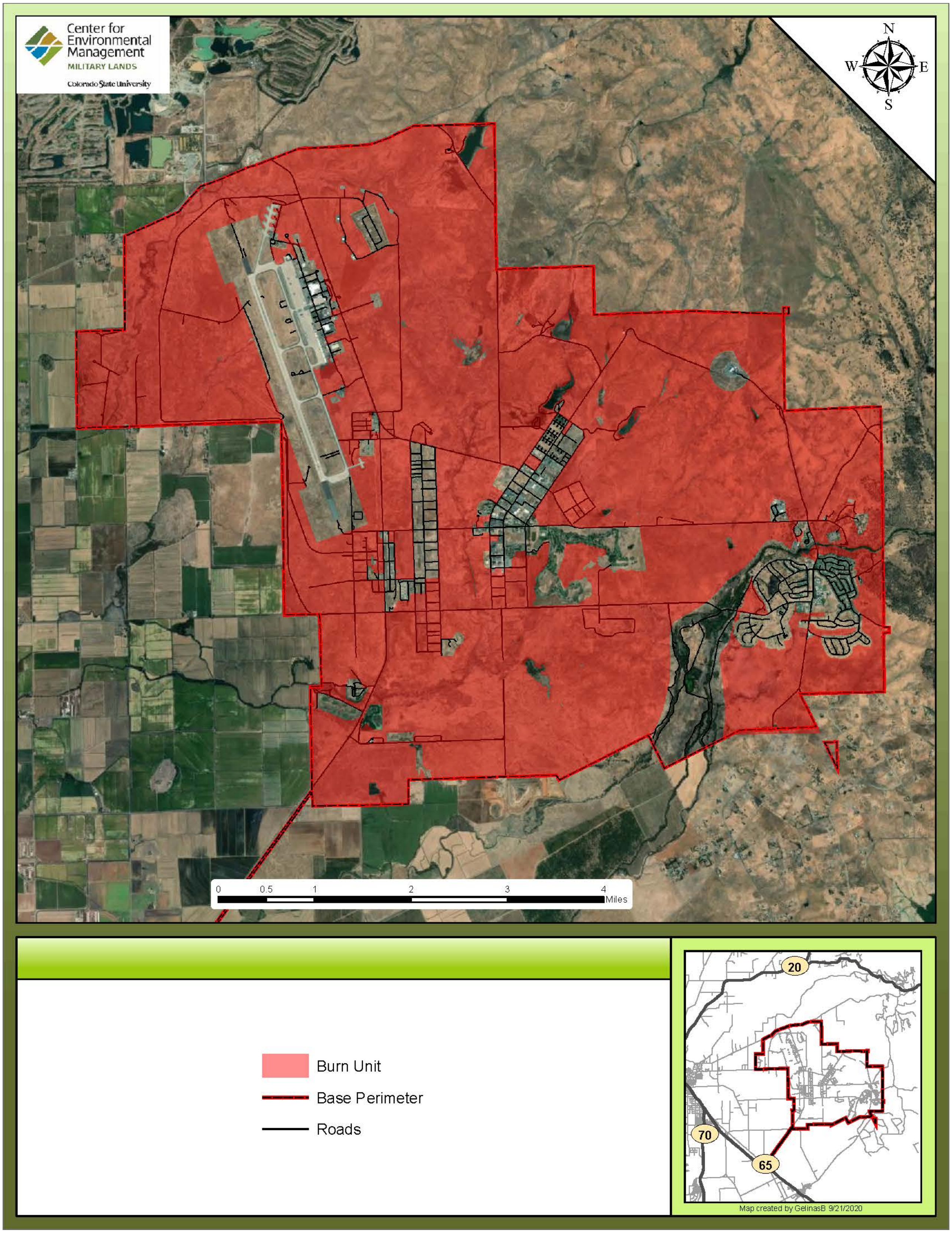

Figure 5. Beale AFB Burn Unit.

According to the current WFMP, the historic mean fire return interval for the dominant grassland areas on Beale AFB is about four years. The historic mean fire return interval for the oak woodland is about 12 years. Because increased native plant biodiversity has been documented to last greater than three years when prescribed fire is applied to vernal pools, the WFMP recommends that vernal pool habitat management follows the mean fire return interval prescribed for surrounding grassland areas. The WFMP includes a table of prescribed fire recommendations for the control of invasive species on Beale AFB, which is reproduced here in Table 4. Annual prescribed fire application on the installation would need to average 3,434 to 5,723 acres to achieve the goals identified in the WFMP. As with other invasive plant control methods, timing of treatment is critical.

"Black Lines" are narrow strips of burned vegetation along the perimeter of a planned prescribed fire project and/or along a pre-identified firebreak. They reduce the chances of slop-over and/or fire advancements outside of the desired burn perimeter. Black Lines would be used in conjunction with larger prescribed burns or used as stand-alone firebreaks in areas where soil disturbance could harm sensitive resources. This method reduces the chances of losing control of a prescribed burn and causing a subsequent wildfire. Black Lines are a non-destructive alternative to traditional firebreaks in areas where ground disturbance is restricted.

Torching, also known as flaming, would be effective in treating some invasive plant infestations. Torching is the use of handheld propane torches to treat seedlings. Timing, as with other methods, is critical. Torching is often used as a retreatment method to control small seedlings where an infestation was treated using another method during the prior year. It can reduce the seed bank in the soil by killing germinated seeds and preventing invasive plant reproduction that would lead to additional seed production during that year. Torching requires a relatively low level of effort and is a precise treatment.

The Beale AFB NRM was involved with the development of the WFMP to ensure that all planned actions that could affect natural resources are in line with and directly supportive of the current INRMP, and conversely, that relevant natural resource goals and objectives are represented in the WFMP. The WFMP undergoes a regular review process, with updates as needed.

Table 4. Beale AFB Prescribed Fire Recommendations for Control of Invasive Species.

Species Controlled	**Prescribed Burn Recommendation**
Barbed goatgrass (*Aegilops triuncialis*)	Early summer or late spring prescribed fire in 2 consecutive years.
Yellow starthistle (*Centaurea solstitialis*)	Early summer or late spring prescribed fire in 3 consecutive years. Repeat treatments may be necessary every 2-4 years.
Himalayan blackberry (*Rubus armeniacus*)	Prescribed fire at any time of the year with follow-up fall herbicide treatment of resprouts.
Medusahead (*Elymus caput-medusae*)	Late spring (after seedhead dispersal but before the seed moisture drops below 30%) prescribed fire followed by fall herbicide application. Repeat treatments may be necessary every 2-4 years.
Source: WFMP Table 3.2 (Beale AFB 2018a).	

The Wildland Fire Program Coordinator initiates, coordinates, and ensures appropriate installation engagement and timely completion of the WFMP and serves as the primary installation point of contact for the Wildland Fire fuels treatment implementation, data collection, large wildfire reporting, and reporting of significant fires. The Beale AFB 9 CES Fire and Emergency Services and the Wildland Fire Support Module are currently responsible for suppressing wildland urban interface fires and supporting natural resource suppression efforts during wildfires and prescribed fires.

2.2.3. Manual/Mechanical Treatments

Under the Proposed Action, manual and mechanical treatments including mowing, hand-pulling, digging up with hand tools, and weed-whacking may be utilized to control certain invasive plant species at Beale AFB and the LRS. Heavy equipment including excavators and flail mowers or masticators may be used to control infestations of giant reed and Himalayan blackberry. Administration of these activities is the responsibility of the Beale AFB NRM.

Standard mowers may be used to control or suppress certain invasive species, particularly annual species. For treatments of annual invasive species, mowing would be carefully timed to coincide with target species' phenology. Mowing may also be used for perennial invasive species when removal of biomass is required (e.g., reduction of BASH hazards, preparation or maintenance of habitat enhancement sites). Regular mowing performed for fuels control and grounds maintenance does not apply as an effective invasive species control technique. Mowing may also be used in conjunction with prescribed fire in order to prepare the site for wet fire-lines. It reduces vegetation height and allows for installation of hose lays and wet lines in order to secure the prescribed burn perimeter, instead of using ground disturbing equipment. This is ideal for locations where ground disturbance is restricted (e.g., vernal pools). Table 5 provides relative benefits and downsides to mowing when compared to other manual/mechanical control methods.

Manual removal methods or use of small hand-powered or hand-held equipment are often the first methods considered for removing small or new invasive plant infestations. Hand removal may also be a good option for containing the leading edge of an infestation where target plants are mixed with desirable native species. When employed, plant material left over would be collected and disposed of in a manner that prevents spread to other areas, unless the timing is such that there are no viable propagules and the species is not capable of vegetative reproduction. For perennial species, especially trees, hand removal would take the form of girdling if the species is incapable of resprouting below the girdling cut. Depending on the target species and environmental constraints, manual and mechanized removal would be used independently or in concert with herbicide application. Staging and maintenance areas would be designated as needed, and reviewed and approved through the USAF Form 103 process. Any in-house work will use existing 9 CES/CEIE equipment yard for maintenance purposes.

Table 5. Manual and Mechanical Control Method Descriptions and Impacts.

Type	Tool/Method	Description of Technique	General Benefit	General Cons	BRC[1]	PGD[2]	LSI[3]	ID[4]	TS[5]	DoA[6]	T[7]
Manual (Conducted by hand or with non-mechanized hand tools)	Cut Stump with Hand Saws	Used to kill tree or shrub species unlikely to resprout or in conjunction with herbicide application	No herbicides, species specific	Generates biomass that may need to be removed	Low	Low	Small	Diffuse	High	High	Flat to mod
	Trim with Hand Sheers, Loppers, or Similar Tools	Used to remove portions of trees and shrubs without killing them	No herbicides, species specific	No kill, generates biomass that may need to be removed	Low	None	Small	Diffuse	High	High	Flat to mod
	Pull by Hand or Weed Wrenches	Used to remove small trees/shrubs and small or intermixed infestations of plants	No herbicides, species specific	Limited to a few species, generates biomass that needs to be removed, very labor/time intensive	Low	Low	Small	Diffuse	High	Mod	Flat to mod
	Excavate with Shovels or similar Tools	Used to dig up small patches of plants that are too difficult to pull by hand	No herbicides, species specific	Limited to a few species, minor soil disturbances, generates biomass that may need to be removed, very labor/time intensive	Low	Mod	Small	Diffuse	High	Mod	Flat to mod
	Mulch	Organic material (wood chips) used to suppress germination of invasive species	No herbicides, can be used in conjunction with restoration activities	Non-selective, only useful against seedlings, physically disruptive, labor intensive	None	None	Mod	Diffuse	Low	High	Flat
Mechanical	Cut Stump with Chain Saw or Similar Tool	Used to kill tree or shrub species unlikely to resprout	No herbicides, species specific	No kill, generates biomass that may need to be removed	Low	Low	Large	Dense	High	High	Flat to mod
	Trim with Chain Saws, Brush-cutters, or Similar Tools	Used to remove portions of trees and shrubs without killing them or in conjunction with herbicide application	No herbicides, species specific	Limited to few a species, generates biomass that may need to be removed	Low	None	Large	Dense	Mod	High	Flat to mod
	Remove Using Excavator or Back Hoe	Used to remove large rhizomatous species like Himalayan blackberry and Arundo	No herbicides, species specific	Limited to a few species, highly disruptive to soil	Low	High	Mod	Diffuse	High	High	Flat
Mowing	Mow using weed-whackers, riding mowers or similar equipment	Used to mow small infestations of annual invasive species or reduce biomass of perennial species	No herbicides, can cover significant areas	Limited to few species, non-selective, equipment must be cleaned to prevent spread of invasive species	Mod	Low	Large	Dense	Low	High	Flat

[1] BRC=Biomass Reduction Capability, [2] PGD= Potential for Ground Disturbance, [3] LSI= Landscape Scale of Infestation,[4] ID= Infestation Density, [5] TS= Target Specificity, [6] DoA= Detection of Application, [7] T= Terrain.

2.2.4. Habitat Enhancement Treatments

Under the Proposed Action, habitat enhancement treatments may be utilized to control invasive plant species at Beale AFB and the LRS by replanting or reseeding with desirable species. Revegetating invasive plant treatment sites may be accomplished using a mixture of native grasses and forbs, and may include trees and shrubs if appropriate. Revegetating decisions would be compatible with future uses and management actions, and would consider suitability and cost of available options as well as the suitability of the site itself. Habitat enhancement guidance is provided in the IPSMG.

For reasons laid out in detail in the IPSMG (Section 4.4) including the lack of commercial availability and locally adapted genotypes, competitive disadvantages against invasive species, and poor site condition, using naturalized non-native species to revegetate treatment sites that are already surrounded by non-native species may be a cheaper, easier, and more successful strategy and shall be considered under the Proposed Action.

Site preparation is not likely to include disking but could, depending on overall project goals and location. Should disking be used, it would occur after herbicide treatment, manual removal, or prescribed burning has been conducted and in accord with other resource goals and protection measures. The most common restoration methods that may be used at Beale AFB include:

- Hand seeding: In very small (under 1/10th acre) upland disturbed areas, hand seeding with the base-approved native seed mix may be used to encourage recolonization by native vegetation.
- Drill seeding: A drill seeder with a row of small disks mounted on the front would be used to plant seeds. The seeder digs a 0.75 to 1-inch groove in which the seed is planted, and then the grove is closed behind the machine. Thatch reduction using grazing, prescribed burning, or mowing would be conducted prior to seeding to improve seed germination.
- Plug planting: A dibble tool would be used to poke a hole in the ground to a depth of about two to three inches. A small container plant would be placed in the hole and the top of the soil is closed around it to seal it in. Typically, these plugs would be planted every 1-3 feet. Thatch reduction using grazing, prescribed burning, or mowing would be conducted prior to planting seeding to improve plant survival.
- Container Planting: Hand tools would be used to dig holes in the ground for the installation of regionally native plants. Generally, container planting would be conducted using methods from the Restoration Plan for the Dry Creek Riparian Area (River Partners 2011).

2.2.5. Chemical Treatments

Under the Proposed Action, chemical treatments in the form of herbicide applications would be utilized to control certain invasive plant species at Beale AFB. Herbicides are most often used when other methods are not effective or feasible. Herbicides may be used to manage dense or large infestations or specific species that cannot be successfully controlled through other management actions. In a successful management program, the amount of herbicide used on a particular site would decrease over time as the invasive plant population declines.

Potential effects of herbicide use on surrounding vegetation, habitats, wildlife, and water resources would always be considered, as the purpose of the activity is to protect and benefit these resources. Selection of the herbicide to be used in any given situation is critical, with attention to toxicity, use restrictions, and timing of the application. In areas where aquatic resources are present, requirements of the Statewide General National Pollutant Discharge Elimination System (NPDES) Permit for Residual Aquatic Pesticide Discharges to Waters of the U.S. (WoUS) from Algae and Aquatic Weed Control, Aquatic Pesticide Application Plan (APAP; Attachment 6) and/or other required permits would be followed.

Herbicides would always be applied in accordance with the IPSMG; the Beale AFB Installation Pest Management Plan (IPMP; Beale AFB 2018b; Attachment 7); the USAF Pest Management Program; the Statewide NPDES Permit and Beale AFB APAP; all applicable federal, DoD, USAF, State of California, and local directives and regulations; and label instructions. The DoD maintains a list of approved pesticides, the 2016 version of which is included as Appendix E in the IPSMG. Additionally, Cal-IPC (2015b) has produced a publication on the use of herbicides in wildlands, especially relating to minimizing impacts on wildlife, which would be consulted.

All individuals who apply herbicide must have either a DoD applicator’s license or a California Qualified Applicator License or Certificate. Pest Management tracks and reports all pesticide use on the installation, and maintains a record of Qualified Applicator Licenses and Certificates. All herbicide use on the installation is reported to the base Pest Management Shop, who report to the county.

Ten herbicides are proposed for use in invasive plant control (Table 6). The herbicide and application method used would depend on the target plant species (Table 7). Application methods that may be used are described below:

- Broadcast Spray (Boom): Spraying herbicide onto an entire infested area, rather than targeting individual plants using a regulated nozzle. This method uses a truck- or ATV-mounted boom sprayer and is limited to areas with moderate terrain. Broadcast methods are used for denser infestations where application to individual plants would not be feasible.
- Targeted Spray: Spraying herbicide onto the foliage of individual target plants. This is done using a regulated nozzle, which helps to concentrate application toward target plants. This method uses a backpack-mounted wand sprayer or a truck- or ATV-mounted hose sprayer. This is used for small infestations or in areas not accessible by vehicle.
- Pre-emergent Spray: Herbicide is applied directly to the soil in areas with known infestations to prevent seed germination or to otherwise inhibit development. Herbicide may be applied using backpack-mounted wand sprayer or a truck- or ATV-mounted hose sprayer. This method is best for large infestations and difficult-to-control species.
- Basal Bark: Basal bark herbicides are mixed with an oil carrier to penetrate the bark of the target plant. Herbicide is sprayed around the circumference of the base of the stem. This is used to control thin-barked plants less than 6 inches in basal diameter.
- Selective Application: Selective applications involves touching individual target plants with applicators containing herbicide. Because these methods involve direct application, there is a very low likelihood of drift, run-off, or accidental nontarget exposure. Specific methods include: hack-and-squirt, cut-stump, and wicking or wiping.

Aquatic Applications: Herbicide is either applied directly to foliage growing at or above the water’s surface or to the water column itself using hoses and weighted nozzles if plants are fully submerged. This method is generally restricted to large infestations of aquatic plants in non-moving water. Only herbicides approved for aquatic use may be applied using this method.

2.2.2. Prescribed Burns

Prescribed fire is defined as fire applied in a knowledgeable manner to fuels on a specific landscape under specific weather conditions to accomplish predetermined and well-defined management objectives. Invasive plant species management using prescribed fire would:

- Control certain invasive species, particularly those present over large areas (over 100 acres),
- Improve wildlife habitat by decreasing thatch, destroying seeds, reducing invasive plant cover, and increasing native species cover and diversity,
- Manage competing vegetation,
- Minimize the negative effects and severity of wildfires,
- Decrease BASH potential,
- Maintain open grasslands and vernal pools.

Under the Proposed Action, prescribed fire may be utilized to control certain invasive plant species at Beale AFB and the LRS. Prescribed burns may not be feasible in some areas due to conflicts with mission-critical operations or other ecological goals. This includes a prohibition on prescribed burns in the Dry Creek riparian corridor. Therefore, prescribed burns will have no effect on CCV steelhead, their habitat, or EFH.

Prescribed burns require careful planning, coordination, and implementation to be successful. Beale AFB has an existing prescribed fire program that serves to maintain and enhance habitat to support a multitude of grassland and woodland species. All prescribed burns are managed in accordance with the IPSMG, in addition to the WFMP (Beale AFB 2018a; Attachment 5), which provides guidance for the suppression and prevention of wildfires as well as the implementation of ecosystem management and fuels reduction on Beale AFB. The WFMP addresses Beale AFB INRMP management goals and objectives, and complies with all applicable laws and regulations. It lays out responsibilities and procedures for prescribed fire management in a manner that is safe, efficient, effective, and highly professional. The WFMP addresses, among other things: prescribed fire planning, project implementation, operations, public notification, smoke management, management protocol, reporting requirements, asset protection, training and qualifications, and monitoring and evaluation.

According to the WFMP, the locations, plans, and staging areas for all prescribed fires in support of the goals and objectives of the INRMP would be approved by the Beale AFB NRM. The NRM alone would set prescribed fire priorities on the installation for the purpose of meeting Natural Resource Program goals, and would be consulted on all planned prescribed fire actions.

A prescribed fire plan would be developed for each burn to guide the implementation process. These plans are driven by the specific management goals and objectives of the burn, and address: smoke management, cultural and resource mitigation measures, personnel and public notifications, burn operations, pre and post monitoring requirements, safety and hazard mitigations, contingency protocol, resource and personnel requirements, and wildfire declaration protocol.

A Burn Unit has been identified for Beale AFB (Figure 5), which is an area defined by similar overall strategic fire management objectives with consideration for specific or dominant constraints, requirements, and guidelines for implementation. Unique characteristics (i.e., fuels, topography, natural resource concerns) are also considered. Prescribed fire is recommended for Burn Units, as described in the WFMP.

The WFMP suggests that the existing prescribed fire program could be enhanced by introducing prescribed fire to more areas on the installation to improve floral and faunal diversity, improve rangeland habitat quality, control certain invasive species, and reduce hazardous fuels that could increase wildfire intensity.

Table 6. Herbicides Proposed for Use Under the Proposed Action

Example Product Name	Active Ingredient	Type	EPA Reg No.	Toxicity to Fish	Mobility	Groundwater Contamination Potential	Half-life in Water
Milestone	Triisopropanolam monium salt of aminopyralid	Liquid	62719-519	Practically non-toxic [2]	Relatively immobile	Minimal leaching below 15 to 30 cm.	Breaks down in sunlight with half-life of 0.6 days.
Capstone, Milestone VM Plus	Triisopropanolam monium salt of aminopyralid and Tricolpyr triethylamine salt (TEA)	Liquid	62719-572	Practically non-toxic [2,8]	Relatively immobile to Highly mobile	Potential to contaminate groundwater.	Breaks down in sunlight with a half-life of 0.6 days to 83.4 hours.
Telar XP	Chlorosulfuron	Dry flowable	432-1561	Practically non-toxic [3]	Highly mobile	Moderate potential to contaminate groundwater. High potential for surface runoff.	Breaks down in water at low pH with a half-life of 22-23 days. Stable in water at higher pH.
Roundup Pro	Isopropylamine salt of glysophosate	Liquid	524-475	Practically non-toxic [4], slightly to highly toxic[9]	Relatively immobile	Very low potential to contaminate groundwater	Breaks down due to microbe degradation to a half-life of 12 days to 10 weeks.
Rodeo [1], Roundup Custom [1]	Isopropylamine salt of glysophosate	Liquid	62719-324; 524-343	Practically non-toxic to slightly toxic [9]	Relatively immobile	Very low potential to contaminate groundwater	Breaks down due to microbe degradation to a half-life of 12 days to 10 weeks.
Clearcast [1]	Ammonium salt of imazamox	Liquid	241-437-67690	Practically non-toxic [5]	Highly mobile	Minimal leaching below 23 cm.	Breaks down in clear water with a half-life of 6.8 hours.
Arsenal [1], Habitat [1]	Isopropylamine salt of imazapyr	Liquid	241-346; 241-426	Practically non-toxic [6], no risk of concern [10]	Highly mobile	High potential to leach to groundwater. High surface water runoff potential.	Breaks down in sunlight with a half-life of ~4 days.
Oust XP	Sulfometuron methyl	Dispersible granules	432-1552	Practically non-toxic [7]	Moderately mobile	Degrades rapidly, not likely to contaminate groundwater. Tends to stay within the top 3 inches of soil.	Breaks down in water and with sunlight with a half-life of 1 day to 2 months.
Garlon 4 Ultra	Triclopyr butoxyethyl ester (BEE)	Liquid	62719-527	Moderately to Highly Toxic [8]	Highly mobile	Potential to contaminate groundwater.	Breaks down in sunlight with a half-life of 2.8 to 83.4 hours.

Example Product Name	Active Ingredient	Type	EPA Reg No.	Toxicity to Fish	Mobility	Groundwater Contamination Potential	Half-life in Water
Garlon 3 [1]	Tricolpyr triethylamine salt (TEA)	Liquid	62719-37	Practically non-toxic [8]	Highly mobile	Potential to contaminate groundwater.	Breaks down in sunlight with a half-life of 2.8 to 83.4 hours.

[1] aquatic-safe formulation
[2] US Office of Prevention, Pesticides, Environmental Protection and Toxic Substances 2005
[3] Oregon State University and Intertox 2006
[4] UC Davis 1996
[5] USEPA 1997
[6] SERA 2011
[7] USEPA 2008
[8] SERA 2010
[9] USEPA 2015
[10] USEPA 2006

Table 7. Herbicide, Application Methods, Rates, and Target Plant Species for invasive species control on Beale AFB.

Herbicide	Application Methods	Target Plant Species	Maximum Application Rate (lbs a.e./acre) [1]	Maximum Treatments/ Year	Maximum Acres/ Year [3,4]
Aminopyralid (Milestone)	Target Spray/Direct Application	bull thistle, blessed milk thistle, skeletonweed, St. John's wort, Italian thistle, yellow starthistle, Indian toothcup, artichoke thistle, Canada thistle, Russian knapweed, spotted knapweed	0.11 (0.22 spot treatment)[2]	1	925
	Broadcast Spray	St. John's wort, yellow starthistle, medusahead	0.11	1	1,000
	Pre-emergent	Italian thistle, medusahead, spotted knapweed	0.11	1	525
Aminopyralid + Triclopyr TEA (Capstone)	Target Spray/Direct Application	black locust, tree-of-heaven, Himalayan blackberry	0.11 + 1.12	1	125
Chlorsulfuron (Telar XP)	Target Spray/Direct Application	bull thistle, blessed milk thistle, black mustard, yellow starthistle, perennial pepperweed, Canada thistle, Russian knapweed	0.122 (0.062 rangeland)	1	475
	Pre-emergent	black mustard		1	50
Chlorsulfuron (Telar XP) + Sulfometuron Methyl	Pre-emergent	barbed goatgrass	0.062 + 0.375	1	250
Glyphosate (Roundup Custom/Rodeo)	Target Spray/Direct Application	black locust, tree-of-heaven, giant reed, stinkwort, edible fig, barbed goatgrass, skeletonweed, St. John's wort, black mustard, Italian thistle, yellow starthistle, medusahead, perennial pepperweed, Canada thistle,	8.0	2	0-1,900

Herbicide	Application Methods	Target Plant Species	Maximum Application Rate (lbs a.e./acre) [1]	Maximum Treatments/ Year	Maximum Acres/ Year [3,4]
		cheatgrass, purple loosestrife, red sesbania, spotted knapweed, vervain			
	Broadcast Spray	barbed goatgrass, medusahead, cheatgrass		2	775
	Cut Stump	black locust, giant reed		1	2.5
Glyphosate (Roundup Pro)	Target Spray/Direct Application	black locust, stinkwort, black mustard, yellow starthistle, Italian thistle, barbed goatgrass, medusahead, skeletonweed, St. John's wort	8.0	1	0-1,900
Glyphosate (Roundup Custom/Rodeo) + Imazapyr (Habitat)	Target Spray	giant reed	8.0 (glyphosate) + 1.5 (imazapyr)	1	15
Imazamox (Clearcast)	Direct aquatic	parrotfeather, water primrose, alligator weed, hydrilla, smallflower tamarisk, South American spongeplant, water hyacinth	1.0	1	25
Imazapyr (Habitat/Arsenal)	Target Spray	bull thistle, skeletonweed, yellow starthistle, black locust, edible fig, tree-of-heaven, giant reed, vervain, perennial pepperweed, pokeweed, artichoke thistle, water primrose, parrotfeather, alligator weed, Canada thistle, cheatgrass, purple loosestrife, red sesbania, Russian knapweed, smallflower tamarisk, spotted knapweed, water hyacinth	1.5	1	540
	Pre-emergent	skeletonweed		1	25
Sulfometuron Methyl	Target Spray	Himalayan blackberry, barbed goatgrass, pokeweed, vervain	0.281	1	375
	Broadcast Spray	medusahead, barbed goatgrass		1	750
	Pre-emergent	barbed goatgrass, black mustard, medusahead, perennial pepperweed, cheatgrass		1	825
Triclopyr triethylamine salt (Garlon 3)	Target Foliar	Himalayan blackberry, barbed goatgrass, bull thistle, yellow starthistle, black locust, edible fig, black mustard, Italian thistle, stinkwort, perennial pepperweed, water-primrose, Indian toothcup, artichoke thistle, Canada thistle, pennyroyal, purple loosestrife, red sesbania, smallflower tamarisk	8.0 (2.0 rangeland)	1	0-895

Herbicide	Application Methods	Target Plant Species	Maximum Application Rate (lbs a.e./acre) [1]	Maximum Treatments/ Year	Maximum Acres/ Year [3,4]
	Cut stump or basal bark	tree-of-heaven, edible fig		1	6.5
Triclopyr butoxyethyl ester (Garlon 4 Ultra)	Target Foliar	black locust, stinkwort, black mustard, yellow starthistle, Italian thistle	8.0 (2.0 rangeland)	1	0-895

[1] Maximum lbs active ingredient or acid equivalent that can be applied per acre/per year on product label. pounds acid equivalent per acre
[2] Cannot spot-treat more than 50% of an acre at this concentration
[3] Total acres per year that would be treated if the maximum proposed acreage for all species listed are treated using a single herbicide and single application method. This is not a likely scenario as a number of herbicides and methods are proposed for use, and the herbicide and method selected would depend on the plant species, location of infestation, and USAF herbicide use approval. More than one herbicide, or more than one application method would not be used for the same species in the same treatment area within a single year.
[4] Acres represent infested acres, so actual acres sprayed for target treatments is estimated to be 10-50% of the total.

Herbicide may be applied using a number of different methods including: broadcast spray, targeted spray, pre-emergent spray, basal bark application, hack and squirt, cut stump or wiping. Herbicides proposed for use are listed in Table 6. Potential effects of herbicide use on surrounding vegetation, habitats, wildlife, and water resources will always be considered, as the purpose of the activity is to protect and benefit these resources. Selection of the herbicide and method to be used in any given situation is critical, with attention to toxicity, use restrictions, and timing of the application. The toxicity of individual herbicides to fish varies, as does the potential for an herbicide to contaminate surface or groundwater (Table 6).

With the exception of giant reed control as described below, aquatic resource buffers will be implemented during herbicide application near suitable listed species habitat to prevent water contamination and protect steelhead and other aquatic species from exposure (see Table 9 in Section 4.2). Direct aquatic application of imazamox (Clearcast) may be used for control of aquatic weeds, but imazamox will not be used in Dry Creek or Best Slough or in waterbodies that feed into them.

Giant Reed Control

Giant reed (*Arundo donax*), occurs at multiple locations within the Dry Creek stream channel (Figures 6 through 8). If left unchecked it has the potential to block the Dry Creek stream channel and obstruct upstream fish passage. Giant reed will be controlled along Dry Creek during late summer (15 June to 31 October). Work will be done when flows in Dry Creek are low enough to allow workers to access the infestations on foot, and salmonids are unlikely to be present. Canes of the plant will be cut down using hand tools, or hand-held gasoline powered tools. The plant biomass will be chipped or removed from the site to reduce the risk of re-infestation. Herbicide will be applied directly to the cut stumps at the time of cane removal, or sprayed onto the leafy regrowth later in the summer.

An aquatic-approved formulation of glyphosate such as Rodeo or Roundup Custom, combined with an aquatic-approved formulation of Imazapyr such as Habitat or Arsenal will be used. These herbicides are considered "practically non-toxic" to fish (USEPA 2015; SERA 2011), and would be applied outside of the time period when CCV steelhead and Chinook salmon would be expected to be present in Dry Creek or Best Slough. The herbicides will be mixed with a non-ionic surfactant approved for use in aquatic habitats. No additional adjuvants would be used. Herbicide would not be applied directly to any flowing or non-flowing water. Foliar applications would be done with a pressurized hydraulic sprayer and/or low volume back pack sprayer. Cut-stump application would be done by spraying a concentrated solution directly onto the cut stumps using a low volume back pack sprayer. All herbicide applications will be done in accordance with the AMMs in Section 4. Potential impacts to CCV steelhead and EFH for Chinook salmon will be avoided by adhering to these AMMs, and applying herbicide outside of the time when salmonids are likely to be present in base waterways.

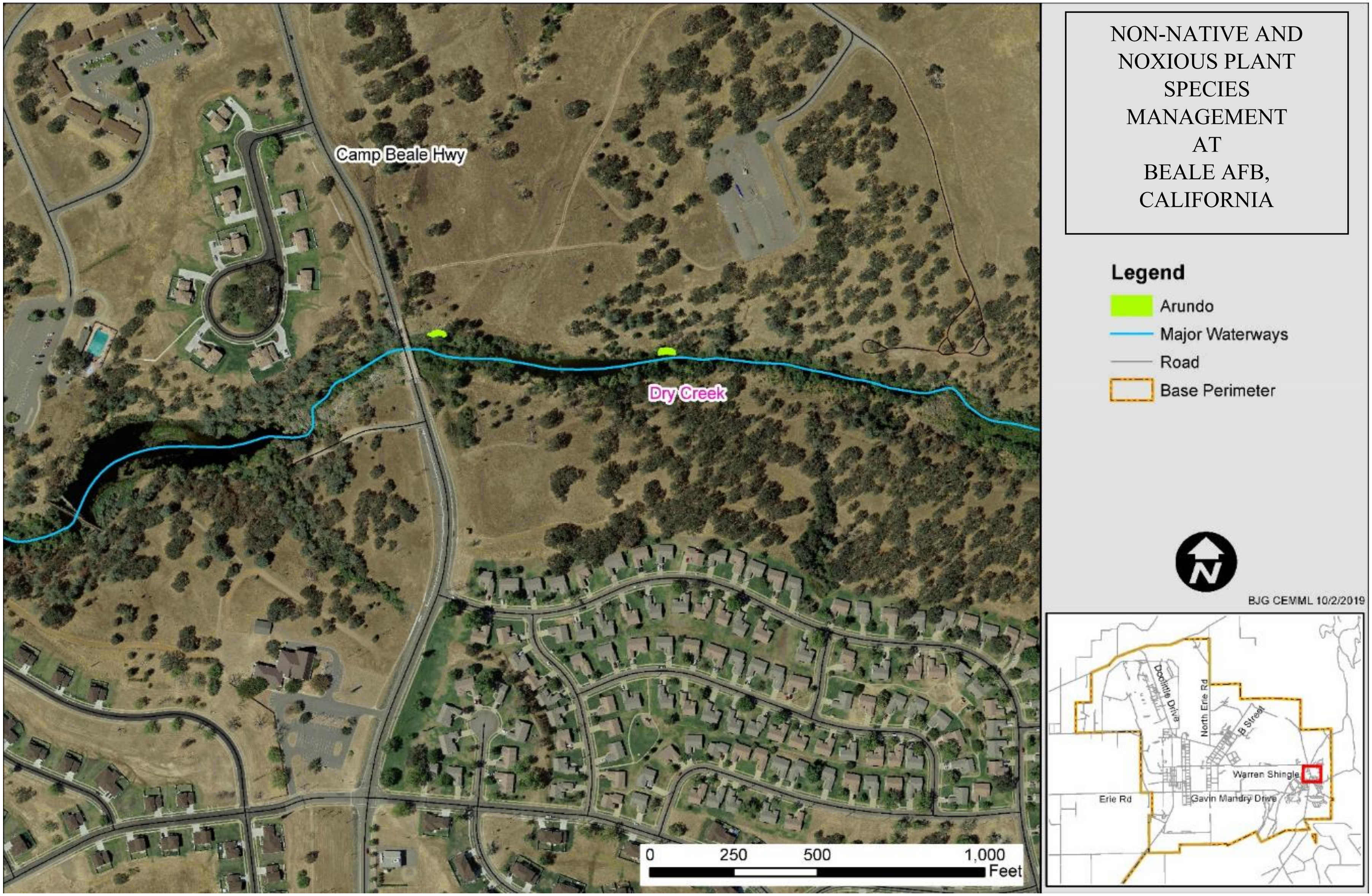

Figure 6. Giant reed (Arundo donax) infestations along Dry Creek (Map 1 of 3)

Figure 7. Giant reed (Arundo donax) infestations along Dry Creek (Map 2 of 3)

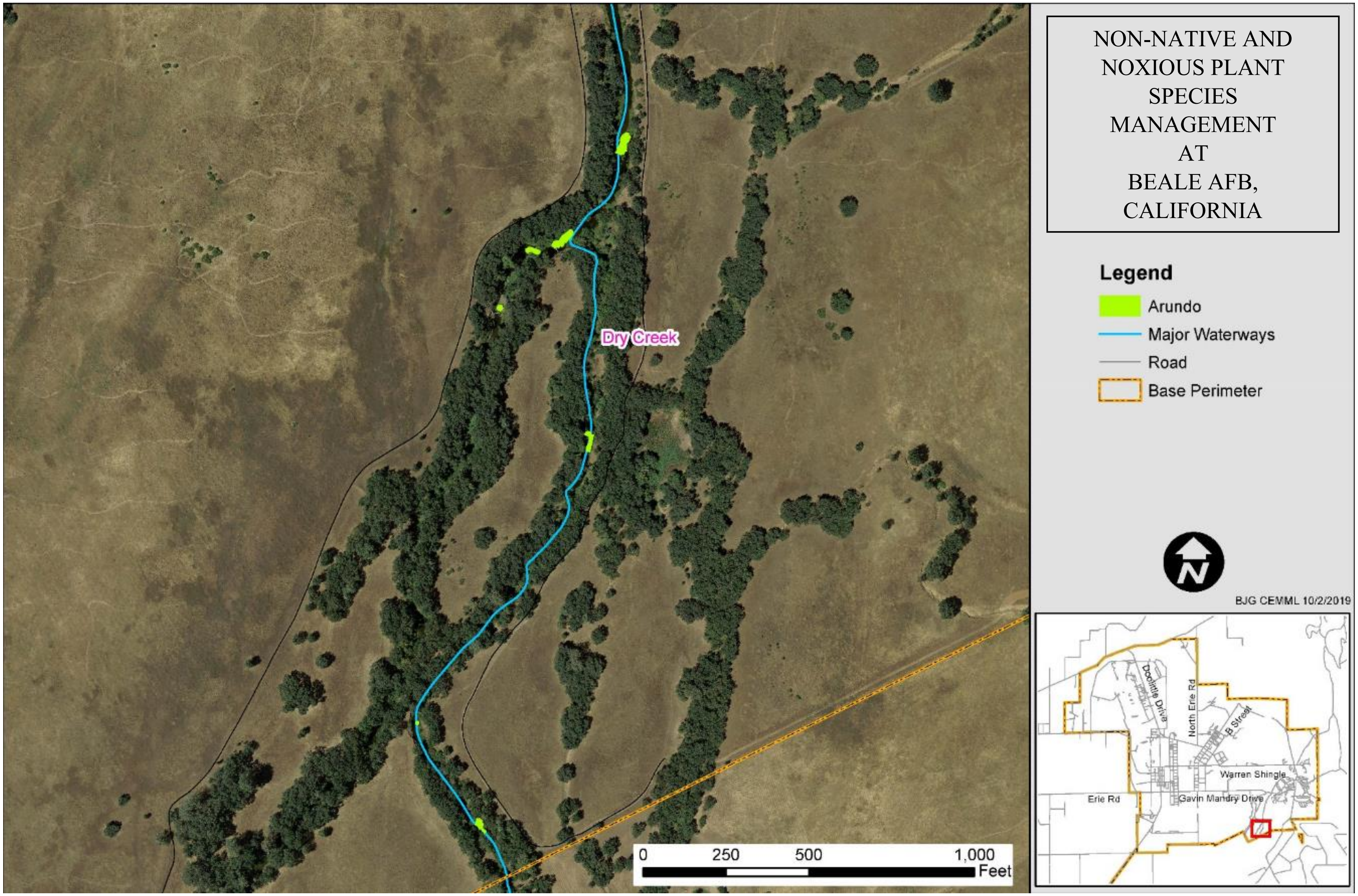

Figure 8. Giant reed (Arundo donax) infestations along Dry Creek (Map 3 of 3)

3.0 AFFECTED ENVIRONMENT

The Region of Influence for the Proposed Action is Beale AFB and LRS (Figure 1). No listed fish species habitat or EFH occur at the LRS. Beale AFB encompasses approximately 23,000 acres in Yuba County, California, in the northeastern portion of the Sacramento Valley. Beale AFB is in the ecological and geographic transition zone between the flat agricultural lands of the Sacramento Valley and the foothills of the western slope of the Sierra Nevada. The Yuba and Bear rivers are north and south of the installation, respectively. The base is in the Bear River watershed, and three named tributaries to the Bear River (Reeds, Hutchinson, and Dry creeks) run through the base.

Land use in the Sacramento Valley near Beale AFB is primarily agriculture, rural-residential, and industrial. Several aggregate extraction operations are located north of Beale AFB. Along the eastern boundary of the base, where the valley begins to rise into the Sierra Nevada foothills, is the larger of two parcels that constitute the Spenceville Wildlife Area managed by the California Department of Fish and Wildlife. Three conservation easements border the installation to the northeast.

3.1 Waters of the United States

Dry Creek, Best Slough, Hutchinson Creek and Reeds Creek are Jurisdictional WoUS that may be affected by the Proposed Action. Dry Creek enters the eastern side of the base from the adjacent Spenceville Wildlife Area (SWA) and is the main drainage for the eastern side of the Base. Surface runoff from the family housing area drains into Dry Creek via small tributaries. Dry Creek was impounded at its northern end on base, creating Beale Lake, but this was recently removed. There is a low-flow crossing blocking upstream fish passage 6 miles downstream of the base that is slated for removal when funding becomes available.

Dry Creek, a tributary of the Bear River in the Feather River basin, has a 114.6 square miles watershed, with elevations ranging from 47 to 2,628 feet and a mean elevation of 809 feet (United States Geological Survey [USGS] Stream Stats). The mean annual precipitation for the Dry Creek basin is 31.6 inches. The upper portion of the Dry Creek watershed is mostly within the California Department of Fish and Wildlife's SWA. Dry Creek then flows through Beale AFB (between River Mile [RM] 12.4 and 16.1) and then flows through agricultural lands before entering the Bear River. Best Slough is a distributary of Dry Creek, with flow coming from Dry Creek at RM 14.3. Best Slough flows for 2.2 miles across Beale AFB, and then flows another 18 miles through agricultural lands before entering the Bear River downstream of the Dry Creek/Bear River confluence. Historical flows were measured on Dry Creek from October 1, 1946 through September 30, 1962 at USGS gage No. 11424500, located 0.3 miles upstream of Highway 65, at RM 5.5. Seasonal operation of this gage, only measuring stage, resumed on April 21, 2006. The median flow for this gage is 3.4 cubic feet per second (cfs), whereas the 99th percentile flow is 982.53 cfs (USFWS 2016).

Hutchinson Creek originates from multiple small tributaries originating north of the base and is the main drainage for the central portion of the base including main base and parts of the flightline. Water from Upper and Lower Blackwelder, Goose, Frisky, Mad Dog, multiple other small lakes and ponds, and recycled wastewater from golf course irrigation all drain into Hutchinson Creek. Hutchinson Creek merges with Reeds Creek southwest of Beale AFB, eventually draining into Plumas Lake.

Reeds Creek is fed by water released from Miller Lake, drainages around the flightline, and Brophy Canal. Reeds Creek enters the base at its northwestern boundary and flows southwest along its northern border before turning south. Brophy Canal joins Reeds Creek at the northern base boundary, fed by water from the Yuba River and groundwater pumping discharges used to rework old hydraulic mine tailings.

Activities associated with the Proposed Action would occur within creek channels and the 100-year floodplain, so under Water Quality Order No. 2013-0002-DWQ a NPDES Permit is required. Beale AFB prepared an APAP and submitted a Notice of Intent to the California State Water Resources Control Board for herbicide applications included in the Proposed Action (Attachment 6). Treatments covered in the APAP are: (1) giant reed control, (2) mission-related control of weeds and vegetation in and along waterways as needed, and (3) mission-related control of Himalayan blackberry along Reeds Creek near the flight line. The APAP describes need, applications, and BMPs to reduce water quality impacts, and monitoring.

3.2 Threatened and Endangered Species, Critical Habitat and Essential Fish Habitat

The CCV steelhead DPS is listed as threatened under the ESA and falls under the jurisdiction of NMFS. Historically, steelhead spawned and reared in the most upstream portions of the upper Sacramento and San Joaquin Rivers and most, if not all, of their perennial tributaries (Beale AFB 2019). Critical habitat has been designated for this species (USFWS 2005), but it does not include the hydrologic units that occur on the base.

Section 305(b)(2) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) requires federal action agencies to consult with NMFS for any action they authorize, fund, or undertake that may adversely affect "essential fish habitat" (EFH). Under the MSA the term EFH means those waters and substrate necessary to fish for spawning, breeding, feeding or growth to maturity. The geographic extent of salmon freshwater EFH is described as all water bodies currently or historically occupied by NMFS-managed salmon within the USGS 4th field hydrologic units. Salmon EFH includes the channels within the designated 4th field hydrological units with a lateral extent as defined by the ordinary high-water line (33 CFR 319.11). Salmon EFH excludes areas upstream of longstanding naturally impassable barriers (i.e., natural waterfalls in existence for several hundred years). Salmon EFH includes aquatic areas above all artificial barriers except the impassable barriers (dams) listed in the Pacific Coast Salmon Fishery Management Plan (Pacific Fisheries Management Council 2014).

Beale AFB contains EFH for Chinook Salmon (Figure 3). The southeastern portion of Beale AFB is within the Upper Bear -Below Camp Far West Dam hydrologic unit, and the northwest portion is within the Honcut Headwaters-Lower Feather – Below Dam hydrologic unit, both which contain EFH for Chinook salmon. Freshwater EFH for Chinook salmon consists of four major components, (1) spawning and incubation; (2) juvenile rearing; (3) juvenile migration corridors; and (4) adult migration corridors and holding habitat. Freshwater EFH depends on lateral (e.g., floodplain, riparian), vertical and longitudinal connectivity to create habitat conditions for spawning, rearing, and migration including: (1) water quality (e.g., dissolved oxygen, nutrients, temperature, etc.); (2) water quantity, depth, and velocity; (3) riparian-stream-marine energy exchanges; (4) channel gradient and stability; (5) prey availability; (6) cover and habitat complexity; (7) space; (8) habitat connectivity from headwaters to the ocean (e.g., dispersal corridors); (9) groundwater-stream interactions; and (10) substrate composition. No Habitat Areas of Particular Concern (HAPC) or EFH Areas Protected from Fishing (EFHA) occur on Beale AFB (Pacific Fisheries Management Council 2014).

The majority of invasive plant control activities on Beale AFB will not occur near potential CCV steelhead habitat or EFH for Chinook salmon. Giant reed and other invasive riparian plant control will be conducted around Dry Creek and Best Slough and other waterways. Most of the giant reed infestations are located along a stretch of Dry Creek south of Gavin Mandery that has multiple small infestations in and along the banks of the waterway (Figures 6-8). Himalayan blackberry will be controlled along Reeds Creek on the western side of the base. Other herbicide application for invasive plant control could potentially be made to drainage ditches, creek beds, and banks throughout the base where invasive weed infestations may interfere with mission requirements, adversely impact water flow, or are degrading native habitat. Habitat restoration treatments may be done within forested riparian habitat; this includes areas within the Dry Creek/Best Slough riparian corridor.

3.2.1 Suitable Habitat

CCV steelhead and fall-run Chinook salmon have both been observed in Dry Creek, but the current status of anadromous salmonids in the Dry Creek watershed is uncertain (AuxiliALL JV and H.T. Harvey & Associates 2018). A baseline survey by the USFWS (USFWS 2016) determined anadromous salmonids likely do not migrate upstream of Beale Lake, due to the presence of the dam and undersized fish ladder, but portions of Dry Creek downstream of Beale Lake could potentially provide suitable spawning habitat, as there is some riffle habitat that exists in this reach. Surveys have not definitely detected CCV steelhead in Dry Creek (EDAW 2008; AECOM 2011; H. T. Harvey & Associates 2012, 2014, 2017; Bhate and HDR 2016). However, there have been anecdotal reports of steelhead observed upstream, on the SWA, after the fish ladder was constructed at Beale Lake in 1987 (Hiscox, pers. comm. 1997), and more recently anadromous salmonids were seen in Beale Lake during high flows in 2017 (McCready pers. Comm. 2019). Fall-run Chinook salmon have also been observed below the Beale Lake Dam in Dry Creek on Beale AFB during high-flow years (Jones & Stokes 2002), and juvenile anadromous salmonids were observed using Dry Creek on the base in 2015 (Bhate and HDR 2016). With the removal of the dam along Dry Creek at Beale Lake and the low flow crossing downstream of Beale AFB, upstream fish passage will be more likely.

According to the USFWS (2016) baseline survey percentages of spawning gravel and bank woody cover indicate that spawning habitat is likely a limiting factor for anadromous fish in Dry Creek, after upstream passage. The portion of Dry Creek downstream of Highway 65 is largely a passage and juvenile rearing reach due to the lack of spawning gravel. Best Slough likely provides high quality non-natal rearing habitat for juvenile anadromous salmonids, based on its habitat characteristics. Based on surveys of riffle minimum passage depths, flows of at least 60 cfs would be needed for upstream passage, suggesting that upstream passage of salmonids would not occur until the first large rainfall event in the fall. Potential migration into Dry Creek is expected to occur between the first large fall rain event and March with a peak in January, similar to migration on the lower American River (Beale AFB 2019). Most spawning takes place between late December and April. The optimum temperature for spawning is 48-52 °F (McEwan and Nelson 1991).

3.2.2 Habitat Considered Unsuitable

Chinook salmon were observed in Reeds Creek, on the west side of Beale AFB, in 2015 and more recently (2017 and 2018), several possible sightings of salmonids (*Oncorhynchus mykiss* or *O. tshawytscha*) at Best Slough, Hutchinson Creek, and Reeds Creek have been reported (AuxiliALL JV and H.T. Harvey & Associates 2018). A qualitative habitat assessment of these sites was conducted as part of field surveys in 2018 to determine the likelihood that additional locations on the base support trout/steelhead or Chinook salmon (AuxiliALL JV and H.T. Harvey & Associates 2018). None of the habitat surveys targeting sites of anecdotal reports discovered habitat conducive to salmonid ecology.

Hutchinson Creek is a shallow system with abundant riparian vegetation, a short (< 30 feet) riffle section and several stagnant pools. A few small fish, probably roach, were seen in the riffle, but water quality seemed poor—warm and murky. Reeds Creek contained so little water that any fish that are present (highly unlikely to include salmonids) are unlikely to survive the summer aside, possibly, from high temperature-tolerant species isolated in several small reservoirs. Best Slough was difficult to access, surrounded by thick shrubs and small trees including abundant blackberry and poison oak, but what standing water was accessible appeared to be isolated from any moving water with the declining flows of the season and was warm, heavily vegetated, and murky. Migrating salmonids, both juveniles and adults, could potentially access these sites under higher flow conditions, but the frequency of this occurrence is likely to be low and the survivorship of the few fish that might appear here would be low. In short, none of the evaluated stream reaches appear capable of meeting the habitat needs of either adult juvenile or anadromous salmonids (AuxiliALL JV and H.T. Harvey & Associates 2018). For this reason, these locations are not discussed further in this consultation.

3.2.3 Potential Effects

The Proposed Action is anticipated to have a long-term benefit to CCV Steelhead and Chinook salmon EFH by removing giant reed obstructing stream flow and other invasive plants currently degrading riparian habitat. The Proposed Action, within Dry Creek and Best Slough, would be conducted 15 June to 31 October prior to the first rains, outside the peak migration and spawning season for CCV steelhead and Chinook salmon. Therefore, no impacts to migrating or spawning CCV steelhead or EFH for Chinook salmon are anticipated as a result of the Proposed Action. With adherence to the BMPs and AMMs outlined in Section 4 of this document, potential impacts to CCV steelhead and Chinook salmon EFH within the Proposed Action Area would be avoided.

Grazing

Grazing would not be conducted in the Dry Creek and Best Slough riparian corridor, therefore, grazing expansion under the Proposed Action would have no effect on CCV steelhead. Potential grazing impacts are changed streambank and channel morphology, increases in water temperatures, and impaired water quality. Under the Proposed Action grazing may be permitted in other riparian and marsh habitats, and around lakes and ponds. Any grazing within riparian corridors, marshes, or other habitat adjacent to water course or bodies of water would be closely monitored, and livestock would be removed if there are signs of streambank erosion, bare soil areas, or increased sediment runoff. Livestock would continue to be excluded from most riparian areas and lakes on the base when not being used for targeted vegetation management.

Prescribed Burns

Prescribed burns are not planned for the Dry Creek riparian corridor, and so would have no effect on CCV steelhead. Other streams on the base could be temporarily affected by fire due to increases in turbidity caused by runoff and erosion from nearby burned uplands, but they do not provide potential habitat for the CCV steelhead. Water temperatures could be affected if vegetation that provided pre-fire shade is removed. If prescribed fires escape, they could have negative effects on riparian forests and stream reaches providing potential habitat for CCV steelhead.

No prescribed burns are planned for the Dry Creek Riparian corridor, so water quality in Dry Creek would not be affected. Prescribed fire would not typically be used to control woody biomass near waterbodies, so there is little risk of elevated water temperatures from a lack of shade as a result of prescribed burns. The topography around Hutchinson and Reeds creeks is generally flat, so the run-off potential would be fairly limited. If prescribed burns are conducted adjacent to a creek or other water body a vegetated buffer would be maintained between it and the burn area to trap sediment and ash before it could enter the water course/body. Mowed, wet line, and/or blackline would be the primary types of controlled fireline perimeters where any riparian or wetland habitat is present. Chemical fire retardants and mineral firebreaks would not be used during prescribed burns. Therefore, no adverse impacts to Chinook salmon EFH would occur as a result of prescribed burns.

Chemical Treatments

Overall, chemical treatments would have significant, long-term, beneficial impacts, but there is the potential for moderate, short-term, adverse effects to steelhead from herbicide toxicity if applied at the wrong time of year. The intent of invasive plant control within riparian areas, where it has the potential to impact CCV steelhead, is to improve native plant diversity and riparian ecosystem health. The toxicity of individual herbicides and surfactants to fish varies (Table 6), as does the potential for an herbicide to contaminate surface or groundwater (Table 6). Studies have found that the surfactants found in some formulations of commercial preparations of glyphosate can be highly toxic to salmonids (US EPA 2009). In general, aquatic organisms are more negatively impacted by surfactants than terrestrial organisms (Bakke 2007).

Two herbicide formulations proposed for use (Roundup Pro and Garlon 4 Ultra) are slightly to highly toxic to fish. There are aquatic-safe formulations that contain the same active ingredients (Rodeo/Roundup Custom and Garlon 3) that are considered “practically non-toxic” to “slightly toxic” to fish (Table 6). The less-toxic formulations would be used if one of these herbicides is applied in or around aquatic resources. Direct aquatic application of imazamox (Clearcast) may be used for control of aquatic plants, but imazamox would not be used in potential listed species habitat (Dry Creek and Best Slough) or in waterbodies that feed into it. Giant reed requires control at multiple locations within the Dry Creek stream channel using herbicide application. This treatment would improve water flow and upstream access for anadromous salmonids. To avoid direct and indirect impacts to CCV steelhead from site access and chemical toxicity, giant reed would be treated between 15 June and 31 October, when flows in Dry Creek are low, and steelhead are unlikely to be present. An aquatic-approved formulation of Glyphosate such as Rodeo or Roundup Custom, combined with an aquatic-approved formulation of Imazapyr such as Habitat would be used. The herbicides would be mixed with a non-ionic surfactant approved for use in aquatic habitats. No additional additives would be used.

If non-aquatic plant control is conducted near a waterway/body aquatic resource buffers (Table 9 in Section 4) and other herbicide application AMMs in Section 4 would be implemented during herbicide application. These AMMs are designed to prevent water contamination and protect CCV steelhead and other aquatic species from exposure.

Manual/Mechanical Treatments

There would be a potential for significant, long-term, beneficial effects and negligible, short-term adverse effects to CCV steelhead as a result of manual and mechanical treatments. These treatments could leave small areas of bare ground in the riparian area which could be susceptible to erosion. Whenever possible a vegetated buffer to trap sediment would be left between the treatment area and flowing water. If treatment is required directly adjacent to a waterway erosion control BMPs would be implemented. Invasive plant control in riparian areas is intended to improve native plant diversity and riparian ecosystem health. Therefore, beneficial effects to CCV steelhead and Chinook salmon EFH would occur as a result of the Proposed Action.

Restoration Treatments

Restoration treatments would have long-term, beneficial effects on aquatic habitats. Revegetation would reduce bare soil and slow the speed of overland water flow. This would result in reduced slower storm runoff, reduced erosion, and reduced water sedimentation. It is anticipated that adherence to the BMPs in Section 4 will result in “no net loss” of riparian vegetation or shaded riverine aquatic habitat as a result of the Proposed Action.

4.0 AVOIDANCE AND MINIMIZATION MEASURES

The Environmental Office (9 CES/CEIE) has identified which avoidance and minimization measures to be implemented as part of the Proposed Action and the Beale AFB NPDES permit APAP (Attachment 6) identified additional AMMs and water quality monitoring requirements. The assessment of the potential impacts of the Proposed Action is based on the implementation of these measures.

4.1 General Avoidance and Minimization Measures

1. Preconstruction Surveys - A biologist approved by the NMFS will conduct preconstruction surveys of all in-channel disturbance areas within sensitive habitats to determine if any federally listed species may be present prior to the start of work. These surveys will be conducted two weeks prior to the start of work activities in any sensitive habitat. If any federally listed species are found during the preconstruction surveys, the NMFS-approved biologist will contact NMFS to determine how to proceed, potentially including fish relocation prior to the start of work. At least 15 working days prior to the onset of activities, Beale AFB will submit the name(s) and credentials of biologists who will conduct these preconstruction surveys. No project activities will begin until proponents have received written approval from the NMFS that the biologist(s) is qualified to conduct the work.

2. Biological Monitor - A NMFS-approved biologist will monitor work activities in or adjacent to sensitive habitats. The biological monitor will ensure compliance with the avoidance and minimization measures required to protect federally listed species and their habitats. If federally listed species are found that are likely to be affected by work activities, the NMFS-approved biologist will have the authority to stop any aspect of the project that could result in unauthorized take of a federally listed species. If the biological monitor exercises this authority, he/she must immediately notify the 9 CES/CEIE. The 9 CES/CEIE will verbally notify the NMFS within one working day by telephone and will provide written notification of the incident within three working days.

3. Environmental Awareness Training - Environmental awareness training will be provided for all personnel working on the Proposed Action. Training will be provided at the start of work and all new workers will be provided with training before conducting project activities. The program will consist of a briefing on environmental issues relative to the Proposed Action. Training will be conducted by a NMFS-approved biologist. The training program will include an overview of the legal status, biology, distribution, habitat needs, and compliance requirements for each federally listed species that may occur in the project area. The presentation will also include a discussion of the legal protection for endangered species under the ESA, including penalties for violations. A fact sheet conveying this information will be distributed to all personnel who enter the project site. Upon completion of the orientation, employees will sign a form stating that they attended the program and understand all avoidance and minimization measures. These forms will be filed at Beale AFB Environmental Element Office and will be accessible to the appropriate resource agencies.

4. Invasive Species - A biological monitor will ensure that the spread or introduction of invasive exotic plant species will be avoided to the maximum extent possible. When practicable, invasive exotic plants identified in the project area will be removed. This includes ensuring all equipment used during work is cleaned before being moved from one location of the installation to another.

5. Erosion Control - When appropriate, isolate the construction area from flowing water until project materials are installed and erosion protection is in place. Effective erosion control measures shall be in place at all times during construction. Do not start construction until all temporary control devices (e.g., straw bales with sterile, weed free straw, silt fences) are in place down slope or downstream of project

site within the riparian area. The devices shall be properly installed at all locations where the likelihood of sediment input exists. These devices shall be in place during and after construction activities for the purposes of minimizing fine sediment and sediment/water slurry input to flowing water and detaining sediment-laden water on site. If continued erosion is likely to occur after construction is complete, then appropriate erosion prevention measures shall be implemented and maintained until erosion has subsided. Erosion control devices such as coir rolls or erosion control blankets will not contain plastic netting of a mesh size that would entrain reptiles (especially snakes) and amphibians. Sediment shall be removed from sediment controls once it has reached one-third of the exposed height of the control. Whenever straw bales are used, they shall be sterile and weed free, staked and dug into the ground 12 cm. Catch basins shall be maintained so that no more than 15 cm of sediment depth accumulates within traps or sumps. Sediment-laden water created by construction activity shall be filtered before it leaves the settling pond or enters the stream network or an aquatic resource area. The contractor/applicant to the Program is required to inspect, maintain or repair all erosion control devices prior to and after any storm event, at 24-hour intervals during extended storm events, and a minimum of every two weeks until all erosion control measures have been completed. Construction boundaries within the buffer will be designated with fencing to ensure no equipment and/or construction workers access those protected areas.

a. Post-construction erosion control: When needed, utilize instream grade control structures to control channel scour, sediment routing, and headwall cutting. For relief culverts or structures, if a structure that empties into a stream is installed, an energy dissipater shall be installed to reduce bed and bank scour. This does not apply to culverts in fish bearing streams. The toe of rock slope protection used for streambank stabilization shall be placed below the bed scour depth to ensure stability.

6. Limited Operations Period - The general construction season shall be from 2 May to 31 October. Restoration, construction, and dewatering within any wetted or flowing stream channel shall only occur 15 June to 31 October. Revegetation outside of the active channel may continue beyond 31 October, if necessary. NMFS will be notified of any work between November 1st and 15 June.

7. Off-Road Travel - Off-road travel outside of the demarcated work boundaries will be prohibited.

8. Demarcation of Work and Staging Areas - Beale AFB (or the contractor to Beale AFB) will provide all materials to stake and flag boundaries of the work area. Beale AFB will coordinate with the biological monitor to stake and flag the boundaries of all work and staging areas in portions that have the potential to support federally listed species or their habitat. The contractor will remove all fencing, stakes and flagging within 60 calendar days of work completion. Orange barrier fencing will designate exclusion zones where work activities cannot occur.

9. Report Kills/Injuries - Any worker that inadvertently kills or injures a federally listed species, or finds one injured or trapped, will immediately report the incident to the biological monitor. The biological monitor will inform the 9 CES/CEIE. The 9 CES/CEIE will verbally notify NMFS within three calendar days and will provide written notification of the incident within five calendar days.

10. Fueling and Servicing in Designated Areas - Motor vehicles and equipment will only be fueled and serviced in designated service areas. All fueling and maintenance of vehicles and other equipment and staging areas will occur at least 250 feet from any wetland/drainage habitat or water body. Prior to the onset of work, contractor will prepare a Spill Prevention Control and Countermeasure Plan to allow a prompt and effective response to any accidental spills. All workers will be informed of the importance of preventing spills and of the appropriate measures to take should a spill occur. All machinery will be

properly maintained and cleaned to prevent spills and leaks. Any spills or leaks from the equipment will be reported and cleaned up in accordance with applicable local, state and federal regulations.

11. Garbage Removal - During work activities, all trash that may attract wildlife will be properly contained, removed from the work site daily, and disposed of daily. Following completion, all refuse and debris will be removed from work areas. All garbage and work-related materials in the areas will be removed immediately following project completion.

12. Disposal of Excavated Soil - If feasible, conserve topsoil for reuse at project location. End haul spoils away from watercourses as soon as possible to minimize potential sediment delivery. All soil excavated during work occurring near drainages will be removed and disposed of outside the project area. Coordination with 9 CES/CEIE and appropriate regulatory agencies is required prior to disposal of the excavated soil.

    a. Minimize temporary stockpiling of material. Stockpile excavated material in areas where it cannot enter the stream channel. Prior to start of construction, coordinate with Beale AFB Environmental Office to see if such sites are available at or near the project location. If nearby sites are unavailable, determine a location where material will be deposited. Establish locations to deposit spoils well away from watercourses. Spoils shall be contoured to disperse runoff and stabilized with mulch and (native) vegetation. Use devices such as plastic sheeting held down with rocks or sandbags over stockpiles, silt fences, or berms of hay bales, to minimize movement of exposed or

13. Minimization of Access Routes etc. - The number of access routes, number and size of staging areas, and the total area of the activity will be limited to the minimum necessary to achieve the project goal. Routes and boundaries will be clearly demarcated. Off-pavement access routes can only be used if the soil is dry.

14. Speed Limits - All vehicle operators will follow the posted speed limit on paved and a 20-mile per hour speed limit on unpaved roads.

15. Pets/Firearms - No pets or non-military firearms will be allowed in the project area.

16. Revegetation and Success Criteria - Decompact disturbed soils at project completion. Any stream bank area left barren of vegetation as a result of the implementation or maintenance of the practices shall be restored to a natural state by seeding, planting, or other means with native trees, shrubs, or grasses prior to November 15 of the project year. Barren areas shall typically be planted with a combination of willow stakes, native shrubs and trees and/or erosion control grass mixes. Native plant species shall be used for revegetation of disturbed and compacted areas. The species used shall be specific to the project vicinity or the region of the state where the project is located, and comprise a diverse community structure (plantings shall include both woody and herbaceous species). For projects where re-vegetation is implemented to compensate for riparian vegetation impacted by the project, a re-vegetation monitoring report will be required after five years to document success. Success is defined as 70 percent survival of plantings or 70 percent ground cover for broadcast planting of seed after a period of three years. If revegetation efforts will be passive (i.e., natural regeneration), success will be defined as total cover of woody and herbaceous material equal to or greater than pre-project conditions. If at the end of five years, the vegetation has not successfully been reestablished, 9 CES will be responsible for replacement planting, additional watering, weeding, invasive exotic eradication, or any other practice, to achieve the revegetation requirements. If success is not achieved within the first five years, the project applicant will need to prepare a follow-up report in an additional five years. This

requirement will proceed in five-year increments until success is achieved. All plastic exclusion netting placed around plantings will be removed after three years.

4.2 Avoidance and Minimization Measures from the Beale AFB Aquatic Pesticide Application Plan

A number of water sampling requirements and avoidance AMMs are required by the base NPDES permit, and will be followed during all herbicide application in or near WoUS.

Sampling Requirements:

1. Beale AFB will monitor the use of glyphosate and imazapyr in compliance with Attachment C of the General Permit.
2. All laboratory analyses will be conducted at a laboratory certified by the California Department of Public Health in accordance with California Water Code section 13176.
3. All analyses shall be conducted in accordance with the USEPA's "Guidelines Establishing Test Procedures for Analysis of Pollutants."
4. Visual monitoring of the aquatic herbicide applications will be accomplished for all applications at all sites using a standardized template.
5. Physical and chemical monitoring of the listed herbicides will be conducted for one application event.
    a. Background samples will be collected upstream at the time of the application event.
    b. Event monitoring samples will be collected immediately outside of the treatment area in non-flowing waters, immediately after the application event, but after sufficient time has elapsed such that contaminated water would have exited the treatment area.
    c. Post-Event samples will be collected within the treatment area within one week after the application event.
6. Monitoring procedures for physical and chemical properties will follow the following table:

Table 8. Post-Herbicide Application Monitoring Procedures

Sample Type	Constituent / Parameter	Sample Method	Sample Type Requirement
Physical	1. Temperature[1] 2. pH[1] 3. Turbidity[1] 4. Electrical conductivity[1]	Grab 3' Below Surface or Mid-depth if Water Body is < 6'	Background, Event and Post Event Monitoring
Chemical	1. Active Ingredient - Imazapyr[2] 2. Active Ingredient – glyphosate[2] 3. Dissolved Oxygen[1]	Grab 3' Below Surface or Mid-depth if Water Body is < 6'	Background, Event and Post Event Monitoring
[1] Field Testing [2] Laboratory Testing			

7. An annual report detailing all required information, as outlined in Attachment C of the General Permit, will be submitted to the state and regional Water Quality Control Board.

8. All samples will be collected in clean, amber glass bottles and properly labeled, including the date and time the sample is collected.
9. Proper personal protective equipment will be worn, including disposable nitrile gloves, to prevent contamination.
10. Samples will be collected without interference from any equipment or vehicles.
11. Samples will be accounted for utilizing a standard “Chain of Custody” form supplied by the laboratory performing the analysis to ensure the integrity of the sample collection and transfer process.
12. Samples will be stored on ice and transported to the lab within appropriate hold times for the required tests.
13. Samples will be transported separately from the aquatic herbicides and application equipment on the day of the application event.

Herbicide Application AMMs:

1. All applications will be performed by Department of Defense (DoD) or state certified pesticide applicators.
2. All personnel will follow the storage, mixing, transport, application, and spill response procedures per USEPA and California Department of Pesticide Regulation rules, regulations, and label instructions.
3. Aquatic herbicide applicators will ensure daily that application equipment is in proper working order. Aquatic herbicides must be stored indoors.
4. Spill response and cleanup supplies will be maintained in all vehicles and pesticide storage areas.
5. All personnel responsible for handling, mixing, or applying pesticides must complete Beale AFB’s Spill Prevention, Control, and Countermeasures training annually (Beale AFB has a comprehensive program for the identification, response, and control of hazardous materials spills, with personnel on stand-by to respond to any releases of hazmat, including pesticides, to the environment).
6. Any contaminated media (water or soil) will be contained and cleaned or properly disposed of to the maximum extent possible.
7. Beale AFB personnel will report all spills to appropriate local, state, and federal agencies according to applicable regulations.
8. Over application will be avoided by following the specific product labels for the aquatic herbicide used.
9. Only sufficient material to carry out the treatment will be transported for the day’s application.
10. To ensure it functions properly, application equipment is calibrated at least annually unless herbicide label instructions require a more frequent calibration.
11. The 9 CES/CEIE will train all personnel applying herbicides and pesticides on the Water Quality Order No. 2013-0002-DWQ State General Permit and the requirements of the APAP annually.

12. With the exception of activities covered under the NPDES permit, herbicide application will not occur within the buffers in Table 9 when applying herbicide near aquatic features.
13. Aquatic herbicides will never be applied directly to flowing water (if this becomes necessary, the Base APAP will be amended and re-submitted to the state and regional Water Quality Control Board for approval).
14. Aquatic herbicide applications are only allowed from 15 June to 31 October to avoid the local wet season. In addition, aquatic herbicides will not be applied during any wet weather or 12 hours before or after a rain event.
15. Aquatic herbicides will only be applied when winds are less than 5 miles per hour.
16. Herbicide applications near aquatic resources will be done with a pressurized hydraulic sprayer and/or low-pressure backpack sprayers to prevent over application and excess herbicide runoff downstream.
17. Sites potentially requiring aquatic herbicide treatment will be surveyed first to assess the area and any potential impacts if herbicides are applied.
18. Herbicides will be mixed in a designated area with appropriate containment and spill-prevention measures.
19. Trained DoD or state certified pesticide applicators will make an informed decision on the application of aquatic herbicides by scouting the area to be treated, making a positive identification of the target species, and checking the herbicide product label for control efficacy.
20. Label instructions will be followed to determine appropriate rates of application and to identify any warnings or conditions that limit the application.
21. The certified applicator may utilize an aquatic approved surfactant according to label instructions.
22. Herbicides will always be applied in accordance with the IPSMG (Hopkinson 2017; Attachment 3); the Beale AFB IPMP (Beale AFB 2018b; Attachment 7); The Beale AFB INRMP (Beale AFB 2019; Attachment 2); the Air Force Pest Management Program; a NPDES Permit and APAP (Attachment 6); all applicable federal, DoD, United States Air Force, State of California, and local directives and regulations; label instructions; and Natural Resource Conservation Service best management practices.
23. All pesticide applicators must hold current Qualified Applicator Certificates (minimum qualification) from the California Department of Pesticide Regulation and submit copies to 9 CES Pest Management within 30 days of contract award date. Any herbicide application within jurisdictional or biological wetlands must be done, or overseen by, someone who passed the Aquatic category on the Qualified Applicator test.
24. All herbicide applicators must receive environmental training and be able to recognize sensitive resources including listed wildlife and plants, vernal pools, and nesting birds.
25. The most effective herbicide for the target species will be used. If necessary, an AF Approval Request will be submitted.
26. Consultation with the Beale Natural Resources Manager will occur if herbicide/surfactant use is planned within 250 feet of a wetland.

27. Non-target vegetation will be protected by minimizing drift and applying only enough herbicide to effectively treat the target plants.

28. Herbicides will not be sprayed in wetlands or WoUS when water is present unless specifically targeting aquatic weeds and all permits and permissions are obtained.

29. When applying herbicides near wetlands in the wet season (1 Nov to 1 May) or when the 2-week chance of rainfall is greater than 70%, herbicides may not be applied within the effective catchment or natural drainage area (as indicated by micro- and macro-topography) of a wetland where they may potentially run off into the wetland (Ripley et al. 2002, 2003). See aquatic resource buffers in Table 9. Note that this AMM does not apply to aquatic-use pesticides (please refer to AMM 14).

30. Herbicides will be applied within specified heat tolerances of volatile herbicides to protect nearby non-target vegetation.

31. All mixing of herbicides will be conducted at least 150 feet from aquatic resources.

32. Herbicide applicators will prescribe and use only non-ionic surfactants near open water. These surfactants are readily biodegradable and low in aquatic toxicity.

33. Herbicide applicators must adhere to the aquatic resource protection buffers listed in Table 9.

Table 9. Minimum buffers for various herbicide application methods

Active Ingredient	Application Method	Dry Aquatic Features [1] (feet)	Streams [1] or Ditches with water (feet)	Special Aquatic Features (vernal swales, springs, vernal pool)[2] (feet)
Aminopyralid	Spot & directed foliar spray	25	25	100
	wiping	15	15	15
Chlorsulfuron	directed foliar spray	25	100	100
	wiping	15	15	15
Glyphosate	directed foliar spray or drizzle	0	25	25[3]
	cut stump or wiping	0	15	15[3]
Imazamox	direct application	0	0[5]	n/a
Imazapyr	Directed foliar spray	25	75[4]	75
Sulfometuron methyl	Spot and preemergent	25	50	50
Triclopyr (TEA)	directed foliar	25	75	75
	wiping or cut stump	15	15	15
Triclopyr BEE	Spot & directed foliar spray	75	250	250
	cut stump	75	75	75

[1] As measured from the edge of the stream channel. If a defined channel is not present (draws do not have defined channels), measurement is from the bottom of the feature.
[2] As measured from the edge of the wet area surrounding the special aquatic feature, or the vernal pool vegetation, whichever is greater.
[3] Only non- Polyoxyethylene Tallow Amine (POEA) containing formulations may be used
[4] With the exception of giant reed treatment in Dry Creek and Best Slough
[5] Imazamox will never be applied directly to flowing water, water where the outflow cannot be controlled, to Dry Creek, Best Slough, or their tributaries.

5.0 JUSTIFICATION FOR NOT LIKELY TO ADVERSELY AFFECT

5.1 Chemical Treatments

Overall, chemical treatments would have significant, long-term, beneficial impacts to CCV steelhead and EFH. To avoid impacts from site access and chemical toxicity, invasive plants below the ordinary high-water mark of waterways or bodies would only be controlled during summer when flows are low, and salmonids are unlikely to be present. Aquatic resource buffers and other herbicide application AMMs in Section 4.2 would be implemented during herbicide application to prevent water contamination and protect CCV steelhead and Chinook Salmon from exposure. Herbicides would always be applied in accordance with the IPSMG; the Beale AFB IPMP; the USAF Pest Management Program; the Statewide NPDES Permit and Beale AFB APAP; all applicable federal, DoD, USAF, State of California, and local directives and regulations; and label instructions. Therefore, chemical treatments are not likely to adversely affect, and are likely to benefit, listed species and EFH.

5.2 Grazing

Grazing would not be conducted in the Dry Creek and Best Slough riparian corridor, therefore, grazing expansion under the Proposed Action would have no effect on CCV steelhead. Any grazing within riparian corridors, marshes, or other habitat adjacent to a water course or body of water would be monitored, and livestock removed if there are signs of streambank erosion, bare soil areas, or increased sediment runoff. Livestock would be excluded from most riparian areas and lakes on the base when not being used for targeted vegetation management. For this reason, there would be no adverse effects to Chinook salmon EFH from grazing.

5.3 Prescribed Burns

Prescribed burns are not planned for the Dry Creek riparian corridor, and so would have no effect on CCV steelhead. Prescribed fire would not typically be used to control woody biomass near waterbodies, so there is little risk of elevated water temperatures from a lack of shade as a result of prescribed burns. Flat topography around Hutchinson and Reeds creeks and keeping vegetated buffers between burns and water bodies would prevent adverse effects to EFH for Chinook salmon from erosion into waterways.

5.4 Manual/Mechanical Treatments

There would be a potential for significant, long-term, beneficial effects and negligible, short-term adverse effects to CCV steelhead as a result of manual and mechanical treatments. These treatments could leave small areas of bare ground which could be susceptible to erosion. Whenever possible a vegetated buffer to trap sediment would be left between the treatment area and flowing water. If treatment is required directly adjacent to a waterway erosion control BMPs would be implemented. Bare areas will be revegetated with appropriate native riparian plant species. Invasive plant control in riparian areas is intended to improve native plant diversity and riparian ecosystem health. Therefore, beneficial effects to CCV steelhead and EFH for Chinook salmon would occur as a result of the Proposed Action.

5.5 Restoration Treatments

Restoration treatments would have long-term, beneficial effects on aquatic habitats. Revegetation would reduce bare soil and slow the speed of overland water flow. This would result in reduced storm runoff, reduced erosion, and reduced water sedimentation. It is anticipated that adherence to the BMPs in Section 4 will result in "no net loss", and potentially improvement of riparian vegetation and shaded riverine aquatic habitat as a result of the Proposed Action.

5.6 Conclusion

Based on the Proposed Action activities, knowledge of the Proposed Action Area, and strict adherence to the BMPs and AMMs outlined in Section 4, the Beale AFB Environmental Office believes that the proposed "Non-native and Noxious Plant Control" project is not likely to adversely affect any federally listed threatened or endangered species, designated or proposed critical habitat under the ESA, or EFH designated under the MSA. Dry Creek provides potential migratory, rearing, and spawning habitat for CCV steelhead. Waterways on the base are EFH for Chinook Salmon. The Proposed Action is anticipated to have a long-term benefit to CCV Steelhead and EFH by removing giant reed obstructing stream flow in Dry Creek and other invasive plants currently degrading riparian habitat.

Invasive plant control below the ordinary high-water mark of a waterway will be done 15 June to 31 October, outside of the peak migration and spawning periods for Chinook Salmon (October – February) and CCV steelhead (generally August through April). With the exception of small-scale manual removal, weed control activities will cease once the base begins to consistently receive precipitation.

Adverse effects to salmonids will primarily be avoided by following AMMs, as outlined in Section 4. Only aquatic safe herbicides will be used near open water, and protective buffers will be implemented around aquatic resources, grazing and prescribed burns would be excluded from the Dry Creek riparian corridor, and any erosion from manual or mechanical control is anticipated to be minimal; therefore, no adverse effects to CCV steelhead are anticipated due to implementation of this project. Strict adherence to erosion and sediment control and herbicide application AMMs, as outlined in Section 4, will avoid potential indirect impacts to CCV steelhead, their habitat, and EFH. Ultimately, the Proposed Action would result in a net beneficial impact to EFH, as it would remove giant reed obstructing stream flow in Dry Creek and other invasive plants degrading riparian habitat. For this reason, Beale AFB believes the Proposed Action warrants a determination of May Affect, Not Likely to Adversely Affect CCV steelhead and Chinook Salmon EFH.

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7.0 ATTACHMENTS

Attachment 1: Beale AFB Non-native and Noxious Plant Species List, Watch List, and Management Status of Priority Species

Attachment 2: Beale AFB Integrated Natural Resource Management Plan (INRMP)

Attachment 3: Updated Invasive Plant Species Management Guidelines (IPSMG)

Attachment 4: Grazing Management Guidelines (GMG)

Attachment 5: Wildland Fire Management Plan (WFMP)

Attachment 6: Statewide General National Pollutant Discharge Elimination System (NPDES) Permit for Residual Aquatic Pesticide Discharges to Waters of the U.S. from Algae and Aquatic Weed Control, Aquatic Pesticide Application Plan (APAP)

Attachment 7: Beale AFB Installation Pest Management Plan (IPMP)

NMFS Response Re: Informal Consultation Initiation Letter with NOAA Fisheries on Biological Assessment for Non-Native and Noxious Plant Species Management at Beale Air Force Base

Dated 22 January 2021

UNITED STATES DEPARTMENT OF COMMERCE
National Oceanic and Atmospheric Administration
NATIONAL MARINE FISHERIES SERVICE
West Coast Region
650 Capitol Mall, Suite 5-100
Sacramento, California 95814-4700

Refer to NMFS No: WCRO-2020-03132

January 22, 2021

Gwendolyn E. Vergara,
Chief, Environmental Element
9th Civil Engineer Squadron
6425 B St
Beale AFB, CA 95903

Re: Endangered Species Act Section 7(a)(2) Concurrence Letter for the Five-Year Implementation of the Beale Air Force Base Non-Native and Noxious Plant Species Management Program.

Dear Ms. Vergara:

On September 9th, 2020, NOAA's National Marine Fisheries Service (NMFS) received your request for a written concurrence that the United States Air Force, Beale Air Force Base (Beale AFB) Non-native and Noxious Plant Species Management Plan is not likely to adversely affect (NLAA) species listed as threatened or endangered or critical habitats designated under the Endangered Species Act (ESA). The request was made under Beale AFB's authority provided by the Federal Noxious Weed Act (PL 93-629; 7 USC §2801 *et seq*.; 88 Stat. 2148, amended 1990), and Executive Orders (EOs) that explicitly direct federal agencies to control invasive species, such as EO 13112, Invasive Species (1999) and EO 13751, Safeguarding the Nation from the Impacts of Invasive Species (2016), On October 6th, 2020, NMFS also received additional information to support your request for a written concurrence that actions taken as part of Beale Air Force Base's Non-Native and Noxious Plant Species Management are NLAA the species listed as threatened or endangered or critical habitats designated under the ESA. This response to your request was prepared by NMFS pursuant to section 7(a)(2) of the ESA and implementing regulations at 50 CFR 402.

Thank you also for your request for consultation pursuant to the essential fish habitat (EFH) provisions in Section 305(b) of the Magnuson-Stevens Fishery Conservation and Management Act (MSA) (16 U.S.C. 1855(b)) for this action. However, it is your determination that the Proposed Action will have "no adverse effects" on EFH, and neither the EFH consultation provisions of the MSA nor NOAA Fisheries' EFH guidelines have any provisions regarding concurrence with a "no adverse effects" determination. Therefore, NOAA Fisheries is not required to provide concurrence. Beale AFB, as the lead Federal action agency, must make the initial determination of whether the action may adversely affect EFH, and then proceed with consultation if, in Beale AFB's view, the project may adversely affect EFH. If Beale AFB determines that the action would not adversely affect EFH, then it has no statutory obligation to consult pursuant to the MSA EFH consultation requirements.

This letter underwent pre-dissemination review using standards for utility, integrity, and objectivity in compliance with applicable guidelines issued under the Data Quality Act (section 515 of the Treasury and General Government Appropriations Act for Fiscal Year 2001, Public Law 106-554). The document will be available within two weeks at the Environmental Consultation Organizer [https://eco.fisheries.noaa.gov]. A complete record of this consultation is on file at NMFS California Central Valley Office.

Consultation History

On September 9th, 2020, NMFS received a request from Beale AFB, for written concurrence that the Proposed Action is NLAA species listed as threatened or endangered or critical habitats designated under the ESA.

On September 11th, 2020, NMFS staff discussed the Proposed Action with staff at Beale AFB, concluding that more information was needed to assess the potential impacts. NMFS staff followed this discussion with a written (email) request for more information.

On October 6th, 2020, Beale AFB staff sent additional information regarding the potential impacts of the Proposed Action and its relation to the larger Natural Resource Management Plan to manage invasive species at Beale AFB.

On November 30th, 2020, Beale AFB staff sent additional information regarding monitoring reporting associated with the Proposed Action. With receipt of the additional, complete information, consultation was initiated.

On December 16th, 2020, Beale AFB staff provided new information clarifying project elements related to the revegetation of disturbed project sites and the timing of requests to extend the seasonal “Limited Operations Period” (or “work-window”). Initiation date was modified to this date to accommodate new information.

Proposed Action

The Proposed Action is to address the threats of numerous non-native plant species on Beale AFB, where there is a need to eliminate or control known infestations, and for prevention of the establishment of new infestations of invasive plants. If allowed to spread unchecked, non-native plant species will continue to degrade native habitat; interfere with management of sensitive resources, economic activities, and quality of life; and impede the military mission. The Proposed Action is to implement non-native and noxious plant species management that adheres to the 5-year Beale AFB Integrated Natural Resource Management Plan (Beale AFB Plan; Beale AFB 2019). That plan relies on and incorporates by reference a number of other guidance documents that contain goals, objectives, and project details that provide more information regarding approaches to natural resource management, and specifically invasive species control at Beale AFB and the Lincoln Receiver Site (LRS).

BEALE AFB INTEGRATED NATURAL RESOURCE MANAGEMENT PLAN

The Beale AFB Plan establishes a 5-year programmatic approach to the stewardship of sensitive, natural resources, which includes invasive plant species control. The Beale AFB Plan ranks each species of non-native and noxious plant, based on ecological impacts, invasive potential, and ecological distribution. The programmatic approach yields a framework by which Beale AFB prioritizes the species to treat and identifies the most effective treatment methods. Using the Beale AFB Plan approach, non-native plant species on Beale AFB have been put into one of five categories: prevention/early detection rapid response (EDRR) stage, eradication stage, containment stage, asset-based protection stage, and no treatment stage.

The Beale AFB Plan also incorporates implementation recommendations from a number of documents that provide further, project-specific guidance. These documents include the updated Invasive Plant Species Management Guidelines (IPSMG; Beale AFB 2017a), Grazing Management Guidelines (GMG; Beale AFB 2017b), and the Wildland Fire Management Plan (WFMP; Beale AFB 2018a), which were developed to help guide the achievement of the overall Beale AFB Plan through application of different management approaches.

1. *Prevention/Early Detection Rapid Response (EDRR)*

The EDRR is the initial stage of the Beale AFB Plan, and it is intended to identify small populations of non-native and invasive species that have not had the opportunity to establish substantial widespread seedbanks or alter ecosystems. This is the most cost-effective stage at which to manage invasive plants. Currently, there are 14 species that are top EDRR priorities for Beale AFB. New species could be added at a later date due to the nature of invasion and introduction, especially if prevention measures fail. Current EDRR species are:

- Alligator weed (*Alternanthera philoxeroides)*
- Downy brome, cheatgrass (*Bromus tectorum*)
- Spotted knapweed (*Centaurea stoebe* ssp. *micranthos*)
- Canada thistle (*Cirsium arvense*)
- Artichoke thistle (*Cynara cardunculus*)
- Brazilian egeria (*Egeria densa*)
- Water hyacinth (*Eichhornia crassipes)*
- Hydrilla (*Hydrilla verticillata)*
- South American spongeplant (*Limnobium laevigatum)*
- Perennial pepperweed (*Lepidium latifolium*)
- Purple loosestrife (*Lythrum salicaria*)
- Pennyroyal (*Mentha pulegium*)
- Red sesbania, scarlet wisteria (*Sesbania punicea*)
- Smallflower tamarisk (*Tamarix parviflora*)

Applicable management approaches during EDRR:

- Monitoring effects of invasive species on mission critical operations, and other data important to the program,
- Surveying (for new species and phenology tracking),
- Tracking the invasive plant species control program,
- Prevention measures (e.g., education, equipment cleaning, weed-free mulch and fill).

2. *Eradication Stage*

Those plants identified as being in the Eradication Stage are those species that are well established in small populations that have not yet spread over a wide area and where necessary resources have been set aside for long-term monitoring. Nine plant species on Beale AFB fall into this category; however two eradication stage species (water primrose and Russian knapweed) have not been identified definitively, so they are also included in the EDRR list. For this stage, infestations of six invasive plant species would be visited and treated each year until eradicated. The remaining three species would be treated annually once positive identification and locations have been established. Species from the EDRR stage would be added to this list if management actions fail to achieve the goals of the EDRR stage. Current eradication stage species are:

- Giant reed (*Arundo donax*)
- Tree-of-heaven (*Ailanthus altissima*)
- Bull thistle (*Cirsium vulgare*)
- Stinkwort (*Dittrichia graveolens*)
- Edible fig (*Ficus carica*)
- Black locust (*Robinia pseudoacacia*)
- Russian knapweed (*Acroptilon repens*) – positive identification and mapping needed
- Water primrose (*Ludwigia hexapetala* and *L. peploides*) – positive identification and mapping needed
- Indian toothcup (*Rotala indica*) – mapping needed
- Waxy mannagrass (*Glyceria declinata*) – mapping needed
- Common pokeweed (*Phytolacca americana*) – mapping needed

Applicable measures during Eradication Stage:

- Manual/Mechanical treatments (*e.g*., mowing, hand-pulling, weed-whacking),
- Burns (prescribed fires, torching/flaming, fire control lines),
- Chemical treatments (herbicide application via broadcast, spot-spray, or cut-stump treatments),
- Monitoring for treatment efficacy, and other data important to the program,

3. *Containment Stage*

Invasive plant species that comprise an established population that has started to spread outward are identified as needing containment. At the containment stage, the focus is on monitoring the original introduction site if known, curtailing spread from that site, and targeting any newly established satellite populations for immediate control. A portion of the five currently mapped occurrences of containment stage invasive plant species would be treated annually, focusing first on eradicating or containing the most isolated, outlying occurrences and, over time, reducing the footprint of larger, less isolated occurrences. There are 1,465 containment stage infestations mapped occurring on 2,753 acres of the base. Approximately 1,525 acres of containment stage infestations would be treated annually under the Proposed Action. Current containment stage species are:

- Barbed goatgrass (*Aegilops triuncialis*)
- Rush skeletonweed (*Chondrilla juncea*)
- Klamathweed (*Hypericum perforatum*)
- Blessed milkthistle (*Silybum marianum*)
- Vervain (*Verbena litoralis* and/or *V. bonariensis*)
- Parrotfeather (*Myriophyllum aquaticum*) – control areas will be determined after mapping

Applicable measures during Containment Stage:

- Continue and expand livestock grazing (cattle, sheep, goats, and horses), including prescribed grazing management strategies and techniques (*e.g*., continuous grazing, seasonal grazing, variable stocking rates, short duration high-intensity grazing methods), new grazing locations, and new infrastructure (*e.g*., permanent barbed wire

fence, temporary or permanent electric fence, water troughs, solar wells, and trenched waterlines),
- Manual/Mechanical treatments (*e.g*., mowing, hand-pulling, weed-whacking),
- Burns (prescribed fires, torching/flaming, fire control lines),
- Chemical treatments (herbicide application via broadcast, spot-spray, or cut-stump treatments),
- Habitat enhancement treatments (*e.g*., soil preparation, digging, planting, drill or broadcast seeding, hydroseeding, tilling, watering),
- Monitoring for treatment efficacy, and other data important to the program,
- Surveying (for new species and phenology tracking),
- Tracking the invasive plant species control program,
- Prevention measures (*e.g*., education, equipment cleaning, weed-free mulch and fill).

4. *Asset-Based Protection Stage*

The asset-based protection stage is similar to the containment stage, but is focused on the targeted control of invasive species that directly threaten the base's resources, operation, or sensitive species. Medusahead (*Elymus caput-medusae*) has infested almost all open space on Beale AFB, and in most cases would not be targeted for individual treatment. It does, however, overlap infestations of many other species, meaning medusahead would be treated incidentally when other plants are controlled. For example medusahead and yellow starthistle (*Centaurea solstitialis*) occur in most of the base's grazing management areas where grazing is used as a non-species-specific means of control. Up to 12,900 acres of medusahead and 2,500 acres of yellow starthistle would be controlled via prescribed grazing. Exact acreage would be determined through coordination between the Beale AFB Natural Resources Manager (NRM) and grazing lessees. There are 31,338 acres of asset-protection stage infestations mapped on the base. Current asset-based protection stage species are:
- Yellow starthistle (*Centaurea solstitialis*)
- Medusahead (*Elymus caput-medusae*)
- Himalayan blackberry (*Rubus armeniacus*)
- Black mustard (*Brassica nigra*)
- Italian thistle (*Carduus pycnocephalus*)

Applicable measures during Asset-Based Protection Stage:
- Continue and expand livestock grazing (cattle, sheep, goats, and horses), including prescribed grazing management strategies and techniques (*e.g*., continuous grazing, seasonal grazing, variable stocking rates, short duration high-intensity grazing methods), new grazing locations, and new infrastructure (*e.g*., permanent barbed wire fence, temporary or permanent electric fence, water troughs, solar wells, and trenched waterlines),
- Manual/Mechanical treatments (*e.g*., mowing, hand-pulling, weed-whacking),
- Chemical treatments (herbicide application via broadcast, spot-spray, or cut-stump treatments),
- Habitat enhancement treatments (*e.g*., soil preparation, digging, planting, drill or broadcast seeding, hydroseeding, tilling, watering),
- Monitoring for treatment efficacy, and other data important to the program,
- Surveying (for new species and phenology tracking),
- Tracking the invasive plant species control program,
- Prevention measures (*e.g*., education, equipment cleaning, weed-free mulch and fill).

5. *No Treatment Proposed at this Time*

The fifth stage of the Beale AFB Plan, identifies an additional 28 invasive plant species on Beale AFB that would not be targeted for eradication or control at this time, because they are too widespread to control and/or have limited ecological impact (Beale AFB, 2020). Future analyses may target specific infestations where ecological or resource damage is observed.

Applicable measures for species identified as No Treatment Proposed at this Time:

- Monitoring effects of invasive species, and other data important to the program,
- Surveying (for new species and phenology tracking),
- Tracking the invasive plant species control program,
- Prevention measures (*e.g*., education, equipment cleaning, weed-free mulch and fill).

PROPOSED ERADICATION AND CONTROL METHODS

The Beale AFB Plan identifies a range of methods and activities tailored to stage-specific goals, constraints, and invasive species. The following methods and activities for invasive plant species containment/control are considered in the Beal AFB Plan:

1. *Livestock Grazing*

Under Proposed Action, the grazing program at Beale AFB and the LRS would be maintained in accordance with the Beale AFB GMG (Beale AFB 2017b), which helps guide livestock grazing management activities to meet Beale AFB Plan goals. As a management strategy, grazing by domestic livestock, including cattle, sheep, goats, and horses, would be implemented to control some invasive plant species and would be used to move plant community composition in a desired direction. The GMG identifies approximately 3,332 acres on Beale AFB and 210 acres on the LRS of land suitable for grazing, and discusses associated infrastructure, livestock species considerations, and other particulars. Of the area suitable for grazing, Beale AFB has identified 1,668 acres for permanent cattle grazing pastures. These areas, proposed for grazing are ecologically identical to currently grazed lands. The areas are predominantly California annual grassland, interspersed with vernal pool complexes, seasonal swales and tributaries, and riparian and oak woodland habitat. Grazing will not occur within the Dry Creek Riparian corridor.

2. *Prescribed Burns*

Under the Proposed Action, prescribed fire may be utilized to control certain invasive plant species at Beale AFB and the LRS. Use of prescribed burns are managed in accordance with the IPSMG, and the WFMP (Beale AFB 2018a), which provide guidance for the suppression and prevention of wildfires as well as the implementation of ecosystem management and wildfire fuels reduction on Beale AFB. The WFMP addresses Beale AFB Plan management goals and objectives, and complies with all applicable laws and regulations. Prescribed burns may not be feasible in some areas due to conflicts with mission-critical operations or other ecological goals. This includes a prohibition on prescribed burns in the Dry Creek riparian corridor.

3. *Manual/mechanical treatments*

Under the Proposed Action, manual and mechanical treatments including mowing, hand-pulling, digging up with hand tools, and weed-whacking may be utilized to control certain invasive plant species at Beale AFB and the LRS. Heavy equipment including excavators and flail mowers or masticators may be used to control infestations of giant reed and Himalayan blackberry. Administration of these activities is the responsibility of the Beale AFB Natural Resource Manager.

4. Habitat enhancement treatments

Habitat enhancement treatments may be utilized under the Proposed Action to control invasive plant species at Beale AFB and the LRS by replanting or reseeding with desirable native species. Habitat enhancement treatments would typically occur after herbicide treatment, manual removal, or prescribed burning has been conducted and in accord with other resource goals and protection measures. Revegetating invasive plant treatment sites may be accomplished using a mixture of native grasses and forbs, and may include trees and shrubs if appropriate. The most common methods include hand seeding, drill seeding, plug planting and container planting Revegetating decisions would be compatible with future uses and management actions, and would consider suitability and cost of available options as well as the suitability of the site itself. The Proposed Action will follow habitat enhancement guidance provided in the IPSMG (Beale AFB, 2017a).

5. Chemical treatments

Under the Proposed Action, chemical treatments in the form of herbicide applications would be utilized to control certain invasive plant species at Beale AFB. Herbicides are most often used when other methods are not effective or feasible. Herbicides may be used to manage dense or large infestations or specific species that cannot be successfully controlled through other management actions. It is expected that the amount of herbicide used on a particular site would decrease over time as the invasive plant population declines.

Herbicides would always be applied in accordance with the IPSMG; the Beale AFB Installation Pest Management Plan (IPMP; Beale AFB 2018b); the U.S. Air Force (USAF) Pest Management Program; the Statewide National Pollutant Discharge Elimination System (NPDES) Permit and Beale AFB Aquatic Pesticide Application Plan (APAP) (SWRCB, 2019); all applicable federal, Department of Defense (DoD), USAF, State of California, and local directives and regulations; and label instructions. The DoD maintains a list of approved pesticides, the 2016 version of which is included as Appendix E in the IPSMG (Beale AFB, 2017a). Additionally, Cal-IPC (2015) guidance would be considered for use of herbicides in wildlands, especially relating to minimizing impacts on wildlife.

Ten herbicides are proposed for use in invasive plant control at Beale AFB (Table 1). For each of the proposed herbicides, the use and application/delivery method would depend on the target plant species (Table 2). Application methods that may be used are described below:

- Broadcast Spray (Boom): Spraying herbicide onto an entire infested area, rather than targeting individual plants using a regulated nozzle. This method uses a truck- or ATV-mounted boom sprayer and is limited to areas with moderate terrain. Broadcast methods are used for denser infestations where application to individual plants would not be feasible.
- Targeted Spray: Spraying herbicide onto the foliage of individual target plants. This is done using a regulated nozzle, which helps to concentrate application toward target plants. This method uses a backpack-mounted wand sprayer or a truck- or ATV-mounted hose sprayer. This is used for small infestations or in areas not accessible by vehicle.
- Pre-emergent Spray: Herbicide is applied directly to the soil in areas with known infestations to prevent seed germination or to otherwise inhibit development. Herbicide may be applied using backpack-mounted wand sprayer or a truck- or ATV-

mounted hose sprayer. This method is best for large infestations and difficult-to-control species.

- Basal Bark: Basal bark herbicides are mixed with an oil carrier to penetrate the bark of the target plant. Herbicide is sprayed around the circumference of the base of the stem. This is used to control thin-barked plants less than 6 inches in basal diameter.
- Selective Application: Selective applications involves touching individual target plants with applicators containing herbicide. Because these methods involve direct application, there is a very low likelihood of drift, run-off, or accidental non-target exposure. Specific methods include: hack-and-squirt, cut-stump, and wicking or wiping.
- Aquatic Applications: Herbicide is either applied directly to foliage growing at or above the water's surface or to the water column itself using hoses and weighted nozzles if plants are fully submerged. This method is generally restricted to large infestations of aquatic plants in non-moving water. Only herbicides approved for aquatic use and administered according to Attachment C of the NPDES General Permit may be applied using this method (SWRCB, 2019).

Table 1: ***Proposed herbicides for use in invasive plant control, and their active ingredient, and potential toxicity to fish.***

Example Product Name	Active Ingredient	Type	EPA Reg No.	Toxicity to Fish	Mobility	Groundwater Contamination Potential	Half-life in Water
Milestone	Triisopropanolam monium salt of aminopyralid	Liquid	62719-519	Practically non-toxic[2]	Relatively immobile	Minimal leaching below 15 to 30 centimeters (cm).	Breaks down in sunlight with half-life of 0.6 days.
Capstone, Milestone VM Plus	Triisopropanolam monium salt of aminopyralid and Tricolpyr triethylamine salt (TEA)	Liquid	62719-572	Practically non-toxic[2,8]	Relatively immobile to Highly mobile	Potential to contaminate groundwater.	Breaks down in sunlight with a half-life of 0.6 days to 83.4 hours.
Telar XP	Chlorosulfuron	Dry flowable	432-1561	Practically non-toxic[3]	Highly mobile	Moderate potential to contaminate groundwater. High potential for surface runoff.	Breaks down in water at low pH with a half-life of 22-23 days. Stable in water at higher pH.
Roundup Pro	Isopropylamine salt of glysophosate	Liquid	524-475	Practically non-toxic[4], slightly to highly toxic[9]	Relatively immobile	Very low potential to contaminate groundwater	Breaks down due to microbe degradation to a half-life of 12 days to 10 weeks.
Rodeo[1], Roundup Custom[1]	Isopropylamine salt of glysophosate	Liquid	62719-324; 524-343	Practically non-toxic to slightly toxic[9]	Relatively immobile	Very low potential to contaminate groundwater	Breaks down due to microbe degradation to a half-life of 12 days to 10 weeks.
Clearcast[1]	Ammonium salt of imazamox	Liquid	241-437-67690	Practically non-toxic[5]	Highly mobile	Minimal leaching below 23 cm.	Breaks down in clear water with a half-life of 6.8 hours.
Arsenal[1], Habitat[1]	Isopropylamine salt of imazapyr	Liquid	241-346; 241-426	Practically non-toxic[6], no risk of concern[10]	Highly mobile	High potential to leach to groundwater. High surface water runoff potential.	Breaks down in sunlight with a half-life of ~4 days.
Oust XP	Sulfometuron methyl	Dispersible granules	432-1552	Practically non-toxic[7]	Moderately mobile	Degrades rapidly, not likely to contaminate groundwater. Tends to stay within the top 3 inches of soil.	Breaks down in water and with sunlight with a half-life of 1 day to 2 months.
Garlon 4 Ultra	Triclopyr butoxyethyl ester (BEE)	Liquid	62719-527	Moderately to highly toxic[8]	Highly mobile	Potential to contaminate groundwater.	Breaks down in sunlight with a half-life of 2.8 to 83.4 hours.
Garlon 3[1]	Tricolpyr triethylamine salt (TEA)	Liquid	62719-37	Practically non-toxic[8]	Highly mobile	Potential to contaminate groundwater.	Breaks down in sunlight with a half-life of 2.8 to 83.4 hours.

[1] aquatic-safe formulation; [2] US Office of Prevention, Pesticides, Environmental Protection and Toxic Substances 2005; [3] Oregon State University and Intertox 2006; [4] UC Davis 1996; [5] USEPA 1997; [6] SERA 2011; [7] USEPA 2008; [8] SERA 2010; [9] USEPA 2015; [10] USEPA 2006

Table 2: ***Herbicide, application methods, rates, and target species for invasive species control on Beale AFB.***

Herbicide	Application Methods	Target Plant Species	Maximum Application Rate (lbs a.e./acre)[1]	Maximum Treatments/ Year	Maximum Acres/ Year [3,4]
Aminopyralid (Milestone)	Target Spray/Direct Application	bull thistle, blessed milk thistle, skeletonweed, St. John's wort, Italian thistle, yellow starthistle, Indian toothcup, artichoke thistle, Canada thistle, Russian knapweed, spotted knapweed	0.11 (0.22 spot treatment)[2]	1	925
Aminopyralid (Milestone)	Broadcast Spray	St. John's wort, yellow starthistle, medusahead	0.11	1	1000
Aminopyralid (Milestone)	Pre-emergent	Italian thistle, medusahead, spotted knapweed	0.11	1	525
Aminopyralid + Triclopyr TEA (Capstone)	Target Spray/Direct Application	black locust, tree-of-heaven, Himalayan blackberry	0.11 + 1.12	1	125
Chlorsulfuron (Telar XP)	Target Spray/Direct Application	bull thistle, blessed milk thistle, black mustard, yellow starthistle, perennial pepperweed, Canada thistle, Russian knapweed	0.122 (0.062 rangeland)	1	475
Chlorsulfuron (Telar XP)	Pre-emergent	black mustard	0.122 (0.062 rangeland)	1	50
Chlorsulfuron (Telar XP) + Sulfometuron Methyl	Pre-emergent	barbed goatgrass	0.062 + 0.375	1	250
Glyphosate (Roundup Custom/Rodeo)	Target Spray/Direct Application	black locust, tree-of-heaven, giant reed, stinkwort, edible fig, barbed goatgrass, skeletonweed, St. John's wort, black mustard, Italian thistle, yellow starthistle, medusahead, perennial pepperweed, Canada thistle, cheatgrass, purple loosestrife, red sesbania, spotted knapweed, vervain	8	2	0-1,900
Glyphosate (Roundup Custom/Rodeo)	Broadcast Spray	barbed goatgrass, medusahead, cheatgrass	8	2	775
Glyphosate (Roundup Custom/Rodeo)	Cut Stump	black locust, giant reed	8	1	2.5
Glyphosate (Roundup Pro)	Target Spray/Direct Application	black locust, stinkwort, black mustard, yellow starthistle, Italian thistle, barbed goatgrass, medusahead, skeletonweed, St. John's wort	8	1	0-1,900

Herbicide	Application Methods	Target Plant Species	Maximum Application Rate (lbs a.e./acre)[1]	Maximum Treatments/ Year	Maximum Acres/ Year [3,4]
Glyphosate (Roundup Custom/Rodeo) + Imazapyr (Habitat)	Target Spray	giant reed	8.0 (glyphosate) + 1.5 (imazapyr)	1	15
Imazamox (Clearcast)	Direct aquatic	parrotfeather, water primrose, alligator weed, hydrilla, smallflower tamarisk, South American spongeplant, water hyacinth	1	1	25
Imazapyr (Habitat/Arsenal)	Target Spray	bull thistle, skeletonweed, yellow starthistle, black locust, edible fig, tree-of-heaven, giant reed, vervain, perennial pepperweed, pokeweed, artichoke thistle, water primrose, parrotfeather, alligator weed, Canada thistle, cheatgrass, purple loosestrife, red sesbania, Russian knapweed, smallflower tamarisk, spotted knapweed, water hyacinth	1.5	1	540
Imazapyr (Habitat/Arsenal)	Pre-emergent	skeletonweed	1.5	1	25
Sulfometuron Methyl	Spray	Himalayan blackberry, barbed goatgrass, okeweed, vervain	0.281	1	375
Sulfometuron Methyl	Broadcast Spray	medusahead, barbed goatgrass	0.281	1	750
Sulfometuron Methyl	Pre-emergent	barbed goatgrass, black mustard, medusahead, perennial pepperweed, cheatgrass	0.281	1	825
Triclopyr triethylamine salt (Garlon 3)	Target Foliar	Himalayan blackberry, barbed goatgrass, bull thistle, yellow starthistle, black locust, edible fig, black mustard, Italian thistle, stinkwort, perennial pepperweed, water-primrose, Indian toothcup, artichoke thistle, Canada thistle, pennyroyal, purple loosestrife, red sesbania, smallflower tamarisk	8.0 (2.0 rangeland)	1	0-895
Triclopyr triethylamine salt (Garlon 3)	Cut stump or basal bark	tree-of-heaven, edible fig	8.0 (2.0 rangeland)	1	6.5
Triclopyr butoxyethyl ester (Garlon 4 Ultra)	Target Foliar	black locust, stinkwort, black mustard, yellow starthistle, Italian thistle	8.0 (2.0 rangeland)	1	0-895

[1] Maximum lbs active ingredient or acid equivalent that can be applied per acre/per year on product label. pounds acid equivalent per acre

[2] Cannot spot-treat more than 50% of an acre at this concentration

[3] Total acres per year that would be treated if the maximum proposed acreage for all species listed are treated using a single herbicide and single application method. This is not a likely scenario as a number of herbicides and methods are proposed for use, and the herbicide and method selected would depend on the plant species, location of infestation, and USAF herbicide use approval. More than one herbicide, or more than one application method would not be used for the same species in the same treatment area within a single year.

[4] Acres represent infested acres, so actual acres sprayed for target treatments is estimated to be 10-50% of the total.

Beal AFB's Proposed Action includes consideration of potential effects of herbicide use on surrounding vegetation, habitats, wildlife, and water resources, as the purpose of the activity is to protect and benefit these resources. Selection of the herbicide and method to be used in any given situation is critical, with attention to toxicity, use restrictions, and timing of the application. The toxicity of individual herbicides to fish varies, as does the potential for an herbicide to contaminate surface or groundwater (Table 1). With the exception of giant reed control as described below, aquatic resource buffers will be implemented during herbicide application near suitable listed species habitat to prevent water contamination and protect steelhead and other aquatic species from exposure (see Table 3). Direct aquatic application of imazamox (Clearcast) may be used for control of aquatic weeds, but imazamox will not be used in Dry Creek or Best Slough or in waterbodies that feed into them.

Table 3: ***Minimum required buffers for proposed herbicides and application methods.***

Active Ingredient	Application Method	Dry Aquatic Features[1] (feet)	Streams[1] or Ditches with water (feet)	Special Aquatic Features (vernal swales, springs, vernal pool)[2] (feet)
Aminopyralid	Spot & directed foliar spray	25	25	100
Aminopyralid	wiping	15	15	15
Chlorsulfuron	directed foliar spray	25	100	100
Chlorsulfuron	wiping	15	15	15
Glyphosate	directed foliar spray or drizzle	0	25	25[3]
Glyphosate	cut stump or wiping	0	15	15[3]
Imazamox	direct application	0	0[4]	n/a
Imazapyr	Directed foliar spray	25	75[5]	75
Sulfometuron methyl	Spot and preemergent	25	50	50
Triclopyr (TEA)	directed foliar	25	75	75
Triclopyr (TEA)	wiping or cut stump	15	15	15
Triclopyr BEE	Spot & directed foliar spray	75	250	250
Triclopyr BEE	cut stump	75	75	75

[1]As measured from the edge of the stream channel. If a defined channel is not present (draws do not have defined channels), measurement is from the bottom of the feature.
[2]As measured from the edge of the wet area surrounding the special aquatic feature, or the vernal pool vegetation, whichever is greater.
[3]Only non-Polyoxyethylene Tallow Amine (POEA) containing formulations may be used
[4]Imazamox will never be applied directly to flowing water, water where the outflow cannot be controlled, to Dry Creek, Best Slough, or their tributaries.
[5]With the exception of giant reed treatment in Dry Creek and Best Slough

<u>Giant Reed Control</u> - As part of the Beale AFB Plan, and specific to the Eradication Stage, Beale AFB is proposing to control giant reed (*Arundo donax*) infestations along Dry Creek during late summer (15 June to 31 October) where Beale AFB will employ mechanical methods of removal. These methods include removing the canes of the plant using hand tools, or hand-held gasoline powered tools. The plant biomass will then be chipped or removed from the site to reduce the

risk of re-infestation. Herbicide will be applied directly to the cut stumps at the time of cane removal, or sprayed onto the leafy regrowth later in the summer. An aquatic-approved formulation of glyphosate such as Rodeo or Roundup Custom, combined with an aquatic-approved formulation of Imazapyr such as Habitat or Arsenal will be used. The herbicides will be mixed with a non-ionic surfactant approved for use in aquatic habitats and no additional adjuvants would be used. Herbicide would not be applied directly to any flowing or non-flowing water. Foliar applications would be done with a pressurized hydraulic sprayer and/or low volume backpack sprayer. Cut-stump application would be done by spraying a concentrated solution directly onto the cut stumps using a low volume back pack sprayer. Beale AFB will repeat treatment of invasive plant infestations each year until eradicated.

AVOIDANCE AND MINIMIZATION MEASURES

Beale AFB has identified a number of avoidance and minimization measures that are considered part of the Proposed Action. The assessment of the potential impacts of the Proposed Action is based on the inclusion of the following measures deemed relevant to the protection of NMFS trust resources.

General Avoidance and Minimization Measures

1. Preconstruction Surveys - A biologist approved by the NMFS will conduct preconstruction surveys of all in-channel disturbance areas within sensitive habitats (*e.g.* vernal pools, wetlands, riparian areas, and potential habitat for federally-listed species) to determine if any federally listed species may be present prior to the start of work. These surveys will be conducted two weeks prior to the start of work activities in any sensitive habitat. If any federally listed species are found during the preconstruction surveys, the NMFS-approved biologist will contact NMFS to determine how to proceed. At least 15 working days prior to the onset of activities, Beale AFB will submit the name(s) and credentials of biologists who will conduct these preconstruction surveys. No project activities will begin until proponents have received written approval from the NMFS that the biologist(s) is qualified to conduct the work.

2. Biological Monitor - A NMFS-approved biologist will monitor work activities in or adjacent to sensitive habitats. The biological monitor will ensure compliance with the avoidance and minimization measures required to protect federally listed species and their habitats. If federally listed species are found that are likely to be affected by work activities, the NMFS-approved biologist will have the authority to stop any aspect of the project that could result in unauthorized take of a federally listed species. If the biological monitor exercises this authority, he/she must immediately notify the 9th Civil Engineer Squadron/Environmental Element (9 CES/CEIE). The 9 CES/CEIE will verbally notify NMFS within one working day by telephone and will provide written notification of the work interruption within three working days.

3. Environmental Awareness Training - Environmental awareness training will be provided for all personnel working on the Proposed Action. Training will be provided at the start of work and all new workers will be provided with training before conducting project activities. The program will consist of a briefing on environmental issues relative to the

Proposed Action. Training will be conducted by a NMFS-approved biologist. The training program will include an overview of the legal status, biology, distribution, habitat needs, and compliance requirements for each federally listed species that may occur in the project area. The presentation will also include a discussion of the legal protection for endangered species under the ESA, including penalties for violations. A fact sheet conveying this information will be distributed to all personnel who enter the project site. Upon completion of the orientation, employees will sign a form stating that they attended the program and understand all avoidance and minimization measures. These forms will be filed at Beale AFB Environmental Element Office and will be accessible to the appropriate resource agencies.

4. Invasive Species - A biological monitor will ensure that the spread or introduction of invasive exotic plant species will be avoided to the maximum extent possible. When practicable, invasive exotic plants identified in the project area will be removed. This includes ensuring all equipment used during work is cleaned before being moved from one location of the installation to another.

5. Erosion Control - When appropriate, isolate the construction area from flowing water until project materials are installed and erosion protection is in place. Effective erosion control measures will be in place at all times during construction. Do not start construction until all temporary control devices (*e.g.*, straw bales with sterile, weed-free straw, silt fences) are in place down slope or downstream of project site within the riparian area. The devices will be properly installed at all locations where the likelihood of sediment input exists. These devices will be in place during and after construction activities for the purposes of minimizing fine sediment and sediment/water slurry input to flowing water and detaining sediment-laden water on site. If continued erosion is likely to occur after construction is complete, then appropriate erosion prevention measures will be implemented and maintained until erosion has subsided. Erosion control devices, such as coir rolls or erosion control blankets, will not contain plastic netting of a mesh size that would entrain reptiles (especially snakes) and amphibians. Sediment will be removed from sediment controls once it has reached one-third of the exposed height of the control. Whenever straw bales are used, they will be sterile and weed-free, staked and dug into the ground 12 cm. Catch basins will be maintained so that no more than 15 cm of sediment depth accumulates within traps or sumps. Sediment-laden water created by construction activity will be filtered before it leaves the settling pond or enters the stream network or an aquatic resource area. The contractor/applicant to the program is required to inspect, maintain or repair all erosion control devices prior to and after any storm event, at 24-hour intervals during extended storm events, and a minimum of every two weeks until all erosion control measures have been completed. Construction boundaries within the buffer will be designated with fencing to ensure no equipment and/or construction workers access those protected areas.

6. Limited Operations Period - The general construction season will be from 2 May to 31 October. Invasive species control activities within any wetted or flowing stream channel will only occur 15 June to 31 October. Revegetation outside of the active channel may

continue beyond 31 October, if necessary. NMFS will be notified prior to any revegetation work needed to occur between November 1 and 15 June.

7. Off-Road Travel - Off-road travel outside of the demarcated work boundaries will be prohibited.

8. Demarcation of Work and Staging Areas - Beale AFB (or the contractor to Beale AFB) will provide all materials to stake and flag boundaries of the work area. Beale AFB will coordinate with the biological monitor to stake and flag the boundaries of all work and staging areas in portions that have the potential to support federally listed species or their habitat. The contractor will remove all fencing, stakes and flagging within 60 calendar days of work completion. Orange barrier fencing will designate exclusion zones where work activities cannot occur.

9. Fueling and Servicing in Designated Areas - Motor vehicles and equipment will only be fueled and serviced in designated service areas. All fueling and maintenance of vehicles and other equipment and staging areas will occur at least 250 feet from any wetland/drainage habitat or water body. Prior to the onset of work, contractor will prepare a Spill Prevention Control and Countermeasure Plan to allow a prompt and effective response to any accidental spills. All workers will be informed of the importance of preventing spills and of the appropriate measures to take should a spill occur. All machinery will be properly maintained and cleaned to prevent spills and leaks. Any spills or leaks from the equipment will be reported and cleaned up in accordance with applicable local, state and federal regulations.

10. Garbage Removal - During work activities, all trash that may attract wildlife will be properly contained, removed from the work site daily, and disposed of daily. Following completion, all refuse and debris will be removed from work areas. All garbage and work-related materials in the areas will be removed immediately following project completion.

11. Disposal of Excavated Soil - If feasible, conserve topsoil for reuse at project location. End haul spoils away from watercourses as soon as possible to minimize potential sediment delivery. All soil excavated during work occurring near drainages will be removed and disposed of outside the project area. Coordination with 9 CES/CEIE and appropriate regulatory agencies is required prior to disposal of the excavated soil.
    a. Minimize temporary stockpiling of material. Stockpile excavated material in areas where it cannot enter the stream channel. Prior to start of construction, coordinate with Beale AFB Environmental Office to see if such sites are available at or near the project location. If nearby sites are unavailable, determine a location where material will be deposited. Establish locations to deposit spoils well away from watercourses. Spoils will be contoured to disperse runoff and stabilized with mulch and (native) vegetation. Use devices such as plastic sheeting held down with rocks or sandbags over stockpiles, silt fences, or berms of hay bales, to minimize movement of exposed spoils.

12. <u>Minimization of Access Routes etc.</u> - The number of access routes, number and size of staging areas, and the total area of the activity will be limited to the minimum necessary to achieve the project goal. Routes and boundaries will be clearly demarcated. Off-pavement access routes can only be used if the soil is dry.

13. <u>Speed Limits</u> - All vehicle operators will follow the posted speed limit on paved and a 20-mile per hour speed limit on unpaved roads.

14. <u>Pets/Firearms</u> - No pets or non-military firearms will be allowed in the project area.

15. <u>Revegetation and Success Criteria</u> - Where the soil-profile is compacted/stratified, preparation of replanting sites will require ripping (fracturing soil profile) to facilitate root growth. Decompacting disturbed soils at the project location depends on the amount of compaction from project activities and the soil type. Typically, fracturing or decompacting the soil profile could extend as deep as 24 inches. Any stream bank area left barren of vegetation as a result of the implementation or maintenance activities will be restored to a natural state by seeding, planting, or other means with native trees, shrubs, or grasses prior to November 15 of the project year. Barren areas would typically be planted with a combination of willow stakes, native shrubs and trees and/or erosion control grass mixes. Native plant species will be used for revegetation of disturbed and compacted areas. The species used will be specific to the project vicinity or the region of the state where the project is located, and comprise a diverse community structure (plantings will include both woody and herbaceous species). For projects where re-vegetation is implemented to compensate for riparian vegetation impacted by the project, a re-vegetation monitoring report will be required after five years to document success. Success is defined as 70 percent survival of plantings or 70 percent ground cover for broadcast planting of seed after a period of three years. If revegetation efforts will be passive (*i.e.*, natural regeneration), success will be defined as total cover of woody and herbaceous material equal to or greater than pre-project conditions. If at the end of five years, the vegetation has not successfully been reestablished, 9 CES/CEIE will be responsible for replacement planting, additional watering, weeding, invasive exotic eradication, or any other practice, to achieve the revegetation requirements. If success is not achieved within the first five years, the project applicant will need to prepare a follow-up report in an additional five years. This requirement will proceed in five-year increments until success is achieved. All plastic exclusion netting placed around plantings will be removed after three years.

Avoidance and Minimization Measures from the Beale AFB Aquatic Pesticide Application Plan

A number of water sampling requirements and AMMs are required by the base NPDES permit, and will be followed during all herbicide application in or near in Dry Creek and Best Slough. Sampling Requirements:

1. Beale AFB will monitor the use of glyphosate and imazapyr in compliance with Attachment C of the NPDES General Permit (SWRCB, 2019).

2. All laboratory analyses will be conducted at a laboratory certified by the California Department of Public Health in accordance with California Water Code section 13176.

3. All analyses will be conducted in accordance with the U.S. Environmental Protection Agency's (USEPA) "Guidelines Establishing Test Procedures for Analysis of Pollutants."

4. Visual monitoring of the aquatic herbicide applications will be accomplished for all applications at all sites using a standardized template.

5. Physical and chemical monitoring of the listed herbicides will be conducted for one application event.
    a. Background samples will be collected upstream at the time of the application event.
    b. Event monitoring samples will be collected immediately outside of the treatment area in non-flowing waters, immediately after the application event, but after sufficient time has elapsed such that contaminated water would have exited the treatment area.
    c. Post-Event samples will be collected within the treatment area within one week after the application event.

6. Monitoring procedures for physical and chemical properties will follow Table 4.

Table 4. ***Post-Herbicide Application Monitoring Procedures***

Sample Type	Constituent / Parameter	Sample Method	Sample Type Requirement
Physical	1. Temperature[1] 2. pH[1] 3. Turbidity[1] 4. Electrical conductivity [1]	Grab 3' Below Surface or Mid-depth if Water Body is < 6'	Background, Event and Post Event Monitoring
Chemical	1. Active Ingredient – Imazapyr[2] 2. Active Ingredient – glyphosate[2] 3. Dissolved Oxygen[1]	Grab 3' Below Surface or Mid-depth if Water Body is < 6'	Background, Event and Post Event Monitoring

[1] Field Testing
[2] Laboratory Testing

7. An annual report detailing all required information, as outlined in Attachment C of the NPDES General Permit, will be submitted to the state and regional Water Quality Control Board and to the NMFS CCVO.

8. All samples will be collected in clean, amber glass bottles and properly labeled, including the date and time the sample is collected.

9. Proper personal protective equipment will be worn, including disposable nitrile gloves, to prevent contamination.

10. Samples will be collected without interference from any equipment or vehicles.

11. Samples will be accounted for utilizing a standard "Chain of Custody" form supplied by the laboratory performing the analysis to ensure the integrity of the sample collection and transfer process.

12. Samples will be stored on ice and transported to the lab within appropriate hold times for the required tests.

13. Samples will be transported separately from the aquatic herbicides and application equipment on the day of the application event.

Herbicide Application AMMs

1. All applications will be performed by Department of Defense (DoD) or state-certified pesticide applicators.

2. All personnel will follow the storage, mixing, transport, application, and spill response procedures per USEPA and California Department of Pesticide Regulation rules, regulations, and label instructions.

3. Aquatic herbicide applicators will ensure daily that application equipment is in proper working order. Aquatic herbicides must be stored indoors.

4. Spill response and cleanup supplies will be maintained in all vehicles and pesticide storage areas.

5. All personnel responsible for handling, mixing, or applying pesticides must complete Beale AFB's Spill Prevention, Control, and Countermeasures training annually (Beale AFB has a comprehensive program for the identification, response, and control of hazardous materials spills, with personnel on stand-by to respond to any releases of hazmat, including pesticides, to the environment).

6. Any contaminated media (water or soil) will be contained and cleaned or properly disposed of to the maximum extent possible.

7. Beale AFB personnel will report all spills to appropriate local, state, and federal agencies, including NMFS (within 48 hours) according to applicable regulations.

8. Over application will be avoided by following the specific product labels for the aquatic herbicide used.

9. Only sufficient material to carry out the treatment will be transported for the day's application.

10. To ensure it functions properly, application equipment is calibrated at least annually unless herbicide label instructions require a more frequent calibration.

11. The 9 CES/CEIE will train all personnel applying herbicides and pesticides on the Water Quality Order No. 2013-0002-DWQ State General Permit and the requirements of the APAP annually.

12. With the exception of activities covered under the NPDES permit, herbicide application will not occur within the buffers in Table 3 when applying herbicide near aquatic features.

13. Aquatic herbicides will never be applied directly to flowing water (if this becomes necessary, the Base APAP will be amended and re-submitted to the state and regional Water Quality Control Board for approval).

14. Aquatic herbicide applications are only allowed from 15 June to 31 October to avoid the local wet season. In addition, aquatic herbicides will not be applied during any wet weather or 12 hours before or after a rain event.

15. Aquatic herbicides will only be applied when winds are less than 5 miles per hour.

16. Herbicide applications near aquatic resources will be done with a pressurized hydraulic sprayer and/or low-pressure backpack sprayers to prevent over application and excess herbicide runoff downstream.

17. Sites potentially requiring aquatic herbicide treatment will be surveyed first to assess the area and any potential impacts if herbicides are applied.

18. Herbicides will be mixed in a designated area with appropriate containment and spill-prevention measures.

19. Trained DoD or state-certified pesticide applicators will make an informed decision on the application of aquatic herbicides by scouting the area to be treated, making a positive identification of the target species, and checking the herbicide product label for control efficacy.

20. Label instructions will be followed to determine appropriate rates of application and to identify any warnings or conditions that limit the application.

21. The certified applicator may utilize an aquatic approved surfactant according to label instructions.

22. Herbicides will always be applied in accordance with the IPSMG (Beale AFB 2017a); the Beale AFB IPMP (Beale AFB 2018b); The Beale AFB Plan (Beale AFB 2019); the Air Force Pest Management Program; a NPDES Permit and APAP; all applicable federal, DoD, United States Air Force, State of California, and local directives and regulations; label instructions; and Natural Resource Conservation Service best management practices.

23. All pesticide applicators must hold current Qualified Applicator Certificates (minimum qualification) from the California Department of Pesticide Regulation and submit copies to 9 CES/CEIE Pest Management within 30 days of contract award date. Any herbicide application within jurisdictional or biological wetlands must be done, or overseen by, someone who passed the Aquatic category on the Qualified Applicator test.

24. All herbicide applicators must receive environmental training and be able to recognize sensitive resources including listed wildlife and plants, vernal pools, and nesting birds.

25. The most effective herbicide for the target species will be used. If necessary, an AF Approval Request will be submitted.

26. Consultation with the Beale Natural Resources Manager will occur if herbicide/surfactant use is planned within 250 feet of a wetland.

27. Non-target vegetation will be protected by minimizing drift and applying only enough herbicide to effectively treat the target plants.

28. Herbicides will not be sprayed in wetlands or Waters of the United States (WoUS) when water is present, unless specifically targeting aquatic weeds and all permits and permissions are obtained.

29. When applying herbicides near wetlands in the wet season (1 Nov to 1 May) or when the 2-week chance of rainfall is greater than 70%, herbicides may not be applied within the effective catchment or natural drainage area (as indicated by micro- and macro-topography) of a wetland where they may potentially run off into the wetland. See aquatic resource buffers in Table 3. Note that this AMM does not apply to aquatic-use pesticides (please refer to AMM 14).

30. Herbicides will be applied within specified heat tolerances of volatile herbicides to protect nearby non-target vegetation.

31. All mixing of herbicides will be conducted at least 150 feet from aquatic resources.

32. Herbicide applicators will prescribe and use only non-ionic surfactants near open water. These surfactants are readily biodegradable and low in aquatic toxicity.

33. Herbicide applicators must adhere to the aquatic resource protection buffers listed in Table 3.

OTHER ACTIVITIES CAUSED BY THE PROPOSED ACTION

We considered, under the ESA whether or not the proposed action would cause any other activities and determined that it would not cause additional activities outside of the invasive plant control activities as managed by the Beale AFB Plan.

ACTION AREA

The Action Area for the Proposed Action is Beale AFB and the LRS (Figure 1). The extent of effects associated with the Proposed Action is expected to remain entirely within the bounds of Beale AFB because these effects are understood to be immobile and proximal to the source of potential disturbance. Beale AFB encompasses approximately 23,000 acres in Yuba County, California, in the northeastern portion of the Sacramento Valley, which constitutes an ecological and geographic transition zone between the flat agricultural lands of the Sacramento Valley and the foothills of the western slope of the Sierra Nevada. The Yuba and Bear rivers are located north and south of Beale AFB, respectively, with the base situated in the Bear River watershed. Three named tributaries to the Bear River run through the base: Reeds, Hutchinson, and Dry creeks.

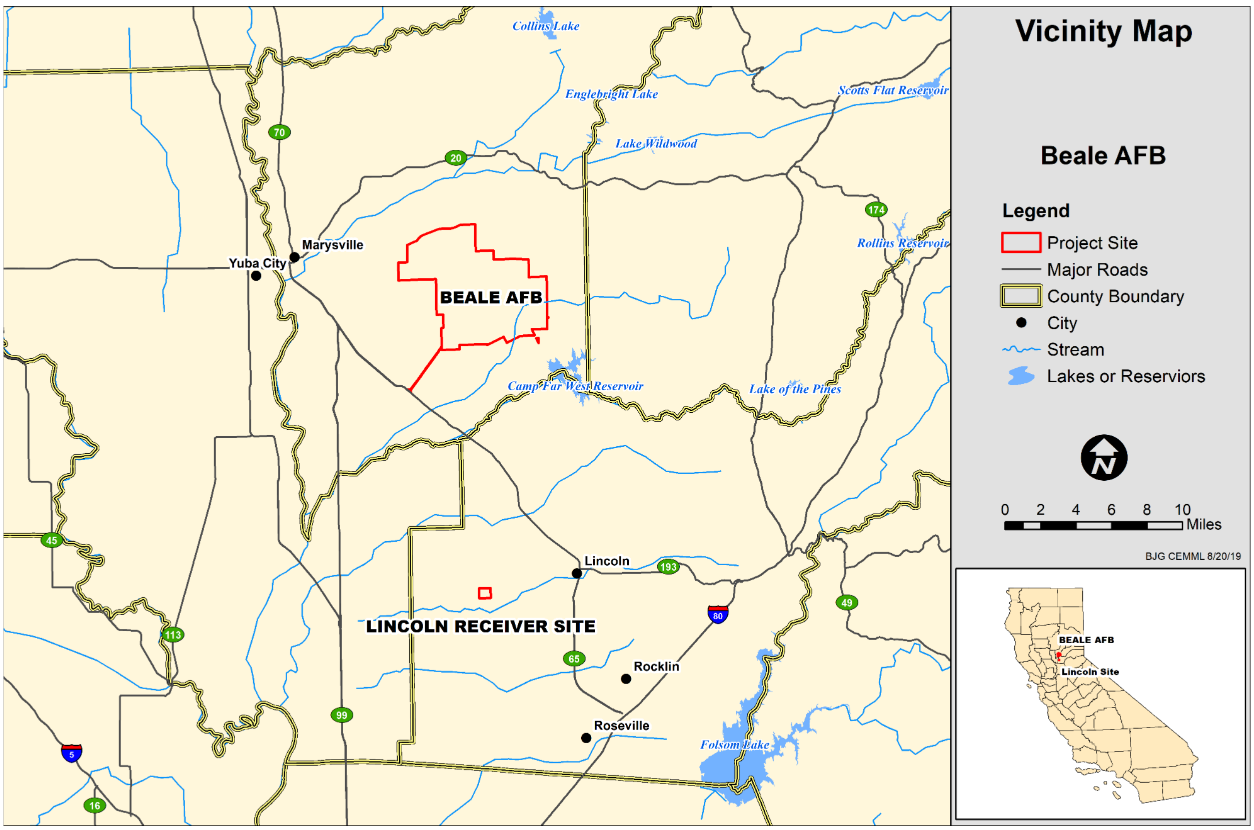

Figure 1. ***Location of Beale AFB and Lincoln Receiver Site.***

Dry Creek, Best Slough, Hutchinson Creek and Reeds Creek are WoUS that may be affected by the Proposed Action. Dry Creek enters the eastern side of the base from the adjacent Spenceville Wildlife Area (SWA) and is the main drainage for the eastern side of the Base. Surface runoff from the family housing area drains into Dry Creek via small tributaries. Dry Creek was impounded at its northern end on base, creating Beale Lake, but this was recently removed. There is a low-flow crossing blocking upstream fish passage 6 miles downstream of the base that is slated for removal when funding becomes available.

Possible sightings of salmonids (*Oncorhynchus mykiss* or *O. tshawytscha*) have been reported at Hutchinson Creek, and Reeds Creek located on Beale AFB. However, recent surveys assessing the habitat quality of sites, which targeted areas of anecdotal reports of salmonids, found that none of the habitats surveyed would be considered conducive to salmonid ecology (H.T. Harvey & Associates 2018). Hutchinson Creek is a shallow system with abundant riparian vegetation, a short (< 30 feet) riffle section and several stagnant pools. Likewise, when surveyed, Reeds Creek contained so little water that any fish present are unlikely to survive the summer temperatures. For both Hutchinson Creek, and Reeds Creek none of the evaluated stream reaches appeared capable of meeting the habitat needs of adult or juvenile anadromous salmonids.

Dry Creek, a tributary of the Bear River in the Feather River basin, has a 114.6 square miles watershed, with elevations ranging from 47 to 2,628 feet and a mean elevation of 809 feet (United States Geological Survey [USGS] Stream Stats). The mean annual precipitation for the Dry Creek basin is 31.6 inches. The upper portion of the Dry Creek watershed is mostly within the California Department of Fish and Wildlife's SWA. Dry Creek then flows through Beale AFB (between River Mile [RM] 12.4 and 16.1) and then flows through agricultural lands before entering the Bear River (Figure 2). Best Slough is a distributary of Dry Creek, with flow coming from Dry Creek at RM 14.3. Best Slough flows for 2.2 miles across Beale AFB, and then flows another 18 miles through agricultural lands before entering the Bear River downstream of the Dry Creek/Bear River confluence.

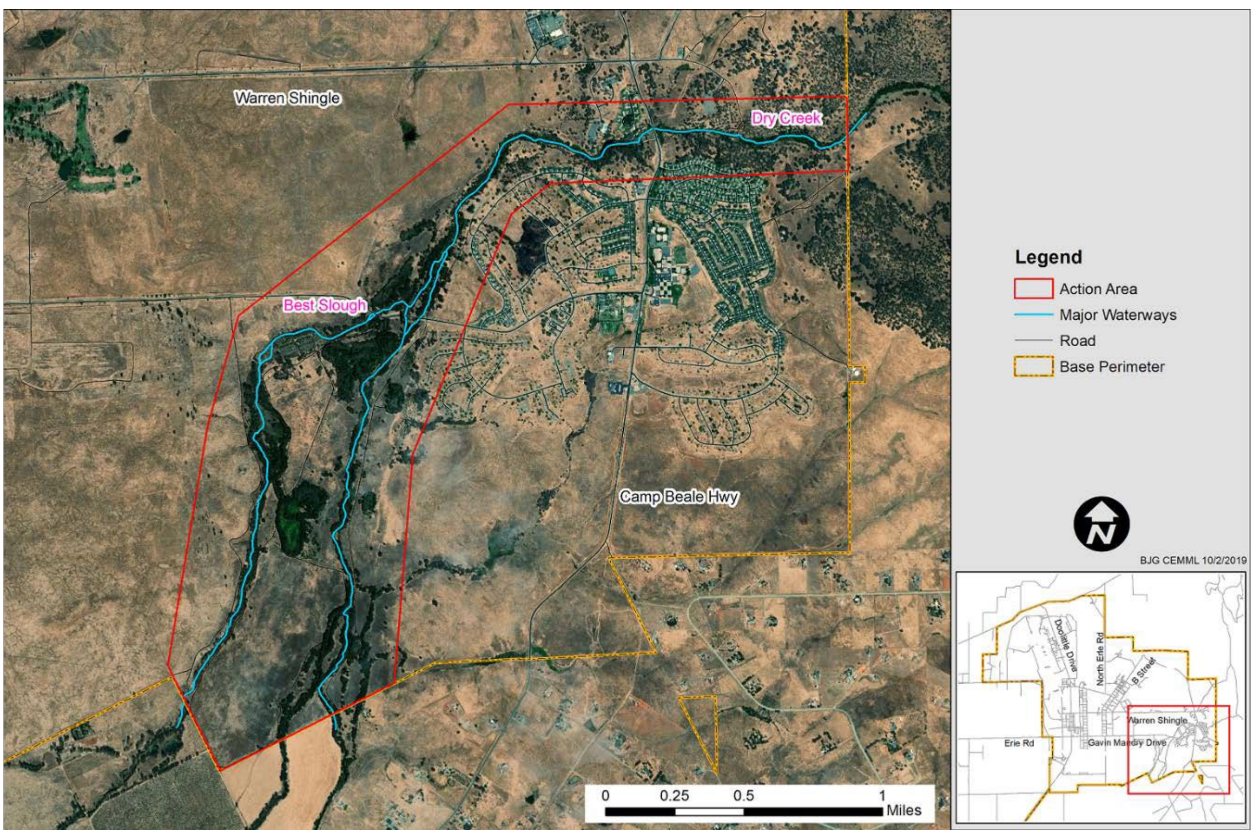

Figure 2. ***Dry Creek and Best Slough, where control of invasive plant species may occur in or adjacent to habitat suitable for listed salmonids.***

The only federally listed fish species occurring in the action area, and under NMFS jurisdiction, is the ESA listed as threatened (71 FR 834), California Central Valley steelhead Distinct Population Segment (DPS).

Background and Action Agency's Effects Determination

Beale AFB has determined that the Proposed Action may affect but is NLAA CCV steelhead, and may benefit the species, as it would remove invasive plants obstructing stream flow and improve riparian habitat. Beale AFB also concluded that the Proposed Action would have no adverse effect on EFH for Pacific Coast salmon. These conclusions were based on the approach to non-native and noxious plant species management on Beale AFB as described in the Beale AFB Plan, including AMMs and conservation measures, and the potential impacts related to the specific methods of invasive species control that were determined, by Beale AFB, to be avoided or minimized to an insignificant level. This included timing of activities (which coincides with least likely listed-fish presence), preconstruction surveys to further ensure no listed species are present, the restriction of activities allowed to occur in the riparian zone, and adherence to aquatic resource buffers thereby isolating potential impacts outside of the riparian zone.

ENDANGERED SPECIES ACT

Effects of the Action

Under the ESA, "effects of the action" are all consequences to listed species or critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 CFR 402.02). In our analysis, which describes the effects of the proposed action, we considered 50 CFR 402.17(a) and (b). When evaluating whether the proposed action is not likely to adversely affect listed species or critical habitat, NMFS considers whether the effects are expected to be completely beneficial, insignificant, or discountable. Completely beneficial effects are contemporaneous positive effects without any adverse effects to the species or critical habitat. Insignificant effects relate to the size of the impact and should never reach the scale where take occurs. Effects are considered discountable if they are extremely unlikely to occur.

The effects of the proposed action include:

The Proposed Action is first and foremost a plan to monitor, control and remove non-native and noxious plant species from Beale AFB. Actions taken as part of the plan are anticipated to provide a long-term benefit to CCV Steelhead through habitat improvement and the removal of invasive plant species that otherwise contribute to obstructed stream flow and a degraded quality of riparian habitat. The remediation of obstructed stream flow in the Dry Creek riparian corridor through the assessment and removal of invasive plant species contributes to accomplishing recovery action DRC-3.1 (*Conduct an anadromous fish passage assessment in Dry Creek and implement projects to fix any obstructions*) from the NMFS Central Valley anadromous fish recovery plan (NMFS 2014).

General invasive plant control activities conducted as part of the Proposed Action, would occur annually between May 2nd and October 31st, with the aquatic measures within Dry Creek and Best Slough, being further limited to the period between June 15th and October 31st. This work window is typically prior to the first seasonal rains, and outside the peak migration and spawning season for CCV steelhead. Adherence to the proposed work windows reduces the likelihood that NMFS trust species will be present in the Action Area at the same time as activities taken as part of the Proposed Action.

The Proposed Action, which would be implemented as part of the Beale AFB Plan would also include a suite of Avoidance and Minimization Measures that further reduce the likelihood of exposure and potential extent of impact caused by the Proposed Action. Specifically, the preconstruction surveys and the biological monitoring that would occur during the Proposed Action would limit the potential for exposure of species to the effects of the action, such that that exposure is unlikely. Likewise General AMMs that reduce the number or scale of activities that occur near sensitive habitats like the erosion control measures, the staging area restrictions and the removal/disposal of waste materials and invasive species reduce the potential for those activities to cause adverse effects. With the application of the AMMs included in the Proposed Action, any potential exposure to CCV steelhead within the Action Area would be reduced, such that they are expected to be insignificant.

Grazing

Grazing would not be conducted in the Dry Creek and Best Slough riparian corridor, such that adverse effects to CCV steelhead from grazing expansion under the Proposed Action would not be expected to occur. Furthermore, grazing activities occurring near the Dry Creek and Best Slough riparian corridor would be separated from those riparian habitats by use of fencing and a vegetative buffer to exclude both livestock and the potential impacts associated with grazing. Grazing impacts outside of the Dry Creek and Best Slough riparian corridor have the potential to change streambank and channel morphology, increase water temperatures, and impair water quality. Under the Proposed Action grazing may be permitted in other riparian and marsh habitats, and around lakes and ponds on Beale AFB, but these activities would be restricted to the Limited Operation Period, when CCV steelhead are least likely to be present. Furthermore, none of these were deemed suitable salmonid habitats, making CCV steelhead presence even less likely. Those few fish that may be exposed, would still be protected by the proposed AMMs, including the preconstruction surveys, erosion control measures and revegetation and success criteria, such that the potential impacts to CCV steelhead would be insignificant.

Prescribed Burns

Prescribed burns are not planned for the Dry Creek riparian corridor, and so it is unlikely to have a negative effect on CCV steelhead. Other streams on the base could be temporarily affected by fire due to increases in turbidity caused by runoff and erosion from nearby burned uplands, but they do not provide potential habitat for the CCV steelhead such that their presence during the Limited Operations Period would be highly unlikely. Furthermore the topography around Hutchinson and Reeds creeks is generally flat, so the potential for run-off would be limited. Also, if prescribed burns are conducted adjacent to any creek or water body a vegetated buffer would be maintained between it and the burn area to trap sediment and ash before it could enter the water course/body. A mowed, wet line, and/or blackline would be the primary type of controlled perimeter around any riparian or wetland habitat. Chemical fire retardants and mineral firebreaks would not be used during prescribed burns. In those streams adjacent to a prescribed burn, water temperatures could be affected if vegetation that provided pre-fire shade is removed however, prescribed fire would not be used to control woody biomass near waterbodies, so there is little risk of elevated water temperatures from a lack of shade as a result of prescribed burns. Given that prescribed burns would only be implemented outside of the Dry Creek riparian corridor and with the inclusion of the AMMs, the likelihood of prescribed burns affecting CCV steelhead is considered discountable. Lastly, the use of prescribed burns and the resulting reduction in wildfire fuel load in the Bear River watershed will contribute to achieving recovery action DRC-3.2 (*Enhance watershed resiliency in Dry Creek by identifying and implementing projects that would reduce the potential for, and magnitude of, a catastrophic wildfire, and restore forested areas within the watershed including riparian areas*) of the NMFS Central Valley anadromous fish recovery plan (NMFS 2014), resulting in long-term benefits.

Manual/Mechanical Treatments

Use of manual and mechanical treatments for the control of invasive plant species would result in a long-term benefit to CCV steelhead by improving native plant diversity and riparian ecosystem health. While these treatments could leave temporary areas of bare ground in the riparian area that could be susceptible to erosion, a vegetated buffer between the treatment area and any flowing water would be used to trap sediment. Also, if treatment is required directly adjacent to a waterway, the erosion control measures identified in the General AMMs would further reduce the magnitude or extent of effects such that they would be insignificant.

Restoration Treatments

Restoration treatments are expected to provide long-term beneficial effects on aquatic habitats and the species that reside therein. The proposed revegetation techniques and application of General AMMs would reduce the potential for storm water runoff to reach riparian habitats, reduce soil erosion, and reduce water sedimentation. With the application of the restoration treatments it is anticipated that the Proposed Action will not result in a loss of riparian vegetation or shaded riverine aquatic habitat. Furthermore, reliance on the restoration treatments in riparian habitats, and as opposed to other, less natural, methods of bank stabilization (*e.g.*, rip rap) is a direct application of recovery action DRC-3.11 (*Utilize biotechnical techniques that integrate riparian restoration for river bank stabilization instead of conventional rip rap in Dry Creek*) of the NMFS Central Valley anadromous fish recovery plan (NMFS 2014).

Chemical Treatments

The chemical treatment of non-native and noxious weeds at Beale AFB is expected to provide a long-term benefit to CCV steelhead by improving native plant diversity and riparian ecosystem health. Although the toxicity of individual herbicides to fish varies, the Proposed Action includes a number of AMMs that would greatly limit the potential to expose CCV steelhead to any herbicides. With the exception of giant reed control, aquatic resource buffers (Table 3) will be implemented during any herbicide application near riparian habitat to prevent water contamination and protect CCV steelhead and other aquatic species from exposure. Two "aquatic-safe" herbicide formulations are proposed for use (Rodeo/Roundup Custom and Garlon 3), which are considered "practically non-toxic" to "slightly toxic" to fish (Table 1). To avoid direct and indirect impacts to CCV steelhead from site access and chemical toxicity, giant reed would be treated according to the Limited Operations Period, described in the General AMMs (June 15 – October 31), when flows in Dry Creek are lowest, and CCV steelhead are not expected to be present.

In addition to the General AMMs, AMMs specific to herbicide application will be implemented to prevent water contamination and protect CCV steelhead from exposure. Herbicides would only be applied in accordance with the IPSMG; the Beale AFB IPMP; the USAF Pest Management Program; the Statewide NPDES Permit and Beale AFB APAP; all applicable federal, DoD, USAF, State of California, and local directives and regulations; and label instructions. Given the limited application of chemical treatments in the riparian environment, General AMMs and AMMs specific to herbicide application, the potential negative effects associated with any CCV steelhead exposure would be insignificant. Lastly, the pre- and post-project water quality monitoring that will be implemented as part of chemical treatments of invasive plant species, and as outlined in the AMMs specific to herbicide application will contribute to recovery action DRC-3.7 (*Increase monitoring and enforcement in Dry Creek to ensure that the water quality criteria established in the Central Valley Water Quality Control Plan (Basin Plan) are met for all potential pollutants*) of the NMFS Central Valley anadromous fish recovery plan (NMFS 2014).

Conclusion

Based on this analysis, NMFS concurs with Beale AFB that the Proposed Action is not likely to adversely affect the subject listed species.

Reinitiation of Consultation

Reinitiation of consultation is required and shall be requested by Beale AFB or by NMFS, where discretionary Federal involvement or control over the action has been retained or is authorized by law and (1) the proposed action causes take; (2) new information reveals effects of the action that may affect listed species or critical habitat in a manner or to an extent not previously considered; (3) the identified action is subsequently modified in a manner that causes an effect to the listed species or critical habitat that was not considered in the written concurrence; or (4) a new species is listed or critical habitat designated that may be affected by the identified action (50 CFR 402.16). This concludes the ESA consultation.

Please direct questions regarding this letter to Evan Sawyer at the NMFS California Central Valley Office, at evan.sawyer@noaa.gov or (916) 930-3656.

Sincerely,

Ellen Roots McBride
Sacramento River Basin Branch Chief

cc: To file No. 151422-WCR2020-SA00036

Ms. Tamara Gallentine, Beale AFB, *TAMARA.GALLENTINE.2@US.AF.MIL*

References:

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Statewide General NPDES Permit for Residual Aquatic Pesticide Discharges from Algae and Aquatic Weed Control Applications,

Notice of Applicability,

Notice of Intent,

and

Aquatic Pesticide Application Plan

for

Beale Air Force Base

State Water Resources Control Board

MAY 2 0 2019

Mr. Bruce Reinhardt
Beale Air Force Base
6425 B Street, Building 25390,
Beale Air Force Base, CA, 95903

NOTICE OF APPLICABILITY; BEALE AIR FORCE BASE;
STATEWIDE AQUATIC WEED CONTROL PERMIT

Dear Mr. Reinhardt:

Thank you for submitting the February 25, 2019 Beale Air Force Base application for regulatory coverage under the Statewide Aquatic Weed Control Permit[1]. The information submitted satisfies the requirements of the Aquatic Weed Control Permit. This Notice of Applicability for coverage under the Statewide Aquatic Weed Control Permit is hereby identified by the waste discharge identification number (WDID) 5A58AP00001. Permit coverage is effective as of the date of this letter.

The Aquatic Weed Control Permit regulates the discharges of algaecides and aquatic herbicides currently registered for use in California that contain the active ingredients listed below. Users of products containing these ingredients are required to obtain coverage under the Aquatic Weed Control Permit prior to application to waters of the United States.

- 2,4-D
- acrolein
- calcium hypochlorite
- copper
- diquat
- endothall
- flumioxazin
- fluridone
- triclopyr-based algaecides and aquatic herbicides
- hydrogen peroxide
- imazamox
- imazapyr
- penoxsulam
- peroxyacetic acid
- sodium carbonate peroxyhydrate
- sodium hypochlorite
- glyphosate
- adjuvants containing ingredients represented by the surrogate of nonylphenol

[1] Statewide General National Pollutant Discharge Elimination System (NPDES) Permit for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications, State Water Board Order 2013-0002-DWQ as amended (https://www.waterboards.ca.gov/board_decisions/adopted_orders/water_quality/2013/wqo2013_0002dwq.pdf).

Discharge Description

The Beale Air Force Base (Discharger) is located within the Dry Creek and Bear River watersheds in Yuba County. The Discharger is proposing to apply algaecides or aquatic herbicides alongside the banks and creek beds, and along drainage ditches flowing into Dry Creek and Reeds Creek. The aquatic pesticide applications are to prevent aquatic weeds and algae growth from obstructing water flow and flood control channels. The aquatic pesticides used may potentially discharge into Dry Creek and Reeds Creek.

The Discharger is proposing to use aquatic pesticide products with the active ingredients of glyphosate and imazapyr to target Giant Reed, Himalayan Blackberry and other invasive vegetations.

General Permit Requirements

To comply with the Aquatic Weed Control Permit, the Discharger shall:

a. Provide a copy of the Notice of Intent, Aquatic Pesticide Application Plan, and all other related materials to the aquatic pesticide applicators.

b. Ensure that all personnel and contractors applying aquatic pesticides under this Notice of Applicability understand and comply with the terms and conditions of the permit and the provisions of the Aquatic Pesticide Application Plan.

c. Take all necessary steps to minimize or prevent pesticide spills, pesticide residue contaminated water, and other pollutants from entering waters of the United States, which may violate the permit.

d. Review and update the effectiveness and adequacy of the control measures and best management practices (BMPs). Documentation of all changes to the BMPs, Aquatic Pesticide Application Plan, or other information on file with our office shall be submitted to the State Water Resources Control Board for review and comment.

e. Submit all information required in this Notice of Applicability to the following address:

   State Water Resources Control Board
   Division of Water Quality
   NPDES Wastewater Permitting Unit
   1001 I Street, 15th Floor
   Sacramento, CA 95814

Discharge Monitoring and Reporting Requirements

To comply with the monitoring and reporting requirements of the Aquatic Weed Control Permit, the Discharger shall:

a. Timely inspect the receiving waters, control measures and BMPs to detect any conditions which may cause violations of the receiving water limitations and other requirements in the Aquatic Weed Control Permit.

b. Conduct monitoring and reporting per the provisions and requirements in Attachment C of the Aquatic Weed Control Permit.

c. Include the following certification in all monitoring reports:

"I certify under penalty of law that this document and all enclosures were prepared under my direction or supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations."

Failure to comply with the requirements set forth in this Notice of Applicability and the Aquatic Weed Control Permit may result in an enforcement action as authorized by provisions in the California Water Code. Any discharges of waste other than those described in this Notice of Applicability are not authorized pursuant to the Aquatic Weed Control Permit.

If you have any questions regarding this Notice of Applicability or the Aquatic Weed Control Permit, please contact Gurgagn Chand at (916) 341-5780 or Gurgagn.Chand@waterboards.ca.gov.

Sincerely,

Karen Mogus

Karen Mogus, Deputy Director
Division of Water Quality

cc [via email]:

Pascal Mues, Environmental Engineer
NPDES Permits Office
U.S. EPA Region 9
Mues.Pascal@epa.gov

Charles Andrews, Associate Director
California Department of Pesticide Regulation
Chuck.Andrews@cdpr.ca.gov

Patrick Pulupa, Executive Officer
Central Valley Regional Water Quality Control Board
Patrick.Pulupa@waterboards.ca.gov

James Marshall, Supervising Water Resource Control Engineer
Central Valley Regional Water Quality Control Board
James.Marshall@waterboards.ca.gov

RECEIVED
FEB 25 2019
DIVISION OF WATER QUALITY

Attachment E – Notice of Intent

WATER QUALITY ORDER NO. 2013-0002-DWQ
GENERAL PERMIT NO. CAG990005

STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES) PERMIT FOR RESIDUAL AQUATIC PESTICIDE DISCHARGES TO WATERS OF THE UNITED STATES FROM ALGAE AND AQUATIC WEED CONTROL APPLICATIONS

I. NOTICE OF INTENT STATUS (see Instructions)

Mark only one item A. X New Applicator B. X Change of Information: WDID# 5A58AP00001

C. ☐ Change of ownership or responsibility: WDID# ____

II. DISCHARGER INFORMATION

A. Name Beale Air Force Base - 9 CES/CEIEC			
B. Mailing Address 6425 B st. Bldg. 25390			
C. City Beale AFB	D. County Yuba	E. State CA	F. Zip 95903
G. Contact Person Bruce Reinhardt	H. E-mail address bruce.reinhardt@us.af.mil	I. Title Stormwater Program Manager	J. Phone 530-634-4398

III. BILLING ADDRESS (Enter Information *only* if different from Section II above)

A. Name			
B. Mailing Address			
C. City	D. County	E. State	F. Zip
G. E-mail address	H. Title	I. Phone	

IV. RECEIVING WATER INFORMATION

A. Algaecide and aquatic herbicides are used to treat (check all that apply):

1. ☒ Canals, ditches, or other constructed conveyance facilities owned and controlled by Discharger.
   Name of the conveyance system: _Drainage ditches throughout Beale Air Force Base________
2. ☐ Canals, ditches, or other constructed conveyance facilities owned and controlled by an entity other than the Discharger.
   Owner's name:______________________________
   Name of the conveyance system: ______________________________
3. X Directly to river, lake, creek, stream, bay, ocean, etc.
   Name of water body: Dry Creek, Reeds Creek

B. Regional Water Quality Control Board(s) where treatment areas are located
(REGION 1, 2, 3, 4, 5, 6, 7, 8, or 9): Region 5
(List all regions where algaecide and aquatic herbicide application is proposed.)

V. ALGAECIDE AND AQUATIC HERBICIDE APPLICATION INFORMATION

A. Target Organisms:

Arundo donax (giant reed), Himalayan blackberry (Rubus armeniacus), other riparian weeds

B. Algaecide and Aquatic Herbicide Used: List Name and Active ingredients

Rodeo, Isopropylamine salt of glyphosate

Habitat, Isopropylamine salt of imazapyr

C. Period of Application: Start Date_April 1 (annually)________ End Date___October 31 (annually)____

D. Types of Adjuvants Used: Pro-tron (surfactant)

VI. AQUATIC PESTICIDE APPLICATION PLAN

Has an Aquatic Pesticide Application Plan been prepared and is the applicator familiar with its contents?
☒ Yes ☐ No

If not, when will it be prepared? ____________________

VII. NOTIFICATION

Have potentially affected public and governmental agencies been notified? ☐ Yes ☒ No

VIII. FEE

Have you included payment of the filing fee (for first-time enrollees only) with this submittal?
~~☒~~ YES ☐ NO ☒ NA

IX. CERTIFICATION

"I certify under penalty of law that this document and all attachments were prepared under my direction and supervision in accordance with a system designed to ensure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system, or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine or imprisonment. Additionally, I certify that the provisions of the General Permit, including developing and implementing a monitoring program, will be complied with."

A. Printed Name: Calvin Hendrix

B. Signature: [signature] **Date:** 7/21/2018

C. Title: Deputy Base Civil Engineer

XI. FOR STATE WATER BOARD STAFF USE ONLY

WDID:	**Date NOI Received:**	**Date NOI Processed:**
Case Handler's Initial:	**Fee Amount Received:** **$**	**Check #:**
☐ **Lyris List Notification of Posting of APAP**	**Date** ____________________	**Confirmation Sent** _______

AQUATIC PESTICIDE APPLICATION PLAN

Beale Air Force Base, CA

STATEWIDE GENERAL NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM PERMIT FOR THE DISCHARGE OF AQUATIC PESTICIDES FOR AQUATIC WEED CONTROL IN WATERS OF THE UNITED STATES
GENERAL PERMIT NO. CAG990005

WATER QUALITY ORDER NO. 2013-0002-DWQ

24 April 2018

Prepared for:

State Water Resources Control Board
Central Valley Water Quality Control Board (Region 5)

CERTIFICATION

In accordance with Attachment B, Section V.B.1. Standard Provisions – Reporting, Signatory and Certification Requirements, Water Quality Order No. 2013-0002-DWQ Statewide General National Pollutant Discharge Elimination System Permit for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications, General Permit No. CAG 990005:

"I certify under penalty of law that this document and all attachments were prepared under my direction or supervision in accordance with a system designed to assure that qualified personnel properly gather and evaluate the information submitted. Based on my inquiry of the person or persons who manage the system or those persons directly responsible for gathering the information, the information submitted is, to the best of my knowledge and belief, true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment for knowing violations." (40 C.F.R. 122.22(d).)

Calvin G. Hendrix
Deputy Base Civil Engineer

7/21/2018
Date

Introduction

Beale Air Force Base (Beale AFB) is located in northern California approximately 10 miles east of the towns of Marysville and Yuba City, and about 45 miles north of Sacramento (see Figure 1). Beale AFB is 23,000 acres of grassland and oak woodlands located at the eastern edge of the Sacramento Valley floor and the Sierra Foothills within the Dry Creek/Bear River Watersheds. The 9th Reconnaissance Wing is responsible for providing national and theater command authorities with timely, reliable, high-quality, high-altitude reconnaissance products. To accomplish this mission, the wing is equipped with the nation's fleet of U-2 and RQ-4 reconnaissance aircraft and associated support equipment. The wing also maintains a high state of readiness in its combat support and combat service support forces for potential deployment in response to theater contingencies. The 9th Reconnaissance Wing at Beale AFB is composed of more than 3,000 personnel in four groups at Beale AFB and multiple overseas operating locations.

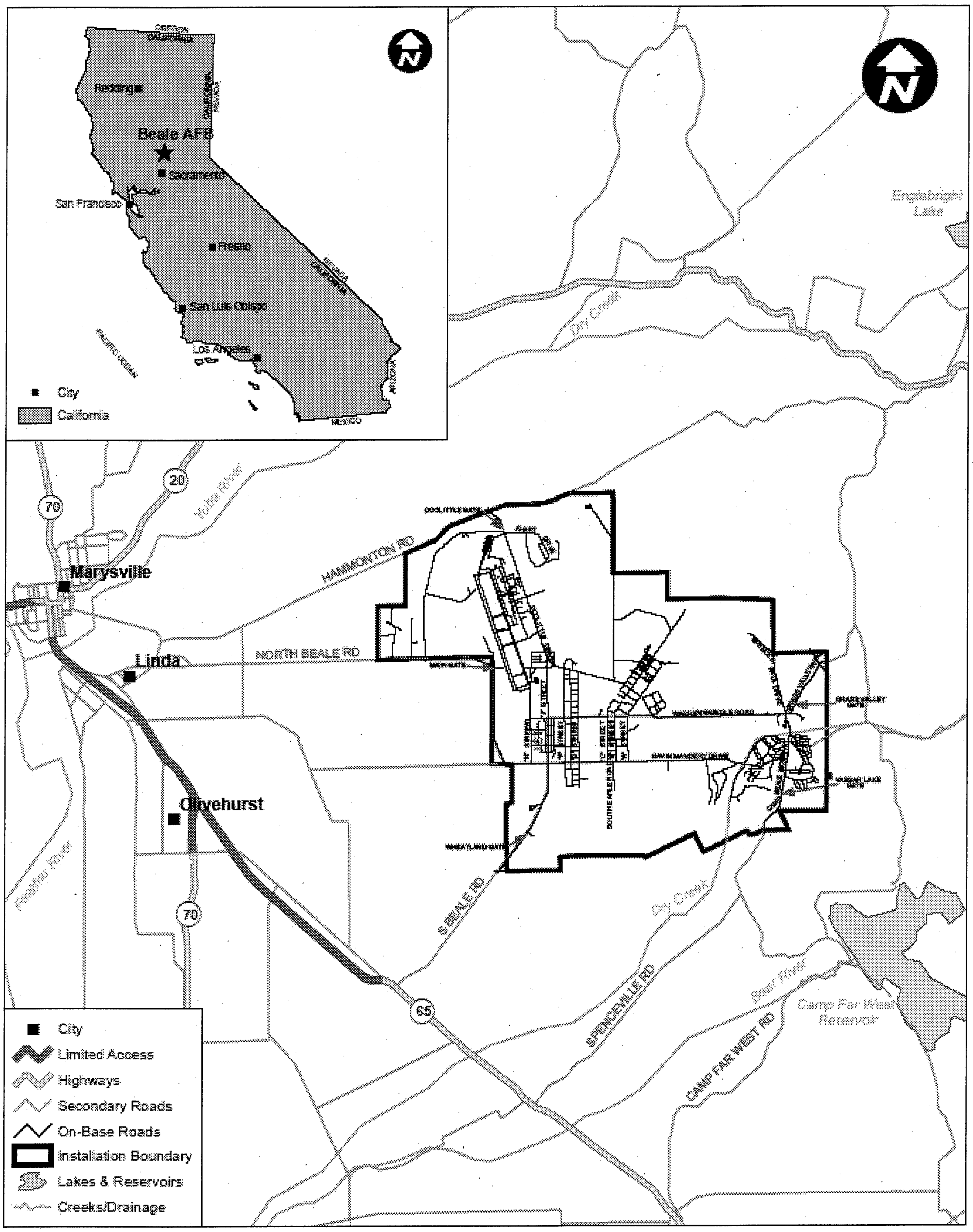
The 9th Civil Engineer Squadron (CES) is responsible for the management of weeds and other unwanted vegetation on Beale AFB. The 9th CES Environmental Section is required to control invasive weeds in order to promote native vegetation and wildlife, reduce fire fuel load, and improve pasture forage. The 9th CES Pest Management Section is required to control vegetation to support base mission requirements, including removing vegetation that impedes the flow of water, reduces stormwater or flood capacity, causes roads and other paths to become impassable, or causes a Bird Aircraft Strike Hazard (BASH) issue. A component of weed and vegetation management at Beale AFB is the responsible application of pesticides.

This Aquatic Pesticide Application Plan (APAP) is a comprehensive plan that describes three separate requirements for aquatic herbicide applications for the control of aquatic weeds on Beale AFB:

1. A project to control the invasive weed *Arundo donax L.*, or giant reed (referred to as "Arundo Project" throughout plan)
2. A mission-related requirement to control weeds and vegetation in waterways on an as needed basis (referred to as "Vegetation Control" throughout plan)
3. A mission-related requirement to control Himalayan blackberry near the flightline.

This plan will describe the applications, the need for the applications, best management practices to be implemented to reduce water quality impacts, and how those impacts will be monitored in accordance with Water Quality Order No. 2013-0002-DWQ.

Figure 1: Regional Location Map – Beale AFB



1. Description of the water system to which algaecides and aquatic herbicides are being applied;

1.1. Arundo Control

Herbicide applications for arundo control will be limited to Dry Creek, shown in Figure 2. Dry Creek is the sum of two perennial streams originating in the Sugarloaf Mountain and Pilot Peak watersheds. The creek is fed by intermittent streams as it flows westward through the Sierra Nevada foothills in eastern Yuba and western Nevada Counties. Dry Creek enters the eastern side of the base from the adjacent Spenceville Wildlife Area. The creek flows southwest and forks towards the southern edge of the base to create a western fork called Best Slough. After exiting the base, it flows southwest and meets the Bear River at Pleasant Grove Drive. Dry Creek flows year-round due to artificial water releases purchased from the Nevada (County) Irrigation District by CDFW.

1.2. Vegetation Control

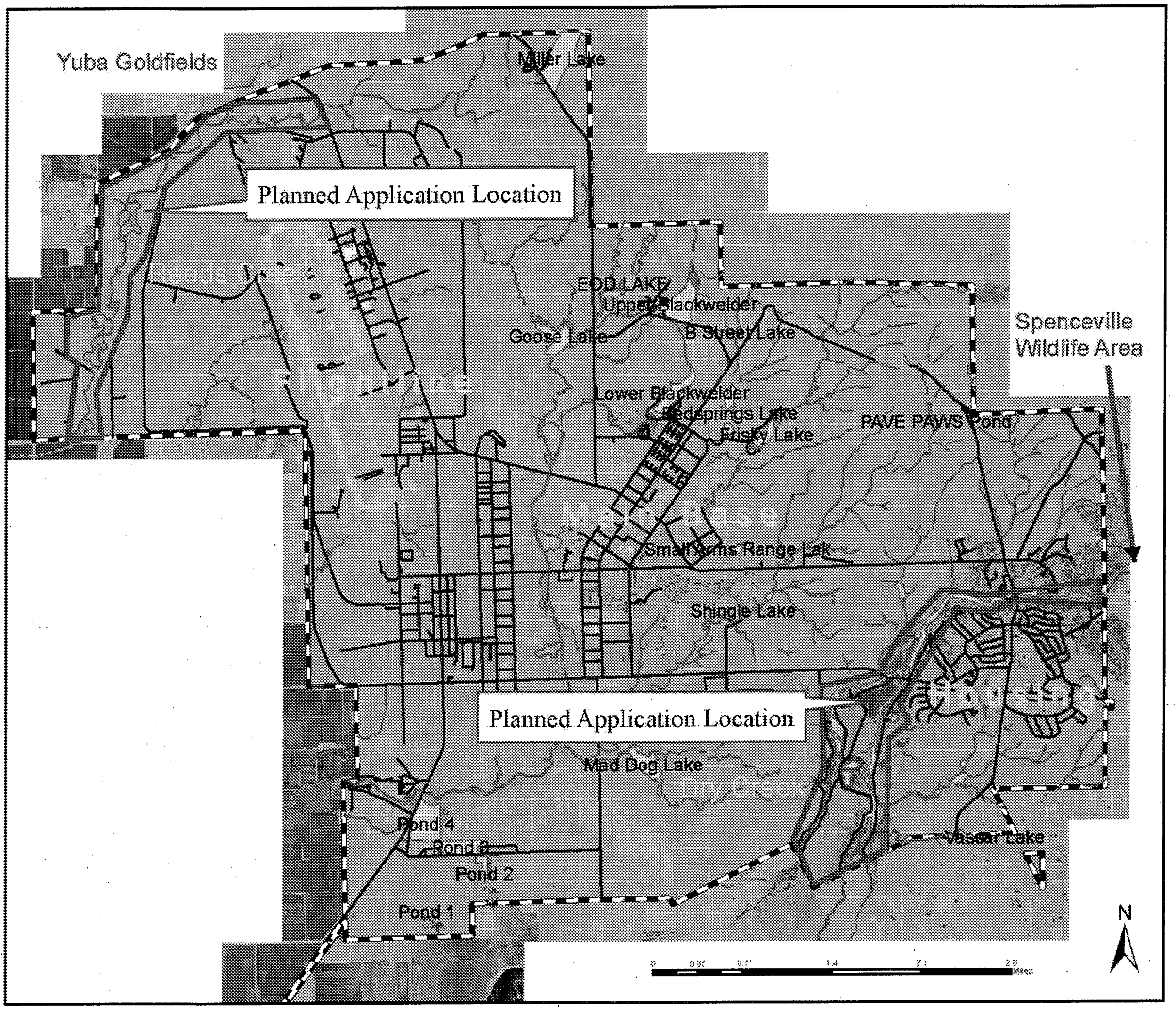
Applications for vegetation control are only performed on an as needed basis. Treatments are expected to happen along Dry Creek and Reeds Creek as shown in Figure 2. Dry Creek is described above in section 1.1. Reeds Creek is a seasonal stream fed by water released from Miller Lake, drainages around the flightline, and a discharge canal fed by groundwater pumping discharges from the adjacent Yuba Goldfields operation. Reeds Creek enters the base at its northwestern boundary and flows southwest along its northern border before turning south. Reeds creeks drains into Plumas Lake, southwest of the base.

Other exact locations and the specific water systems to be treated are unknown at this time. Applications could potentially be made to drainage ditches, creek beds and banks throughout the base where infestations of invasive weeds could interfere with mission requirements.

1.3. Himalayan Blackberry Control

Himalayan blackberry control will be conducted along Reeds Creek, shown in Figure 2. Reeds Creek is described above in section 1.2.

Figure 2: Facility Map and Planned Application Locations



2. Description of the treatment area in the water system;

2.1. Arundo Project

The application areas are a stretch of Dry Creek south of Gavin Mandery that has multiple small infestations in and along the banks of the waterway and a single infestation where Dry Creek enters the base form the Spenceville Wildlife Area. Planned treatment areas are shown in Figure 3. The total application area will be 0.5-1.0 acre.

Plants will be manually cut and removed from the site. Following manual removal an aquatic herbicide will be applied to the cut stumps or subsequent regrowth will be sprayed with an aquatic herbicide. The herbicide will not be applied directly to any flowing or non-flowing water.

2.2. Vegetation Control

Applications for vegetation control are only performed on an as needed basis. Treatments are expected to happen in Reeds Creek. Other exact locations and the specific water systems to be treated are unknown at this time. Applications could potentially be made to drainage ditches, creek beds and banks throughout the base where invasive weed infestations may interfere with mission requirements or adversely impact water flow. The planned treatment location along Reeds Creek is shown in Figure 4. Infestations will be sprayed with aquatic herbicide. Herbicides will never be applied directly to any flowing water.

2.3. Himalayan Blackberry Control

The application areas are along Reeds Creek west of the flightline, shown in Figure 4. Approximately 15 acres of Himalayan blackberry will be treated in this area. This acreage includes infestations that are not directly adjacent to Reeds Creek. Aquatic herbicide will be applied to in August or September. At this time of year water levels in Reeds Creek are low, or water is no longer flowing. Herbicides will never be applied directly to any flowing water.

Figure 3. Planned Application Locations along Dry Creek

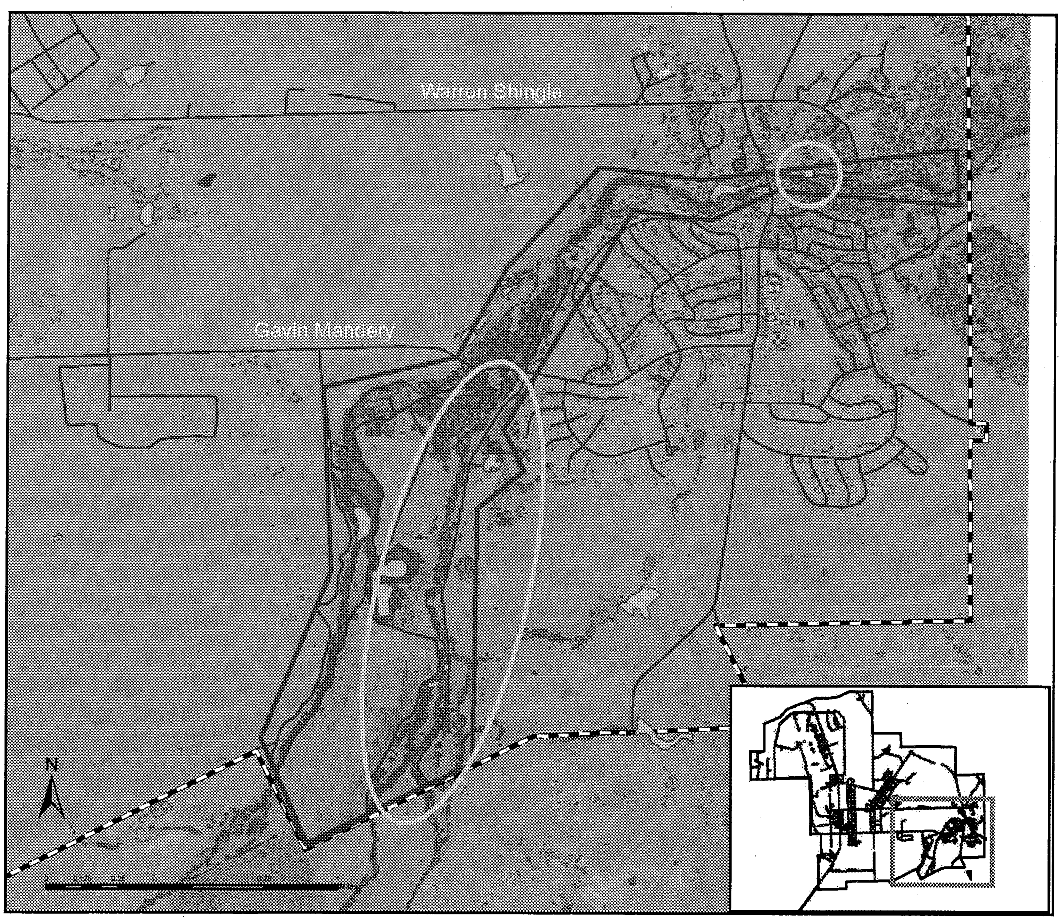
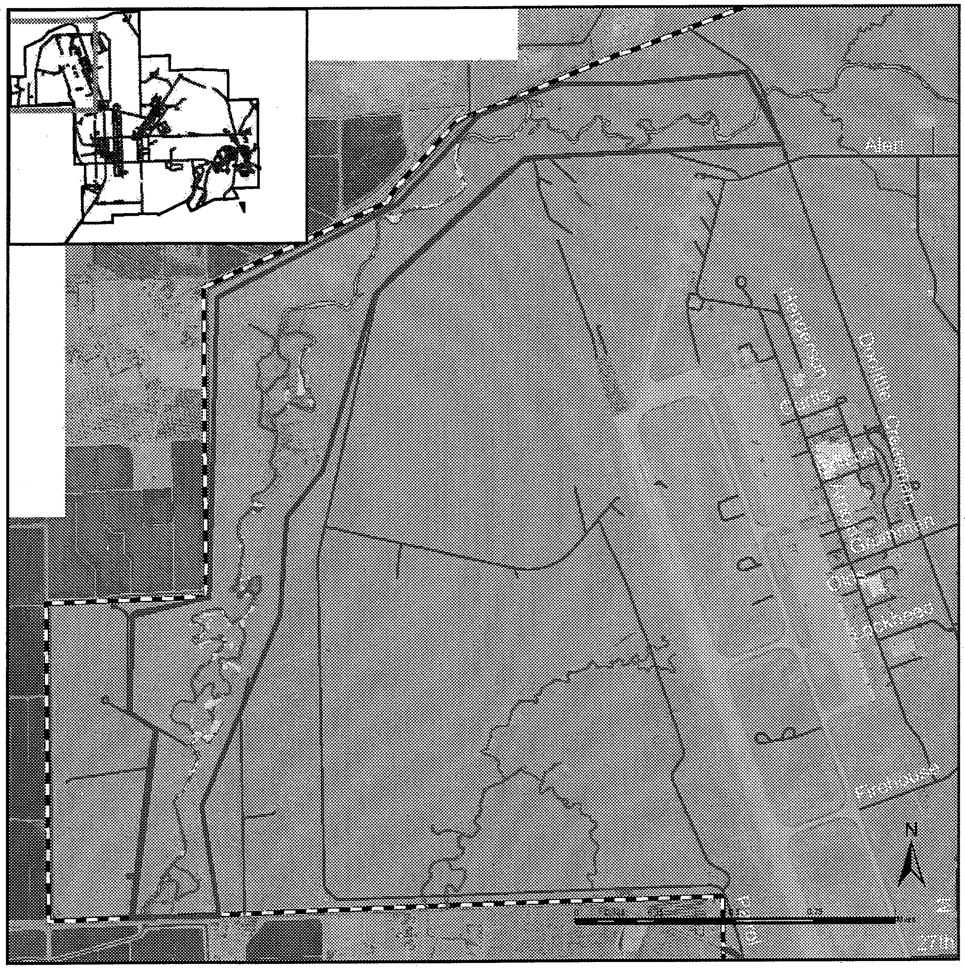


Figure 4. Planned Application Locations along Reeds Creek



3. Description of types of weed(s) and algae that are being controlled and why;

3.1. Arundo Project

Arundo donax L., or Giant Reed. This weed is an invasive species that is blocking upstream passage for special-status anadromous fish.

3.2. Vegetation Control

Vegetation that may be controlled includes Himalayan blackberry and other invasive terrestrial weeds, aquatic weeds and willows. Vegetation control in ditches, creeks, or other waterways will be accomplished on an as needed basis to meet mission requirements, and may include the removal of vegetation that impedes the flow of water, causes roads and other paths to become impassable, or causes a Bird/Wildlife Aircraft Strike Hazard (BASH) concern.

3.3. Himalayan Blackberry Control

Himalayan blackberry infestations west of the flightline create potential bird nesting habitat, which in turn creates a Bird/Wildlife Aircraft Strike Hazard (BASH) concern.

4. Algaecide and aquatic herbicide products or types of algaecides and aquatic herbicides expected to be used and if known their degradation byproducts, the method in which they are applied, and if applicable, the adjuvants and surfactants used;

4.1. Arundo Project

An aquatic approved formulation of Glyphosate such as AquaMaster or Rodeo combined with an approved formulation of Imazapyr such as Habitat will be used.

Active Ingredients: Isopropylamine salt of glyphosate and Isopropylamine salt of Imazapyr, there are no known degradation byproducts.

Applications will be done according to label instructions by DoD or state certified pesticide applicators. Foliar applications will be done with a pressurized hydraulic sprayer and/or by hand with small pressurized 1-4 gallon sprayers. Cut-stump application will be done by spraying a dilute solution directly onto the cut stumps using a low volume back pack sprayer.

The herbicides will be mixed with the aquatic approved non-ionic surfactant Pro-tron. No additional adjuvants will be used.

4.2. Vegetation Control

An aquatic approved formulation of Glyphosate such as AquaMaster or Rodeo will be used.

Active Ingredient: Isopropylamine salt of glyphosate, there are no known degradation byproducts.

Applications will be done according to label instructions and applied by DoD or state certified pesticide applicators. Applications will be done with a pressurized hydraulic sprayer and/or by hand with small pressurized 1-4 gallon sprayers.

Herbicides may be mixed with an aquatic approved non-ionic surfactant such as Pro-tron. No additional adjuvants will be used.

4.3. Himalayan Blackberry Control

An aquatic approved formulation of Glyphosate such as AquaMaster or Rodeo will be used.

Active Ingredient: Isopropylamine salt of glyphosate, there are no known degradation byproducts.

Applications will be done according to label instructions by DoD or state certified pesticide applicators. Applications will be done with a pressurized hydraulic sprayer and/or by hand with small pressurized 1-4 gallon sprayers.

Herbicides may be mixed with an aquatic approved non-ionic surfactant such as Pro-tron. No additional adjuvants will be used.

5. Discussion of the factors influencing the decision to select algaecide and aquatic herbicide applications for algae and weed control;

5.1. Arundo Project

No growth of this weed can be allowed. Even small stands of Arundo should be removed due to its invasive nature. Aquatic herbicide application is the preferred control method for this weed because of its invasive nature. Limiting the control method to mechanical means is not possible because this technique would disturb the streambed in an environmentally-sensitive area and would likely spread viable shoots downstream, further spreading the invasive weed. Herbicide will be applied directly to cut stumps of canes or to re-sprouts from cut cane stumps.

5.2. Vegetation Control

Vegetation control in ditches, creeks, or other waterways will be accomplished on an as needed basis according to mission requirements, and can include the removal of vegetation that impedes the flow of water, causes roads and other paths to become impassable, and may cause a BASH concern. Nonchemical control efforts, specifically mechanical removal and mowing, will be used to the maximum extent possible to control vegetation before applying herbicides. However, removal of vegetation in drainages, creeks, or other waterways by mechanical means has limitations in certain cases, such as the inability for heavy equipment to access some locations. Aquatic herbicides will be applied by backpack sprayer in these locations, which eliminates the need for equipment to travel through wetlands and vernal pools. Aquatic herbicide will be used because infestations are along the banks of a stream channel. Aquatic herbicides will never be applied directly to any flowing water.

5.3. Himalayan Blackberry Control

Control of this species is needed west of the flightline to reduce the potential for creating a BASH concern. Himalayan blackberry in this area was initially removed as an emergency activity due to birds using it as nesting habitat. Continued control of this species is required to protect human safety and reduce the need for take of migratory birds posing a BASH. Blackberry in this area was initially removed using mechanical methods. Aquatic herbicide will be used to spray re-sprouts and plants in areas that are not accessible to machinery. Aquatic herbicides will be applied by backpack sprayer in these locations, which eliminates the need for equipment to travel through wetlands and vernal pools. Aquatic herbicide will be used because infestations are along the banks of a stream channel. Aquatic herbicides will never be applied directly to any flowing water.

6. If applicable, list the gates or control structures to be used to control the extent of receiving waters potentially affected by algaecide and aquatic herbicide application and provide an inspection schedule of those gates or control structures to ensure they are not leaking;

6.1. Arundo Project - N/A

6.2. Vegetation Control - N/A

6.3. Himalayan Blackberry Control - N/A

7. If the Discharger has been granted a short-term or seasonal exception under State Water Board *Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bays,* and Estuaries of California* (Policy) section 5.3 from meeting acrolein and copper receiving water limitations, provide the beginning and ending dates of the exception period, and justification for the needed time for the exception. If algaecide and aquatic herbicide applications occur outside of the exception period, describe plans to ensure that receiving water criteria are not exceeded because the Dischargers must comply with the acrolein and copper receiving water limitations for all applications that occur outside of the exception period;

7.1. Arundo Project – N/A

7.2. Vegetation Control – N/A

7.3. Himalayan Blackberry Control – N/A

8. Description of monitoring program

8.1. Arundo Project

Beale AFB will monitor the use of glyphosate in compliance with Attachment C of the General Permit. All laboratory analyses will be conducted at a laboratory certified by the California Department of Public Health in accordance with California Water Code section 13176. All analyses shall be conducted in accordance with the EPA's "Guidelines Establishing Test Procedures for Analysis of Pollutants."

Visual monitoring of the aquatic herbicide applications will be accomplished for all applications at all sites using the template in Figure 4.

Because the active ingredient of the aquatic herbicide used for vegetation control is glyphosate, physical and chemical monitoring will be conducted for one application event. Background samples will be collected upstream at the time of the application event. Since aquatic herbicides will never be applied to flowing waters, event monitoring samples will be collected immediately outside of the treatment area in non-flowing waters, immediately after the application event, but after sufficient time has elapsed such that treated water would have exited the treatment area. Post-Event samples will be collected within the treatment area within one week after the application event.

Monitoring procedures for physical and chemical properties will follow the following table:

Sample Type	Constituent / Parameter	Sample Method	Sample Type Requirement
Physical	1. Temperature[1] 2. pH[1] 3. Turbidity[1] 4. Electrical conductivity[1]	Grab 3' Below Surface or Mid-depth if Water Body is < 6'	Background, Event and Post Event Monitoring
Chemical	1. Active Ingredient - Imazapyr[2] 2. Dissolved Oxygen[1]	Grab 3' Below Surface or Mid-depth if Water Body is < 6'	Background, Event and Post Event Monitoring

[1] Field Testing
[2] Laboratory Testing

An annual report detailing all required information, as outlined in Attachment C of the General Permit, will be submitted to the state and regional Water Quality Control Board.

8.2. Vegetation Control

Beale AFB will use the same monitoring protocol as that outlined in section 8.1 for this activity.

8.3 Himalayan Blackberry Control

Beale AFB will use the same monitoring protocol as that outlined in section 8.1 for this activity.

Figure 4: Beale AFB Pesticide Usage and Visual Monitoring Log

Beale AFB Pesticide Usage and Visual Monitoring Log

Name: ______________________________ Date: ______________________________

Event type: ___Background ___Event ___Post-Event

Location (Address, crossroads, map coordinates, etc.): ____

Water body being treated (Canal, creek, lake, etc.): ____

Was the 9 CES/CEIE Natural Resources Manager consulted before application? ___ Yes ___ No

9 CES/CEIE Comments: ____

Pesticide details (include brand name, active ingredient w/ % concentration): ____________________

____

Amount of pesticide applied: ____

Describe application techniques and/or procedures: ____

____

Describe the reasoning for this application event: ____

____

Visual Monitoring Results

Appearance of Waterway

Flow rate of the target area = ___________________________

Surface area of water being treated = ___________________________

Volume of water being treated = ______________________________

Describe the appearance of waterway (sheen, color, clarity, etc.) = ______________________________

Weather Conditions

Temperature = ________°F

Wind Speed = _________

Date of last rain event: ___________________

Is a rain event projected in the next 12 hours? ______ Yes ______ No

I certify that this pesticide application event followed all guidelines and BMPs described in the Beale AFB Aquatic Pesticide Application Plan.

____ ____________________

Signature Date

9. Description of procedures used to prevent sample contamination from persons, equipment, and vehicles associated with algaecide and aquatic herbicide application;

9.1. Arundo Project

All samples will be collected in clean, amber glass bottles and properly labeled, including the date and time the sample is collected. Proper personal protective equipment will be worn, including disposable nitrile gloves, to prevent contamination. Samples will be collected without interference from any equipment or vehicles. Samples will be accounted for utilizing a standard "Chain of Custody" form supplied by the laboratory performing the analysis to ensure the integrity of the sample collection and transfer process. Samples will be stored on ice and transported to the lab within appropriate hold times for the required tests. Samples will be transported separately from the aquatic herbicides and application equipment on the day of the application event.

9.2. Vegetation Control

The same procedures outlined in section 9.1 will be used for this activity.

9.3. Himalayan Blackberry Control

The same procedures outlined in section 9.1 will be used for this activity.

10. Description of the BMPs to be implemented. The BMPs shall include, at the minimum:

10.1. Arundo Project

10.1.a. Measures to prevent algaecide and aquatic herbicide spill and for spill containment during the event of a spill;

All applications will be performed by DoD or state certified pesticide applicators. All personnel will follow the storage, mixing, transport, application, and spill response procedures per USEPA and DPR rules, regulations and label instructions. Aquatic herbicide applicators ensure daily that application equipment is in proper working order. Aquatic herbicides are stored inside. Spill response and cleanup supplies are maintained in all vehicles and pesticide storage areas.

All personnel responsible for handling, mixing, or applying pesticides must complete Beale's Spill Prevention, Control, and Countermeasures training annually. Beale has a comprehensive program for the identification, response, and control of hazardous materials spills, with personnel on stand-by to respond to any releases of hazmat, including pesticides, to the environment. Any contaminated media (water or soil) will be contained and cleaned or properly disposed of to the maximum extent possible. Beale personnel will report all spills to appropriate local, state, and federal agencies according to applicable regulations.

10.1.b. Measures to ensure that only an appropriate rate of application consistent with product label requirements is applied for the targeted weeds or algae;

All applications will be performed by DoD or state certified pesticide applicators. Over application will be avoided by following the specific product labels for the aquatic herbicide used. Only sufficient material to carry out the treatment will be transported for the day's application.

To ensure it functions properly, application equipment is calibrated at least annually unless herbicide label instructions require a more frequent calibration.

10.1.c. The Discharger's plan in educating its staff and algaecide and aquatic herbicide applicators on how to avoid any potential adverse effects from the algaecide and aquatic herbicide applications;

All aquatic herbicide applicators will possess DoD or state certification for applying pesticides and be trained to follow the storage, mixing, transport, application, and spill response procedures per USEPA and DPR rules, regulations and label instructions. Aquatic herbicide applicators will complete the Beale Spill Prevention, Control, and Countermeasures training annually. Beale AFB Environmental Section will train all personnel applying herbicides and pesticides on the Water Quality Order No. 2013-0002-DWQ State General Permit and the requirements of this APAP annually.

10.1.d. Discussion on planning and coordination with nearby farmers and agencies with water rights diversion so that beneficial uses of the water (irrigation, drinking water supply, domestic stock water, etc.) are not impacted during the treatment period;

Aquatic herbicide applications for treatment of Arundo at Beale AFB are not expected to impact any beneficial uses of water. Aquatic herbicides will never be applied directly to flowing water. Aquatic herbicide applications are only allowed from May 1 to October 1 to avoid the local wet season. In addition, aquatic herbicides will not be applied during any wet weather or 12 hours before or after a rain event. Aquatic herbicides will only be applied when winds are less than 5 mph.

10.1.e. A description of measures that will be used for preventing fish kill when algaecides and aquatic herbicides will be used for algae and aquatic weed controls.

Aquatic herbicide applications at Beale AFB are not expected to have any potential for fish kill. Several measures will be taken to limit the impact of the herbicides in water. Aquatic herbicides will never be applied directly to flowing water. Aquatic herbicide applications are only allowed from May 1 to October 1 to avoid the local wet season. In addition, aquatic herbicides will not be applied during any wet weather or 12 hours before or after a rain event. Aquatic herbicides will only be applied when winds are less than 5 mph.

Applications will be done according to the label instructions by DoD or a state certified pesticide applicators. Applications will be done with a pressurized hydraulic sprayer and/or by hand with small pressurized 1-4 gallon sprayers to prevent over application and excess herbicide runoff downstream.

10.2. Vegetation Control

10.2.a. Measures to prevent algaecide and aquatic herbicide spill and for spill containment during the event of a spill;

All applications will be performed by DoD or state certified pesticide applicators. All personnel will follow the storage, mixing, transport, application, and spill response procedures per USEPA and DPR rules, regulations and label instructions. Aquatic herbicide applicators ensure daily that application equipment is in proper working order. Aquatic herbicides are stored inside. Spill response and cleanup supplies are maintained in all vehicles and pesticide storage areas. Spill response plans are posted in the office area, breezeway and chemical mixing area.

All personnel responsible for handling, mixing, or applying pesticides must complete Beale's Spill Prevention, Control, and Countermeasures training annually. Beale has a comprehensive program for the identification, response, and control of hazardous materials spills, with personnel on stand-by to respond to any releases of hazmat, including pesticides, to the environment. Any contaminated media (water or soil) will be contained and cleaned or properly disposed of to the maximum extent possible. Beale personnel will report all spills to appropriate local, state, and federal agencies according to applicable regulations.

10.2.b. Measures to ensure that only an appropriate rate of application consistent with product label requirements is applied for the targeted weeds or algae;

All applications will be performed by DoD or state certified pesticide applicators. Over application will be avoided by following the specific product labels for the aquatic herbicide used. Only sufficient material to carry out the treatment will be transported for the day's application.

To ensure it functions properly, application equipment is calibrated at least annually unless herbicide label instructions require a more frequent calibration.

10.2.c. The Discharger's plan in educating its staff and algaecide and aquatic herbicide applicators on how to avoid any potential adverse effects* from the algaecide and aquatic herbicide applications;

All aquatic herbicide applicators will possess DoD or state certification for applying pesticides and be trained to follow the storage, mixing, transport, application, and spill response procedures per USEPA and DPR rules, regulations and label instructions. Aquatic herbicide applicators will complete the Beale Spill Prevention, Control, and Countermeasures training annually. Beale AFB Environmental Section will train all personnel applying herbicides and pesticides on the

Water Quality Order No. 2013-0002-DWQ State General Permit and the requirements of this APAP annually.

10.2.d. Discussion on planning and coordination with nearby farmers and agencies with water rights diversion so that beneficial uses of the water (irrigation, drinking water supply, domestic stock water, etc.) are not impacted during the treatment period;

Aquatic herbicide applications for vegetation control at Beale AFB are not expected to impact any beneficial uses of water. Aquatic herbicides will never be applied directly to flowing water. Aquatic herbicide applications are only allowed from May 1 to October 1 to avoid the local wet season. In addition, aquatic herbicides will not be applied during any wet weather or 12 hours before or after a rain event. Aquatic herbicides will only be applied when winds are less than 5 mph.

10.2.e. A description of measures that will be used for preventing fish kill when algaecides and aquatic herbicides will be used for algae and aquatic weed controls.

Aquatic herbicide applications for vegetation control at Beale AFB are not expected to have any potential for fish kill. Several measures will be taken to limit the impact of the herbicides in water. Aquatic herbicides will never be applied directly to flowing water. Aquatic herbicide applications are only allowed from May 1 to October 1 to avoid the local wet season. In addition, aquatic herbicides will not be applied during any wet weather or 12 hours before or after a rain event. Aquatic herbicides will only be applied when winds are less than 5 mph.

Applications will be done according to the label instructions by DoD or state certified pesticide applicator. Applications will be done with a pressurized hydraulic sprayer and/or by hand with small pressurized 1-4 gallon sprayers to prevent over application and excess herbicide runoff downstream.

10.3 Himalayan Blackberry Control

10.3.a. Measures to prevent algaecide and aquatic herbicide spill and for spill containment during the event of a spill;

All applications will be performed by DoD or state certified pesticide applicators. All personnel will follow the storage, mixing, transport, application, and spill response procedures per USEPA and DPR rules, regulations and label instructions. Aquatic herbicide applicators ensure daily that application equipment is in proper working order. Aquatic herbicides are stored inside. Spill response and cleanup supplies are maintained in all vehicles and pesticide storage areas.

All personnel responsible for handling, mixing, or applying pesticides must complete Beale's Spill Prevention, Control, and Countermeasures training annually. Beale has a comprehensive program for the identification, response, and control of hazardous materials spills, with personnel on stand-by to respond to any releases of hazmat, including pesticides, to the environment. Any contaminated media (water or soil) will be contained and cleaned or properly disposed of to the maximum extent possible. Beale personnel will report all spills to appropriate local, state, and federal agencies according to applicable regulations.

10.3.b. Measures to ensure that only an appropriate rate of application consistent with product label requirements is applied for the targeted weeds or algae;

All applications will be performed by DoD or state certified pesticide applicators. Over application will be avoided by following the specific product labels for the aquatic herbicide used. Only sufficient material to carry out the treatment will be transported for the day's application.

To ensure it functions properly, application equipment is calibrated at least annually unless herbicide label instructions require a more frequent calibration.

10.3.c. The Discharger's plan in educating its staff and algaecide and aquatic herbicide applicators on how to avoid any potential adverse effects from the algaecide and aquatic herbicide applications;

All aquatic herbicide applicators will possess DoD or state certification for applying pesticides and be trained to follow the storage, mixing, transport, application, and spill response procedures per USEPA and DPR rules, regulations and label instructions. Aquatic herbicide applicators will complete the Beale Spill Prevention, Control, and Countermeasures training annually. Beale AFB Environmental Section will train all personnel applying herbicides and pesticides on the Water Quality Order No. 2013-0002-DWQ State General Permit and the requirements of this APAP annually.

10.3.d. Discussion on planning and coordination with nearby farmers and agencies with water rights diversion so that beneficial uses of the water (irrigation, drinking water supply, domestic stock water, etc.) are not impacted during the treatment period;

Aquatic herbicide applications for treatment of Himalayan blackberry at Beale AFB are not expected to impact any beneficial uses of water. Aquatic herbicides will never be applied directly to flowing water. Aquatic herbicide applications are only allowed from May 1 to October 1 to avoid the local wet season. In addition, aquatic herbicides will not be applied during any wet weather or 12 hours before or after a rain event. Aquatic herbicides will only be applied when winds are less than 5 mph.

10.3.e. A description of measures that will be used for preventing fish kill when algaecides and aquatic herbicides will be used for algae and aquatic weed controls.

Aquatic herbicide applications at Beale AFB are not expected to have any potential for fish kill. Several measures will be taken to limit the impact of the herbicides in water. Aquatic herbicides will never be applied directly to flowing water. Aquatic herbicide applications are only allowed from May 1 to October 1 to avoid the local wet season. In addition, aquatic herbicides will not be applied during any wet weather or 12 hours before or after a rain event. Aquatic herbicides will only be applied when winds are less than 5 mph.

Applications will be done according to the label instructions by DoD or a state certified pesticide applicators. Applications will be done with a pressurized hydraulic sprayer and/or by hand with small pressurized 1-4 gallon sprayers to prevent over application and excess herbicide runoff downstream.

11. Examination of Possible Alternatives. Dischargers should examine the alternatives to algaecide and aquatic herbicide use to reduce the need for applying algaecides and herbicides. Such methods include:

11.1 Arundo Project

11.1.a. Evaluating the following management options, in which the impact to water quality, impact to non-target organisms including plants, algaecide and aquatic herbicide resistance, feasibility, and cost effectiveness should be considered:

11.1.a.i. No action;

Arundo (Giant Reed) is an invasive species that is impacting fish passage on a stream that is habitat for special-status anadromous fish. No action will continue to allow the weed to spread and negatively impact special-status fish species.

11.1.a.ii. Prevention;

Arundo's invasive nature makes prevention very difficult. The canes cut down during vegetation removal will be collected and disposed of properly off base at a landfill to prevent them from spreading further.

11.1.a.iii. Mechanical or physical methods;

The alternative method of mechanical control was considered but is not possible because this method would disturb the streambed in an environmentally-sensitive area and would likely spread viable shoots downstream, further spreading the invasive weed.

11.1.a.iv. Cultural methods;

There are no cultural control methods to remove Arundo.

11.1.a.v. Biological control agents; and

There are no biological control agents to remove Arundo.

11.1.a.vi. Algaecides and aquatic herbicides;

If there are no alternatives to algaecides and aquatic herbicides, Dischargers shall use the minimum amount of algaecides and aquatic herbicides that is necessary to have an effective control program and is consistent with the algaecide and aquatic herbicide product label requirements.

Sites potentially requiring aquatic herbicide treatment will be surveyed first to assess the area and any potential impacts if herbicides are applied. Herbicides will be mixed in a designated area with appropriate containment and spill-prevention measures. Only the required amount of herbicide for that day's applications will be transported to the site. Applications will be done according to the label instructions by DoD or state certified pesticide applicators to ensure the proper amount of herbicide is used.

11.1.b. Using the least intrusive method of algaecide and aquatic herbicide application;

Applications will be done with a pressurized hydraulic sprayer and/or by hand with small pressurized 1-4 gallon sprayers to prevent over application and excess herbicide runoff downstream.

Several measures will be taken to limit the impact of the herbicides in water. Aquatic herbicides will never be applied directly to flowing water. Aquatic herbicide applications are only allowed from May 1 to October 1 to avoid the local wet season. In addition, aquatic herbicides will not be applied during any wet weather or 12 hours before or after a rain event. Aquatic herbicides will only be applied when winds are less than 5 mph.

11.1.c. Applying a decision matrix concept to the choice of the most appropriate formulation.

Trained, DoD or state certified pesticide applicators make an informed decision on the application of aquatic herbicides by scouting the area to be treated, making a positive identification of Arundo present, and checking the herbicide product label for control efficacy. Label instructions will be followed to determine appropriate rates of application and to identify any warnings or conditions that limit the application. The certified applicator may utilize an aquatic approved surfactant according to label instructions in order to improve the penetration and translocation of the herbicide into the weed stumps.

11.2. Vegetation Control

11.2.a. Evaluating the following management options, in which the impact to water quality, impact to non-target organisms including plants, algaecide and aquatic herbicide resistance, feasibility, and cost effectiveness should be considered:

11.2.a.i. No action;

As feasible, this technique is used. Vegetation control in ditches, creeks, or other waterways will be accomplished on an as needed basis according to mission requirements. No action is taken until the unwanted and invasive vegetation could impact the base mission by impeding the flow of water, causing roads and other paths to become impassable, and causing a BASH issue.

11.2.a.ii. Prevention;

The Beale AFB Civil Engineer Squadron utilizes preventative maintenance measures to try to limit the potential for excess vegetation that could impact the base mission. An example of this preventative maintenance is removing sediment build-up in drainages according to applicable water quality regulations to increase the capacity of the drainage and improve water flow. However, this technique has limitations, including the potential for environmental impacts by disturbed sediment in waterways.

11.2.a.iii. Mechanical or physical methods;

Mechanical removal, hand-pulling, weed-whacking, and mowing of vegetation will be used to the maximum extent possible to control vegetation before applying aquatic herbicides. However, removal of vegetation in drainages, creeks, or other waterways by mechanical means has limitations in many cases. These techniques are very labor intensive per unit acre or length of water treated. Environmental impacts due to the use of mechanical techniques include the creation of water-borne sediment and turbidity by personnel and equipment, which lowers dissolved oxygen and prevents light penetration. Mechanical means can cause fragmentation of aquatic weeds, which in many cases helps weeds re-establish and spread. Applying aquatic herbicides by backpack sprayer eliminates the need for equipment to travel through wetlands and vernal pools.

11.2.a.iv. Cultural methods;

Beale AFB has a grounds maintenance contract to provide general grounds upkeep service to the main base areas and provide a measure of preventative maintenance. However, cultural methods cannot be utilized to respond quickly to control aquatic weeds that are identified to have the potential to impact the base mission.

11.2.a.v. Biological control agents;

The biological control of cattle grazing is used to control vegetation in many locations throughout Beale AFB. However, grazing is not suitable for most aquatic locations and is not feasible in the short timeframe required for control when aquatic weeds are identified to have the potential to impact the base mission.

11.2.a.vi. Algaecides and aquatic herbicides;

If there are no alternatives to algaecides and aquatic herbicides, Dischargers shall use the minimum amount of algaecides and aquatic herbicides that is necessary to

have an effective control program and is consistent with the algaecide and aquatic herbicide product label requirements.

Sites potentially requiring aquatic herbicide treatment will be surveyed first to assess the area and any potential impacts if herbicides are applied. Herbicides will be mixed in a designated area with appropriate containment and spill-prevention measures. Only the required amount of herbicide for that day's applications will be transported to the site. Applications will be done according to the label instructions by DoD or state certified pesticide applicators to ensure the proper amount of herbicide is used.

11.2.b. Using the least intrusive method of algaecide and aquatic herbicide application;

Applications will be done with a pressurized hydraulic sprayer and/or by hand with small pressurized 1-4 gallon sprayers to prevent over application and excess herbicide runoff downstream.

Several measures will be taken to limit the impact of the herbicides in water. Aquatic herbicides will never be applied directly to flowing water. Aquatic herbicide applications are only allowed from May 1 to October 1 to avoid the local wet season. In addition, aquatic herbicides will not be applied during any wet weather or 12 hours before or after a rain event. Aquatic herbicides will only be applied when winds are less than 5 mph.

11.2.c. Applying a decision matrix concept to the choice of the most appropriate formulation.

Trained, DoD or state certified pesticide applicators make an informed decision on the application of aquatic herbicides by scouting the area to be treated, making a positive identification of aquatic weeds, determining any potential mission impacts related to the weeds, and checking the aquatic herbicide product label for control efficacy. Label instructions will be followed to determine appropriate rates of application and to identify any warnings or conditions that limit the application.

11.1 Himalayan Blackberry Control

11.1.a. Evaluating the following management options, in which the impact to water quality, impact to non-target organisms including plants, algaecide and aquatic herbicide resistance, feasibility, and cost effectiveness should be considered:

11.1.a.i. No action;

Himalayan blackberry is located west of the flightline on the base. If it is not treated it will re-sprout and create nesting habitat attractive to migratory birds. Nesting birds near the flightline create a Bird/wildlife Aircraft Strike Hazard (BASH). If blackberry is not controlled it may lead to injuries or fatalities due to air strikes and/or take of migratory birds and damage to wetlands if emergency mechanical removal is required. Himalayan blackberry outside of the area indicated in Figure 3 will not be treated.

11.1.a.ii. Prevention;

Himalayan blackberry is already well-established in the area to be treated. Cultural measures to prevent future re-introduction to the area will be implemented. Reducing bird habitat will prevent future seed introduction in bird feces. Care will be taken to prevent the movement of plant parts downstream. If needed, area will be seeded with native plants to prevent re-invasion. Follow-up monitoring will be conducted so that re-sprouts can be identified and removed.

11.1.a.iii. Mechanical or physical methods;

Weed-whacking, and mowing of vegetation will be used to the maximum extent possible to control vegetation before applying aquatic herbicides. However, some blackberry will still re-sprout after mowing or weed-whacking. In addition, removal of vegetation in drainages, creeks, or other waterways by mechanical means has limitations in many cases. These techniques are very labor intensive per unit acre or length of water treated. Environmental impacts due to the use of mechanical techniques include the creation of water-borne sediment and turbidity by personnel and equipment, which lowers dissolved oxygen and prevents light penetration. Mechanical means can cause fragmentation of aquatic weeds, which in many cases helps weeds re-establish and spread. Applying aquatic herbicides by backpack sprayer eliminates the need for equipment to travel through wetlands and vernal pools.

11.1.a.iv. Cultural methods;

The following cultural methods will be used to prevent re-introduction: Ensuring soil, gravel, and other fill material brought into the area is not contaminated. Avoiding unloading, parking, or storing equipment and vehicles in infested areas. Removing plants, plant parts, and seeds from personal gear, clothing, pets, vehicles, and equipment. Washing vehicles, including tires and undercarriage, and equipment at designated cleaning sites before leaving infested areas. Bagging or tarp plants, plant parts, and seeds before transporting to a designated disposal site (e.g. landfill).

11.1.a.v. Biological control agents; and

There are no biological control agents for Himalayan blackberry.

11.1.a.vi. Algaecides and aquatic herbicides;

If there are no alternatives to algaecides and aquatic herbicides, Dischargers shall use the minimum amount of algaecides and aquatic herbicides that is necessary to have an effective control program and is consistent with the algaecide and aquatic herbicide product label requirements.

Sites potentially requiring aquatic herbicide treatment will be surveyed first to assess the area and any potential impacts if herbicides are applied. Herbicides will be mixed in a designated area with appropriate containment and spill-prevention measures. Only the required amount of herbicide for that day's applications will be transported to the site. Applications will be done according to the label instructions by DoD or state certified pesticide applicators to ensure the proper amount of herbicide is used.

11.1.b. Using the least intrusive method of algaecide and aquatic herbicide application;

Applications will be done with a pressurized hydraulic sprayer and/or by hand with small pressurized 1-4 gallon sprayers to prevent over application and excess herbicide runoff downstream.

Several measures will be taken to limit the impact of the herbicides in water. Aquatic herbicides will never be applied directly to flowing water. Aquatic herbicide applications are only allowed from May 1 to October 1 to avoid the local wet season. In addition, aquatic herbicides will not be applied during any wet weather or 12 hours before or after a rain event. Aquatic herbicides will only be applied when winds are less than 5 mph.

11.1.c. Applying a decision matrix concept to the choice of the most appropriate formulation.

Trained, DoD or state certified pesticide applicators make an informed decision on the application of aquatic herbicides by scouting the area to be treated, making a positive identification of Himalayan blackberry present, and checking the herbicide product label for control efficacy. Label instructions will be followed to determine appropriate rates of application and to identify any warnings or conditions that limit the application. The certified applicator may utilize an aquatic approved surfactant such as Pro-tron according to label instructions in order to improve the penetration and translocation of the herbicide into the weed stumps.

Feather River Air Quality Management District (FRAQMD)

Air Quality Agricultural Open Burn Permit

FEATHER RIVER AIR QUALITY MANAGEMENT DISTRICT

Serving the Counties of Yuba and Sutter
541 Washington Avenue, Yuba City, CA 95991
PHONE: (530) 634-7659 ext. 201 FAX: (530) 634-7660
e-mail: fraqmd@fraqmd.org Web Site: http://www.fraqmd.org

Christopher D. Brown AICP
Air Pollution Control Officer

AGRICULTURAL OPEN BURN PERMIT

BEALE AFB 9TH CES/CEV
6451 B St; B2539
BEALE AFB, CA 95903
Phone: (530) 634-2738

Permit#: **92187**
Issued: 6/1/2020
Expires: 6/30/2021

Site#	Fld#	Burn Site Location(s)	CO	Acres	Crop
0-0	M-60	APP.75 MI S/HAMNTON-SMRTVLE RD. 1.5 MI E/DOOLITTLE	Yuba	110	Weeds
1-0	S. BASE	1 MI E/BROPHY, N/NORTH BEALE RD	Yuba	744	Weeds
2-0	M ARM	APP. .25 MI N/14TH ST., .25 MI E/DOOLITTLE	Yuba	99	Weeds
3-0		ROD AND GUN CLUB	Yuba	20	Weeds
4-0	EOD	1.75 MI E/DOOLITTLE, 2 MI S/HAMMONTON-SMARTVILLE	Yuba	247	Weeds
5-0	1	CANNON FIELD PLOT S/ WASTE WATER TREATMENT	Yuba	103	Weeds
6-0		GAVIN MANDRY/A STREET	Yuba	12	Weeds
7-0		GOLF COURSE: S/ WARREN SHINGLE ROAD, E/A STREET	Yuba	1	Weeds
8-0		SADDLE CLUB	Yuba	1	Weeds

NO SITE VALID AFTER THIS LINE

I have reviewed the contents of this permit for completeness and accuracy and have read the attached open burning handout and further acknowledge that failure to comply with burn regulations is a misdemeanor. In addition, the issuance of this permit does not relieve the permittee of responsibility to use reasonable and ordinary care to prevent damage to the property of others or injury to persons as prescribed by law.

Signature: Susan Stewart   Title: Air Quality Program Manager

Name (printed): Susan Stewart   Date: 25 JUNE 2020

National Historic Preservation Act
Section 106 Consultation
with the
State Historic Preservation Officer

Ms. Gwendolyn E. Vergara
9 CES/CEIE
6425 B Street Bldg. 25390
Beale AFB, CA 95903-1708

Ms. Julianne Polanco
State Historic Preservation Officer
Department of Parks and Recreation
Office of Historic Preservation
1725 23rd Street, Suite 100
Sacramento, CA 95816

Dear Ms. Polanco

In accordance with Section 106 of the National Historic Preservation Act (NHPA) and 36 CFR Part 800, the Department of the Air Force, Beale Air Force Base (AFB), is advising you of a proposed undertaking that has the potential to affect historic properties. The undertaking is the adoption of revised methods and strategies to manage invasive plant species at Beale AFB, Yuba County, and the Lincoln Receiver Site (LRS), Placer County, California. The LRS is a geographically separated unit managed by Beale AFB. This consultation describes the undertaking, discusses the Area of Potential Effect (APE) for the undertaking and presents a discussion of the National Register of Historic Places (NRHP) eligibility for historic properties within the project footprint (per 36 CFR 800.4). Cultural resource investigations have been conducted to determine the presence of historic properties that may be affected by the proposed undertaking. As a result of these efforts, our conclusion is that implementation of the plan will result in a finding of No Adverse Effect.

Background Information

Beale AFB and the LRS are situated on the eastern margin of the Sacramento Valley (Attachment 1-Figure 1a and b). The base is about 35 miles north-northeast of Sacramento and more than 23,000 acres in size. The LRS occupies about 235 acres and is located approximately 20 miles east-northeast of Sacramento. Both facilities are located in the Southern Maidu (Nisenan) culture area, and after disruption of prehistoric lifeways, both facilities were in agricultural and mining regions. Military pursuits began at the base in World War II and at the LRS during the Cold War. Today, Beale AFB is home to the 9th Reconnaissance Wing where fleets of manned and unmanned surveillance aircraft are used to train pilots and gather intelligence throughout the world, for the Air Force and other United States armed forces.

Air Force Instruction (AFI) 32-7064, *Integrated Natural Resources Management* (Section 3.8.4), instructs the base to "Develop and implement management strategies oriented toward the control of exotic and invasive species when practical and consistent with the military mission. The plan must curb and decrease invasive plants while conserving and benefiting sensitive, threatened, and endangered species and their habitats. Beale AFB has managed both sensitive species and non-native species since 2010 in accordance with the Beale AFB 2010 Invasive Plant Species Management Guidelines (IPSMG), but a concerted effort to manage both together has been determined to be more effective and is the approach to be adopted as this undertaking. Additionally, studies of the base have shown that more areas need to be managed, in order to control unwanted invasive plants (Attachment 2).

PROJECT DESCRIPTION

Proposed Undertaking—CFR 800.11(d)(1)

The goal of the undertaking is to return base habitats to as near a prehistoric state as possible by managing non-native plant species in order to reduce their prevalence. The undertaking abatement methods are all surface treatments and include mechanical and hand control (e.g., mowing, weed whacking, hand pulling), chemical applications, prescribed burning, and grazing (including goats, sheep, cattle, horses, etc.). To support expanded grazing pastures, fencing and solar-powered wells will be installed. Additionally, habitat enhancements (e.g., replanting via seeds or seedlings) are part of this undertaking. These methods will be employed in an efficient, sustainable, and long-term strategy. Successful containment/control often requires multiple years of treatment, and sometimes requires multiple treatments per year involving a combination of methods. The Beale AFB IPSMG (2017), Grazing Management Guidelines (2017), and draft Wildland Fire Management Plan (2018) provide the technical basis for this undertaking (Attachments 3, 4 and 5).

Area of Potential Effects—CFR 800.4(a)(1)

The APE for the undertaking (i.e., the areas to be managed with these methods and strategies), includes all undeveloped portions of the base and LRS (Attachment 1- Figure 1a and b). Implementation of the undertaking across all annual grasslands, riparian, wetland (including vernal pool), and oak woodland habitats on Beale AFB and the LRS is the focus for this effort. Actual hard surfaces (e.g., runway, buildings, paved streets, etc.) are not part of the undertaking.

NATIVE AMERICAN CONSULTATION—CFR 800.2(c)(2)(ii)

Beale AFB routinely contacts nine Native American groups as part of Section 106 consultations. Consultations consist of an initial letter, and if needed telephone calls are extended as a follow-up. For the current undertaking, consultation is in progress, and Beale AFB will continue consultation with interested tribes for the life of the undertaking. Substantive comments received will be brought to the attention of the Office of Historic Preservation (OHP).

FINDINGS OF IDENTIFICATION EFFORTS—CFR 800.4, 800.5

A records search of the Beale cultural resources database, which includes records obtained from the North Central Information Center of the California Historical Resources Information System, was conducted in October 2019. As a result, it was determined that the non-built areas of Beale AFB and the LRS have been previously surveyed for cultural resources (Attachment 1; Attachment 6). To date, 38 surveys have been performed, resulting in identification of 162 archaeological sites. With all areas of the APE having been surveyed for cultural resources, Beale AFB has conducted a reasonable and good-faith effort to identify historic properties within the APE pursuant to 36 CFR 800.4(a)-(d) and 36 DFR 800.5(a)-(d).

DETERMINATIONS OF ELIGIBILITY—CFR 800.4(c)(2)

Of the 162 sites, the OHP has concurred with the Air Force on the eligibility for listing in the NRHP of 82 sites, or site components, that are part of the undertaking (Attachment 7). This includes one site eligible for listing, 80 found not eligible, and one site with a military component found not eligible, but with unevaluated prehistoric bedrock milling and rock art features. All unevaluated sites (or components) will be considered eligible for the NRHP for the purposes of this undertaking unless formal evaluation, and OHP and Tribal consultation is warranted by the base for other projects during the duration of this undertaking.

EFFECTS OF THE PROPOSED UNDERTAKING—CFR 800.11(e)(4)

With implementation of this undertaking, management practices will prevent damage to historic properties, and therefore, a finding of No Adverse Effects is appropriate. The weed abatement/ habitat restoration methods described are currently employed on the base with no affects to historic properties. Presently, trained staff document historic property condition through annual site inspections. As part of the undertaking, the area and frequency that abatement methods are employed will be expanded in order to succeed with reversal of the spread of invasive weeds. The Beale AFB cultural and natural resources (CR/NR) manager approves all treatment operations and access routes associated with this undertaking (see Attachments 3-5). As a result, the base CR/NR manager is the conduit to location information for cultural resources and coordination of avoidance procedures. Effects will be avoided by either excluding properties from the treatment methods, or if restoration is necessary, methods will be tailored to the locale to prevent effects. The following bullets outline method specific considerations:

- *Hand Control*. Mowing, weed whacking, hand cutting or hand pulling of invasive plants will not disturb surface archaeological sites or those with subsurface components.
- *Chemical Applications*. Applications of herbicides will be circumscribed to controlled areas or individual specimens, thereby allowing protection of historic properties through complete avoidance or, if return to native specimens is the goal in an infested property, through focused treatment.
- *Prescribed Burns*. The ecology of this area evolved with fire: fires caused by lightning, by the Nisenan in their well-known management of their foraging grounds, and by ranchers (extensively into the late 20th Century). As such, the archaeological sites at Beale and the LRS have been exposed to fire over a long timeline without loss of integrity. Prescribed burn techniques include site boundary delineation by the CR/NR manager and excluding machinery used to support the burn from these locales. If significant quantities of woody plants have built up (due to fire suppression) around bedrock features or other historic properties where fire intensity may constitute a problem, the brush would be hand-cleared before a burn was prescribed to a site area. Many of the prehistoric sites at Beale are bedrock mortar features located in areas of riparian habitat; burns would not be prescribed in this ecological zone.
- *Grazing*. Grazing also has a deep time depth in the region. Tule elk (*Cervus canadensis nannodes*) and pronghorn (*Antilocapra americana*) grazed this range and have been associated with the spread of such desirable native plants as purple needlegrass (*Nassella pulchra*), and European livestock have been a fixture on the land since the advent of the ranching period. As with prescribed burns, the centuries of grazing has occurred on historic properties on the base without affecting site integrity. For the purposes of the undertaking, the CR/NR manager will determine where grazing can occur without damage to cultural resources through either complete avoidance or instigation of any necessary restrictions. For instance, cattle grazing an area will not adversely affect a site unless the area is over utilized. Therefore, the CR/NR

manager will determine the length of time an area can be grazed and will require that livestock "magnet" features (e.g., salt licks, water troughs, etc.) not be placed within site boundaries in order to minimize non-dispersed animal traffic. Riparian areas, the location of many of the prehistoric sites on base, will generally be excluded from grazing except by limited treatment by smaller livestock (e.g., sheep, goats). Infrastructure to support grazing (fencing, solar-powered wells) will be excluded from historic property boundaries.

- *Habitat Enhancements.* No habitat enhancements that affect the subsurface (e.g., planting large specimens) will be employed within historic property boundaries. Base approved seed mixes may be applied through broadcasting to areas that have received hand control management, chemical treatment or been improved via prescribed burns.
- Through avoidance or implementation of intelligent application of the undertaking methods, and performance of continual monitoring and site inspection, the CR/NR manager will insure impacts to historic properties will not occur.

Summary

The US Air Force, Beale AFB, with the adoption of revised methods and strategies to manage invasive plant species, intends to extend and intensify current management practices to control nonnative and noxious vegetation. The goal is to use updated scientific data to work towards returning the lands of Beale AFB and the LRS to a pre Euroamerican ecological state. The entire APE has been surveyed for cultural resources; 162 historic properties were identified in the APE. When employing the various methods of the undertaking, the base CR/NR manager will determine if weed abatement and habitat enhancement should occur at a cultural resource, and if so, how to implement the method(s), so as to not affect the resource.

Your concurrence is requested on the following:

- The APE defined for the proposed undertaking is appropriate pursuant to 800.4(a)(1)
- The efforts to identify historic properties is adequate pursuant to 800.4(b)
- A finding of "No Adverse Effect" is appropriate for the proposed undertaking, implementing the Invasive Plant Species Management Guidelines (2017), Grazing Management Guidelines (2017), and draft Wildland Fire Management Plan (2018) pursuant to 800.4(d)(1).

Please contact the Beale AFB Cultural Resources Manager, Ms. Tamara Gallentine, at (530) 634-2738 or tamara.gallentine.2@us.af.mil if you have questions about the undertaking described in this letter.

Sincerely,

Gwendolyn E. Vergara
Chief, Environmental Element
9 CES/CEIE

Attachments:

Attachment 1: Map Package

Attachment 2: Integrated Natural Resources Management Plan (2019)

Attachment 3: Invasive Plant Species Management Guidelines (2017)

Attachment 4: Grazing Management Guidelines (2017)

Attachment 5: Wildland Fire Management Plan (2018)

Attachment 6: TABLE 1- Cultural Resources Surveys Conducted at Beale AFB and the LRS

Attachment 7: TABLE 2- Cultural Resources Eligibility Status

Response Re: National Historic Preservation Act

Section 106 Consultation

with the

State Historic Preservation Officer

State of California • Natural Resources Agency

Gavin Newsom, *Governor*

DEPARTMENT OF PARKS AND RECREATION
OFFICE OF HISTORIC PRESERVATION

Armando Quintero, *Director*

Julianne Polanco, State Historic Preservation Officer

1725 23rd Street, Suite 100, Sacramento, CA 95816-7100
Telephone: (916) 445-7000 FAX: (916) 445-7053
calshpo.ohp@parks.ca.gov www.ohp.parks.ca.gov

February 16, 2021

Reply in Reference To: USAF_2020_0817_001

VIA ELECTRONIC MAIL

Mr. Calvin Hendrix
Deputy Base Civil Engineer
9 CES/CD
6425 B Street, Bldg. 25390
Beale AFB, CA 95903-1708

Re: Non-Native and Noxious Plant Species Management, Beale AFB's letter of August 14, 2020 and e-mails of January 12, 2021 and February 12, 2021

Dear Mr. Hendrix:

The Beale Air Force Base (BAFB), the United States Air Force is initiating consultation with the State Historic Preservation Officer (SHPO) on the above-cited undertaking in accordance with Section 106 of the National Historic Preservation Act of 1966 (54 U.S.C. § 306108), as amended, and its implementing regulation found at 36 CFR Part 800.

BAFB proposes to adopt a new Non-Native and Noxious Plant Species Management (NNPSM) system for both the BAFB and the Lincoln Receiver Site (LRS). The BAFB contains 23,192 acres in Yuba County and the LRS contains 235 acres in Placer County and is located approximately 15 miles south of Beale AFB. The area of potential effects (APE) includes all undeveloped areas of both the BAFB and the LRS. Those areas include all annual grasslands, riparian, wetland (including vernal pools), and oak woodland habitats. Actual hard surfaces (e.g., runways, paved streets, and buildings) are not part of the APE. All of the activities involved in this proposed undertaking and the APE are described adequately in your submission.

A records review of the BAFB's cultural resources records and the North Central Information Center, CSU-Sacramento identified that all of the APE had been surveyed by 38 previous surveys conducted between 1961 and 2019. A total of 162 archaeological sites have been identified, of which the BAFB and the SHPO have concurred on the eligibility of 80 sites for listing on the National Register of Historic Places (NRHP), while the other 80 have not been evaluated. All unevaluated sites will be considered to be eligible for the NRHP for the purposes of the proposed undertaking unless formal evaluation, and SHPO and tribal consultation is warranted by BAFB for other projects during the duration of the proposed undertaking.

The goal of the proposed undertaking is to return the BAFB's habitats to as near prehistoric state as possible my managing non-native plant species in order to reduce their prevalence. The proposed abatement methods are all surface treatments and include mechanical and hand control (e.g., mowing, week whacking, and hand pulling), chemical applications, prescribed burning, and grazing. The weed abatement/habitat restoration methods described above are currently used on the BAFB with no effects to cultural resources. BAFB's Cultural and Natural Resources Manager will approved all treatment operations and access routes associated with this proposed undertaking.

Effects to cultural resources will be avoided by either excluding the sites from the treatment methods, or if restoration is necessary, methods will be tailored to the locale to prevent effects. Consequently, the BAFB has determined that the proposed undertaking would have No Adverse Effect on cultural resources.

On August 17, 2020, Tamara Gallentine (BAFB) consulted with ten Native American tribes in regards to this proposed undertaking. The BAFB received the following responses:

1) Kyle McHenry, THPO, Mechoopda Indian Tribe of Chico Rancheria, declined to consult because the APE was located outside of the tribal area of concern;
2) Matthew Hatcher, THPO, Mooretown Rancheria is unaware of any known cultural resources being located within the APE, but did request to be notified if any new information or human remains are found;
3) Anna M. Starkey, Cultural Resource Specialist, United Auburn Indian Community of the Auburn Rancheria, said that no traditional cultural properties are located within the APE, but asked how cultural sites will be avoided or protected by the NNPSM plan. Ms. Gallentine responded that BAFB has prepared an environmental assessment (EA) and that it contains the avoidance measures described above. The EA will be available for public review and comment in the near future.

Based on the records review, the previous pedestrian surveys, and the tribal consultation, the BAFB has determined that a finding of No Adverse Effect to Historic Properties Affected is appropriate for this proposed undertaking. The BAFB has requested the SHPO to review and comment on that finding and the identification of the APE. After reviewing the information submitted by the USAF, the SHPO has the following comments:

1) The SHPO has no objections to your identification and delineation of the area of potential effects pursuant to 36 CFR Parts 800.4 (a)(1) and 800.16(d);
2) The SHPO request the BAFB to provide to the SHPO copies of any pertinent comments it receives regarding this proposed undertaking and;
3) The SHPO does not object to your Finding of No Adverse Effects to Historic Properties, as described above, pursuant to 36 CFR Part 800.5(d)(1).

Be advised that under certain circumstances, such as an unanticipated discovery or a change in project description, the BAFB may have additional future responsibilities for this undertaking under 36 CFR Part 800. Should cultural artifacts be encountered during ground disturbing activities, please halt all work until a qualified archaeologist can be consulted on the nature and significance of such artifacts.

If you have any questions or concerns, please contact Ed Carroll of my staff at (916) 445-7006 or Ed.Carroll@parks.ca.gov.

Sincerely,

Julianne Polanco
State Historic Preservation Officer

National Historic Preservation Act
Section 106, Tribal Consultation List

Native American Contact Log
Invasive Plant Management Project

Name	Affiliation, per NAHC	Date Contacted				Confirmation Letter Received? Yes or No (date)	Letter or Verbal Response Received?		Comments
		1. Letter (sender's name)	2. Phone (caller's name)	3. Phone (caller's name)	Letter emailed		If yes, Date	If Letter, Post-mark Date	
Estom Yumeka Maidu Tribe of the Enterprise Rancheria Ms. Glenda Nelson, Chairperson 2133 Monte Vista Avenue Oroville, CA 95966 530-532-9214 530-532-1768 Fax info@enterpriserancheria.org	Maidu	Dated and sent on 08/17/2020	09/04/2020 FHA	09/15/2020 JH		No			09/04/2020 at 12:28 PM, FHA call was unanswered and a left a voicemail. 09/15/2020 at 9:01 AM, JH call was unanswered and a left a voicemail.
Estom Yumeka Maidu Tribe of the Enterprise Rancheria Mr. Reno Franklin, THPO 2133 Monte Vista Avenue Oroville, CA 95966 530-532-9214 707-694-4783 Cell info@enterpriserancheria.org	Maidu	Dated and sent on 08/17/2020	09/04/2020 FHA	09/15/2020 JH		No			09/04/2020 at 12:28 PM, FHA call was unanswered and a left a voicemail. 09/15/2020 at 9:03 AM, JH call was unanswered and a left a voicemail.
Shingle Springs Band of Miwok Indians, Shingle Springs Rancheria Ms. Regina Cuellar, Chairperson PO Box 1340 Shingle Springs CA 95682 530-676-8010 office 530-676-8033 fax	Miwok, Maidu	Dated and sent on 08/17/2020	09/04/2020 FHA	09/15/2020 JH		No			09/04/2020 at 12:40 PM, FHA call was unanswered and left a voicemail. 09/15/2020 at 9:06 AM, JH call was unanswered and a left a voicemail.
Shingle Springs Band of Miwok Indians, Shingle Springs Rancheria Ms. Jennifer Barker, Executive Assistant PO Box 1340 Shingle Springs CA 95682 530-387-4970 office 530-409-4638 fax jbarker@ssband.org	Miwok, Maidu	Not Letter in Ltr Pkg	09/04/2020 FHA	09/15/2020 JH		No			09/04/2020 at 12:35 PM, FHA call was unanswered and left a voicemail. 09/15/2020 at 9:08 AM, JH call was unanswered and a left a voicemail.
Shingle Springs Band of Miwok Indians, Shingle Springs Rancheria Ms. Annie Jones, Vice Chairperson PO Box 1340 Shingle Springs CA 95682	Miwok, Maidu	Dated and sent on 08/17/2020	09/04/2020 FHA	09/15/2020 JH		No			09/04/2020 at 12:40 PM, FHA call was unanswered and left a voicemail. 09/15/2020 at 9:010 AM, JH call was unanswered at main number 530-698-1400 and JH a left a voicemail.

Native American Contact Log
Invasive Plant Management Project

Name	Affiliation, per NAHC	Date Contacted				Confirmation Letter Received? Yes or No (date)	Letter or Verbal Response Received?		Comments
		1. Letter (sender's name)	2. Phone (caller's name)	3. Phone (caller's name)	Letter emailed		If yes, Date	If Letter, Post-mark Date	
Shingle Springs Band of Miwok Indians, Shingle Springs Rancheria Mr. Daniel Fonseca, Director Language Preservation/THPO PO Box 1340 Shingle Springs CA 95682 530-698-1460 dfonseca@ssband.org	Miwok, Maidu	Dated and sent on 08/17/2020	09/04/2020 FHA	09/15/2020 JH		No			09/04/2020 at 12:40 PM, FHA call was unanswered and left a voicemail. 09/15/2020 at 9:12 AM, JH call was unanswered and a left a voicemail.
Shingle Springs Band of Miwok Indians, Shingle Springs Rancheria Ms. Kara Perry, Site Protection Manager PO Box 1340 Shingle Springs CA 95682 530-488-4049 office kperry@ssband.org	Miwok, Maidu	No Letter in Ltr Pkg	09/04/2020 FHA	09/15/2020 JH		No			09/04/2020 at 12:30 PM, FHA call was unanswered and left a voicemail. 09/15/2020 at 9:12 AM, JH call was unanswered and a left a voicemail.
Berry Creek Rancheria of Maidu Indians Mr. Francis Steele, Chairperson 5 Tyme Way Oroville, CA 95966 530-534-3859 530-534-1151 Fax fsteele@berrycreekrancheria.com	Maidu	Dated and sent on 08/17/2020	09/04/2020 FHA	09/15/2020 JH		No			09/04/2020 at 12:47 PM, FHA call was unanswered and left a voicemail. 09/15/2020 at 9:15 AM, JH received a busy signal and then called back immediate but phone continued to ring.
Berry Creek Rancheria of Maidu Indians Ms. Jennifer Santos, Tribal Administrator 5 Tyme Way Oroville, CA 95966 530-534-3859 jsantos@berrycreekrancheria.com	Maidu	No Letter in Ltr Pkg	09/04/2020 FHA	09/15/2020 JH		No			09/04/2020 at 12:47 PM, FHA call was unanswered and left a voicemail. 09/15/2020 at 9:20 AM, JH call was unanswered and a left a voicemail.
Mechoopda Indian Tribe of Chico Rancheria Mr. Dennis Ramirez, Chairperson 125 Mission Ranch Blvd. Chico, CA 95926 530-899-8922 530-899-8517 Fax dramirez@mechoopda-nsn.gov	Mechoopda	Dated and sent on 08/17/2020	09/04/2020 FHA	N/A	09/04/2020 FHA	Yes 09/08/2020	Verbal 09/08/2020 Email 09/09/2020		09/04/2020 at 12:49 PM, FHA call was unanswered and left a voicemail at 1:21 FHA received a voicemail from Mr. Mark Alabanza at 530-924-2717 and asked for an email copy to mit@mechoopda-nsn.gov. FHA emailed the letter and figures. 09/08/2020 at 8:50 AM, Mr. Mark Alabanza, Tribal Administrative Officer, conformed receipt of email. 09/08/2020, Mr. Kyle McHenry, THPO, called TG and stated Beale AFB was outside of the tribal area of concern and discussed that Beale AFB didn't need to consult with the Mechoopda tribe any further for future projects. 09/09/2020, Mr. Mark Alabanza emailed TG confirming Mr. Kyle McHenry's assessment that Beale AFB is outside of the Tribe's area and Beale AFB no longer needs to consult with the Mechoopda Indian Tribe of Chico Rancheria on any future projects.

Native American Contact Log
Invasive Plant Management Project

Name	Affiliation, per NAHC	Date Contacted				Confirmation Letter Received? Yes or No (date)	Letter or Verbal Response Received?		Comments
		1. Letter (sender's name)	2. Phone (caller's name)	3. Phone (caller's name)	Letter emailed		If yes, Date	If Letter, Post-mark Date	
Mooretown Rancheria of Maidu Indians Mr. Benjamin Clark, Chairperson #1 Alverda Drive Oroville, CA 95966 530-533-3625 office 530-533-3680 Fax frontdesk@mooretown.org	Maidu, KonKow/ Concow	Dated and sent on 08/17/2020	09/04/2020 FHA	09/15/2020 JH		Yes 08/31/2020	Letter 08/31/2020		09/04/2020 at 12:52 PM, FHA call was unanswered and left a voicemail. 09/15/2020 at 9:20 AM, JH call was unanswered and a left a voicemail. Letter received dated 08/31/2020 from Mr. Matthew Hatcher stating that the Mooretown Rancheria is unaware of new or known cultural resources in the area and provided contact information if tribal cultural items or Native American human remains are discovered
Mooretown Rancheria of Maidu Indians Mr. Matthew Hatcher, THPO #1 Alverda Drive Oroville, CA 95966 530-533-3625 office matthew.hatcher@mooretown.org	Maidu, KonKow/ Concow	Dated and sent on 08/17/2020	09/04/2020 FHA	09/15/2020 JH		Yes 08/31/2020	Letter 08/31/2020		09/04/2020 at 12:52 PM, FHA call was unanswered and left a voicemail. 09/15/2020 at 9:20 AM, JH call was unanswered and a left a voicemail. Letter received dated 08/31/2020 from Mr. Matthew Hatcher stating that the Mooretown Rancheria is unaware of new or known cultural resources in the area and provided contact information if tribal cultural items or Native American human remains are discovered.
United Auburn Indian Community of the Auburn Rancheria Mr. Gene Whitehouse, Chairperson 10720 Indian Hill Road Auburn, CA 95603 (530) 883-2390 (530) 883-2380 Fax bguth@auburnrancheria.com	Maidu Miwok	Dated and sent on 08/17/2020	09/15/2020 JH	N/A	09/04/2020 FHA	Yes 09/08/2020	Email 09/24/2020		09/04/2020 at 10:00 PM FHA emailed the letter and attachments per Ms. Tamara Gallentine 09/15/2020 at 9:30 AM, JH call was unanswered and a left a voicemail. 09/24/2020 at 4:21 PM, Ms. Anna Starkey stated no traditional cultural properties exist in the area and inquired how cultural sites will be avoided or protected. 09/24/2020 at 6:25 PM, Ms. Tamara Gallentine responded to Ms. Anna Starkey's email requesting comments and input regarding the project and that the Environmental Assessment for the project will include avoidance measures.
United Auburn Indian Community of the Auburn Rancheria Matthew Moore, THPO 10720 Indian Hill Road Auburn, CA 95603 (530) 883-2320 (530) 401-6821 Cell mmoore@auburnrancheria.com	Maidu Miwok	Dated and sent on 08/17/2020	09/15/2020 JH	N/A	09/04/2020 FHA	Yes 09/08/2020	Email 09/24/2020		09/04/2020 at 10:00 PM FHA emailed the letter and attachments per Ms. Tamara Gallentine 09/15/2020 at 9:32 AM, JH call was unanswered and a left a voicemail. 09/24/2020 at 4:21 PM, Ms. Anna Starkey stated no traditional cultural properties exist in the area and inquired how cultural sites will be avoided or protected. 09/24/2020 at 6:25 PM, Ms. Tamara Gallentine responded to Ms. Anna Starkey's email requesting comments and input regarding the project and that the Environmental Assessment for the project will include avoidance measures.
United Auburn Indian Community of the Auburn Rancheria Anna Starkey, Cultural Regulatory Specialist 10720 Indian Hill Road Auburn, CA 95603 (530) 863-6503 (916) 251-1565 (cell) astarkey@auburnrancheria.com	Maidu Miwok	No Letter in Ltr Pkg	09/15/2020 JH	N/A	09/04/2020 FHA	Yes 09/08/2020	Email 09/24/2020		09/04/2020 at 10:00 PM FHA emailed the letter and attachments per Ms. Tamara Gallentine 09/08/2020 at 9:26 AM, Ms. Anna Starkey confirmed receipt of the information. 09/15/2020 at 10:15 AM, JH call was unanswered and a left a voicemail. 09/24/2020 at 4:21 PM, Ms. Anna Starkey stated no traditional cultural properties exist in the area and inquired how cultural sites will be avoided or protected. 09/24/2020 at 6:25 PM, Ms. Tamara Gallentine responded to Ms. Anna Starkey's email requesting comments and input regarding the project and that the Environmental Assessment for the project will include avoidance measures.
Konkow Valley Band of Maidu Ms. Jessica Lopez, Chairperson 2136 Meyers Street Oroville, CA 95966 530-777-8094 jessica@konkowmaidu.org	Konkow Maidu	Dated and sent on 08/17/2020	09/04/2020 FHA	09/15/2020 JH	09/04/2020 FHA	No			09/04/2020 at 2:02 PM, FHA call and spoke with Ms. Jessica Lopez who requested the letter by email. Ms. J. Lopez confirmed her email as jessica@konkowmaidu.org FHA emailed the letter and attachments. 09/15/2020 at 10:18 AM, JH call was unanswered and a left a voicemail.

Native American Contact Log
Invasive Plant Management Project

Name	Affiliation, per NAHC	Date Contacted				Confirmation Letter Received? Yes or No (date)	Letter or Verbal Response Received?		Comments
		1. Letter (sender's name)	2. Phone (caller's name)	3. Phone (caller's name)	Letter emailed		If yes, Date	If Letter, Post-mark Date	
Konkow Valley Band of Maidu Mr. Eric Josephson, NAGPRA Coordinator PO Box 938 Cottonwood, CA 96022 530-347-5022 eric@maidu.com	Konkow Maidu	Dated and sent on 08/17/2020	09/04/2020 FHA	09/15/2020 JH	09/04/2020 FHA	Yes 08/21/2020			09/04/2020 at 2:20 PM, FHA called and spoke with Mr. Eric Josephson who confirmed his email address as eric@maidu.com. FHA emailed the letter and attachments. 09/15/2020 at 10:22 AM, JH call was unanswered and a left a voicemail.
Pakan'yani Maidu of Strawberry Valley Rancheria Ms. Tina Goodwin Chairperson P.O. Box 984 Marysville, CA 95901 916-501-4472 tinagoodwin@washoetanf.org	Maidu Miwok	Dated and sent on 08/17/2020	09/04/2020 FHA	09/15/2020 JH		No			09/04/2020 at 2:28, FHA called and left a voicemail. 09/15/2020 at 10:28 AM, JH call was unanswered and a left a voicemail.
Pakan'yani Maidu of Strawberry Valley Rancheria Mr. Scott Dinsmore Tribal Chair Members P.O. Box 984 Marysville, CA 95901 617-417-2166 sdinsmore@strawberryvalleymaidu.org	Maidu Miwok	Dated and sent on 08/17/2020	09/04/2020 FHA	09/15/2020 JH	09/04/2020 FHA	No			09/04/2020 at 2:31, FHA called and left a voicemail. 09/04/2020 at 2:42, Mr. Dinsmore returned the call and left a voicemail with a spelled out email address as sdinsmore@strawberryvalleymaidu.org. FHA emailed the letter and attachments. 09/09/2020 at 4:19 PM, TG notified Mr. Dinsmore via email that the letters sent were retuned by the USPS as "unable to forward". 09/15/2020 at 10:32 AM, JH call was unanswered and a left a voicemail.
Colfax-Todds Valley Consolidated Tribe Ms. Pamela Cubbler, Treasurer PO Box 4884 Auburn, CA 95604 [redacted] pcubbler@colfaxrancheria.com	Miwok Maidu	Dated and sent on 08/17/2020	09/04/2020 FHA	09/15/2020 JH	09/04/2020 FHA	No			09/04/2020 at 2:35, FHA called and spoke with Ms. Pamela Cubbler who requested the letter by email. Ms. Cubbler confirmed her email address as pcubbler@colfaxrancheria.com. FHA emailed the letter and attachments. 09/15/2020 at 10:35 AM, JH call was unanswered and a left a voicemail.
Butte Tribal Council Mr. Ren Reynolds, Chairperson 1671 Mt. Ida Road Oroville, CA 95966 [redacted]	(not listed)	No Letter in Ltr Pkg	09/04/2020 FHA	09/15/2020 JH	09/04/2020 FHA	No			09/04/2020 at 2:39, FHA called and spoke with Mr. Ren Reynolds. My Reynolds confirmed his postal address and provided [redacted] as his email address. FHA emailed the letter and attachments. 09/15/2020 at 10:41 AM, JH call was unanswered and a left a voicemail.

TG = Tamara Gallentine
WLN = William Norton, CEMML
FHA = Francisco Arellano, Jacobs Engineering Group
JH = Jeremy Hollins, Jacobs Engineering Group

Representative Tribal National Historic Preservation Act Section 106 Letter

To: Ms. Glenda Nelson, Chairperson

Enterprise Rancheria

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 9TH RECONNAISSANCE WING (ACC)
BEALE AIR FORCE BASE, CALIFORNIA

Mr. Calvin Hendrix
Deputy Base Civil Engineer
9 CES/CC
6425 B Street, Bldg. 25390
Beale AFB, CA 95903-1708

AUG 17 2020

Ms. Glenda Nelson
Chairperson
Enterprise Rancheria
2133 Monte Vista Ave
Oroville, CA 95966

Dear Ms. Nelson,

The U.S Air Force (USAF), Beale Air Force Base (AFB), in accordance with Section 106 of the National Historic Preservation Act (NHPA) of 1966, as amended, and 36 Code of Federal Regulations (CFR) Part 800, *Protection of Historic Properties,* is writing to ask for your assistance in identifying historic properties of religious and cultural significance to your tribe for the proposed adoption of the Non-Native and Noxious Plant Species Management on Beale Air Force Base and the Lincoln Receiver Site, California (undertaking). The Lincoln Receiver Site (LRS) is a geographically separated unit managed by Beale AFB.

Beale AFB and the LRS are situated on the eastern margin of the Sacramento Valley (Attachment 1-Figures 1a and b). The Base is about 35 miles north-northeast of Sacramento and more than 23,000 acres in size. The LRS occupies about 235 acres and is located approximately 20 miles east-northeast of Sacramento. Today, Beale AFB is home to the 9th Reconnaissance Wing where fleets of manned and unmanned surveillance aircraft are used to train pilots and gather intelligence throughout the world, for the USAF and other United States armed forces.

The goal of the undertaking is to return Base habitats to as near a native state as possible by managing non-native plant species in order to reduce their prevalence. The undertaking abatement methods are all surface treatments currently employed on the base and include mechanical and hand control (e.g., mowing, weed whacking, hand pulling, chain-sawing), chemical applications, prescribed burning, and grazing (including goats, sheep, cattle, horses). To support expanded grazing pastures, fencing and solar-powered wells will be installed (but not within historic property boundaries). Additionally, habitat enhancements (e.g., replanting via seeds or seedlings) are part of this undertaking. In order to revive the pre-Euroamerican ecological environment, these methods will be employed in an efficient, sustainable, and long-term strategy. Successful containment/control often requires multiple years of treatment, and sometimes requires multiple treatments per year involving a combination of methods.

The area of potential effects for the undertaking (i.e., the areas to be managed with these methods and strategies), includes all undeveloped portions of the Base and LRS (Attachment, Figures 1a and b). Implementation of the undertaking across all annual grasslands, riparian, wetland (including vernal pools), and oak woodland habitats on Beale AFB and the LRS is the focus for this effort. Actual hard surfaces (e.g., runway, buildings, paved streets, etc.) are not part of the undertaking.

The non-built areas of Beale AFB and the LRS have been previously surveyed for cultural resources with 38 surveys having been performed, resulting in identification of 162 archaeological sites (including both Native American and historic sites). With implementation of this undertaking, management practices will prevent damage to cultural resources. The weed abatement/ habitat restoration methods are currently employed on the base with no effects to historic properties. As part of the undertaking, the area and frequency that abatement methods are employed will be expanded. The Beale AFB Cultural and Natural Resources Manager (CRM/NRM) approves all treatment operations and access routes associated with this undertaking. As a result, the Base CRM/NRM is the conduit to location information for cultural resources and coordination of avoidance procedures. Effects will be avoided by either excluding properties from the treatment methods (i.e., complete avoidance), or if restoration is necessary, methods will be tailored to the locale to prevent effects. Presently, trained staff document historic property condition through annual site inspections, and will continue to do so.

Beale AFB is currently unaware of any Native American Traditional Cultural Properties (TCPs) within the APE. Nevertheless, we ask for your assistance in identifying any TCPs, particularly those which may be affected by the Undertaking described above.

At this time, we respectfully request your comments and input under the NHPA for the Undertaking. It will not affect the handling or disposition of human remains, funerary objects, sacred objects, or objects of cultural patrimony under the Native American Graves Protection and Repatriation Act. In the event such items are discovered, we will contact you regarding their handling and disposition.

If you have any questions or desire additional information, please contact Ms. Tamara Gallentine, Beale AFB CRM/NRM, 9 CES/CEIEC, 6425 B St., Bldg. 25390, Beale AFB, CA 95903-1708, tamara.gallentine.2@us.af.mil, (530) 913-2975. Please refer to the Non-Native and Noxious Plant Species Management on Beale Air Force Base and the Lincoln Receiver Site, in any correspondence.

Sincerely,

CALVIN G. HENDRIX, GS-14, DAF
Deputy Base Civil Engineer, 9th Civil Engineer Squadron

Attachments:
1. Project Location and APE

Tribal National Historic Preservation Act Section 106 Letter Notification Responses

From: Anna Starkey
To: GALLENTINE, TAMARA A GS-12 USAF ACC 9 CES/CEIEC
Subject: [Non-DoD Source] Lincoln Receiver Site
Date: Thursday, September 24, 2020 4:21:29 PM
Attachments: image001.png

Good afternoon Tamara,
Thank you for the letter for the Lincoln Receiver Site. Sorry for the delayed response. Some of the letters I process are a couple months behind.

Our records do not show any TCPs in the area. It is great to hear about the Non-Native and Noxious Plant Species Management plan for the base though. We received a copy of the plan, correct? How cultural sites will be avoided or protected in the plan?
Thank you.

Sincerely,
Anna Starkey

Anna M. Starkey, M.A., RPA
Cultural Regulatory Specialist
Tribal Historic Preservation Department| UAIC
10720 Indian Hill Road
Auburn, CA 95603
Direct line: (916) 251-1565 | Cell: (530) 863-6503
astarkey@auburnrancheria.com |www.auburnrancheria.com

From:	GALLENTINE, TAMARA A GS-12 USAF ACC 9 CES/CEIEC
To:	Anna Starkey
Cc:	NORTON, WILLIAM L CTR USAF AFMC AFCEC/AFCEC/CZOW
Subject:	RE: Lincoln Receiver Site
Date:	Thursday, September 24, 2020 6:25:00 PM
Attachments:	image001.png

Hi Anna,

I just want to confirm that you are referencing the Non-Native and Noxious Plant Species Management Section 106 letter. This letter covers both Beale AFB and the Lincoln Receiver Site for the management actions briefly discussed in the letter. At this time, we respectfully request your comments and input under the NHPA for the Undertaking.

We will be publishing an environmental assessment (EA) for review that will contain avoidance measures, hopefully this fall. We sent a letter of notification and solicitation of comments for the EA to UAIC on August 29, 2019.

Hope to talk to you soon and that this finds you safe and healthy.

Thank you,

Tamara Gallentine
Natural & Cultural Resources Program Manager
9 CES/CEIEC
6425 B St
Beale AFB, CA 95903
Teleworking, please call 530-913-2975

From: Anna Starkey <astarkey@auburnrancheria.com>
Sent: Thursday, September 24, 2020 4:21 PM
To: GALLENTINE, TAMARA A GS-12 USAF ACC 9 CES/CEIEC <tamara.gallentine.2@us.af.mil>
Subject: [Non-DoD Source] Lincoln Receiver Site

Good afternoon Tamara,

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Mooretown Rancheria
#1 Alverda Drive
Oroville, CA 95966
(530) 533-3625 Office
(530) 533-3680 Fax

August 31, 2020DATE

Mr. Calvin Hendrix
Deputy Base Civil Engineer
9 CES/CC
6425 B Street, Bldg. 25390
Beale AFB, CA 95903-1708

Re: Proposed (Non-Native and Noxious Plant Species Management) Project – Beale AFB, Yuba, CA

Dear Mr. Hendrix:

Thank you for your letter dated, August 17, 2020, seeking information regarding the proposed Non-Native and Noxious Plant species management project in Yuba County, California. Based on the information provided, the Mooretown Rancheria is not aware of any new or known cultural resources on this site. However, as the project progresses, if any new information or human remains are found, we do have a process to protect such important and sacred artifacts (especially near rivers or streams).

Please contact the following individuals if tribal cultural items or Native American human remains are found:

THPO
Mooretown Rancheria
1 Alverda drive
Oroville, CA 95966
(5300 533-3625 Office
(530) 533-3680 Fax
E-mail:matthew.hatcher@mooretown.org

Thank you for providing us with this notice and opportunity to comment.

Sincerely,

Matthew Hatcher

Matthew Hatcher
Tribal Historic Preservation Officer

"Concow - Maidu"

APPENDIX G

Impact Avoidance and Minimization Measures (AMMs) and Best Management Practices (BMPs) for Invasive Plant Control on Beale AFB and the LRS

Impact Avoidance and Minimization Measures (AMMs) and Best Management Practices (BMPs) for Invasive Plant Control on Beale AFB

Avoidance and Minimization Measures (AMMs) and Best Management Practices (BMPs) define a set of conditions or requirements that an activity must meet to avoid or minimize potential effects on sensitive resources and to ensure consistency with the Beale Air Force Base (AFB) Integrated Natural resources management Plan (INRMP) and compliance with inter-agency consultations. AMMs involving herbicides are an added layer of caution to the already-regulated and approved use of these chemicals. AMMs are not optional.

These project AMMs and BMPs are based on site-specific resource conditions within the project area, including (but not limited to) the current invasive plant inventory, the presence of sensitive species and their habitats, proximity to water and potential for herbicide delivery to water, and the social environment as described in the *Environmental Assessment of Non-native and Noxious Plant Species Management on Beale Air Force Base and the Lincoln Receiver Site*. For emphasis, some AMMs include herbicide label guidance, INRMP (Beale AFB 2019), Installation Pest Management Plan (Beale AFB 2018a), or Aquatic Pesticide Application Plan (Beale AFB 2018b) standards. The AMMs listed are not an exhaustive list of all base, DoD or State rules and regulations, or label guidance. In general, all projects would employ the lowest impact methods for effective management of invasive plant species in areas with sensitive resources.

Invasive Plant Species Management Guidelines BMPs

BMPs ranging from programmatic recommendations for how goals are accomplished to specific protocols for executing tasks are outlined in Section 5.2, *Best Management Practices for Weed Management* of the Invasive Plant Species Management Guidelines (Beale AFB 2017a). These BMPs should be made available to all contractors, residents, and installation divisions (in addition to BMPS and AMMs below) as appropriate to guide their work and reduce the possibility that projects would introduce, spread, or increase invasive plant species infestations, or harm sensitive resources.

U.S. Fish and Wildlife Service (USFWS) and National Oceanic and Atmospheric Administration Marine Fisheries Service (NMFS) Consultation AMMs

The following measures are intended to avoid and minimize any potential adverse effects to listed species during implementation of the project activities. The general AMMs would be fully implemented as part of the project activities, and species-specific AMMs would be implemented based on the potential for the presence of federally threatened or endangered species.

General

1. A USFWS/NMFS-approved biologist will brief all project personnel prior to participating in project activities. At a minimum, the briefing will include a summary of the Proposed Actions, a description of the federally-listed species that may occur in the project area, and a summary of the measures that the USAF will implement to avoid or minimize the adverse effects to the federally-listed species within a projects’ footprint.

2. A natural resources monitor will conduct spot compliance checks during control activities in or adjacent to sensitive habitats as required. The natural resources monitor will ensure compliance with all applicable AMMs required to protect federally-listed species and their habitats. Full-time on-site monitoring may occur if activity is particularly sensitive, if personnel conducting control activities are not well trained or experienced with federally listed species, or if personnel have a history of non-compliance.

3. A USFWS/NMFS-approved biologist will conduct environmental awareness training for all field personnel working within and near sensitive habitat on Beale AFB. Training will be provided at the start of work and within 15 calendar days of any new worker arrival. The program will consist of a briefing on environmental issues relative to the proposed project. The training program will include an overview of the legal status, biology, distribution, habitat needs, and compliance requirements for each federally-listed species that may occur in the project area. The presentation will also include a discussion of the legal protection for endangered species under the ESA, including penalties for violations. A fact sheet conveying this information will be distributed to all personnel who enter the project site. Upon completion of the orientation, employees will sign a form stating that they attended the program and understand all avoidance and minimization measures. These forms will be maintained at Beale AFB and will be accessible to the appropriate resource agencies.

4. The fueling of vehicles and equipment will occur on impervious surfaces to the maximum extent practicable. Spill containment equipment will be present at all project sites where fuels or other hazardous substances, including herbicides, are brought to the site. In addition, qualified personnel will conduct daily inspections of the equipment and the staging and maintenance areas for leaks of hazardous substances.

5. Prior to initiation of weed control or restoration activities, sensitive areas, such as vernal pools, wetlands, riparian areas, and potential habitat for federally-listed species (i.e., vernal pool fairy shrimp, vernal pool tadpole shrimp, valley elderberry longhorn beetle, western yellow-billed cuckoo, or Monarch), will be identified. If work will be conducted by contractors or other personnel not familiar with applicable federally-listed species and their habitat, sensitive areas will be staked and flagged as exclusion zones where control activities cannot take place. Orange construction barrier fencing (or an appropriate alternative method) will designate exclusion zones where control activities cannot occur. The flagging and fencing will be clearly marked as an environmentally sensitive area. The contractor will remove all fencing, stakes and flagging within 60 calendar days of project completion. If work is conducted by in-house personnel, familiar with applicable sensitive species and their habitat, sensitive areas will be flagged or marked as needed.

6. Plants propagated for habitat enhancement planting will be inspected and ensured to be free of invasive species (e.g., Argentine ants, *Linepithema humile*).

7. All livestock forage, seed, and erosion control materials will be weed free so as not to be a vector for invasive species.

8. All equipment used to control invasive plants will be cleaned before being moved from one location on the installation to another.

9. All plant debris potentially containing reproductive parts (i.e., seeds or plant fragments for species that reproduce vegetatively) will be disposed of at an off-site landfill or green waste facility. It will be transported in a manner that prevents the spread of invasive plants to other locations. This action may require, but is not limited to, bagging the material before it is transported off-site.

10. During project activities, all trash that may attract animals will be properly contained, removed from the work site daily, and disposed of properly. Following construction, all refuse and construction debris will be removed from work areas. All garbage and project construction-related materials in construction areas will be removed immediately following project completion.

11. Any worker that kills or injures a federally-listed species, or finds one injured or trapped, will immediately report the incident to the on-site biologist and stop activities. The biologist will

inform the Beale Natural Resources Manager immediately (9 CES/CEIEC). The Beale Natural Resources Manager will verbally notify the Sacramento USFWS Office POC immediately and will provide written notification of the incident within five calendar days.

12. A USFWS-approved biologist or natural resources monitor will inspect heavy equipment being brought from off-base for cleanliness to minimize spread of invasive and noxious weeds onto and around Beale AFB. The designated biologist or monitor may reject equipment that has visible clumps of mud when arriving on site. The biologist or monitor will also identify any listed noxious weed found on the project site, and will hand-pull noxious weeds where practical.

Site Access

1. Established roads, both paved and unpaved, will be used to the maximum extent practicable. In areas where this is not possible, preexisting disturbed areas will be used to the maximum extent practicable.
2. No work requiring vehicles/equipment will be done when the ground is soft enough that travel will cause depressions as determined by a Natural Resources monitor.
3. When it is not practical to stage or operate project vehicles or equipment on paved or existing roadways and trails, the USAF will stage and operate vehicles and equipment in an area designated by a USFWS-approved biologist, where activities are least likely to impact native vegetation.
4. The number of access routes, number and size of staging areas, and the total area of the activity will be limited to the minimum necessary to achieve the project goal. Routes and boundaries will be clearly demarcated, and these areas will avoid wetlands/drainage areas whenever feasible. All access routes will be restored to normal grade and revegetated with a certified weed free seed mix approved by 9 CES/CEIEC at project completion.
5. In the event that a new vehicle access route is required in special status species habitat, the Natural Resources Manager and USFWS will be notified to determine actions required to minimize impacts. If routes will be reused over multiple years, they will be assessed annually to ensure that they are clear of special status species.
6. All vehicle operators will follow the posted speed limit on paved roads and a 15-miles per hour speed limit on unpaved roads. Per the Fugitive Dust Emissions Rule, a person shall take every reasonable precaution to not cause or allow the emissions of fugitive dust from being airborne past the action area especially near threatened or endangered species or their habitats.

General Herbicide Application

1. Herbicide will only be applied by current Qualified Applicator Certificate holders (minimum qualification) from the California Department of Pesticide Regulation. If the applicator will be using herbicides within jurisdictional wetlands or waters of the U.S., the applicator must also have passed the Aquatic Category of the California Qualified Applicator Test. The Installation Pest Management Coordinator will receive qualifications from applicators within 30 calendar days of contract award. These applicators must know and be able to recognize sensitive resources including listed wildlife, plants, vernal pools, and nesting birds. If not, they will receive Environmental Awareness Training.
2. All herbicides will be applied in accordance with the IPSMG (Beale AFB 2017a); the Beale AFB Installation Pest Management Plan (Beale AFB 2018a); the USAF Pest Management Program; a General NPDES Permit for Residual Aquatic Pesticide Discharges; all applicable federal, DoD, USAF, State of California, and local directives and regulations; and label instructions. All pesticides applied must be USAF-approved.

3. Hazardous materials storage and equipment staging and storage will occur at least 150 feet away from sensitive habitats.
4. Herbicide applications will not be conducted during rain nor immediately following rain when soil is saturated or runoff or standing water is present. Application will occur only under favorable weather conditions, defined as:
    a. 50% or less chance of precipitation on the day of application based upon NOAA weather forecasting, and
    b. If rain, showers or light rains are predicted within 48 hours, the amount of rain predicted shall be no more than ¼ inch of rain, and
    c. Rain does not appear likely at the time of application.
5. Drift of herbicides will be limited by not spraying when wind speeds exceed 10 miles per hour or as indicated by label instruction to protect nearby non-target vegetation by minimizing drift. Drift will be further reduced by using the largest possible droplet size and lowest possible boom height (if applicable), according to label instructions. Applicators will ensure that only the necessary amount of herbicide to effectively treat the target plants is used and that all herbicides are used within their given heat tolerances to avoid volatilization.
6. Herbicide applicators will prescribe and use only non-ionic surfactants near open water. These surfactants are readily biodegradable and low in aquatic toxicity.
7. In areas with sensitive resources, low-volume applications and reduced application rates will be used. Spot applications rather than broadcast applications will be used when feasible to limit the effects of contamination of small mammals' insect-based diets (Cal-IPC 2015).
8. All herbicide application will follow the minimum buffers in Table 1 when applying herbicide near aquatic features. Note that these buffers do not apply to imazamox (Clearcast), which is an aquatic herbicide that will not be used near vernal pools. A USFWS-approved biologist or Natural Resources Manager who is supervising or conducting treatment may, on a case by case basis, reduce buffers after getting verbal (followed by email) agreement from the base's USFWS Sacramento office point of contact. Herbicide will not be applied directly into a vernal pool or vernal swale.
9. Only an herbicide labeled for aquatic use may be applied (e.g. non-POEA glyphosate formulations) near aquatic resources, even when dry.
10. When using sprayable or dust formulations and the air is calm or moving away from habitat, commence applications on the side nearest the habitat and proceed away from the habitat (CA Department of Pesticide Regulations [DPR] 2019).
11. When air currents are moving toward habitat, do not make applications within 120 feet upwind from occupied habitat for spray drift near suitable listed species habitat for sprayable or dust formulations (CA DPR 2019).
12. The county agricultural commissioner may reduce or waive buffer zones following a site inspection, if there is an adequate hedgerow, windbreak, riparian corridor or other physical barrier that substantially reduces the probability of drift (CA DPR 2019).
13. Soil Active Herbicides (chlorsulfuron and imazapyr) near suitable federally-listed species habitat: Do not apply within 30 yards upslope of habitat unless a suitable method is used to contain or divert runoff waters (CA DPR 2019).
14. Specific rinse and drain procedures will be followed to clean pesticide containers unless they are to be returned to the registrant. This text describes two procedures that may be used for

containers that hold less than 28 gal of a liquid pesticide that gets diluted prior to application. These procedures will be performed at the time of final use (i.e., empty, unrinsed containers will not be stored and rinsed later). One method is a series of agitation and drain cycles. Containers less than 5 gal will be rinsed with a volume of rinse medium (e.g., water) equal to one-quarter of the container's total volume, and containers 5 gal or larger will be rinsed with one-fifth of the container's total volume. With this first method, the container will be filled with the required volume of rinse medium, closed securely, agitated, and then drained into the tank mix for 30 seconds after the majority of the volume had already drained. This will be repeated at least 2 more times for a minimum of 3 total rinses. The second method is to position the pesticide container over a rinse nozzle at the opening of the mix tank. The rinse nozzle must have at least 15 psi and will be sprayed at all of the inner surfaces of the container using enough rinse medium equal to at least one-half of the container's total volume.

15. Properly rinsed containers will be disposed of following guidelines set by Recology, the waste management provider for Yuba County. Properly rinsed and drained plastic (#1-7) and metal containers may be sent for recycling. If recycling is not available or the container unaccepted plastic number, then the container should be punctured and placed in the garbage and sent to a landfill. Nonrefillable paper or plastic bags, fiber sacks, and fiber drums should be emptied completely by shaking and tapping the sides of the container into the mixing tank or other application equipment. These containers should be placed in the garbage. Outer foil pouches of water-soluble packets may be recycled if the water-soluble packet remained unbroken. If the water-soluble packet has broken and thus contaminated the foil pouch, then the foil pouch should be triple-rinsed with clean water and the rinsate drained into the mix tank, before it may be recycled.

Table 1. Aquatic Resource Buffers for Herbicide Application.

Active Ingredient	Application Method	Dry Aquatic Features (feet)[1]	Streams [1] or Ditches with water (feet)	Special Aquatic Features (feet)[2]
Aminopyralid	Spot & directed foliar spray	25	25	100
	wiping	15	15	15
Chlorsulfuron	directed foliar spray	25	100	100
	wiping	15	15	15
Glyphosate	directed foliar spray or drizzle	0	25	25 [3]
	cut stump or wiping	0	15	15 [3]
Imazamox	direct application	0	0 [5]	na
Imazapyr	Directed foliar spray	25	75 [4]	75
Sulfometuron methyl	Spot and preemergent	50	100	100
Triclopyr TEA	directed foliar	25	75	75
	wiping or cut stump	15	15	15
Triclopyr BEE	Spot & directed foliar spray	75	250	250
	cut stump	75	75	75

[1] As measured from the edge of the stream channel. If a defined channel is not present (draws do not have defined channels), measurement is from the bottom of the feature.
[2] Vernal swales, springs, vernal pools. As measured from the edge of the wet area surrounding the special aquatic feature, or the vernal pool vegetation, whichever is greater.
[3] Only non-POEA containing formulations may be used
[4] With the exception of giant reed treatment in Dry Creek and Best Slough
[5] Imazamox will never be applied directly to flowing water, water where the outflow cannot be controlled, to Dry Creek, Best Slough, or their tributaries.

Vernal Pool Fairy Shrimp

Note: Project-specific requirements may be added as necessary by 9 CES/CEIEC staff to meet requirements under the Endangered Species Act and INRMP.

All projects that occur within 250 feet of known or potential vernal pool fairy shrimp habitat, will implement the following measures to avoid or minimize disturbances and adverse effects to the species:

1. With the exception of manual removal (i.e., hand-pulling), no work will be conducted in the vicinity of suitable vernal pool species' habitat between 1 November and 1 May. Permission to work outdoors outside of the 1 November and 1 May timeframe may be granted from the Natural Resources Manager in coordination with the USFWS, in certain weather conditions. Work continuation is dependent on prevailing conditions, forecasted weather, and whether or not activities will damage soil or vegetative cover. The only outdoor work allowed 12 hours before or after a storm event is the inspection, installation, and/or maintenance of erosions control BMPs. The Natural Resources Manager must be contacted to obtain permission to work after each storm event. Permission to work after 1 November will not be granted once wetlands are activated (standing water present).
2. If mowing occurs in or near vernal pools, it will occur only when the soil is no longer saturated to ensure tracks are not left in or near wetlands. The mower height must be set to avoid the flowering heads of sensitive vernal pool plant species.
3. No hand-lines will be cut within 50 feet of wetlands during a prescribed fire conducted near or within potential vernal pool fairy shrimp habitat. Only black lining (back burning a perimeter) and wet lining (mowing and then wetting an area to prevent combustion) will be used to create fire lines within 50 feet of wetlands.
4. Projects that occur on road surfaces and along road shoulders will avoid direct impacts to wetland habitats, including roadside ditches that act as seasonal wetlands.
    a. Roadside herbicide application will avoid ditches and other potential vernal pool fairy shrimp habitat.
    b. Roadside mechanical or hand removal will avoid leaving biomass in ditches or other vernal pool fairy shrimp and tadpole shrimp habitat.
5. If access routes crossing vernal pool habitats cannot be avoided, ground protection mats will be used to disperse the weight of vehicles and equipment so as to not harm any existing cysts. This method cannot be used while vernal pools are wet.
6. Upon approval from the Natural Resources Manager in coordination with the USFWS, a USFWS-approved biologist will flag vernal pool species' habitat to be avoided. The area will be protected by placing construction fencing or other appropriate protective fencing around the pools, including a buffer. Fencing will be used in locations where project equipment and/or personnel will be situated adjacent to or in the vicinity of suitable vernal pool species' habitat.
7. If herbicide spraying is required near vernal pool species' habitat, only herbicides and adjuvants approved for use in aquatic environments will be used. Buffer distances in Table 1 will be followed. A USFWS-approved biologist who is supervising or conducting treatment may, on a case by case scenario, and after approval from the NRM and coordination with the base's Sacramento USFWS Office point of contact, reduce these buffers.
8. No herbicide will be sprayed within vernal pools at any time (inundated or dry).
9. If necessary to meet conservation goals, non-POEA glyphosate may be applied up to the boundary of a vernal pool when the pools and surrounding habitat is dry. All applications must

be conducted by a USFWS-approved biologist, and after approval from the NRM and coordination with the base's USFWS Sacramento office point of contact.

10. If invasive species removal is required within a vernal pool (e.g., *Glyceria* infestations), only hand-pulling or hand tools will be used, with the minimum amount of soil disturbance required to remove target invasive species. All non-native biomass removed will be disposed of in a landfill. All soil will be replaced/left in the vernal pool it came from.
11. All equipment used in projects requiring access to sites within vernal pool species' habitat will be staged outside of vernal pool habitat and will be on paved or gravel surfaces wherever possible. If paved or gravel surfaces are not available, construction mats and or drip pans will be placed under vehicles to minimize impacts. To further minimize adverse effects, the following measures will be implemented at project sites near vernal pools:
    a. No work shall occur within vernal pool habitat when water is present.
    b. As necessary, a USFWS-approved biologist will be present during access and project work within vernal pool habitat to monitor activities.
    c. For projects adjacent to (within 30 feet) vernal pool species' habitat or hydrologically connected to the habitat, silt fencing or other appropriate BMPs to prevent siltation shall be implemented prior to work within that area. A USFWS-approved biologist will flag areas where silt fencing or BMPs shall be implemented. BMPs may include sand bags and weed-free straw bales or straw wattles.
    d. Spill containment kits will be present at all sites where petroleum-fueled equipment is used.
12. If project activities encroach within the perimeter of a pool, the following measures will be implemented:
    a. Protective mats should be used as a first resort, if not possible, equipment with pneumatic tires should be used over tracked equipment.
    b. Non-wetlands present within adjacent habitat will be used as an equipment-parking platform. Alternately, ground protection mats, boards, or plates will be used to distribute the weight of construction equipment for access. Drip pans will also be placed under vehicles parked on non-wetland vegetation.
    c. Project will be implemented during the dry season only, when the pool is dry.
13. Pre- and post-project surveys will be conducted to record habitat condition before the start of a project and after completion of the project for tracking purposes. This may include photos and/or species surveys and will be used to better manage for the species.

Vernal Pool Tadpole Shrimp

Note: Project-specific requirements may be added as necessary by 9 CES/CEIEC staff to meet requirements under the ESA and INRMP.

All projects that occur within 250 feet of known or potential vernal pool tadpole shrimp habitat will implement the following measures to avoid or minimize disturbances and adverse effects to the species:

See AMMs for vernal pool fairy shrimp.

Valley Elderberry Longhorn Beetle

Note: Project-specific requirements may be added as necessary by 9 CES/CEIEC staff to meet requirements under the ESA and INRMP. Conservation measures are in accordance with the *Framework for Assessing Impacts to the Valley Elderberry Longhorn Beetle* (*Desmocerus californicus dimorphus*) (USFWS 2017).

All projects that occur within 100 feet of elderberry shrubs (*Sambucus* spp.) with stems of 1-inch diameter or more will implement the following measures to avoid or minimize disturbances and adverse effects to the species:

1. Prior to start of construction activities in known valley elderberry longhorn beetle habitat, a USFWS-approved biologist will conduct surveys to determine the presence of elderberry shrubs within a buffer of 100 feet of the project footprint to determine areas to be avoided.
2. All areas to be avoided during construction will be fenced and flagged by a USFWS-approved biologist.
3. A USFWS-approved biologist will monitor the work area at project-appropriate intervals to ensure that all AMMs are implemented. The amount and duration of monitoring required will depend on the project specifics and should be discussed with the USFWS-approved biologist (USFWS 2017).
4. If encroachment of the 100-foot buffer cannot be avoided, a 20-foot buffer from the dripline of the plant will be established, fenced, and flagged.
5. As much as feasible, all activities that could occur within 100 feet of an elderberry shrub, will be conducted outside of the flight season of the valley elderberry longhorn beetle (March–July; USFWS 2017).
6. No herbicides, or other chemicals that might harm the beetle or its host plant will be used within 100 feet of any elderberry plant. All herbicides used within 250 feet of an elderberry plant will be applied using a backpack sprayer or similar direct application method (USFWS 2017). Herbicide may be applied up to 20 feet from the drip line of elderberry shrubs, but only under the direction of a USFWS-approved biologist.
7. No pre-emergent or persistent herbicides will be used within 100 feet of elderberry shrubs.
8. Mechanical weed removal such as mowing and weed-whacking, within the dripline of the shrub will be limited to the season when adult valley elderberry longhorn beetles are not active (August–February). When weed removal needs to occur during the active season, weeds will be removed by hand or using non-electric hand tools only. Project site will be accessed by foot only. No chemicals or electric tools (mowers, weed-whackers) will be used (USFWS 2017).
9. As necessary, a USFWS-approved biologist will be present during access and project work within valley elderberry longhorn beetle habitat to ensure that no damage to elderberry shrubs occurs.
10. Erosion control will be implemented, and the affected area will be re-vegetated with appropriate native plants (USFWS 2017).
11. If prescribed burns are conducted in an area with elderberry shrubs present, a minimum 100-foot buffer will be maintained around each shrub.
12. Any shrubs within grazed areas will be fenced and adequately protected. A natural resources monitor will periodically check protected shrubs to maintain fences etc.

13. Pre- and post-project surveys will be conducted to record habitat condition before the start of a project and after completion of the project for tracking purposes. This may include photos and/or species surveys and will be used to better manage for the species (USFWS 2017).

Western Yellow-Billed Cuckoo

Note: Project-specific requirements may be added as necessary by 9 CES/CEIEC staff to meet requirements under the Endangered Species Act and INRMP.

If projects will be conducted within 1,000 feet of suitable western yellow-billed cuckoo breeding habitat (e.g. “Poor” habitat quality or greater as identified in Halterman 2019), during the breeding season (1 June – 31 August) a USFWS-approved biologist will make an initial site visit to verify the habitat suitability and determine the need for implementation of any of the below AMMs or whether additional surveys are needed. Beale AFB may (depending on survey results) implement the following measures to avoid or minimize disturbances and adverse effects to the species:

1. Any projects that involve excessive noise (81 dB or more) or other disturbance within suitable western yellow-billed cuckoo habitat, commencing between 1 June and 31 August (migration and breeding season), will require a minimum of three pre-construction surveys to be conducted by a USFWS-approved biologist.
    a. Surveys will follow *Western Yellow-billed Cuckoo Natural History Summary and Survey Methodology* (Halterman et al. 2015).
    b. A minimum of three pre-project surveys will be conducted within a 1,000-foot buffer of the project footprint and shall take place within 30 calendar days before the onset of construction or vegetation removal activities. The final survey will be within three days of commencement of activities.
2. If nests are detected, Beale AFB Environmental staff will establish buffers around nests that are sufficient to ensure that breeding is not likely to be disrupted or adversely impacted by the proposed project.
    a. No-disturbance buffers around active nests will be a minimum of 1,000 feet, unless a USFWS-approved biologist determines that smaller buffers would be sufficient to avoid impacts to nesting cuckoos.
    b. Factors to be considered for determining buffer size will include: the presence of natural buffers provided by vegetation or topography, nest height, locations of foraging territory, and baseline levels of noise and human activity.
    c. Buffers will be maintained until a USFWS-approved biologist has determined that young have fledged and are no longer reliant upon the nest or parental care for survival.
3. No riparian vegetation alterations will occur in confirmed yellow-billed cuckoo breeding habitat area during the nesting season (1 June – 31 August). This includes mechanical removal and herbicide spray treatment.
    a. If vegetation removal cannot be avoided, a qualified biologist will conduct a minimum of five surveys in the 30 calendar days leading up to the commencement of the project, with the final survey conducted within the three days of commencement of the project.
4. Herbicide treatments will be applied without motorized equipment during the nesting season (1 June – 31 August) unless otherwise approved by the Natural Resources Manager. If a need for this is determined, surveys will be conducted first to ensure no nests are present.
5. Conservation measures will be adjusted if additional guidelines are released by the USFWS.

6. Pre- and post-project surveys will be conducted to record habitat condition before the start of a project and after completion of the project for tracking purposes. This may include photos and/or species surveys and will be used to better manage for the species.
7. Prescribed burns will be limited to non-breeding season (1 September – 31 May) within 500 feet of suitable western yellow-billed cuckoo breeding habitat.
8. No high-intensity grazing will occur within the Dry Creek and Best Slough riparian corridor or other suitable western yellow-billed cuckoo breeding habitat. Targeted grazing for invasive plant and vegetation control may occur.

Monarch Butterfly

Note: These AMMs will not be fully implemented unless the species is listed under the ESA. Project-specific requirements may be added or amended as necessary by 9 CES/CEIEC staff to meet requirements under the ESA and INRMP. Conservation measures are in accordance with the *Monarch Conservation on Department of Defense Lands in the West: Best Management Practices* (Pelton et al. 2019).

Note: For habitat enhancement projects with specific conservation goals benefitting monarchs, not all the listed AMMs may be adhered to.

All projects that occur within 100 feet of milkweed plants or 250 feet from occupied habitat (roosting and breeding sites), will implement the following measures to avoid or minimize disturbances and adverse effects to the species. Where surveys for milkweed haven't been conducted, either pre-project surveys or during-project surveys will identify milkweed stands. Additionally, if milkweeds are identified within the project area, then surveys for adult and larval monarchs will be conducted both before and after the project.

1. All individuals conducting weed control activities within the buffer area (100 or 250 feet as defined above) will receive training by a USFWS-approved biologist on the identification of milkweed plants and a description of both adult and larval monarchs in order to identify and avoid milkweed and monarchs during all activities.
2. No herbicide application will take place within 100 feet of occupied monarch habitat when monarchs are present (adults or larvae), generally 15 March – 31 October (Pelton et al. 2019). If herbicide application must occur within 100 feet of occupied monarch habitat, then application will only be conducted using targeted spraying, cut stump, or wiping by a USFWS-approved biologist and will be no closer than 2 feet.
3. Actively unoccupied growing milkweed will be avoided by a minimum of two feet during the application of herbicides (target spray, cut-stump, wiping and wicking). Herbicide application within 50 feet of a milkweed plant will be conducted with a low-pressure backpack sprayer to reduce the risk of drift.
4. No broad-spectrum herbicide application will take place within 100 feet of occupied monarch habitat when wind speeds exceed 10 mph, or temperatures exceed 85 °F to minimize potential for drift and volatilization.
5. No persistent or pre-emergent herbicides will be used within 100 feet of milkweed or other occupied monarch habitats (e.g., roosting sites).
6. Milkweed numbers and species will be assessed in project areas where impacts to milkweed may occur due to activities such as ATV access and herbicide application.
7. The impacts of milkweed removal in known monarch breeding areas will be minimized by planting equivalent milkweed species at a 3:1 ratio. The impacts of milkweed removal in

habitat not known to be used by monarchs will be minimized by planting milkweed at a 2:1 ratio.

8. Areas within or adjacent to occupied habitat (within 250 feet of a documented monarch breeding or roosting location), lacking extensive milkweed, where successful control of invasive species has been achieved, will be prioritized for planting.
9. All newly planted milkweed will be regionally native and preferably of the same species removed. Milkweed species selection and replanting location will be at the discretion of the Natural Resources Manager.
10. A 2-foot buffer will be maintained around extant milkweed plants during off-road vehicle access, restoration and habitat enhancement planting, and other ground-disturbing activities to protect breeding habitat.
11. Willows and other trees known to or with the potential to be (within occupied habitat) used as roosting sites will be preserved.
    a. Except for cut stump and wiping of target species, no herbicide application will occur during the active season of monarchs (15 March – 31 October) within 50 feet of known or potential roosting sites.
    b. No trimming of trees used by monarchs as roosting sites will occur during the active season (15 March – 31 October).
12. Heavy cattle or horse grazing in areas with low residual dry matter (below approximately 1000-1200 pounds per acre [lbs/acre]) or grazing with sheep and goats will not occur in locations known to be occupied by monarchs during the active season (15 March – 31 November) to prevent soil compaction and trampling of milkweeds.
13. Riparian areas and drainages with known habitat used by monarchs (e.g., milkweed stands and roosting sites along Dry Creek, Hutchinson Creek) will be excluded from grazing.
14. Any enhancement projects occurring in or adjacent to known monarch breeding locations will incorporate native plants important for monarchs (e.g., milkweeds, late-season flowering shrubs).
15. No prescribed fire treatment will occur within 100 feet of habitat occupied by monarchs during the active monarch season (15 March – 31 October).
16. Any areas within 250 feet of known monarch breeding habitat requiring reseeding will include species beneficial to monarchs, including native milkweed. All seed mixes must be approved by the Natural Resources Manager.
17. Mowing projects during the summer will be conducted during the morning to avoid injuring resting monarchs.
18. Generally, mowing will not be conducted within 100 feet of areas with suitable monarch habitat during the active season (15 March – 31 October).
    a. If mowing must be conducted (i.e. for habitat restoration projects benefiting Monarchs or other listed species) and vehicle access must be allowed, all milkweed plants will be identified and avoided.
    b. Additionally, if mowing occurs from March to June near areas where breeding occurs, mowing height will be set to a minimum of 10-12 inches to avoid cutting newly emerged plants.

19. Conservation measures will be adjusted if additional guidelines are released by the USFWS, and the USFWS will be notified at that time.

Central Valley Steelhead

1. Preconstruction Surveys - A biologist approved by the NMFS will conduct preconstruction surveys of all in-channel disturbance areas within sensitive habitats to determine if any federally listed species may be present prior to the start of work. These surveys will be conducted two weeks prior to the start of work activities in any sensitive habitat. If any federally-listed species are found during the preconstruction surveys, the NMFS-approved biologist will contact NMFS to determine how to proceed, potentially including fish relocation prior to the start of work. At least 15 working days prior to the onset of activities, Beale AFB will submit the name(s) and credentials of biologists who will conduct these preconstruction surveys. No project activities will begin until proponents have received written approval from the NMFS that the biologist(s) is qualified to conduct the work.
2. Biological Monitor - A NMFS-approved biologist will monitor work activities in or adjacent to sensitive habitats. The biological monitor will ensure compliance with the avoidance and minimization measures required to protect federally listed species and their habitats. If federally- listed species are found that are likely to be affected by work activities, the NMFS-approved biologist will have the authority to stop any aspect of the project that could result in unauthorized take of a federally listed species. If the biological monitor exercises this authority, he/she must immediately notify the 9th Civil Engineer Squadron/Environmental Section (9 CES/CEIEC). The 9 CES/CEIEC will verbally notify the NMFS within one working day by telephone and will provide written notification of the incident within three working days.
3. Erosion Control - All drainages will have erosion control measures (straw waddles, hay bales, silt fencing) installed when soil-disturbing work occurs within 250 feet of a drainage or where hydrological continuity exists between the activities and the drainage.
4. Limited Operations Period - No work will be conducted in the vicinity of drainages between 1 November and 15 June, unless specifically approved by the Beale AFB Natural Resources Manager who will field verify soil saturation, visual ponding, and expected surface disturbance. NMFS will be notified of any work approved between 1 November and 1 May.
5. Report Kills/Injuries - Any worker that inadvertently kills or injures a federally listed fish species, or finds one injured or trapped, will immediately report the incident to the biological monitor. The biological monitor will inform the 9th Civil Engineer Squadron/Environmental Section (9 CES/CEIEC). The 9 CES/CEIEC will verbally notify NMFS within three calendar days and will provide written notification of the incident within five calendar days.
6. Revegetation and Success Criteria - Decompact disturbed soils at project completion. Any stream bank area left barren of vegetation as a result of the implementation or maintenance of the practices shall be restored to a natural state by seeding, planting, or other means with native trees, shrubs, or grasses prior to 15 November of the project year. Barren areas shall typically be planted with a combination of willow stakes, native shrubs and trees and/or erosion control grass mixes. Native plant species shall be used for revegetation of disturbed and compacted areas. The species used shall be specific to the project vicinity or the region of the state where the project is located, and comprise a diverse community structure (plantings shall include both woody and herbaceous species). For projects where re-vegetation is implemented to compensate for riparian vegetation impacted by the project, a re-vegetation monitoring report will be required after five years to document success. Success is defined as 70 percent survival of plantings or 70 percent ground cover for broadcast planting of seed after a period of three years. If revegetation efforts will be passive (i.e., natural

regeneration), success will be defined as total cover of woody and herbaceous material equal to or greater than pre-project conditions. If at the end of five years, the vegetation has not successfully been reestablished, 9 CES will be responsible for replacement planting, additional watering, weeding, invasive exotic eradication, or any other practice, to achieve the revegetation requirements. If success is not achieved within the first five years, the project applicant will need to prepare a follow-up report in an additional five years. This requirement will proceed in five-year increments until success is achieved. All plastic exclusion netting placed around plantings will be removed after three years.

Special Status Plant BMPs

The need for protection measures for special status plants will be assessed if treatments are planned within 500 feet of occurrences. A qualified biologist will review any new treatment sites identified under EDRR that are within 500 feet of sensitive and special interest plant occurrences.

1. Herbicide protection buffers shown in Table 2. will be implemented unless a qualified biologist identifies treatments that are consistent with management direction for the particular sensitive plant species.
2. Where needed, sensitive plant buffers will be flagged prior to treatments.
3. Treatment areas with bare soil created by the treatment of invasive plants will be evaluated for restoration and revegetation. BMPs, such as weed-free ground cover, will be implemented as needed.
4. Where treatments occur within special status plant occurrences, workers will be instructed in the proper identification of plant species to be avoided and ensure that individual plants are protected.

Table 2. Distances from Sensitive Plants within which Herbicide Application Will Not Occur [1].

Herbicide	Distance from sensitive plants for spot and directed foliar spray (feet)[1]	Direct Application Distance from sensitive plants (feet)[1]
Aminopyralid	200	25
Chlorsulfuron	500	
Glyphosate	300	
Imazamox	na	
Imazapyr	50	
Sulfometuron Methyl	200	
Triclopyr TEA	200	
Triclopyr BEE	300	

[1] Distances may be reduced based upon the determination of a qualified biologist that treatments are consistent with management direction for a given sensitive plant species.

Beale AFB Aquatic Pesticide Application Plan (APAP) AMMs

A number of water sampling requirements and avoidance AMMs are required by the Statewide General National Pollutant Discharge Elimination System (NPDES) Permit for Residual Aquatic Pesticide Discharges to Waters of the United States from Algae and Aquatic Weed Control Applications, Water Quality Order 2013-0002-DWQ from the California State Water Resources Control Board (Beale AFB 2018b), and will be followed during all herbicide application in or near WoUS.

Water Sampling Requirements

1. Beale AFB will monitor the use of glyphosate and imazapyr in compliance with Attachment C of the General Permit.

2. All laboratory analyses will be conducted at a laboratory certified by the California Department of Public Health in accordance with California Water Code section 13176.
3. All analyses shall be conducted in accordance with the USEPA's "Guidelines Establishing Test Procedures for Analysis of Pollutants."
4. Visual monitoring of the aquatic herbicide applications will be accomplished for all applications at all sites using a standardized template.
5. Physical and chemical monitoring will be conducted for one application event.
    a. Background samples will be collected upstream at the time of the application event.
    b. Since aquatic herbicides will never be applied to flowing waters, event monitoring samples will be collected immediately outside of the treatment area in non-flowing waters, immediately after the application event, but after sufficient time has elapsed such that treated water would have exited the treatment area.
    c. Post-Event samples will be collected within the treatment area within one week after the application event.
6. Monitoring procedures for physical and chemical properties will follow Table 3.
7. An annual report detailing all required information, as outlined in Attachment C of the General Permit, will be submitted to the state and regional Water Quality Control Board.
8. All samples will be collected in clean, amber glass bottles and properly labeled, including the date and time the sample is collected.
9. Proper personal protective equipment will be worn, including disposable nitrile gloves, to prevent contamination.
10. Samples will be collected without interference from any equipment or vehicles.
11. Samples will be accounted for utilizing a standard "Chain of Custody" form supplied by the laboratory performing the analysis to ensure the integrity of the sample collection and transfer process.
12. Samples will be stored on ice and transported to the lab within appropriate hold times for the required tests.
13. Samples will be transported separately from the aquatic herbicides and application equipment on the day of the application event.

Table 3. Water Sampling Requirements for Aquatic Herbicide Application per the NPDES Permit.

Sample Type	Constituent / Parameter	Sample Method	Sample Type Requirement
Physical	1. Temperature[1] 2. pH[1] 3. Turbidity[1] 4. Electrical conductivity[1]	Grab 3' Below Surface or Mid-depth if Water Body is < 6'	Background, Event and Post Event Monitoring
Chemical	1. Active Ingredient - Imazapyr[2] 2. Active Ingredient – glyphosate[2] 3. Dissolved Oxygen[1]	Grab 3' Below Surface or Mid-depth if Water Body is < 6'	Background, Event and Post Event Monitoring

[1] Field Testing
[2] Laboratory Testing

Aquatic Herbicide Application

1. All applications will be performed by DoD or state certified pesticide applicators.
2. All personnel will follow the storage, mixing, transport, application, and spill response procedures per USEPA and California Department of Pesticide Regulation rules, regulations and label instructions.
3. Aquatic herbicide applicators will ensure daily that application equipment is in proper working order. Aquatic herbicides must be stored inside.
4. Spill response and clean-up supplies will be maintained in all vehicles and pesticide storage areas.
5. All personnel responsible for handling, mixing, or applying pesticides must complete Beale's Spill Prevention, Control, and Countermeasures training annually (Beale has a comprehensive program for the identification, response, and control of hazardous materials spills, with personnel on stand-by to respond to any releases of hazmat, including pesticides, to the environment).
6. Any contaminated media (water or soil) will be contained and cleaned or properly disposed of to the maximum extent possible.
7. Beale personnel will report all spills to appropriate local, state, and federal agencies according to applicable regulations.
8. Over application will be avoided by following the specific product labels for the aquatic herbicide used.
9. Only sufficient material to carry out the treatment will be transported for the day's application.
10. To ensure it functions properly, application equipment is calibrated at least annually unless herbicide label instructions require a more frequent calibration.
11. Beale AFB Environmental Section will train all personnel applying herbicides and pesticides on the Water Quality Order No. 2013-0002-DWQ State General Permit and the requirements of this APAP annually.
12. Aquatic herbicides will never be applied directly to flowing water (if necessary, the base APAP will be amended and re-submitted to the state and regional Water Quality Control Board for approval).
13. Aquatic herbicide applications are only allowed from 2 May to 31 October to avoid the local wet season. In addition, aquatic herbicides will not be applied during any wet weather or 12 hours before or after a rain event (see *General Herbicide Application* BMP #11).
14. Aquatic herbicides will only be applied when winds are less than 5 mph.
15. Herbicide applications near aquatic resources will be done with a pressurized hydraulic sprayer and/or low-pressure backpack sprayers to prevent over application and excess herbicide runoff downstream.
16. Sites potentially requiring aquatic herbicide treatment will be surveyed first to assess the area and any potential impacts if herbicides are applied.

17. Herbicides will be mixed in a designated area with appropriate containment and spill-prevention measures.
18. Trained DoD or state certified pesticide applicators will make an informed decision on the application of aquatic herbicides by scouting the area to be treated, making a positive identification of giant reed present, and checking the herbicide product label for control efficacy.
19. Label instructions will be followed to determine appropriate rates of application and to identify any warnings or conditions that limit the application.
20. The certified applicator may utilize an aquatic approved surfactant according to label instructions in order to improve the penetration and translocation of the herbicide into the weed stumps.

Grazing Management Guidelines (GMG) BMPs

1. Grazing lessees shall adhere to all provisions set forth in the Beale AFB Grazing Operating Agreement, provided to lessees at the time of lease award.
2. In Beale AFB grazing leases, include:
    a. Specific allowed stocking rates but allow for adjustments based on fall residual dry matter (RDM) and other evaluations, monthly livestock reporting requirements, fall RDM targets, animal management specifications, and contingencies for low forage years.
    b. Lessee grazing plans, submitted as a requirement of Beale grazing leases, should include drought, wildfire, and prescribed burn contingency plans. Consider the use of a grassland bank during droughts and following invasive species control treatments or wildfire (see Sections 4.3 and 5.0 of the GMG; Beale AFB 2017b).
3. For the initial grazing season following implementation of the GMG, the Beale AFB stocking rate will be set at 16,097 AUMs (see Section 4.2.2.2 of the *Environmental Assessment of Non-native and Noxious Plant Species Management on Beale Air Force Base and the Lincoln Receiver Site*, Table 4.1 for pasture unit-specific AUMs). The potential cattle grazing season in Management Areas A, B, C, D, and F extends from 1 November through 31 May, with the exception of overnight Holding Fields C4 and C5 that are for temporary use and Pasture Unit C6, which is potentially available from 1 February through 30 April depending on presence of surface water. The horse grazing season in Management Area E pasture units is year-round.
4. RDM will be mapped in each pasture unit every fall, prior to the onset of germinating rains (generally undertaken in early October; see Section 9.1 and Appendix B of the GMG).
    a. Table 4 provides the University of California Agriculture and Natural Resources recommended minimum fall RDM guidelines based on slope. The majority of Beale's pasture units are less than 10% slope, some pasture units do contain slopes of 10-40% and require greater RDM.
    b. If minimum fall RDM targets are not achieved for a given season over a significant area of a pasture unit, the Base Natural Resources Manager may adjust the stocking rate for the following year and/or shorten the season for those pasture units that did not meet fall RDM targets. The lessee(s) will be put on notice in October that fall RDM targets have not been met, that fall RDM targets cannot be missed in a second consecutive year, and that, after a field assessment in the following February, stocking rate and/or grazing season may need to be curtailed for that year to ensure that fall RDM targets are met.

Table 4. Fall Residual Dry Matter (RDM) Targets for Annual Grassland.

0-10 % slope	10-20 % slope	20-40 % slope	>40 % slope
500 lbs/acre	600 lbs/acre	700 lbs/acre	800 lbs/acre

Source: GMG (Beale AFB 2017b) from Bartolome et al. 2006

5. In years when rainfall is running significantly below average, forage production projections, animal numbers, and levels of utilization will be re-evaluated in mid-February. Following the February evaluation, modify livestock use if necessary, either by reducing animal numbers or curtailing the grazing season. Lessees should be informed and participate in fall RDM evaluations and in any February evaluations.
6. Lessees will report monthly AUMs and animal numbers, Beale range technicians will confirm these reports with occasional compliance monitoring (see Section 9.1 of the GMG)
7. Supplemental feeding of livestock is restricted to mineral and limited protein supplements. Salt and mineral licks and other supplements will be placed no less than ¼ mile away from any vernal pools, riparian areas, wetlands, oak seedling protection sites, or other sensitive natural resources, unless approved by the Natural Resources Manager. The placement of salt licks or other attractants will require coordination with the base Cultural Resources Manager.
8. Up-to-date, accurate, and detailed records, including GIS shapefiles, of the base's grazing infrastructure will be maintained to improve planning for management actions related to the grazing program, including infrastructure maintenance (see Section 4.3 of the GMG). Grazing program infrastructure needs will be assessed at least annually. The Cultural Resources Manager will be consulted before construction or removal of livestock fences, ponds, troughs, or livestock water pipelines running cross country.
9. Lessees will move cattle that are soon to give birth out of pasture units near the airfield or implement other approved methods for minimizing BASH hazard. Livestock carcasses will be immediately reported to the Beale Natural Resources Manager and removed as instructed.
10. Livestock grazing impacts will be evaluated, especially regarding bank erosion and special-status wildlife that use riparian habitat, in the grazed sections of Reeds Creek, the Management Area D portions of Hutchinson Creek, and any additional riparian areas subject to grazing (see Section 4.5 of the GMG). Additional riparian zone grazing management will be implemented as necessary to protect these resources.
11. From March through July (or as long as livestock are present), spring cover will be monitored in Beale AFB's black rail breeding marsh habitat and grazing will be reduced in those areas if spring vegetation cover falls below 60% of normal levels (see Section 9.1 of the GMG).
12. An adaptive management process will be implemented when the optimal management activity to achieve a particular management goal is not obvious (see Section 9.3 of the GMG).
13. Wildlife escape ramps will be installed in new livestock troughs and that do not already have them.
14. Blue oak and valley oak recruitment into the sapling stage will be evaluated, especially in Management Area E horse pastures and in Pasture Unit D-6, to ascertain the need for oak seedling protection (see Section 4.5 of the GMG).

Grazing Expansion Fencing Installation Avoidance and Minimization Measures

During informal consultation with USFWS in 2014, Beale AFB discussed and received verbal concurrence on project assumptions for power pole replacements, which required larger excavations than those proposed for fence installation, within and adjacent to vernal pool habitats (USFWS personal communication 2014). The same assumptions were used for actions similar to the power pole replacements (H-brace and gate brace installation):

7. In areas where potential vernal pool shrimp habitat occurs within 100 feet of the Proposed Action Area, additional field analysis will be performed by a Beale AFB biologist to determine whether the project activities may affect the habitat.
8. Access routes will be established in upland areas, when feasible. Where it is necessary for access routes to go through a wetland feature, the work will be completed in the dry season (2 May – 31 October) and matting will be put down to avoid effects to species and/or sensitive habitats.
9. T-posts will be spaced so as to avoid being placed in wetlands.
10. All current, and future fence lines may require annual repair and maintenance. These activities will be implemented so as to avoid and minimize any potential effects on suitable habitat for federally-listed vernal pool shrimp and valley elderberry longhorn beetle to the extent possible.
11. All new posts for H-braces will be placed greater than 12.5 feet from any potential vernal pool shrimp habitat to avoid all direct and indirect effects (USFWS 2014).
12. Activities that may damage or kill an elderberry shrub (e.g., trenching, paving, etc.) may need an avoidance area of at least 6 meters (20 feet) from the drip-line, depending on the type of activity. A USFWS-approved biologist will determine if/when this is necessary prior to construction.
13. Work will be limited to the greatest extent possible in areas with elderberry shrubs within 50 feet of the proposed infrastructure locations during the flight season of valley elderberry longhorn beetle (March-July).
14. Any applicable general AMMs will be implemented as required.

Soil Protection BMPs

1. Herbicide application will not occur within the established buffers for aquatic features shown in Table 1.
2. Maintain effective soil cover as follows: 70% or greater on slopes exceeding 35%, shallow soils or other soils with high runoff potential, soils within riparian areas; effective soil cover of 50% or greater for all other areas. Apply weed free mulch where treatment causes effective soil cover to be deficient. It is not necessary to consider effective soil cover where soil cover is not normally expected such as road treads and quarries.
    a. Effective soil cover shall be defined as …"living vegetation (grasses, forbs and prostrate shrubs), plant and tree litter (fine organic matter), surface rock fragments, and applied mulches (straw or chips)". Surface rock fragments do not include those fragments partially imbedded in the soil surface).
3. Annual herbicide treatments within 150 feet from the water's edge will not exceed 10 acres of treatment along any 1.6 miles of stream.

4. Avoid application of Aminopyralid sprayed mulch materials on revegetation sites.
5. Hand pulling or wrenching of invasive plants along streambanks or natural lake or pond shorelines will not exceed 20% of the stream reach or 20% of the shoreline.

Prescribed Fire BMPs

A Prescribed Fire Plan following the National Wildfire Coordinating Group template (NWCG 2018) will be created for each prescribed burn unit. The template is filled out following the *Interagency Prescribed Fire Planning and Implementation Procedures Guide* (NWCG 2017). Generic BMPs for Beale AFB are included below:

General

1. Prior to Ignition: If any prescription element is outside the approved prescription on the hot/dry side, but all other elements are such that the flame lengths stay within the approved level, the burn is considered to still be within prescription. Prior to commencing ignition, a BehavePlus run must be conducted, using on-site weather readings, showing that the burn will still produce flame lengths less than 4 feet if the burn spreads outside the unit boundary. This will be documented and retained.
2. During Ignition: If the on-site environmental conditions exit the prescription parameters in any element during the ignition phase, the Burn Boss may choose to continue firing to square up burn area, do defensive firing, or hold and monitor firing as necessary until weather/fuel conditions come back into prescription. Burn Boss may only continue firing if objectives are being met.
6. Prior To and During Ignition: The Burn Boss will take into consideration the potential smoke impact to sensitive receptors. This will be based on wind direction, mixing height, and on the ground conditions.
7. All prescribed burns are dependent on Beale AFB's mission activity. Burning may be completed on weekends with enough time for ignition, burn down, and mop-up to declare out. Weekday operations are allowable, with airspace coordination a Notice to Airman filed.
8. An approved notification list must be developed as part of the Prescribed Fire Plan, and residences in the smoke impact area will be notified in advance by phone or other media sources. Prescribed fire notifications will be done on the day of the prescribed fire and via email 5-7 days before a planned prescribed fire. The Wildland Fire Program Coordinator would confirm that these contacts have been made according to the Prescribed Fire Plan notification list. Adjacent landowners with living quarters within one mile of a prescribed fire would be notified of plans to burn at least 48 hours ahead of the scheduled prescribed fire.

On Site

1. All mowing/ground disturbance will be coordinated with the Beale AFB Natural Resources Manager.
2. Ensure existing paved roads to be used as control lines are adequate, and clear of debris or obstructions. Evaluate if there is a need for contingency lines.
3. Ensure lines that are designated as wet lines are mowed prior to ignitions.
4. Initial monitoring of weather and fuel moisture will begin a minimum of 48 hours prior to ignition, the schedule of which will be dictated by the Burn Boss.

5. On the day of the burn weather measurements will be recorded at a minimum of every hour. A daily/post burn summary documentation sheet will be given to the weather monitor daily.
6. Prep any power poles that are next to or near containment lines prior to ignitions. These power poles will be identified and located prior days of ignition. Make it known that they are in the area during morning briefing.

Forecasts

1. A spot weather forecast is required for all days of ignition where prescribed burning is planned. The forecast should at a minimum include: General Weather Discussion Specific to Work Location, Max/Min. Temperature, Wind Speed/Gusts/Direction (20 foot & ridgetop), Smoke Dispersion, Three Day Outlook, Smoke management forecast would be obtained by going to the Prescribed Fire Information Reporting System site. Spot or area forecast will be used to determine mop-up and patrol needs. Copies will be retained in the project file.
2. Each day prior to ignitions, utilize the Prescribed Fire Information Reporting System to request air quality clearance for burning. Request should be placed by 1500 hours the day prior to each planned ignition.
3. Smoke Sensitive Receptors: Prior to and during ignition, the Burn Boss will take into consideration the potential to effect smoke sensitive receptors. Forecasts will be monitored for mixing height and transport wind speed/direction and on the ground smoke conditions will be monitored during the burn.

Occupational Safety

1. All military, civilian, contractor, and emergency services personnel involved in wildland fire management must possess certifications appropriate for their expected level of involvement in the wildland fire organization. Individuals will not be assigned to duties for which they are not adequately trained or certified, unless they are assigned as a trainee under the direct supervision of a qualified person.
   a. Beale AFB FES personnel, whether on wildfires or prescribed fires, must meet National Wildfire Coordinating Group training standards contained in PMS 310-1, *National Incident Management System: Wildland Fire Qualification System Guide* (PMS 310-1; NWCG 2019a), and associated supplement.
   b. Any instructor utilized must be National Wildfire Coordinating Group qualified and must adhere to the standards stated in PMS 901-1, *NWCG Standards for Course Delivery* (NWCG 2019b).
   c. USAF personnel who participate in wildland fire activities will be certified, as a minimum requirement, in Cardio-Pulmonary Resuscitation and Standard First Aid by the American Red Cross or comparable certification authority.
   d. All personnel operating ATVs or UTVs on the fireline are required to obtain ATV/UTV safety certification from the ATV Safety Institute or an equivalent certifying agency.
   e. In compliance with the National Wildfire Coordinating Group standards, annual safety refresher training and work capacity test at the arduous level is a requirement.
2. All personnel are issued fire-resistant clothing, a hard hat with chinstrap and shroud, fire shelter, leather gloves, leather boots minimum of 8 inches tall, eye protection and hearing protection. Personnel must use the appropriate PPE in conjunction with their assigned task. Additionally, chainsaw chaps will be available and required for sawyer assignments. PPE

requirements are detailed in Section 4.1.1.2.1 of the Wildland Fire Management Plan (Beale AFB 2018c), and individual Prescribed Fire Plans.

3. Any proposed prescribed fires in the controlled airfield area must be approved in advance by the USAF Safety Center.
4. Any safety issues that have the potential to cause an aviation-related mishap will be reported on the Aviation Safety Communiqué webpage.
5. Mobilization: All personnel will follow Agency and Inter-Agency policy regarding work/rest guidelines and driving for mobilization and demobilization (wear seat belts and no smoking).
6. Operational: If portions of the prescribed burn area located along Wildland-Urban Interface, the potential exists for civilians to enter burn area. Care should be taken while working near Wildland-Urban Interface. Area will be cleared of unqualified personnel and public prior to ignition. UTV and equipment use will be performed by agency qualified personnel.
7. Unexploded Ordinance: If suspicious items are encountered, personnel will STOP, report to Burn Boss, and mark general area.
8. Emergency Medical Procedures, including chain of command that will be followed will be outlined in individual Prescribed Fire Plans.

Natural Resource Protection BMPs

1. Nesting bird surveys will be conducted prior to prescribed burns conducted from 1 March – 31 August. In grasslands this may be accomplished by holding a rope between two people and dragging it through the grass. If a bird is flushed, the area it flushed from would be checked for signs of nesting.
2. Consideration of Water Quality in Formulating Fire Prescriptions: Provide for water quality protection while achieving the management objectives through the use of prescribed fire. Prescription elements may include, but are not limited to, such factors as fire weather, slope, aspect, and fuel moisture. These elements influence the fire intensity and thus have a direct effect on meeting the desired ground-cover requirements.
    a. Direct ignition will take place outside designated aquatic resource buffers (where applicable), but fire is permitted to back into the buffer areas.
    b. Both the optimum and allowable limits for the burn to ensure water quality protection will be established prior to preparation of the Prescribed Fire Plan.
    c. Effects of prescribed fire within the aquatic resource buffers will be assessed and mitigation measures, such as mulching or lop and scatter of existing vegetation, may be prescribed for the specific aquatic feature.
3. Protection of Water Quality from Prescribed Burning Effects: To maintain soil productivity, minimize erosion, and prevent ash, sediment, and nutrients from entering water bodies:
    a. construct waterbars in fire lines (as-needed in areas where it will not cause additional disturbance to sensitive resources);
    b. reduce fuel loading in drainage channels;
    c. maintain the integrity of the aquatic resources within limits of the Prescribed Fire Plan;
    d. burn within prescription to avoid intense fires, which may promote hydrophobicity, nutrient leaching, and erosion; and/or
    e. retain or plan for sufficient ground cover to prevent erosion of the burned site.

4. Riparian Protection Buffers: Riparian buffers will be established around perennial/large streams (Dry Creek/Best Slough, Reeds Creek, Hutchinson Creek) and permanent water bodies. The purpose of the riparian buffer is to minimize impacts from management activities to the stream-adjacent zone and riparian habitat. The following are specified widths of the riparian buffer related to stream types:
   a. Perennial streams or lakes with native riparian corridor or desirable aquatic vegetation - 100 feet slope distance from the edge of the existing riparian/aquatic vegetation.
   b. Perennial/Seasonal Streams without a riparian corridor or desirable vegetation - 50 feet slope distance from the apparent high water mark.
   c. To minimize the spread of fire into riparian vegetation during prescribed fire activities, no direct ignition will occur within the riparian buffer. Fire may back into the riparian buffer.
   d. No pile burning will occur within the riparian buffers or within ephemeral aquatic resources.
   e. The riparian buffer may vary in width if needed to achieve fuels or resource protection objectives upon field review by resource specialists.

Cultural Resource Avoidance and Minimization Measures

1. All invasive plant control activities will be reviewed and approved by the Beale AFB Cultural Resources manager via the USAF 103 process.
2. Livestock-holding areas (e.g., corrals), livestock water sources, and mineral supplements will be placed outside of cultural resource site boundaries.
3. The location of permanent or temporary livestock infrastructure will be reviewed and approved by the Cultural Resources manager via the USAF 103 process, and will be placed outside of cultural resource boundaries.
4. Sensitive area maps will be created for fire personnel if prescribed burns will be conducted in areas containing cultural resources.
5. Fire response vehicles and heavy equipment will be excluded from cultural resource boundaries.
6. If excessive vegetation that could cause extreme heat is growing on or near cultural resources it will be removed by hand or using non-soil disturbing equipment prior to conducting prescribed burns in the area.
7. Herbicide will not be applied directly to archeological features.
8. Beale AFB is considering establishment of gathering areas for traditional stewardship of sensitive cultural sites and native plants for use by associated tribes. Herbicide use within such sites may not be allowed once established, per traditional management practices.
9. Any invasive plant treatment located near sensitive cultural resources will be done by hand or machinery that will not cause soil disturbance (e.g., mowers, weed whackers, etc.).
10. Restoration treatments in areas with sensitive cultural resources will be limited to re-seeding or planting of seedlings (i.e., no planting of large specimens that require soil disturbance).

Nesting Birds BMPs for Project Sites

1. Pre-construction surveys for migratory bird nests are required for any construction projects or maintenance activities conducted during the breeding season (1 March -31 August).
2. Incomplete or empty nests will be removed; nests containing eggs or chicks are not to be removed. Birds exhibiting nesting behavior in construction areas are hazed when possible (excludes federally protected species).
3. Once nests are established, avoidance is the only practical protection measure. A buffer is flagged around active nests at a distance that is sufficient to protect the nest from disturbance by project activities.
4. Contractors are encouraged to conduct any project-related vegetation removal before 1 March.
5. Proactive exclusion measures are encouraged to prevent birds from using areas and structures where construction will occur.
6. Other methods to discourage nesting birds include noise cannons and scarecrows or other visual deterrents.
7. If nest removal or re-location cannot be avoided, permits are obtained from USFWS on an as-needed basis by 9 CES/CEIEC.
8. Injured or trapped birds will be reported to 9 CES/CEIEC. Trapped birds will be freed or exit holes created, and injured native birds are taken to rehabilitation facilities by permitted 9 CES/CEIEC staff.

Contracted Services Design Features from Air Force Manual 32-1053, Pest Management

1. Pest management contracts may be used when more cost effective than in-house services. All pest management contractors must use processes and procedures identified in the installation pest management plan. Contractors shall comply with the pesticide certification, licensing, and registration requirements of the state or country where the work is performed.
2. The MAJCOM Pest Management Coordinator will review and approve all performance work statements for contracted pest management services. Installation personnel must receive MAJCOM Pest Management Coordinator approval before making a request for procuring commercial pest management service.
3. The Civil Engineering contract management office will work with the installation contracting office to ensure all prospective contractors send proof that all their personnel have current state pesticide applicator certifications for the types of operations specified in the contract statement of work prior to starting work.
4. The prospective contractor must operate in compliance with state and local regulations that apply. All pest management contractors must also comply with DoDI 4150.07, *DoD Pest Management Program*, (DoD 2011) and contents of AFI 32-1053, *Integrated Pest Management Program*, (USAF 2014) that apply to contract pest management operations.
5. Only state-certified contract pesticide applicators may mix or apply pesticides on continental USAF installations.
6. The contracting officer and integrated PMC shall approve the location where pesticides are mixed or stored prior to starting work. This site should have secondary containment and

backflow prevention as identified in Armed Forces Pest Management Board Technical Guide No. 17. The contractor will properly manage the area to prevent spills.

7. The contractor must comply with all applicable parts of 29 CFR Part 1910, *Occupational Safety and Health Standards*, 29 CFR Part 1925, *Safety and Health Standards for Federal Service Contracts*, 40 CFR Parts 150-189 and 49 CFR Part 171, *Hazardous Materials Regulations*, while on a USAF installation.

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APPENDIX H

Air Conformity Applicability Model (ACAM) Reports

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

1. General Information

- Action Location
Base: BEALE AFB
State: California
County(s): Placer; Yuba
Regulatory Area(s): Sacramento, CA; NOT IN A REGULATORY AREA; Yuba City-Marysville, CA

- Action Title: Non-Native and Noxious Plant Species Management - Beale AFB and Lincoln Receiver Site (LRS)

- Project Number/s (if applicable): N/A

- Projected Action Start Date: 1 / 2020

- Action Purpose and Need:
The purpose of the Proposed Action is to manage plant species on Beale AFB and the Lincoln Receiver Site to reduce the prevalence of non-native vegetation in order to protect and preserve the military mission, ecosystem function, and valued resources and programs. The need for the Proposed Action is to address the threats of numerous non-native plant species on Beale AFB. There is a need for elimination or control of known priority infestations, and for prevention of the establishment of new infestations of invasive plants. If allowed to spread unchecked, non-native plant species will degrade the remaining native habitat; interfere with management of sensitive resources, economic activities, and quality of life; and impede the military mission.

- Action Description:
Beale AFB proposes to manage non-native plant species on the installation and at the Lincoln Receiver Site GSU in order to satisfy resource management goals outlined in the installation INRMP (Beale AFB 2019) and other installation management plans. Implementation of a procedural approach incorporating an integrated pest management (IPM) process will reduce the negative effects of these species under a manageable annual scope of work. Treatments could include but are not limited to broad-scale actions such as grazing and prescribed fire, targeted treatments including manual/mechanical and chemical applications, habitat enhancement activities, and biosecurity actions. The annual scope of work presented for each alternative and associated BMPs allow for predictable reduction of non-native plant species and inform the associated effects analyses presented in Chapter 4.

The current installation INRMP (Beale AFB 2019) includes several goals, objectives, and projects that provide explicit drivers for non-native plant species management, framed in terms of conserving and benefiting sensitive, threatened, and endangered species and their habitats; reducing the potential for BASH incidents; and maintaining a sustainable rangeland ecosystem that reduces fire hazard and supports the Beale AFB livestock grazing program. Over the past several years, new invasive plant management science and recommended methodologies have become available; invasive species mapping surveys have been performed; and local sensitive and invasive species data have been collected and analyzed. Beale AFB proposes to satisfy non-native plant species and resource management goals as outlined in the INRMP and other installation management plans in accordance with current available data and information, in the safest, most cost effective, efficient, and effectual way possible

Alternative 1 - No Action:
The No Action Alternative is required by law to be analyzed fully and serves as a baseline for comparison with the action alternatives. Under the No Action Alternative, current management activities will be maintained, including manual/mechanical activities, chemical applications, grazing, and burning. Implementation of these activities will lack a programmatic, cohesive approach and long-term strategy, and will not assimilate the most current science, effective treatment methods, or integrated approaches. While measures under this alternative will help slow the spread of non-native plant species, they are not enough to prevent the expansion of infestations. Current management addresses approximately 728 acres a year on average (excluding grazing operations), which is less than 3 percent of the base, and therefore achieves little, if any net gain in control (see

Table 2.4), conservation benefit, or mission support since non-native vegetation continually re-invades when seed sources are not adequately controlled. Specifically, it allows Containment Stage species to expand base-wide (see Table 2.5), reaching the Asset-Based Protection Stage and gives Eradication Stage species the opportunity to reach Containment Stage within 15 years.

Current management activities include limited and small scale manual/mechanical control (less than 50 acres annually); chemical applications for approximately 13 acres of Himalayan blackberry and 75 acres of yellow star thistle in locations where its presence affects Bird Airstrike Hazard (BASH) at the airfield; small, individual habitat enhancement sites; grazing operations on approximately 12,800 acres within 36 pastures that have been grazed for 30+ years, without the ability to expand grazing operations to new areas, change stocking rates, or vary residual dry matter (RDM) targets (a measure of consumed vegetation that is dependent on stocking rates) to adjust to annual weather variability or specific invasive species goals; and sporadic burning activities often limited to less than 100 acres. Environmental impacts for these activities are analyzed on a project-by-project basis using the AF EIAP.

The current limitations on grazing locations and the inability to vary grazing management techniques (i.e., targeted prescriptions, RDM, and stocking rates), together with currently limited fire management activities, create negative impacts on ungrazed wildlands, which are highly invaded, and perpetuate current problems such as the high cover of medusahead in current pastures. According to the Director of the University of California Sierra Foothill Research and Extension Center, the cover of medusahead at Beale AFB is the worst he’s ever seen at any location in northern California.

This alternative does not meet the purpose and need because current management activities lack a programmatic approach and long-term strategy; effective scale; and don't consider the most current science, data and analyses, and management recommendations. Ten years of range monitoring and survey data, analysis, and results; new science; and new management techniques and recommendations are now available but are not being utilized in current management activities. This alternative does not satisfy current INRMP and other management goals and does not optimize cost, efficacy, and efficiency.

Alternative 2 - Preferred Alternative:

Alternative 2, the Preferred Alternative, is to manage non-native plant species in order to reduce their prevalence using an efficient, sustainable, and long-term strategy that incorporates a programmatic, adaptive approach, maximizes opportunities for stewardship of sensitive resources, and utilizes a varied toolkit of control methods including manual/mechanical activities, chemical applications, grazing, and burning. The current Beale AFB INRMP (Beale AFB 2019) contains several goals, objectives, and projects that provide explicit drivers for invasive species control. The Updated Invasive Plant Species Management Guidelines (IPSMG; Beale AFB 2017a) and Grazing Management Guidelines (GMG; Beale AFB 2017c) were developed to guide their achievement. The Wildland Fire Management Plan (WFMP; Beale AFB 2018) includes guidance for invasive plant control using prescribed burning. These documents are incorporated by reference in this EA, and are included as Appendices x, x &x respectively.

The IPSMG, based on the current science, data, and recommendations, and designed to be reviewed and updated regularly as conditions, science, and drivers change, provide the foundation for this alternative. The IPSMG is intended to be used by Beale AFB Natural Resource staff and contractors who manage vegetation on the installation. Beale AFB has managed both sensitive species and non-native species for many years, but a concerted effort to manage both together may be more effective and is the approach adopted in the IPSMG.

Successful containment/control often requires multiple years of treatment, and sometimes requires multiple treatments per year involving a combination of methods. To increase the likelihood of successful long-term control, invasive plant management experts often recommend combining several management methods, tailored to situation-specific goals, constraints, and opportunities. Treatments are tailored based upon:

• The target invasive plant species and its biology (e.g., mode of reproduction).
• Population size and density.
• Site type (e.g., disturbed roadside, riparian, upland).
• Prior treatments and their efficacy.

The IPSMG includes protocols for preventing the spread of existing non-native plant species and the introduction of new species, methods for controlling specific non-native species, and general management strategies for the sensitive species and habitats on the installation. For certain species and situations, asset-based work plans are advantageous. Mechanical and manual methods, chemical treatments, grazing, and burning are all effective treatment methods for specific species in specific situations. For all control methods, timing of

treatment to coincide with the vulnerable phenological stage of the target species is an essential consideration (Beale AFB 2017a). The IPSMG includes specific situational and species work plans.
While the preferred alternative is designed to reduce overall non-native plant cover, it also simultaneously aims to improve forage quality for grazing animals, as grazing is the primary tool for controlling non-native species biomass. Improving forage quality equates to maintaining or increasing certain desirable non-native species, often referred to as naturalized species (normally annual grasses and forbs) that have been on the landscape for decades or centuries (i.e. Erodium sp.). Such species are too ubiquitous to warrant control, do not threaten the ecosystem like non-natives targeted for control, and provide a benefit, primarily supporting cattle grazing operations, which provide other non-native species control benefits.

Beale AFB 2017a) and Grazing Management Guidelines (GMG; Beale AFB 2017c) were developed to guide their achievement. The Wildland Fire Management Plan (WFMP; Beale AFB 2018) includes guidance for invasive plant control using prescribed burning. These documents are incorporated by reference in this EA, and are included as Appendices x, x &x respectively.
The IPSMG, based on the current science, data, and recommendations, and designed to be reviewed and updated regularly as conditions, science, and drivers change, provide the foundation for this alternative. The IPSMG is intended to be used by Beale AFB Natural Resource staff and contractors who manage vegetation on the installation. Beale AFB has managed both sensitive species and non-native species for many years, but a concerted effort to manage both together may be more effective and is the approach adopted in the IPSMG.
Successful containment/control often requires multiple years of treatment, and sometimes requires multiple treatments per year involving a combination of methods. To increase the likelihood of successful long-term control, invasive plant management experts often recommend combining several management methods, tailored to situation-specific goals, constraints, and opportunities. Treatments are tailored based upon:
• The target invasive plant species and its biology (e.g., mode of reproduction).
• Population size and density.
• Site type (e.g., disturbed roadside, riparian, upland).
• Prior treatments and their efficacy.
The IPSMG includes protocols for preventing the spread of existing non-native plant species and the introduction of new species, methods for controlling specific non-native species, and general management strategies for the sensitive species and habitats on the installation. For certain species and situations, asset-based work plans are advantageous. Mechanical and manual methods, chemical treatments, grazing, and burning are all effective treatment methods for specific species in specific situations. For all control methods, timing of
treatment to coincide with the vulnerable phenological stage of the target species is an essential consideration (Beale AFB 2017a). The IPSMG includes specific situational and species work plans.
While the preferred alternative is designed to reduce overall non-native plant cover, it also simultaneously aims to improve forage quality for grazing animals, as grazing is the primary tool for controlling non-native species biomass. Improving forage quality equates to maintaining or increasing certain desirable non-native species, often referred to as naturalized species (normally annual grasses and forbs) that have been on the landscape for decades or centuries (i.e. Erodium sp.). Such species are too ubiquitous to warrant control, do not threaten the ecosystem like non-natives targeted for control, and provide a benefit, primarily supporting cattle grazing operations, which provide other non-native species control benefits.

Alternative 3 – Limited Control Methods – Same as Alternative 2 Excluding Chemical Treatments:
This alternative would not meet the purpose and need because many invasive species cannot be controlled without chemical treatments (herbicide applications). Manual and mechanical treatments can be too costly for large infestations, and other control methods are not effective on certain species. This alternative does not satisfy current INRMP and other management goals and does not optimize cost, efficacy, and efficiency. This alternative is not carried forward for analysis in this EA.

- Point of Contact

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Organization:	AFCEC/CZOW
Email:	
Phone Number:	

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Activity List:

Activity Type		Activity Title
2.	Personnel	Alternative 1 - No Action

Emission factors and air emission estimating methods come from the United States Air Force's Air Emissions Guide for Air Force Stationary Sources, Air Emissions Guide for Air Force Mobile Sources, and Air Emissions Guide for Air Force Transitory Sources.

2. Personnel

2.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Placer; Yuba
Regulatory Area(s): Sacramento, CA; NOT IN A REGULATORY AREA; Sacramento, CA; Yuba City-Marysville, CA

- Activity Title: Alternative 1 - No Action

- Activity Description:
Under the No-Action Alternative, the Preferred Alternative (or any of the action alternatives) would not occur and current management activities would continue, which include limited and small-scale manual/mechanical control and chemical applications; grazing without the ability to expand operations into new areas, change stocking rates, or vary residual dry matter (RDM) targets (a measure of consumed vegetation that is dependent on stocking rates) in accordance with annual weather variability or specific non-native species control goals; and sporadic burning activities.

- Activity Start Date
Start Month: 1
Start Year: 2020

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions:

Pollutant	Emissions Per Year (TONs)
VOC	0.042521
SO_x	0.000506
NO_x	0.023116
CO	0.275803
PM 10	0.006662

Pollutant	Emissions Per Year (TONs)
PM 2.5	0.002896
Pb	0.000000
NH_3	0.003409
CO_2e	48.7

2.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 0
Civilian Personnel: 2
Support Contractor Personnel: 9

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: No

- Average Personnel Round Trip Commute (mile): 80

- Personnel Work Schedule
Active Duty Personnel: 5 Days Per Week
Civilian Personnel: 5 Days Per Week
Support Contractor Personnel: 10 Days Per Month
Air National Guard (ANG) Personnel: 4 Days Per Week
Reserve Personnel: 4 Days Per Month

2.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

2.4 Personnel Emission Factor(s)

- On Road Vehicle Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.114	000.003	000.084	000.992	000.047	000.020		000.023	00298.845
LDGT	000.288	000.004	000.178	001.871	000.048	000.021		000.024	00379.038
HDGV	000.600	000.011	001.339	008.875	000.183	000.078		000.045	01128.468
LDDV	000.026	000.003	000.125	000.281	000.060	000.032		000.008	00271.718
LDDT	000.094	000.003	000.533	000.594	000.112	000.082		000.008	00364.857
HDDV	000.194	000.014	004.796	001.133	000.211	000.117		000.028	01514.699
MC	004.452	000.002	001.252	023.791	000.019	000.009		000.054	00187.891

2.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year
$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year
$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_C: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year
$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF CONFORMITY ANALYSIS (ROCA)

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform an analysis to assess the potential air quality impact/s associated with the action in accordance with the Air Force Instruction 32-7040, Air Quality Compliance And Resource Management; the Environmental Impact Analysis Process (EIAP, 32 CFR 989); and the General Conformity Rule (GCR, 40 CFR 93 Subpart B). This report provides a summary of the ACAM analysis.

a. Action Location:
Base: BEALE AFB
State: California
County(s): Placer; Yuba
Regulatory Area(s): Sacramento, CA; NOT IN A REGULATORY AREA; Yuba City-Marysville, CA

b. Action Title: Non-Native and Noxious Plant Species Management - Beale AFB and Lincoln Receiver Site (LRS)

c. Project Number/s (if applicable): N/A

d. Projected Action Start Date: 1 / 2020

e. Action Description:

Beale AFB proposes to manage non-native plant species on the installation and at the Lincoln Receiver Site GSU in order to satisfy resource management goals outlined in the installation INRMP (Beale AFB 2019) and other installation management plans. Implementation of a procedural approach incorporating an integrated pest management (IPM) process will reduce the negative effects of these species under a manageable annual scope of work. Treatments could include but are not limited to broad-scale actions such as grazing and prescribed fire, targeted treatments including manual/mechanical and chemical applications, habitat enhancement activities, and biosecurity actions. The annual scope of work presented for each alternative and associated BMPs allow for predictable reduction of non-native plant species and inform the associated effects analyses presented in Chapter 4.

The current installation INRMP (Beale AFB 2019) includes several goals, objectives, and projects that provide explicit drivers for non-native plant species management, framed in terms of conserving and benefiting sensitive, threatened, and endangered species and their habitats; reducing the potential for BASH incidents; and maintaining a sustainable rangeland ecosystem that reduces fire hazard and supports the Beale AFB livestock grazing program. Over the past several years, new invasive plant management science and recommended methodologies have become available; invasive species mapping surveys have been performed; and local sensitive and invasive species data have been collected and analyzed. Beale AFB proposes to satisfy non-native plant species and resource management goals as outlined in the INRMP and other installation management plans in accordance with current available data and information, in the safest, most cost effective, efficient, and effectual way possible

Alternative 1 - No Action:
The No Action Alternative is required by law to be analyzed fully and serves as a baseline for comparison with the action alternatives. Under the No Action Alternative, current management activities will be maintained, including manual/mechanical activities, chemical applications, grazing, and burning. Implementation of these activities will lack a programmatic, cohesive approach and long-term strategy, and will not assimilate the most current science, effective treatment methods, or integrated approaches. While measures under this alternative will help slow the spread of non-native plant species, they are not enough to prevent the expansion of infestations. Current management addresses approximately 728 acres a year on average (excluding grazing operations), which is less than 3 percent of the base, and therefore achieves little, if any net gain in control (see Table 2.4), conservation benefit, or mission support since non-native vegetation continually re-invades when seed sources are not adequately controlled. Specifically, it allows Containment Stage species to expand base-wide (see Table 2.5), reaching the Asset-Based Protection Stage and gives Eradication Stage species the opportunity to reach Containment Stage within 15 years.

Current management activities include limited and small scale manual/mechanical control (less than 50 acres annually); chemical applications for approximately 13 acres of Himalayan blackberry and 75 acres of yellow star thistle in locations where its presence affects Bird Airstrike Hazard (BASH) at the airfield; small, individual habitat enhancement sites; grazing operations on approximately 12,800 acres within 36 pastures that have been grazed for 30+ years, without the ability to expand grazing operations to new areas, change stocking rates, or vary residual dry matter (RDM) targets (a measure of consumed vegetation that is dependent on stocking rates) to adjust to annual weather variability or specific invasive species goals; and sporadic burning activities often limited to less than 100 acres. Environmental impacts for these activities are analyzed on a project-by-project basis using the AF EIAP.
The current limitations on grazing locations and the inability to vary grazing management techniques (i.e., targeted prescriptions, RDM, and stocking rates), together with currently limited fire management activities, create negative impacts on ungrazed wildlands, which are highly invaded, and perpetuate current problems such as the high cover of medusahead in current pastures. According to the Director of the University of California Sierra Foothill Research and Extension Center, the cover of medusahead at Beale AFB is the worst he's ever seen at any location in northern California.
This alternative does not meet the purpose and need because current management activities lack a programmatic approach and long-term strategy; effective scale; and don't consider the most current science, data and analyses, and management recommendations. Ten years of range monitoring and survey data, analysis, and results; new science; and new management techniques and recommendations are now available but are not being utilized in current management activities. This alternative does not satisfy current INRMP and other management goals and does not optimize cost, efficacy, and efficiency.

Alternative 2 - Preferred Alternative:
Alternative 2, the Preferred Alternative, is to manage non-native plant species in order to reduce their prevalence using an efficient, sustainable, and long-term strategy that incorporates a programmatic, adaptive approach, maximizes opportunities for stewardship of sensitive resources, and utilizes a varied toolkit of control methods including manual/mechanical activities, chemical applications, grazing, and burning. The current Beale AFB INRMP (Beale AFB 2019) contains several goals, objectives, and projects that provide explicit drivers for invasive species control. The Updated Invasive Plant Species Management Guidelines (IPSMG; Beale AFB 2017a) and Grazing Management Guidelines (GMG; Beale AFB 2017c) were developed to guide their achievement. The Wildland Fire Management Plan (WFMP; Beale AFB 2018) includes guidance for invasive plant control using prescribed burning. These documents are incorporated by reference in this EA, and are included as Appendices x, x &x respectively.
The IPSMG, based on the current science, data, and recommendations, and designed to be reviewed and updated regularly as conditions, science, and drivers change, provide the foundation for this alternative. The IPSMG is intended to be used by Beale AFB Natural Resource staff and contractors who manage vegetation on the installation. Beale AFB has managed both sensitive species and non-native species for many years, but a concerted effort to manage both together may be more effective and is the approach adopted in the IPSMG. Successful containment/control often requires multiple years of treatment, and sometimes requires multiple treatments per year involving a combination of methods. To increase the likelihood of successful long-term control, invasive plant management experts often recommend combining several management methods, tailored to situation-specific goals, constraints, and opportunities. Treatments are tailored based upon:
• The target invasive plant species and its biology (e.g., mode of reproduction).
• Population size and density.
• Site type (e.g., disturbed roadside, riparian, upland).
• Prior treatments and their efficacy.
The IPSMG includes protocols for preventing the spread of existing non-native plant species and the introduction of new species, methods for controlling specific non-native species, and general management strategies for the sensitive species and habitats on the installation. For certain species and situations, asset-based work plans are advantageous. Mechanical and manual methods, chemical treatments, grazing, and burning are all effective treatment methods for specific species in specific situations. For all control methods, timing of treatment to coincide with the vulnerable phenological stage of the target species is an essential consideration (Beale AFB 2017a). The IPSMG includes specific situational and species work plans.
While the preferred alternative is designed to reduce overall non-native plant cover, it also simultaneously aims to improve forage quality for grazing animals, as grazing is the primary tool for controlling non-native species

biomass. Improving forage quality equates to maintaining or increasing certain desirable non-native species, often referred to as naturalized species (normally annual grasses and forbs) that have been on the landscape for decades or centuries (i.e. Erodium sp.). Such species are too ubiquitous to warrant control, do not threaten the ecosystem like non-natives targeted for control, and provide a benefit, primarily supporting cattle grazing operations, which provide other non-native species control benefits.

Beale AFB 2017a) and Grazing Management Guidelines (GMG; Beale AFB 2017c) were developed to guide their achievement. The Wildland Fire Management Plan (WFMP; Beale AFB 2018) includes guidance for invasive plant control using prescribed burning. These documents are incorporated by reference in this EA, and are included as Appendices x, x &x respectively.
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• The target invasive plant species and its biology (e.g., mode of reproduction).
• Population size and density.
• Site type (e.g., disturbed roadside, riparian, upland).
• Prior treatments and their efficacy.
The IPSMG includes protocols for preventing the spread of existing non-native plant species and the introduction of new species, methods for controlling specific non-native species, and general management strategies for the sensitive species and habitats on the installation. For certain species and situations, asset-based work plans are advantageous. Mechanical and manual methods, chemical treatments, grazing, and burning are all effective treatment methods for specific species in specific situations. For all control methods, timing of treatment to coincide with the vulnerable phenological stage of the target species is an essential consideration (Beale AFB 2017a). The IPSMG includes specific situational and species work plans.
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Alternative 3 – Limited Control Methods – Same as Alternative 2 Excluding Chemical Treatments:
This alternative would not meet the purpose and need because many invasive species cannot be controlled without chemical treatments (herbicide applications). Manual and mechanical treatments can be too costly for large infestations, and other control methods are not effective on certain species. This alternative does not satisfy current INRMP and other management goals and does not optimize cost, efficacy, and efficiency. This alternative is not carried forward for analysis in this EA.

f. Point of Contact:

Name:	Darren Rector
Title:	GS-13/Remedial Program Manager
Organization:	AFCEC/CZOW
Email:	
Phone Number:	

2. Analysis: Total combined direct and indirect emissions associated with the action were estimated through ACAM on a calendar-year basis for the “worst-case” and “steady state” (net gain/loss upon action fully

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF CONFORMITY ANALYSIS (ROCA)

implemented) emissions. General Conformity under the Clean Air Act, Section 1.76 has been evaluated for the action described above according to the requirements of 40 CFR 93, Subpart B.

Based on the analysis, the requirements of this rule are: _____ applicable
__X__ not applicable

Conformity Analysis Summary:

2020

Pollutant	Action Emissions (ton/yr)	GENERAL CONFORMITY	
		Threshold (ton/yr)	Exceedance (Yes or No)
Sacramento, CA			
VOC	0.043	100	No
NOx	0.023	100	No
CO	0.276		
SOx	0.001	100	No
PM 10	0.007		
PM 2.5	0.003	100	No
Pb	0.000		
NH3	0.003	100	No
CO2e	48.7		
NOT IN A REGULATORY AREA			
VOC	0.043		
NOx	0.023		
CO	0.276		
SOx	0.001		
PM 10	0.007		
PM 2.5	0.003		
Pb	0.000		
NH3	0.003		
CO2e	48.7		
Sacramento, CA			
VOC	0.043		
NOx	0.023		
CO	0.276	100	No
SOx	0.001		
PM 10	0.007		
PM 2.5	0.003		
Pb	0.000		
NH3	0.003		
CO2e	48.7		
Yuba City-Marysville, CA			
VOC	0.043	100	No
NOx	0.023	100	No
CO	0.276		
SOx	0.001	100	No
PM 10	0.007		
PM 2.5	0.003	100	No
Pb	0.000		
NH3	0.003	100	No
CO2e	48.7		

2021 - (Steady State)

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF CONFORMITY ANALYSIS (ROCA)

Pollutant	Action Emissions (ton/yr)	GENERAL CONFORMITY	
		Threshold (ton/yr)	Exceedance (Yes or No)
Sacramento, CA			
VOC	0.043	100	No
NOx	0.023	100	No
CO	0.276		
SOx	0.001	100	No
PM 10	0.007		
PM 2.5	0.003	100	No
Pb	0.000		
NH3	0.003	100	No
CO2e	48.7		
NOT IN A REGULATORY AREA			
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NOx	0.023		
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CO2e	48.7		
Yuba City-Marysville, CA			
VOC	0.043	100	No
NOx	0.023	100	No
CO	0.276		
SOx	0.001	100	No
PM 10	0.007		
PM 2.5	0.003	100	No
Pb	0.000		
NH3	0.003	100	No
CO2e	48.7		

None of estimated emissions associated with this action are above the conformity threshold values established at 40 CFR 93.153 (b); Therefore, the requirements of the General Conformity Rule are not applicable.

13 Dec 2019

Darren Rector, GS-13/Remedial Program Manager

DATE

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

1. General Information

- Action Location
Base: BEALE AFB
State: California
County(s): Placer; Yuba
Regulatory Area(s): Sacramento, CA; NOT IN A REGULATORY AREA; Yuba City-Marysville, CA

- Action Title: Non-Native and Noxious Plant Species Management - Beale AFB and Lincoln Receiver Site (LRS)

- Project Number/s (if applicable): N/A

- Projected Action Start Date: 1 / 2020

- Action Purpose and Need:
The purpose of the Proposed Action is to manage plant species on Beale AFB and the Lincoln Receiver Site to reduce the prevalence of non-native vegetation in order to protect and preserve the military mission, ecosystem function, and valued resources and programs. The need for the Proposed Action is to address the threats of numerous non-native plant species on Beale AFB. There is a need for elimination or control of known priority infestations, and for prevention of the establishment of new infestations of invasive plants. If allowed to spread unchecked, non-native plant species will degrade the remaining native habitat; interfere with management of sensitive resources, economic activities, and quality of life; and impede the military mission.

- Action Description:
Beale AFB proposes to manage non-native plant species on the installation and at the Lincoln Receiver Site GSU in order to satisfy resource management goals outlined in the installation INRMP (Beale AFB 2019) and other installation management plans. Implementation of a procedural approach incorporating an integrated pest management (IPM) process will reduce the negative effects of these species under a manageable annual scope of work. Treatments could include but are not limited to broad-scale actions such as grazing and prescribed fire, targeted treatments including manual/mechanical and chemical applications, habitat enhancement activities, and biosecurity actions. The annual scope of work presented for each alternative and associated BMPs allow for predictable reduction of non-native plant species and inform the associated effects analyses presented in Chapter 4.

The current installation INRMP (Beale AFB 2019) includes several goals, objectives, and projects that provide explicit drivers for non-native plant species management, framed in terms of conserving and benefiting sensitive, threatened, and endangered species and their habitats; reducing the potential for BASH incidents; and maintaining a sustainable rangeland ecosystem that reduces fire hazard and supports the Beale AFB livestock grazing program. Over the past several years, new invasive plant management science and recommended methodologies have become available; invasive species mapping surveys have been performed; and local sensitive and invasive species data have been collected and analyzed. Beale AFB proposes to satisfy non-native plant species and resource management goals as outlined in the INRMP and other installation management plans in accordance with current available data and information, in the safest, most cost effective, efficient, and effectual way possible

Alternative 1 - No Action:
The No Action Alternative is required by law to be analyzed fully and serves as a baseline for comparison with the action alternatives. Under the No Action Alternative, current management activities will be maintained, including manual/mechanical activities, chemical applications, grazing, and burning. Implementation of these activities will lack a programmatic, cohesive approach and long-term strategy, and will not assimilate the most current science, effective treatment methods, or integrated approaches. While measures under this alternative will help slow the spread of non-native plant species, they are not enough to prevent the expansion of infestations. Current management addresses approximately 728 acres a year on average (excluding grazing operations), which is less than 3 percent of the base, and therefore achieves little, if any net gain in control (see

Table 2.4), conservation benefit, or mission support since non-native vegetation continually re-invades when seed sources are not adequately controlled. Specifically, it allows Containment Stage species to expand base-wide (see Table 2.5), reaching the Asset-Based Protection Stage and gives Eradication Stage species the opportunity to reach Containment Stage within 15 years.
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This alternative does not meet the purpose and need because current management activities lack a programmatic approach and long-term strategy; effective scale; and don't consider the most current science, data and analyses, and management recommendations. Ten years of range monitoring and survey data, analysis, and results; new science; and new management techniques and recommendations are now available but are not being utilized in current management activities. This alternative does not satisfy current INRMP and other management goals and does not optimize cost, efficacy, and efficiency.

Alternative 2 - Preferred Alternative:
Alternative 2, the Preferred Alternative, is to manage non-native plant species in order to reduce their prevalence using an efficient, sustainable, and long-term strategy that incorporates a programmatic, adaptive approach, maximizes opportunities for stewardship of sensitive resources, and utilizes a varied toolkit of control methods including manual/mechanical activities, chemical applications, grazing, and burning. The current Beale AFB INRMP (Beale AFB 2019) contains several goals, objectives, and projects that provide explicit drivers for invasive species control. The Updated Invasive Plant Species Management Guidelines (IPSMG; Beale AFB 2017a) and Grazing Management Guidelines (GMG; Beale AFB 2017c) were developed to guide their achievement. The Wildland Fire Management Plan (WFMP; Beale AFB 2018) includes guidance for invasive plant control using prescribed burning. These documents are incorporated by reference in this EA, and are included as Appendices x, x &x respectively.
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Successful containment/control often requires multiple years of treatment, and sometimes requires multiple treatments per year involving a combination of methods. To increase the likelihood of successful long-term control, invasive plant management experts often recommend combining several management methods, tailored to situation-specific goals, constraints, and opportunities. Treatments are tailored based upon:
• The target invasive plant species and its biology (e.g., mode of reproduction).
• Population size and density.
• Site type (e.g., disturbed roadside, riparian, upland).
• Prior treatments and their efficacy.
The IPSMG includes protocols for preventing the spread of existing non-native plant species and the introduction of new species, methods for controlling specific non-native species, and general management strategies for the sensitive species and habitats on the installation. For certain species and situations, asset-based work plans are advantageous. Mechanical and manual methods, chemical treatments, grazing, and burning are all effective treatment methods for specific species in specific situations. For all control methods, timing of

treatment to coincide with the vulnerable phenological stage of the target species is an essential consideration (Beale AFB 2017a). The IPSMG includes specific situational and species work plans.
While the preferred alternative is designed to reduce overall non-native plant cover, it also simultaneously aims to improve forage quality for grazing animals, as grazing is the primary tool for controlling non-native species biomass. Improving forage quality equates to maintaining or increasing certain desirable non-native species, often referred to as naturalized species (normally annual grasses and forbs) that have been on the landscape for decades or centuries (i.e. Erodium sp.). Such species are too ubiquitous to warrant control, do not threaten the ecosystem like non-natives targeted for control, and provide a benefit, primarily supporting cattle grazing operations, which provide other non-native species control benefits.

Beale AFB 2017a) and Grazing Management Guidelines (GMG; Beale AFB 2017c) were developed to guide their achievement. The Wildland Fire Management Plan (WFMP; Beale AFB 2018) includes guidance for invasive plant control using prescribed burning. These documents are incorporated by reference in this EA, and are included as Appendices x, x &x respectively.
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Alternative 3 – Limited Control Methods – Same as Alternative 2 Excluding Chemical Treatments:
This alternative would not meet the purpose and need because many invasive species cannot be controlled without chemical treatments (herbicide applications). Manual and mechanical treatments can be too costly for large infestations, and other control methods are not effective on certain species. This alternative does not satisfy current INRMP and other management goals and does not optimize cost, efficacy, and efficiency. This alternative is not carried forward for analysis in this EA.

- Point of Contact

Name: Darren Rector
Title: GS-13/Remedial Program Manager
Organization: AFCEC/CZOW
Email:
Phone Number:

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

- Activity List:

Activity Type		Activity Title
2.	Personnel	Alternative 2 - Perferred Alternative

Emission factors and air emission estimating methods come from the United States Air Force's Air Emissions Guide for Air Force Stationary Sources, Air Emissions Guide for Air Force Mobile Sources, and Air Emissions Guide for Air Force Transitory Sources.

2. Personnel

2.1 General Information & Timeline Assumptions

- Add or Remove Activity from Baseline? Add

- Activity Location
County: Placer; Yuba
Regulatory Area(s): Sacramento, CA; NOT IN A REGULATORY AREA; Sacramento, CA; Yuba City-Marysville, CA

- Activity Title: Alternative 2 - Perferred Alternative

- Activity Description:
Under Alternative 2 non-native and noxious plant species would be managed in order to reduce their prevalence using an efficient, sustainable, and long-term strategy that incorporates a programmatic, adaptive approach, maximizes opportunities for stewardship of sensitive resources, and utilizes a varied toolkit of control methods including manual/mechanical activities, chemical applications, grazing, and burning. The Beale AFB Invasive Plant Species Management Guidelines, Grazing Management Guidelines, and Wildland Fire Management Plan provide the basis for this alternative.

- Activity Start Date
Start Month: 1
Start Year: 2020

- Activity End Date
Indefinite: Yes
End Month: N/A
End Year: N/A

- Activity Emissions:

Pollutant	Emissions Per Year (TONs)
VOC	0.076538
SO_x	0.000910
NO_x	0.041609
CO	0.496445
PM 10	0.011991

Pollutant	Emissions Per Year (TONs)
PM 2.5	0.005213
Pb	0.000000
NH_3	0.006136
CO_2e	87.7

2.2 Personnel Assumptions

- Number of Personnel
Active Duty Personnel: 0
Civilian Personnel: 0
Support Contractor Personnel: 24

Air National Guard (ANG) Personnel: 0
Reserve Personnel: 0

- Default Settings Used: No

- Average Personnel Round Trip Commute (mile): 80

- Personnel Work Schedule
Active Duty Personnel: 5 Days Per Week
Civilian Personnel: 5 Days Per Week
Support Contractor Personnel: 10 Days Per Month
Air National Guard (ANG) Personnel: 4 Days Per Week
Reserve Personnel: 4 Days Per Month

2.3 Personnel On Road Vehicle Mixture

- On Road Vehicle Mixture (%)

	LDGV	LDGT	HDGV	LDDV	LDDT	HDDV	MC
POVs	37.55	60.32	0	0.03	0.2	0	1.9
GOVs	54.49	37.73	4.67	0	0	3.11	0

2.4 Personnel Emission Factor(s)

- On Road Vehicle Emission Factors (grams/mile)

	VOC	SO_x	NO_x	CO	PM 10	PM 2.5	Pb	NH_3	CO_2e
LDGV	000.114	000.003	000.084	000.992	000.047	000.020		000.023	00298.845
LDGT	000.288	000.004	000.178	001.871	000.048	000.021		000.024	00379.038
HDGV	000.600	000.011	001.339	008.875	000.183	000.078		000.045	01128.468
LDDV	000.026	000.003	000.125	000.281	000.060	000.032		000.008	00271.718
LDDT	000.094	000.003	000.533	000.594	000.112	000.082		000.008	00364.857
HDDV	000.194	000.014	004.796	001.133	000.211	000.117		000.028	01514.699
MC	004.452	000.002	001.252	023.791	000.019	000.009		000.054	00187.891

2.5 Personnel Formula(s)

- Personnel Vehicle Miles Travel for Work Days per Year
$VMT_P = NP * WD * AC$

VMT_P: Personnel Vehicle Miles Travel (miles/year)
NP: Number of Personnel
WD: Work Days per Year
AC: Average Commute (miles)

- Total Vehicle Miles Travel per Year
$VMT_{Total} = VMT_{AD} + VMT_C + VMT_{SC} + VMT_{ANG} + VMT_{AFRC}$

VMT_{Total}: Total Vehicle Miles Travel (miles)
VMT_{AD}: Active Duty Personnel Vehicle Miles Travel (miles)
VMT_C: Civilian Personnel Vehicle Miles Travel (miles)
VMT_{SC}: Support Contractor Personnel Vehicle Miles Travel (miles)
VMT_{ANG}: Air National Guard Personnel Vehicle Miles Travel (miles)
VMT_{AFRC}: Reserve Personnel Vehicle Miles Travel (miles)

- Vehicle Emissions per Year
$V_{POL} = (VMT_{Total} * 0.002205 * EF_{POL} * VM) / 2000$

DETAIL AIR CONFORMITY APPLICABILITY MODEL REPORT

V_{POL}: Vehicle Emissions (TONs)
VMT_{Total}: Total Vehicle Miles Travel (miles)
0.002205: Conversion Factor grams to pounds
EF_{POL}: Emission Factor for Pollutant (grams/mile)
VM: Personnel On Road Vehicle Mixture (%)
2000: Conversion Factor pounds to tons

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF CONFORMITY ANALYSIS (ROCA)

1. General Information: The Air Force's Air Conformity Applicability Model (ACAM) was used to perform an analysis to assess the potential air quality impact/s associated with the action in accordance with the Air Force Instruction 32-7040, Air Quality Compliance And Resource Management; the Environmental Impact Analysis Process (EIAP, 32 CFR 989); and the General Conformity Rule (GCR, 40 CFR 93 Subpart B). This report provides a summary of the ACAM analysis.

a. Action Location:
Base: BEALE AFB
State: California
County(s): Placer; Yuba
Regulatory Area(s): Sacramento, CA; NOT IN A REGULATORY AREA; Yuba City-Marysville, CA

b. Action Title: Non-Native and Noxious Plant Species Management - Beale AFB and Lincoln Receiver Site (LRS)

c. Project Number/s (if applicable): N/A

d. Projected Action Start Date: 1 / 2020

e. Action Description:

Beale AFB proposes to manage non-native plant species on the installation and at the Lincoln Receiver Site GSU in order to satisfy resource management goals outlined in the installation INRMP (Beale AFB 2019) and other installation management plans. Implementation of a procedural approach incorporating an integrated pest management (IPM) process will reduce the negative effects of these species under a manageable annual scope of work. Treatments could include but are not limited to broad-scale actions such as grazing and prescribed fire, targeted treatments including manual/mechanical and chemical applications, habitat enhancement activities, and biosecurity actions. The annual scope of work presented for each alternative and associated BMPs allow for predictable reduction of non-native plant species and inform the associated effects analyses presented in Chapter 4.

The current installation INRMP (Beale AFB 2019) includes several goals, objectives, and projects that provide explicit drivers for non-native plant species management, framed in terms of conserving and benefiting sensitive, threatened, and endangered species and their habitats; reducing the potential for BASH incidents; and maintaining a sustainable rangeland ecosystem that reduces fire hazard and supports the Beale AFB livestock grazing program. Over the past several years, new invasive plant management science and recommended methodologies have become available; invasive species mapping surveys have been performed; and local sensitive and invasive species data have been collected and analyzed. Beale AFB proposes to satisfy non-native plant species and resource management goals as outlined in the INRMP and other installation management plans in accordance with current available data and information, in the safest, most cost effective, efficient, and effectual way possible

Alternative 1 - No Action:
The No Action Alternative is required by law to be analyzed fully and serves as a baseline for comparison with the action alternatives. Under the No Action Alternative, current management activities will be maintained, including manual/mechanical activities, chemical applications, grazing, and burning. Implementation of these activities will lack a programmatic, cohesive approach and long-term strategy, and will not assimilate the most current science, effective treatment methods, or integrated approaches. While measures under this alternative will help slow the spread of non-native plant species, they are not enough to prevent the expansion of infestations. Current management addresses approximately 728 acres a year on average (excluding grazing operations), which is less than 3 percent of the base, and therefore achieves little, if any net gain in control (see Table 2.4), conservation benefit, or mission support since non-native vegetation continually re-invades when seed sources are not adequately controlled. Specifically, it allows Containment Stage species to expand base-wide (see Table 2.5), reaching the Asset-Based Protection Stage and gives Eradication Stage species the opportunity to reach Containment Stage within 15 years.

Current management activities include limited and small scale manual/mechanical control (less than 50 acres annually); chemical applications for approximately 13 acres of Himalayan blackberry and 75 acres of yellow star thistle in locations where its presence affects Bird Airstrike Hazard (BASH) at the airfield; small, individual habitat enhancement sites; grazing operations on approximately 12,800 acres within 36 pastures that have been grazed for 30+ years, without the ability to expand grazing operations to new areas, change stocking rates, or vary residual dry matter (RDM) targets (a measure of consumed vegetation that is dependent on stocking rates) to adjust to annual weather variability or specific invasive species goals; and sporadic burning activities often limited to less than 100 acres. Environmental impacts for these activities are analyzed on a project-by-project basis using the AF EIAP.
The current limitations on grazing locations and the inability to vary grazing management techniques (i.e., targeted prescriptions, RDM, and stocking rates), together with currently limited fire management activities, create negative impacts on ungrazed wildlands, which are highly invaded, and perpetuate current problems such as the high cover of medusahead in current pastures. According to the Director of the University of California Sierra Foothill Research and Extension Center, the cover of medusahead at Beale AFB is the worst he's ever seen at any location in northern California.
This alternative does not meet the purpose and need because current management activities lack a programmatic approach and long-term strategy; effective scale; and don't consider the most current science, data and analyses, and management recommendations. Ten years of range monitoring and survey data, analysis, and results; new science; and new management techniques and recommendations are now available but are not being utilized in current management activities. This alternative does not satisfy current INRMP and other management goals and does not optimize cost, efficacy, and efficiency.

Alternative 2 - Preferred Alternative:
Alternative 2, the Preferred Alternative, is to manage non-native plant species in order to reduce their prevalence using an efficient, sustainable, and long-term strategy that incorporates a programmatic, adaptive approach, maximizes opportunities for stewardship of sensitive resources, and utilizes a varied toolkit of control methods including manual/mechanical activities, chemical applications, grazing, and burning. The current Beale AFB INRMP (Beale AFB 2019) contains several goals, objectives, and projects that provide explicit drivers for invasive species control. The Updated Invasive Plant Species Management Guidelines (IPSMG; Beale AFB 2017a) and Grazing Management Guidelines (GMG; Beale AFB 2017c) were developed to guide their achievement. The Wildland Fire Management Plan (WFMP; Beale AFB 2018) includes guidance for invasive plant control using prescribed burning. These documents are incorporated by reference in this EA, and are included as Appendices x, x &x respectively.
The IPSMG, based on the current science, data, and recommendations, and designed to be reviewed and updated regularly as conditions, science, and drivers change, provide the foundation for this alternative. The IPSMG is intended to be used by Beale AFB Natural Resource staff and contractors who manage vegetation on the installation. Beale AFB has managed both sensitive species and non-native species for many years, but a concerted effort to manage both together may be more effective and is the approach adopted in the IPSMG. Successful containment/control often requires multiple years of treatment, and sometimes requires multiple treatments per year involving a combination of methods. To increase the likelihood of successful long-term control, invasive plant management experts often recommend combining several management methods, tailored to situation-specific goals, constraints, and opportunities. Treatments are tailored based upon:
• The target invasive plant species and its biology (e.g., mode of reproduction).
• Population size and density.
• Site type (e.g., disturbed roadside, riparian, upland).
• Prior treatments and their efficacy.
The IPSMG includes protocols for preventing the spread of existing non-native plant species and the introduction of new species, methods for controlling specific non-native species, and general management strategies for the sensitive species and habitats on the installation. For certain species and situations, asset-based work plans are advantageous. Mechanical and manual methods, chemical treatments, grazing, and burning are all effective treatment methods for specific species in specific situations. For all control methods, timing of treatment to coincide with the vulnerable phenological stage of the target species is an essential consideration (Beale AFB 2017a). The IPSMG includes specific situational and species work plans.
While the preferred alternative is designed to reduce overall non-native plant cover, it also simultaneously aims to improve forage quality for grazing animals, as grazing is the primary tool for controlling non-native species

biomass. Improving forage quality equates to maintaining or increasing certain desirable non-native species, often referred to as naturalized species (normally annual grasses and forbs) that have been on the landscape for decades or centuries (i.e. Erodium sp.). Such species are too ubiquitous to warrant control, do not threaten the ecosystem like non-natives targeted for control, and provide a benefit, primarily supporting cattle grazing operations, which provide other non-native species control benefits.

Beale AFB 2017a) and Grazing Management Guidelines (GMG; Beale AFB 2017c) were developed to guide their achievement. The Wildland Fire Management Plan (WFMP; Beale AFB 2018) includes guidance for invasive plant control using prescribed burning. These documents are incorporated by reference in this EA, and are included as Appendices x, x &x respectively.
The IPSMG, based on the current science, data, and recommendations, and designed to be reviewed and updated regularly as conditions, science, and drivers change, provide the foundation for this alternative. The IPSMG is intended to be used by Beale AFB Natural Resource staff and contractors who manage vegetation on the installation. Beale AFB has managed both sensitive species and non-native species for many years, but a concerted effort to manage both together may be more effective and is the approach adopted in the IPSMG. Successful containment/control often requires multiple years of treatment, and sometimes requires multiple treatments per year involving a combination of methods. To increase the likelihood of successful long-term control, invasive plant management experts often recommend combining several management methods, tailored to situation-specific goals, constraints, and opportunities. Treatments are tailored based upon:
• The target invasive plant species and its biology (e.g., mode of reproduction).
• Population size and density.
• Site type (e.g., disturbed roadside, riparian, upland).
• Prior treatments and their efficacy.
The IPSMG includes protocols for preventing the spread of existing non-native plant species and the introduction of new species, methods for controlling specific non-native species, and general management strategies for the sensitive species and habitats on the installation. For certain species and situations, asset-based work plans are advantageous. Mechanical and manual methods, chemical treatments, grazing, and burning are all effective treatment methods for specific species in specific situations. For all control methods, timing of treatment to coincide with the vulnerable phenological stage of the target species is an essential consideration (Beale AFB 2017a). The IPSMG includes specific situational and species work plans.
While the preferred alternative is designed to reduce overall non-native plant cover, it also simultaneously aims to improve forage quality for grazing animals, as grazing is the primary tool for controlling non-native species biomass. Improving forage quality equates to maintaining or increasing certain desirable non-native species, often referred to as naturalized species (normally annual grasses and forbs) that have been on the landscape for decades or centuries (i.e. Erodium sp.). Such species are too ubiquitous to warrant control, do not threaten the ecosystem like non-natives targeted for control, and provide a benefit, primarily supporting cattle grazing operations, which provide other non-native species control benefits.

Alternative 3 – Limited Control Methods – Same as Alternative 2 Excluding Chemical Treatments:
This alternative would not meet the purpose and need because many invasive species cannot be controlled without chemical treatments (herbicide applications). Manual and mechanical treatments can be too costly for large infestations, and other control methods are not effective on certain species. This alternative does not satisfy current INRMP and other management goals and does not optimize cost, efficacy, and efficiency. This alternative is not carried forward for analysis in this EA.

f. Point of Contact:

Name:	Darren Rector
Title:	GS-13/Remedial Program Manager
Organization:	AFCEC/CZOW
Email:	
Phone Number:	

2. Analysis: Total combined direct and indirect emissions associated with the action were estimated through ACAM on a calendar-year basis for the “worst-case” and “steady state” (net gain/loss upon action fully implemented) emissions. General Conformity under the Clean Air Act, Section 1.76 has been evaluated for the action described above according to the requirements of 40 CFR 93, Subpart B.

Based on the analysis, the requirements of this rule are: _____ applicable
__X__ not applicable

Conformity Analysis Summary:

2020

Pollutant	Action Emissions (ton/yr)	GENERAL CONFORMITY	
		Threshold (ton/yr)	Exceedance (Yes or No)
Sacramento, CA			
VOC	0.077	100	No
NOx	0.042	100	No
CO	0.496		
SOx	0.001	100	No
PM 10	0.012		
PM 2.5	0.005	100	No
Pb	0.000		
NH3	0.006	100	No
CO2e	87.7		
NOT IN A REGULATORY AREA			
VOC	0.077		
NOx	0.042		
CO	0.496		
SOx	0.001		
PM 10	0.012		
PM 2.5	0.005		
Pb	0.000		
NH3	0.006		
CO2e	87.7		
Sacramento, CA			
VOC	0.077		
NOx	0.042		
CO	0.496	100	No
SOx	0.001		
PM 10	0.012		
PM 2.5	0.005		
Pb	0.000		
NH3	0.006		
CO2e	87.7		
Yuba City-Marysville, CA			
VOC	0.077	100	No
NOx	0.042	100	No
CO	0.496		
SOx	0.001	100	No
PM 10	0.012		
PM 2.5	0.005	100	No
Pb	0.000		
NH3	0.006	100	No
CO2e	87.7		

2021 - (Steady State)

AIR CONFORMITY APPLICABILITY MODEL REPORT
RECORD OF CONFORMITY ANALYSIS (ROCA)

Pollutant	Action Emissions (ton/yr)	GENERAL CONFORMITY	
		Threshold (ton/yr)	Exceedance (Yes or No)
Sacramento, CA			
VOC	0.077	100	No
NOx	0.042	100	No
CO	0.496		
SOx	0.001	100	No
PM 10	0.012		
PM 2.5	0.005	100	No
Pb	0.000		
NH3	0.006	100	No
CO2e	87.7		
NOT IN A REGULATORY AREA			
VOC	0.077		
NOx	0.042		
CO	0.496		
SOx	0.001		
PM 10	0.012		
PM 2.5	0.005		
Pb	0.000		
NH3	0.006		
CO2e	87.7		
Sacramento, CA			
VOC	0.077		
NOx	0.042		
CO	0.496	100	No
SOx	0.001		
PM 10	0.012		
PM 2.5	0.005		
Pb	0.000		
NH3	0.006		
CO2e	87.7		
Yuba City-Marysville, CA			
VOC	0.077	100	No
NOx	0.042	100	No
CO	0.496		
SOx	0.001	100	No
PM 10	0.012		
PM 2.5	0.005	100	No
Pb	0.000		
NH3	0.006	100	No
CO2e	87.7		

None of estimated emissions associated with this action are above the conformity threshold values established at 40 CFR 93.153 (b); Therefore, the requirements of the General Conformity Rule are not applicable.

13 Dec 2019

Darren Rector, GS-13/Remedial Program Manager　　　　DATE

APPENDIX I

Beale Air Force Base Plant and Wildlife Species Lists

Beale Air Force Base Plant List

Species	Common Name	Family Name	Species Acronym
Acer negundo	boxelder	Sapindaceae	ACNE2
Achillea millefolium	common yarrow	Asteraceae	ACMI2
Achyrachaena mollis	blow wives	Asteraceae	ACMO2
Acmispon brachycarpus	foothill deervetch	Fabaceae	LOHU2
Acmispon parviflorus	desert deervetch	Fabaceae	LOMI
Acroptilon repens	Russian knapweed	Asteraceae	ACRE3
Aegilops triuncialis	barbed goatgrass	Poaceae	AETR
Aesculus californica	California buckeye	Hippocastanaceae	AECA
Agrostis avenacea	pacific bentgrass	Poaceae	AGAV
Agrostis microphylla	small-leaf bentgrass	Poaceae	AGMI3
Ailanthus altissima	tree-of-heaven	Simaroubaceae	AIAL
Aira caryophyllea	silver hairgrass	Poaceae	AICA
Alisma triviale	northern water plantain	Alismataceae	ALTR7
Allium amplectens	narrowleaf onion	Liliaceae	ALAM2
Allium hyalinum	foothill onion	Liliaceae	ALHY
Alnus rhombifolia	white alder	Betulaceae	ALRH2
Alopecurus aequalis	short-awn foxtail	Poaceae	ALAE
Alopecurus saccatus	Pacific foxtail	Poaceae	ALSA3
Amaranthus blitoides	prostate amaranth	Amaranthaceae	AMBL
Amsinckia intermedia	common fiddleneck	Boraginaceae	AMME12
Amsinckia menziesii	fiddleneck	Boraginaceae	AMME
Andropogon virginicus	broomsedge bluestem	Poaceae	ANVI2
Anthemis cotula	mayweed	Asteraceae	ANCO2
Aphanes occidentalis	western lady's mantle	Rosaceae	APOC
Arctostaphylos viscida	whiteleaf manzanita	Ericaceae	ARVI4
Aristida oligantha	oldfield three awn	Poaceae	AROL
Aristida ternipes var. gentilis	hook thee-awned grass	Poaceae	ARTEH
Artemesia californica	coastal sagebrush	Asteraceae	ARCA11
Artemesia douglasiana	California mugwort	Asteraceae	ARDO3
Arundo donax	giant reed	Poaceae	ARDO4
Asclepias eriocarpa	Indian milkweed	Asclepiadaceae	ASER
Asclepias fascicularis	Mexican whorled milkweed	Asclepiadaceae	ASFA
Avena barbata	slender wild oat	Poaceae	AVBA
Avena fatua	wild oat	Poaceae	AVFA
Azolla filiculoides	mosquito fern	Azollaceae	AZFI
Baccharis pilularis	coyote brush	Asteraceae	BAPI
Baccharis salicifolia	mule-fat	Asteraceae	BASA4
Bidens frondosa	devil's beggars-tick	Asteraceae	BIFR
Blennosperma nanum	yellow carpet	Asteraceae	BLNA
Bolboschoenus glaucus	tubered bullrush	Cyperaceae	SCGL11
Brasica rapa	field mustard	Brassicaceae	BRRA
Brassica nigra	black mustard	Brassicaceae	BRNI

Species	Common Name	Family Name	Species Acronym
Briza maxima	big quakinggrass	Poaceae	BRMA
Briza minor	little quakinggrass	Poaceae	BRMI2
Brodiaea appendiculata	appendaged brodiaea	Liliaceae	BRAP
Brodiaea californica	California brodiaea	Liliaceae	BRCA4
Brodiaea coronaria	harvest brodiaea	Liliaceae	BRCO3
Brodiaea elegans	elegant harvest brodiaea	Liliaceae	BREL
Brodiaea minor	vernal pool brodiaea	Liliaceae	BRMI3
Bromus carinatus	California brome grass	Poaceae	BRCA5
Bromus diandrus	ripgut brome	Poaceae	BRDI3
Bromus hordeaceus	soft chess	Poaceae	BRHO2
Bromus inermis	smooth brome	Poaceae	BRIN2
Bromus madritensis	foxtail chess	Poaceae	BRMA3
Bromus madritensis ssp. Rubens	red brome	Poaceae	BRRU2
Calandrinia menziesii	red maids	Portulacaceae	CACIM
Callitriche heterophylla	Bolander's water-starwort	Plantaginaceae	CAHE3
Callitriche marginata	California water-starwort	Plantaginaceae	CAMA3
Calochortus luteus	yellow mariposa lily	Liliaceae	CALU9
Cardamine oligosperma	few-seeded bittercress	Brassicaceae	CAOL
Carduus pycnocephalus	Italian thistle	Asteraceae	CAPY2
Carduus tenuiflorus	slender flowered thistle	Asteraceae	CATE2
Carex barbarae	Santa Barbara sedge	Cyperaceae	CABA4
Carex densa	dense sedge	Cyperaceae	CADE8
Carex praegracilis	clustered field sedge	Cyperaceae	CAPR5
Castilleja attenuata	valley tassels	Scrophulariaceae	CAAT25
Castilleja campestris	yellow owl's clover	Scrophulariaceae	CACA79
Castilleja tenuis	hairy owl's-clover	Scrophulariaceae	CATE26
Ceanothus cuneatus	buck brush	Rhamnaceae	CECU
Centaurea solstitialis	yellow star thistle	Asteraceae	CESO3
***Centaurium* sp.**	centaury	Gentianaceae	CENTA2
Centromadia fitchii	Fitch's spikeweed	Asteraceae	HEFI
Centromadia pungens	common spikeweed	Asteraceae	CEPU14
Centunculus minimus	chaffweed	Gentianaceae	CEMI
Cephalanthus occidentalis	common buttonbush	Rubiaceae	CEOC2
Cerastium arvense	mouse-ear chickweed	Caryophllaceae	CEAR4
Cerastium fontanum var. vulgare	common chickweed	Caryophllaceae	CEFOV2
Cerastium glomeratum	mouse-ear chickweed	Caryophllaceae	CeGL2
Cercis occidentalis	western redbud	Fabaceae	CECAT
Chlorogalum angustifolium	narrowleaf soap plant	Liliaceae	CHAN2
Chlorogalum pomeridianum	soaproot	Liliaceae	CHPO3
Chondrilla juncea	skeleton weed	Asteraceae	CHJU
Cicendia quadrangularis	timwort	Gentianaceae	CIQU3
Cichorium intybus	chicory	Asteraceae	CIIN

Species	Common Name	Family Name	Species Acronym
Cirsium vulgare	bull thistle	Asteraceae	CIVU
Clarkia purpurea ssp purpurea	clarkia	Onagraceae	CLPUP
Conium maculatum	poison hemlock	Apiaceae	COMA2
Convolvulus arvensis	field bindweed	Convolvulaceae	COAR4
Crassula aquatica	water pygmy-weed	Crassulaceae	CRAQ
Crassula connata	sand pygmy weed	Crassulaceae	CRCO3
Crassula tillaea	Mediterranean pygmy weed	Crassulaceae	CRTI
Croton setiger	turkey mullein	Euphorbiaceae	CRSE11
Crucianella angustifolia	narrowleaf crucianella	Rubiaceae	CRAN11
Cuscuta californica	California dodder	Cuscutaceae	CUCAP
Cuscuta howelliana	Bogg's lake dodder	Cuscutaceae	CUHO
Cynodon dactylon	Bermuda gras	Poaceae	CYDA
Cynosurus echinatus	bristly dogstail grass	Poaceae	CYEC
Cyperus difformis	variable nutsedge	Cyperaceae	CYDI4
Cyperus eragrostis	umbrella sedge	Cyperaceae	CYER
Cyperus niger	black nutsedge	Cyperaceae	CYNI2
Damasonium californicum	Damasonium	Alisataceae	DACA12
Datura stramonium	Jimson weed	Solanaceae	DAST
Delphinium variegaum	royal larkspur	Ranunulaceae	DEVA
Deschampsia danthonioides	annual hairgrass	Poaceae	DEDA
Dichelostemma capitatum	blue-dicks	Lilaceae	DICA14
Dichelostemma multiflorum	wild hyacinth	Lilaceae	DIMU
Distichlis spicata	salt grass	Poaceae	DISP
Dittrichia graveolens	stinkwort	Asteraceae	DIGR3
Downingia arnatissima	ornate downingia	Campunulaceae	DOOR
Downingia bicornuta	Hoover's Downingia	Campunulaceae	DOBI
Downingia cuspidata	toothed downingia	Campunulaceae	DOCU
Downingia ornatissima Greene	folded calicoflower	Campanulaceae	DOOR
Downingia pulchella	valley downingia	Campunulaceae	DOPU2
Downingia pusilla	dwarf downingia	Campunulaceae	DOPU3
Draba verna	spring whitlow grass	Brassicaceae	DRVE2
Echinochloa crus-galli	barnyard grass	Poaceae	ECCR
Elatine brachysperma	short-seed waterwort	Elatinaceae	ELBR5
Elatine californicia	California waterwort	Elatinaceae	ELCA
Eleocharis acicularis	least rush	Cyperaceae	ELAC
Eleocharis engelmannii	Engelmann's spikerush	Cyperaceae	ELOBE
Eleocharis macrostachya	common spikerush	Cyperaceae	ELMA5
Eleocharis pachycarpa	black sand spikerush	Cyperaceae	ELPA
Eleocharis pauciflora	fewflower spikerush	Cyperaceae	ELQU2
Eleoharis obtusa	broad spiked spikerush	Cyperaceae	ELOB2
Elodea nuttallii	western waterweed	Hydrocharitaceae	ELNU2
Elymus caput-medusae	medusahead grass	Poaceae	TACA8
Elymus elymoides	squirrel tail grass	Poaceae	ELEL5
Elymus glaucus	blue wildrye	Poaceae	ELGL

Species	Common Name	Family Name	Species Acronym
Elymus ponticus	tall wheat grass	Poaceae	NL
Elymus triticoides	creeping wild rye	Poaceae	LETR5
Epilobium brachycarpum	pannicled willow-herb	Onagraceae	EPBR3
Epilobium campestre	smooth boisduvalia	Onagraceae	EPCA
Epilobium ciliatum	northern willow-herb	Onagraceae	EPCI
Epilobium densiflorum	dense-flowered spike-primrose	Onagraceae	EPDE4
Epilobium torreyi	stiff spike-primrose	Onagraceae	EPTO4
Eragrostis sp.	lovegrass	Poaceae	ER
Eriogonum nudum	barestem buckwheat	Polygonaceae	ERNU3
Erodium botrys	long-beaked filaree	Geraniaceae	ERBO
Erodium brachycarpum	early filaree	Geraniaceae	ERBR14
Erodium cicutarium	red-stemmed filaree	Geraniaceae	ERCI6
Erodium moschatum	white-stemmed filaree	Geraniaceae	ERMO7
Eryngium castrense	great valley button celery	Apiaceae	ERCA33
Eryngium vaseyi	coyote thistle	Apiaceae	ERVA5
Eschscholzia californica	California poppy	Papaveraceae	ESCA2
Eschscholzia lobbii	frying pan poppy	Papaveraceae	ESLO
Eucalyptus sp.	eucalyptus	Myrtaceae	
Euphorbia crenulata	beetle spurge	Euphorbiaciae	EUCR2
Euphorbia serpyllifolia	Thyme-leafed spurge	Euphorbiaciae	EUSEH
Festuca bromoides	foxtail fescue	Poaceae	VUBR
Festuca microstachys	small fescue	Poaceae	VUMIM
Festuca myuros	rattail fescue	Poaceae	VUMY
Festuca octoflora	sixweeks fescue	Poaceae	VUOC
Festuca perennis	Italian ryegrass	Poaceae	LOMU
Ficus carica	common fig	Moraceae	FICA
Frangula californica	California coffeeberry	Rhamnaceae	FRCA12
Fraxinus latifolia	Oregon ash	Oleaceae	FRLA
Fritillaria agresti	stinkbells	Liliaceae	FRAG
Galium aparine	catchweed bedstraw	Rubiaceae	GAAP2
Galium murale	tiny bedstraw	Rubiaceae	GAMU4
Galium parisiense	wall bedstraw	Rubiaceae	GAPA5
Gastridium phleoides	nit grass	Poaceae	GAVE3
Geranium dissectum	cutleaf geranium	Geraniaceae	GEDI
Geranium molle	annual cranesbill	Geraniaceae	GEMO
Glyceria declinata	waxy mannagrass	Poaceae	GLDE
Glyceria occidentalis	western mannagrass	Poaceae	GLOC
Gnaphalium palustre	western marsh cudweed	Asteraceae	GNPA
Gratiola ebracteata	bractless hedge-hyssop	Scrophulariaceae	GREB
Grindelia camporum	Great Valley gumplant	Asteraceae	GRCA
Hesperevax caulescens	dwarf dwarf-cudweed	Asteraceae	HECA30
Heterocodon rariflorum	heterocodon	Campunulaceae	HERA3
Heteromeles arbutifolia	toyon	Rosaceae	HEAR5

Species	Common Name	Family Name	Species Acronym
Holocarpha virgata	virgate tarweed	Asteraceae	HOVI
Holozonia filipes	holozonia	Asteraceae	HOFI
Hordeum brachyantherum	meadow barley	Poaceae	HOBR2
Hordeum depressum	low barley	Poaceae	HODE
Hordeum marinum	seaside barley	Poaceae	HOMA2
Hordeum marinum ssp. gussoneanum	Mediterranean barley	Poaceae	HOMAG
Hordeum murinum ssp leporinum	hare barley	Poaceae	HOMUL
Hordeum murinun	mouse barley	Poaceae	HOMU
Hypericum concinnum	goldwire	Clusiaceae	HYCO3
Hypericum perforatum	Klamathweed	Hypericaceae	HYPE
Hypochaeris glabra	smooth cats ear	Asteraceae	HYGL2
Hypochaeris radicata	hairy cats ear	Asteraceae	HyRA3
Isoetes howellii	Howell's quillwort	Isoetaceae	ISHO
Isoetes nutallii	Nuttall's quillwort	Isoetaceae	ISNU
Isoetes orcuttii	Orcutt's quillwort	Isoetaceae	ISOR
Juglans hindsii	Northern california black walnut	Juglandaceae	JUHI
Juglans regia	English walnut	Juglandaceae	JURE80
Juncus acuminatus	sharp-fruited rush	Juncaceae	JUAC
Juncus balticus	baltic rush	Juncaceae	JUBA
Juncus bufonius	toad rush	Juncaceae	JUBA
Juncus capitatus	capped rush	Juncaceae	JUCA5
Juncus effusus	soft rush	Juncaceae	JUEF
Juncus mexicanus	mexican rush	Juncaceae	JUHE
Juncus patens	spreading rush	Juncaceae	JUPA2
Juncus tenuis	slender rush	Juncaceae	JUTE
Juncus uncialis	inch-high dwarf rush	Juncaceae	JUUN
Juncus xiphioides	iris-leaved rush	Juncaceae	JUXI
Keckiella breviflora	bushbeard tongue	Plantaginaceae	KEBE
Lactuca serriola	prickly lettuce	Asteraceae	LASE
Lagophylla glandulosa	glandular harleaf	Asteraceae	LAGL
Lasthenia californica	California goldfields	Asteraceae	LACA7
Lasthenia fremontii	Fremont's goldfields	Asteraceae	LAFR4
Lasthenia glaberrima	smooth goldfields	Asteraceae	LAGL3
Lasthenia platycarpha	alkali goldfields	Asteraceae	LAPL2
Lathyrus angulatus	angled pea	Fabaceae	LAAN3
Layia chrysanthemoides	chrysanthemum tidy tips	Asteraceae	LACH
Layia fremontii	Fremont's tidy tips	Asteraceae	LAFR2
Legenere limosa	legenere	Campunulaceae	LELI
Lemna aequinoctialis	lesser duckweed	Araceae	LEAE2
Leontodon saxatilis	hawkbit	Asteraceae	LETA
Lepidium dictyotum	net peppergrass	Brassicaceae	LEDI2

Species	Common Name	Family Name	Species Acronym
Lepidium nitidum	shiny peppergrass	Brassicaceae	LENI
Lepidium strictum	narrow peppergrass	Brassicaceae	LEST2
Leptochloa fusca ssp. fascicularis	bearded sprangletop	Poaceae	LEFUF
Leptosiphon bicolor	true babystars	Polemoniaceae	LEBI8
Lessingia virgata	wand lessingia	Asteraceae	LEV18
Limnanthes alba	white meadowfoam	Limnanthaceae	LIAL3
Limnanthes douglasii	common meadowfoam	Limnanthaceae	LIDOD
Limnanthes douglasii ssp nivea	snow white meadowfoam	Limnanthaceae	LIDON2
Limnanthes douglasii ssp rosea	Rosy douglas' meadowfoam	Limnanthaceae	LIDOR2
Limnanthes douglasii ssp.douglasii	Douglas' meadowfoam	Limnanthaceae	LIDO2
Limosella aquatica	northern mudwort	Scrophulariaceae	LIAQ
Linum usitatissimum	common flax	Linaceae	LIUS
Logfia gallica	narrowleaf cottonrose	Asteraceae	LOGA2
Lomatium caruifolium	alkali desertparsley	Apiaceae	LOCA5
Lomatium caruifolium var. denticulatum	Sacramento Valley lomatium	Apiaceae	LOCAD
Lotus coniculatus	bird's-foot trefoil	Fabaceae	LOCO6
Lotus wrangelianus	Chilean bird’s-foot trefoil	Fabaceae	LOWR2
Ludwigia palustris	marsh purslane	Onagraceae	LUPA
Ludwigia peploides	floating water primrose	Onagraceae	LUPE
Lupinus bicolor	miniature lipine	Fabaceae	LUBT
Lupinus nanus	sky lupine	Fabaceae	LUNA3
Lupinus succulentus	arroyo lupine	Fabaceae	LUSU3
Lysimachia arvensis	scarlet pimpernel	Primulaceae	ANAR
Lythrum hyssopifolium	hyssop loosestrife	Lythraceae	LYHY2
Lythrum portula	purslane loosestrife	Lythraceae	LYPOE
Maclura pomifera	Osage orange	Moraceae	MAPO
Madia elegans	spring madia	Asteraceae	MAELV
Malva parviflora	cheeseweed	Malvaceae	MAPA5
Marsilea vestita	hairy water fern	Marsileaceae	MAVE2
Matricaria discoidea	pineapple weed	Asteraceae	MAIDI6
Medicago polymorpha	bur-clover	Fabaceae	MEPO3
Melica californica	California melic	Poaceae	MECA2
Mentha canadensis	wild mint	Lamiaceae	MEAR4
Mentha pulegium	pennyroyal	Lamiaceae	MEPU
Micropus californicus	q-tips	Asteraceae	MICA
Microseris acuminata	sierra foothills microseris	Asteraceae	MIAC
Microseris douglasii	Douglas' microseris	Asteraceae	MIDO
Mimulus bicolor	bicolor monkeyflower	Phrymaceae	MIB4
Mimulus cardinalis	Cardinal monkey flower	Phrymaceae	MIEA
Mimulus guttatus	seep-spring monkeyflower	Phrymaceae	MIGU

Species	Common Name	Family Name	Species Acronym
Mimulus tricolor	tricolor moneyflower	Phrymaceae	MITR3
Minuartia californica	California stitchwort	Caryophllaceae	MICA7
Minuartia douglasii	Douglas' stitchwort	Caryophllaceae	MIDO3
Mollugo verticillata	green carpet-weed	Molluginaceae	MOVE
Montia fontana	water chickweed	Montiaceae	MOFO
Morus alba	white mulberry	Moraceae	MOAL
Muhlenbergia rigens	deergrass	Poaceae	MURI2
Myosotis discolor	changing forget-me-not	Boraginaceae	MYDI
Myosurus minimus	mouse-tail	Ranunculaceae	MYMI2
Myriophyllum aquaticum	parrot's feather	Haloragaceae	MYAQ2
Myriophyllum spicatum	Eurasian milfoil	Haloragaceae	MYSP2
Navarretia heterandra	Tehama navarretia	Polemoniaceae	NAHE
Navarretia intertexta	needle-leaved navarretia	Polemoniaceae	NAIN2
Navarretia leucocephala	white-headed navarretia	Polemoniaceae	NALE
Navarretia pubescens	purple navarretia	Polemoniaceae	NAPU2
Navarretia tagetina	marigold navarretia	Polemoniaceae	NATA3
Nemophila maculata	fivespot	Hydrophyllaceae	NEMA
Nemophila pedunculata	meadow nemophila	Hydrophyllaceae	NEPE
Nerium oleander	oleander	Apocynaceae	NEOL
Odontostomum hartwegii	Hartweg's odontostomum	Liliaceae	ODHA
Olea europaea	olive	Oleaceae	OLEU
Panicum capillare	witch grass	Poaceae	PACA6
Parentucellia viscosa	yellow glandweed	Orobanchaceae	PAVI3
Parvisedum pumilum	pigmy stonecrop	Crassulaceae	PAPU10
Paspalum dilatatum	dallis grass	Poaceae	PADI3
Paspalum distichum	ditch grass	Poaceae	PADI6
Persicaria hydropiper	common smartweed	Polygonaceae	POHY
Persicaria lapathifolia	common knotweed	Polygonaceae	POLA4
Petrohogia dubia	grass pink	Caryophllaceae	PEDU
Phalaris aquatica	Harding grass	Poaceae	PHAQ
Phalaris paradoxa	hood canarygrass	Poaceae	PHPA5
Phyla nodiflora	common frog-fruit	Verbenaceae	PHNO2
Phytolacca americana	pokeweed	Phytolaccaceae	PHAM4
Pilularia americana	American pillwort	Marsileaceae	PIAM
Pinus sabiniana	gray pine	Pinaceae	PISA2
Plagiobothrys acanthocarpus	adobe popcornflower	Boraginaceae	PLAC
Plagiobothrys bracteatus	bracted popcornflower	Boraginaceae	PLBR
Plagiobothrys fulvus	common popcornflower	Boraginaceae	PLPU
Plagiobothrys glyptocarpus	sculptured popcornflower	Boraginaceae	PLGL2
Plagiobothrys greenei	Greene's popcornflower	Boraginaceae	PLGR
Plagiobothrys leptocladus	alkali popcornflower	Boraginaceae	PLLE
Plagiobothrys nothofulvus	dye popcornflower	Boraginaceae	PLNO
Plagiobothrys shastensis	Shasta popcornflower	Boraginaceae	PLSH

Species	Common Name	Family Name	Species Acronym
Plagiobothrys stipitatus var. micranthus	small-flowered popcornflower	Boraginaceae	PLSTM
Plagiobothrys stipitatus var. stipitatus	stipitate popcornflower	Boraginaceae	PLSTS
Plagiobothrys undulatus	undulate popcornflower	Boraginaceae	PLUN2
Plantago coronopus	cutleaf plantain	Plantaginaceae	PLCO3
Plantago elongata	annual coast plantain	Plantaginaceae	PLEL
Plantago erecta	California plantain	Plantaginaceae	PLER3
Plantago lanceolata	narrow leaved plantain	Plantaginaceae	PLLA
Platanus racemosa	California sycamore	Platanaceae	PLRA
Pleuropogon californicus	California semaphore grass	Poaceae	PLCA6
Poa annua	annual bluegrass	Poaceae	POAN
Poa bulbosa	bulbous bluegrass	Poaceae	POBU
Pogogyne zizyphoroides	Sacramento mesamint	Lamiaceae	POZI
Polygonum aviculare ssp. depressum	porostrate knotweed	Polygonaceae	POAR11
Polypogon monspeliensis	rabbit's-foot grass	Poaceae	POMO5
Populus fremontii	Fremont cottonwood	Salicaceae	POFR2
Potamogeton crispus	curly pondweed	Potamogetonaceae	POCR3
Primula clevelandii var. patula	Padre's shooting star	Primulaceae	NL
Psilocarphus brevissimus	woolly marbles	Asteraceae	PSBR
Psilocarphus brevissimus var. brevissimus	woolly heads	Asteraceae	PSBRB
Psilocarphus oregonus	Oregon woolly marbles	Asteraceae	PSOR
Psilocarphus tenellus	slender woolly marbles	Asteraceae	PSTE
Quercus douglasii	blue oak	Fagaceae	QUDO
Quercus lobata	valley oak	Fagaceae	QULO
Quercus wislizenii	interior live oak	Fagaceae	QUWI2
Ranunculus aquatilis var. hispidulus	hispid water buttercup	Ranunculaceae	RAAQH
Ranunculus bonariensis var. trisepalus	vernal pool buttercup	Ranunculaceae	RABOT
Ranunculus californicus	California buttercup	Ranunculaceae	RACA2
Ranunculus muricatus	prickle-fruited buttercup	Ranunculaceae	RAMU2
Ranunculus occidentalis	western buttercup	Ranunculaceae	RAOC
Ranunculus sceleratus	celery-leaf buttercup	Ranunculaceae	RASC3
Raphanus raphanistrum	yellow wild radish	Brassicaceae	RARA2
Robina pseudoacacia	black locust	Fabaceae	ROSP
Rorippa curvisiliqua	curve-pod yellow-cress	Brassicaceae	ROCU
Rorippa curvisiliqua var. occidentalis	western-yellow-cress	Brassicaceae	ROCUO
Rorippa nasturtium-aquaticum	watercress	Brassicaceae	RONA2
Rosa californica	California wildrose	Rosaceae	ROCA2

Species	Common Name	Family Name	Species Acronym
Rotala indica	Indian toothcup	Lythraceae	ROIN3
Rubus armeniacus	Himalayan blackberry	Rosaceae	RUAR9
Rumex acetosella	common sheep sorrel	Polygonaceae	RUAC3
Rumex crispus	curly dock	Polygonaceae	RUCR
Rumex plucher	fiddle dock	Polygonaceae	RUPU3
Sagina decumbens ssp. occidentalis	Crow western pearlwort	Caryophyllaceae	SADEO
Salix exigua	sandbar willow	Salicaceae	SAEX
Salix gooddingii	Goodding's black willow	Salicaceae	SAGO
Salix laevigata	red willow	Salicaceae	SALA3
Salix lasiolepis	arroyo willow	Salicaceae	SALA6
Sambucus mexicana	blue elberberry	Caprifoliaceae	SAME5
Sanicula bipinnata	sanicle	Apiaceae	SABI2
Sanicula bipinnatifida	purple sanicle	Apiaceae	SABI3
Schoenoplectus acutus	hardstem bulrush	Cyperaceae	SCAC3
Schoenoplectus acutus var. occidentalis	tule	Cyperaceae	SCACO2
Scleranthus annuus	German knotgrass	Caryophyllaceae	SCAN2
Scribneria bolanderi	Bolander's scribneria	Poaceae	SCBO
Senecio vulgaris	common groundsel	Asteraceae	SEVU
Setaria parviflora	knotroot bristlegrass	Poaceae	SEPA10
Sherardia arvensis	field madder	Rubiaceae	SHAR
Sidalcea calycosa ssp. calycosa	annual checker mallow	Malvaceae	SICAC3
Sidalcea diploscypha	fringed checker mallow	Malvaceae	SIDA
Sidalcea hartwegii	Hartweg's checkerbloom	Malvaceae	SIHA
Sidalcea hirsuta	hairy checkerbloom	Malvaceae	SIHI2
Silene gallica	windmill pink	Caryophllaceae	SIGA
Silybum marianum	milk thistle	Asteraceae	SIMA3
Sisyrinchium bellum	blue eyed grass	Iridaceae	SIBE
Solanum americanum	small-flowered nightshade	Solanaceae	SOAH
Solidago velutina ssp. californica	California goldenrod	Asteraceae	NL
Soliva sessilis	lawn burrweed	Asteraceae	SOSE2
Sonchus oleraceus	common sow-thistle	Asteraceae	SOOL
Sorghum halepense	Johnsongrass	Poaceae	SOHA
Spergularia rubra	purple sandspurry	Caryophllaceae	SPRU
Stellaria media	common chickweed	Caryophllaceae	STME2
Stipa lepida	foothill needlegrass	Poaceae	
Stipa pulchra	purple nedlegrass	Poaceae	
Symphyotrichum chilense	California aster	Asteraceae	SYCH4
Thysanocarpus curvipes	lace pod	Brassicaceae	THCU
Thysanocarpus radians	spoke pod	Brassicaceae	THRA
Toxicodendron diversilobum	poison oak	Anacardiaceae	TODI

Species	Common Name	Family Name	Species Acronym
Tribulus terrestris	puncture vine	Zygophyllaceae	TRTE
Trichostema lanceolatum	vinegar weed	Lamiaceae	TRLAY
Trifolium albopurpureum	whitetip clover	Fabaceae	TRAL5
Trifolium bifidum	bifid clover	Fabaceae	TRBI
Trifolium campestre	hop clover	Fabaceae	TRCA5
Trifolium ciliolatum	tree clover	Fabaceae	TRCI
Trifolium depauperatum var. amplectens	pale sac clover	Fabaceae	TRDEA
Trifolium depauperatum var. depauperatum	dwarf sac clover	Fabaceae	TRDED
Trifolium dubium	shamrock	Fabaceae	TRDU
Trifolium hirtum	rose clover	Fabaceae	TRHI4
Trifolium incarnatum	crimson clover	Fabaceae	TRIN3
Trifolium microcephalum	small-headed clover	Fabaceae	TRMI4
Trifolium repens	white clover	Fabaceae	TRRE3
Trifolium subterraneum	subterranean clover	Fabaceae	TRSU3
Trifolium variegatum	white-topped clover	Fabaceae	TRVA
Trifolium willdenowii	tomcat clover	Fabaceae	TRWI
Trifolium womskioldii	cow clover	Fabaceae	TRWO
Triglochin scilloides	flowering quillwort	Juncaginaceae	LISC4
Triphysaria eriantha	Johnny-tuck	Scrophulariaceae	TRER6
Triphysaria pusilla	dwarf owl's-clover	Scrophulariaceae	TRPU16
Triteleia hyacinthina	white brodiaea	Liliaceae	TRHY3
Triteleia laxa	Ithuriel's spear	Liliaceae	TRLM6
Typha angustifolia	narrow leaf cattail	Typhaceae	TYAN
Typha latifolia	broadleaf cattail	Typhaceae	TYLA
Urtica dioica	stinging nettle	Urticaceae	URDI
Verbascum blattaria	moth mullein	Scrophulariaceae	VEBL
Verbascum thapsus	woolly mullein	Scrophulariaceae	VETH
Verbena bonariensis	purple top vervain	Verbenaceae	VEBO
Verbena hastata	blue vervain	Verbenaceae	VEHA2
Verbena littoralis	seashore vervain	Verbenaceae	VELI
Veronica anagallis-aquatica L.	water speedwell	Scrophulariaceae	VEAN2
Veronica peregrina ssp peregrina xalapensis	purslane speedwell	Scrophulariaceae	VEPEX2
Vicia sativa	common vetch	Fabaceae	VISA
Vicia villosa	winter vetch	Fabaceae	VIVI
Vitis californica	California wild grape	Vitaceae	VICA5
Wyethia angustifolia (DC.) Nutt.	California compassplant	Asteraceae	WYAN
Xanthium strumarium	cockleburr	Asteraceae	XAST
Zeltnera muehlenbergii	Muehlenberg's centaury	Gentianaceae	CEMU2
Zeltnera venustum	charming centaury	Gentianaceae	CEVE3

Vertebrate Wildlife Species Observed at Beale Air Force Base

Common and Scientific Name	Habitat Association [a] Annual Grassland	Oak Woodland	Riparian	Seasonal Wetlands	Permanent Wetland	Aquatic	Native or Non-native	Seasonal Occurrence at Beale AFB
Birds								
Greater white-fronted goose *Anser albifrons*				1	1	3	Native	Fall, winter
Snow goose *Chen caerulescens*				1	1	3	Native	Fall, winter
Ross's goose *Chen rossii*				1	1	3	Native	Fall, winter
Canada goose *Branta canadensis*				1	1	3	Native	Spring, fall, winter
Cackling Goose *Branta hutchinsii*				1	1	3	Native	Winter
Tundra swan *Cygnus columbianus*				1	1	3	Native	Fall, winter
Mute Swan *Cygnus olor*				1	1	2	Non-native	Fall
Wood duck *Aix sponsa*			1	2	2	2	Native	Year-round resident
Gadwall *Anas strepera*				1	1	2	Native	Year-round resident
American wigeon *Anas americana*				1	1	2	Native	Fall, winter
Mallard *Anas platyrhynchos*				1	1	2	Native	Year-round resident
Blue-winged teal *Anas discors*				1	1	2	Native	Fall, winter
Cinnamon teal *Anas cyanoptera*				1	1	2	Native	Spring, fall, winter
Northern shoveler *Anas clypeata*				1	1	3	Native	Fall, winter
Northern pintail *Anas acuta*				1	1	3	Native	Fall, winter
Green-winged teal *Anas crecca*				1	1	2	Native	Fall, winter
Canvasback *Aythya valisineria*				1	1	3	Native	Fall, winter
Ring-necked duck *Aythya collaris*				1	1	3	Native	Fall, winter

	Habitat Association [a]							
Common and Scientific Name	**Annual Grassland**	**Oak Woodland**	**Riparian**	**Seasonal Wetlands**	**Permanent Wetland**	**Aquatic**	**Native or Non-native**	**Seasonal Occurrence at Beale AFB**
Long-Tailed Duck *Clanguta hyemalis*					1		Native	Winter
Lesser scaup *Aythya affinis*				1	1	2	Native	Fall, winter
Bufflehead *Bucephala albeola*				1	1	2	Native	Fall, winter
Common goldeneye *Bucephala clangula*				1	1	1	Native	Fall, winter
Hooded merganser *Lophodytes cucullatus*				1	1	1	Native	Fall, winter
Common merganser *Mergus merganser*				1	1	1	Native	Spring, fall, winter
Ruddy duck *Oxyura jamaicensis*				1	1	2	Native	Year-round resident
Ring-necked pheasant *Phasianus colchicus*	1	2	3				Non-native	Year-round resident
Common peafowl *Pavo cristatus*							Non-native	Year-round resident
Wild turkey *Meleagris gallopavo*	2	1	1				Native	Year-round resident
California quail *Callipepla californica*		1	2				Native	Year-round resident
Pied-billed grebe *Podilymbus podiceps*				2	1	1	Native	Year-round resident
Eared grebe *Podiceps nigricollis*					1	1	Native	Year-round resident
Western grebe *Aechmophorus occidentalis*				2[b]	1	1	Native	Spring, summer
Rednecked grebe *Podiceps grisegena*					1	1	Native	Winter
American white pelican *Pelecanus erythrorhynchos*				3	2	1	Native	Winter
Double-crested cormorant *Phalacrocorax auritus*			3		1	1	Native	Year-round resident
American bittern *Botaurus lentiginosus*				2	1		Native	Year-round resident

	Habitat Association [a]							
Common and Scientific Name	**Annual Grassland**	**Oak Woodland**	**Riparian**	**Seasonal Wetlands**	**Permanent Wetland**	**Aquatic**	**Native or Non-native**	**Seasonal Occurrence at Beale AFB**
Great blue heron *Ardea herodias*			3	1	1	1	Native	Year-round resident
Great egret *Ardea alba*			3	1	1	1	Native	Year-round resident
Snowy egret *Egretta thula*			2	1	1	2	Native	Spring, fall (rare)
Cattle egret *Bubulcus ibis*	1		3	1	1	2	Non-native	Year-round resident
Green heron *Butorides virescens*				2	1	1	Native	Spring, summer, fall
Black-crowned night heron *Nycticorax nycticorax*				2	1	1	Native	Year-round resident
White-faced ibis *Plegadis chihi*				1	1	2	Native	Year-round resident
Turkey vulture *Cathartes aura*	1	1	2	3			Native	Year-round resident
Osprey *Pandion haliaetus*			1		1	1	Native	Spring, summer
White-tailed kite *Elanus leucurus*	1	1	1	3			Native	Year-round resident
Bald eagle *Haliaeetus leucocephalus*			2			2	Native	Fall, winter
Northern harrier *Circus cyaneus*	1			2			Native	Year-round resident
Sharp-shinned hawk *Accipiter striatus*		2	1				Native	Fall, winter
Cooper's hawk *Accipiter cooperii*		2	1				Native	Year-round resident
Red-shouldered hawk *Buteo lineatus*		2	1				Native	Year-round resident
Swainson's hawk *Buteo swainsoni*	1	2	2				Native	Spring, summer
Red-tailed hawk *Buteo jamaicensis*	1	1	1				Native	Year-round resident
Ferruginous hawk *Buteo regalis*	1	2	2				Native	Fall, winter
Rough-legged hawk *Buteo lagopus*	1	2	2				Native	Fall, winter

	Habitat Association [a]							
Common and Scientific Name	**Annual Grassland**	**Oak Woodland**	**Riparian**	**Seasonal Wetlands**	**Permanent Wetland**	**Aquatic**	**Native or Non-native**	**Seasonal Occurrence at Beale AFB**
Golden eagle *Aquila chrysaetos*	1	1	2	3			Native	Year-round resident
American kestrel *Falco sparverius*	1	1	1				Native	Year-round resident
Merlin *Falco columbarius*	1	1	1				Native	Fall, winter
Peregrine falcon *Falco peregrinus*	2	3	3	1		3	Native	Fall, winter
Prairie falcon *Falco mexicanus*	1	3					Native	Fall, winter
California black rail *Laterallus jamaicensis*	3			2	1		Native	Year-round resident
Virginia rail *Rallus limicola*				2	1		Native	Year-round resident
Sora *Porzana carolina*				2	1		Native	Year-round resident
Common moorhen *Gallinula chloropus*				1	1	2	Native	Year-round resident
American coot *Fulica americana*				1	1	2	Native	Year-round resident
Sandhill crane *Grus canadensis*	2			1	3		Native	winter
Black-bellied plover *Pluvialis squatarola*				1	2	3	Native	Winter
Killdeer *Charadrius vociferus*	3			1	2	3	Native	Year-round resident
Snowy Plover *Charadrius alexandrinus*	2			2			Native	Spring
Mountain Plover *Charadrius montanus*	1						Native	Winter
Black-necked stilt *Himantopus mexicanus*				1	2	3	Native	Year-round resident
American avocet *Recurvirostra americana*				1	2	3	Native	Year-round resident
Lesser Yellowlegs *Tringa flavipes*				1	2	3	Native	Spring
Greater yellowlegs *Tringa melanoleuca*				1	2	3	Native	Spring, fall, winter

	Habitat Association [a]							
Common and Scientific Name	**Annual Grassland**	**Oak Woodland**	**Riparian**	**Seasonal Wetlands**	**Permanent Wetland**	**Aquatic**	**Native or Non-native**	**Seasonal Occurrence at Beale AFB**
Long-billed curlew *Numenius americanus*				1	2	3	Native	Spring, fall, winter
Dunlin *Calidris alpine*				1	2	3	Native	Spring
Western sandpiper *Calidris mauri*				1	2	3	Native	Fall, winter
Least sandpiper *Calidris minutilla*				1	2	3	Native	Fall, winter
Long-billed dowitcher *Limnodromus scolopaceus*				1	2	3	Native	Spring, fall, winter
Wilson's snipe *Gallinago delicata*				1	1	2	Native	Spring, fall, winter
Ring-billed gull *Larus delawarensis*				1	1	2	Native	Spring, fall, winter
California gull *Larus californicus*				1	1	2	Native	Spring, fall, winter
Herring gull *Larus argentatus*				3	2	1	Native	winter
Glaucous-Winged gull *Larus glaucencens*	2			3	2	1	Native	Fall, Winter
Caspian tern *Sterna caspia*					2	1	Native	Spring, summer
Forster's tern *Sterna forsteri*					2	1	Native	Rare (identification uncertain)
Black tern *Chlidonias niger*					2	1	Native	Spring, summer (rare)
Rock pigeon *Columba livia*	1	2	3				Non-native	Year-round resident
Band-tailed pigeon *Patagioenas fasciata*		1	2				Native	Year-round resident
Eurasian Collard Dove *Streptopelia decaocto*	2	1	1				Non-native	Year-round resident
Mourning dove *Zenaida macroura*	1	1	2				Native	Year-round resident
Barn owl *Tyto alba*	1	1	1	2			Native	Year-round resident
Western screech-owl *Megascops kennicottii*		2	1				Native	Year-round resident

	Habitat Association [a]							
Common and Scientific Name	**Annual Grassland**	**Oak Woodland**	**Riparian**	**Seasonal Wetlands**	**Permanent Wetland**	**Aquatic**	**Native or Non-native**	**Seasonal Occurrence at Beale AFB**
Great-horned owl *Bubo virginianus*	1	1	1	2			Native	Year-round resident
Burrowing owl *Athene cunicularia*	1	3					Native	Year-round resident
Short-eared owl *Asio flammeus*	2			1	3		Native	Year-round resident
Northern saw-whet owl *Aegolius acadicus*		3	1				Native	Rare
Lesser nighthawk *Chordeiles acutipennis*	2						Native	Spring, summer
Common nighthawk *Chordeiles minor*	2			3			Native	Spring, summer
White-throated Swift *Aeronautes saxatalis*			1				Native	Spring
Black-chinned hummingbird *Archilochus alexandri*			2				Native	Summer
Anna's hummingbird *Calypte anna*		1	1				Native	Year-round resident
Rufous Hummingbird *Selasphorus rufus*			2				Native	Spring
Calliope Hummingbird *Stellula calliope*			2				Native	Spring
Belted kingfisher *Ceryle alcyon*			2			1	Native	Year-round resident
Red-breasted Sapsucker *Sphyrapicus ruber*		1	1				Native	Winter
Acorn woodpecker *Melanerpes formicivorus*		1	2				Native	Year-round resident
Nuttall's woodpecker *Picoides nuttallii*		1	1				Native	Year-round resident
Downy woodpecker *Picoides pubescens*		2	1				Native	Year-round resident
Hairy woodpecker *Picoides villosus*		1	1				Native	Year-round resident
Lewis' Woodpecker *Melanerpes lewis*		1	1				Native	Winter

	Habitat Association [a]							
Common and Scientific Name	**Annual Grassland**	**Oak Woodland**	**Riparian**	**Seasonal Wetlands**	**Permanent Wetland**	**Aquatic**	**Native or Non-native**	**Seasonal Occurrence at Beale AFB**
Northern flicker *Colaptes auratus*		1	1				Native	Year-round resident
Olive-sided flycatcher *Contopus cooperi*		2	1				Native	Spring, fall
Scissor-tailed flycatcher *Tyrannus forticatus*	1						Native	Spring, Fall
Western wood-peewee *Contopus sordidulus*		2	1				Native	Spring, fall
Willow flycatcher *Empidonax traillii*			1	2	2		Native	Spring, fall
Dusky flycatcher *Empidonax oberholseri*			1				Native	Spring, fall
Pacific-slope flycatcher *Empidonax difficilis*		2	1				Native	Spring, summer
Black phoebe *Sayornis nigricans*	2			1	1		Native	Year-round resident
Say's phoebe *Sayornis saya*	1			2			Native	Winter, spring
Ash-throated flycatcher *Myiarchus cinerascens*	2	1	1				Native	Spring, summer
Western kingbird *Tyrannus verticalis*	1	2	2				Native	Spring, summer
Loggerhead shrike *Lanius ludovicianus*	1	2	2	2			Native	Year-round resident
Northern shrike *Lanius excubitor*		2					Native	Winter
Western scrub-jay *Aphelocoma californica*		1	1				Native	Year-round resident
Yellow-billed magpie *Pica nuttalli*	2	1	2				Native	Year-round resident
American crow *Corvus brachyrhynchos*	1	1	1				Native	Year-round resident
Common raven *Corvus corax*							Native	Year-round resident

	Habitat Association [a]							
Common and Scientific Name	**Annual Grassland**	**Oak Woodland**	**Riparian**	**Seasonal Wetlands**	**Permanent Wetland**	**Aquatic**	**Native or Non-native**	**Seasonal Occurrence at Beale AFB**
Horned lark *Eremophila alpestris*	1			2			Native	Year-round resident
Tree swallow *Tachycineta bicolor*	2	1	1				Native	Year-round resident
Violet-green swallow *Tachycineta thalassina*	2	1	1				Native	Spring, summer
Northern rough-winged swallow *Stelgidopteryx serripennis*	1			2			Native	Spring, summer
Cliff swallow *Petrochelidon pyrrhonota*	1			2			Native	Spring, summer
Barn swallow *Hirundo rustica*	1			2			Native	Spring, summer
Oak titmouse *Baeolophus inornatus*		1	2				Native	Year-round resident
Bushtit *Psaltriparus minimus*		1	1				Native	Year-round resident
White-breasted nuthatch *Sitta carolinensis*		1	1				Native	Year-round resident
Pygmy nuthatch *Sitta pygmaea*		1	1				Native	Year-round resident (rare)
Brown Creeper *Certhia americana*			1				Native	Winter
Rock wren *Salpinctes obsoletus*	3						Native	Winter (rare)
Bewick's wren *Thryomanes bewickii*		1	1				Native	Year-round resident
House wren *Troglodytes aedon*		2	1				Native	Spring, summer, fall
Pacific wren *Troglodytes troglodytes*		2	2				Native	Rare
Marsh wren *Cistothorus palustris*			3	2	1		Native	Year-round resident
Golden-crowned kinglet *Regulus satrapa*		2	1				Native	Fall, winter

	Habitat Association [a]							
Common and Scientific Name	**Annual Grassland**	**Oak Woodland**	**Riparian**	**Seasonal Wetlands**	**Permanent Wetland**	**Aquatic**	**Native or Non-native**	**Seasonal Occurrence at Beale AFB**
Ruby-crowned kinglet *Regulus calendula*		1	1				Native	Fall, winter
Western bluebird *Sialia mexicana*	2	1	1	2			Native	Year-round resident
Mountain bluebird *Sialia currucoides*	1	1	2				Native	Spring, fall, winter
Hermit thrush *Catharus guttatus*		1	1				Native	Spring, fall, winter
American robin *Turdus migratorius*	2	1	2	3			Native	Year-round resident
Varied thrush *Ixoreus naevius*		1	1				Native	Fall, winter
Northern mockingbird *Mimus polyglottos*		1	1				Native	Year-round resident
European starling *Sturnus vulgaris*	2	1	1	2			Non-native	Year-round resident
American pipit *Anthus rubescens*	3			1			Native	Fall, winter
Cedar waxwing *Bombycilla cedrorum*		1	2				Native	winter
Orange-crowned warbler *Vermivora celata*		2	1				Native	Spring, summer
Nashville Warbler *Oreothlypis ruficapilla*		2	1				Native	Spring
Yellow warbler *Dendroica petechia*		2	1				Native	Summer
Yellow-rumped warbler *Dendroica coronata*		1	1				Native	Spring, fall, winter
Black-throated gray warbler *Dendroica nigrescens*		2	1				Native	Spring, fall, winter
Common yellowthroat *Geothlypis trichas*		2	1				Native	Year-round resident
Wilson's warbler *Wilsonia pusilla*		2	1				Native	Spring, fall
Yellow-breasted chat *Icteria virens*		3	1				Native	Spring, summer
Western tanager *Piranga ludoviciana*		2	2				Native	Spring, fall

	Habitat Association [a]							
Common and Scientific Name	**Annual Grassland**	**Oak Woodland**	**Riparian**	**Seasonal Wetlands**	**Permanent Wetland**	**Aquatic**	**Native or Non-native**	**Seasonal Occurrence at Beale AFB**
Spotted towhee *Pipilo maculatus*		2	1				Native	Year-round resident
California towhee *Pipilo crissalis*	3	1	2				Native	Year-round resident
Chipping Sparrow *Spizella passerina*	1	2					Native	Fall
Vesper sparrow *Pooecetes gramineus*	1						Native	Fall, winter
Savannah sparrow *Passerculus sandwichensis*	1	3		2			Native	Year-round resident
Grasshopper Sparrow *Ammodramus savannarum*	1						Native	Summer
Fox sparrow *Passerella iliaca*		2	1				Native	Fall, winter
Song sparrow *Melospiza melodia*		3	1	2	2		Native	Year-round resident
Lincoln's sparrow *Melospiza lincolnii*	1	3		1	3		Native	Fall, winter
Dark-eyed junco *Junco hyemalis*	3	1	1				Native	Fall, winter
White-crowned sparrow *Zonotrichia leucophrys*	3	1	1	3	3		Native	Fall, winter
Golden-crowned sparrow *Zonotrichia atricapilla*		1	1				Native	Fall, winter
Lark sparrow *Chondestes grammacus*	1						Native	Year-round resident
Black-headed grosbeak *Pheucticus melanocephalus*		1	1				Native	Spring, summer, fall
Blue grosbeak *Passerina caerulea*		2	1				Native	Summer
Lazuli bunting *Passerina amoena*		2	1				Native	Summer
Red-winged blackbird *Agelaius phoeniceus*	1	3	3	2	1		Native	Year-round resident

	Habitat Association [a]							
Common and Scientific Name	**Annual Grassland**	**Oak Woodland**	**Riparian**	**Seasonal Wetlands**	**Permanent Wetland**	**Aquatic**	**Native or Non-native**	**Seasonal Occurrence at Beale AFB**
Tricolored blackbird *Agelaius tricolor*	1	3	3	2	1		Native	Year-round resident
Western meadowlark *Sturnella neglecta*	1	3		2			Native	Year-round resident
Yellow-headed blackbird *Xanthocephalus xanthocephalus*				3	1		Native	Spring, summer
Brewer's blackbird *Euphagus cyanocephalus*	1	1	3	2	3		Native	Year-round resident
Great-tailed Grackle *Quiscalus mexicanus*							Native	Spring, summer
Brown-headed cowbird *Molothrus ater*	1	1	2	2	3		Native	Year-round resident
Bullock's oriole *Icterus bullockii*		1	1				Native	Spring, summer
House finch *Carpodacus mexicanus*	2	2	2	3			Native	Year-round resident
Lesser goldfinch *Carduelis psaltria*	2	1	2	3			Native	Year-round resident
American goldfinch *Carduelis tristis*	2	1	2	3			Native	Year-round resident
House sparrow *Passer domesticus*	2	2	2	3			Non-native	Year-round resident
Mammals								
California myotis *Myotis californicus*							Native	Summer, fall
Western small-footed myotis *Myotis ciliolabrum*							Native	Summer, fall
Little brown myotis *Myotis lucifugus*							Native	Summer, fall
Long-legged bat *Myotis volans*							Native	Summer, fall
Yuma bat *Myotis yumanensis*							Native	Summer, fall
Western pipstrelle *Pipstrellus hesperus*							Native	Summer, fall

	Habitat Association [a]							
Common and Scientific Name	**Annual Grassland**	**Oak Woodland**	**Riparian**	**Seasonal Wetlands**	**Permanent Wetland**	**Aquatic**	**Native or Non-native**	**Seasonal Occurrence at Beale AFB**
Big brown bat *Eptesicus fuscus*							Native	Summer, fall
Western red bat *Lasiurus blossevillii*							Native	Summer, fall
Hoary bat *Lasiurus cinereus*							Native	Fall
Townsend's big-eared bat *Corynorhinus townsendii*							Native	Not detected, but presence very likely
Pallid bat *Antrozous pallidus*							Native	Summer
Mexican free-tailed bat *Tadarida brasiliensis*							Native	Summer, fall
Desert cottontail *Sylvilagus audubonii*		2	1				Native	Year-round resident
Black-tailed jackrabbit *Lepus californicus*	1	2	3	3			Native	Year-round resident
Beaver *Castor canadensus*			1			1	Native	Year-round resident
Porcupine *Erethizon dorsatum*		1	2				Native	Year-round resident
Botta's pocket gopher *Thomomys bottae*	1	2	3				Native	Year-round resident
California ground squirrel *Spermophilus beecheyi*	1	1	3	3			Native	Year-round resident
Western gray squirrel *Sciurus griscus*		1	1				Native	Year-round resident
Western harvest mouse *Reithrodontomys megalotis*	1	2	3	2			Native	Year-round resident
Deer mouse *Peromyscus maniculatus*	2	2	2				Native	Year-round resident
California vole *Microtus californicus*	1	2	2	2			Native	Year-round resident
Muskrat *Ondatra zibethicus*			1		1	1	Native	Year-round resident
Norway rat *Rattus noreigicus*		3	1				Non-native	Year-round resident

	Habitat Association [a]							
Common and Scientific Name	**Annual Grassland**	**Oak Woodland**	**Riparian**	**Seasonal Wetlands**	**Permanent Wetland**	**Aquatic**	**Native or Non-native**	**Seasonal Occurrence at Beale AFB**
Black rat *Rattus rattus*	3		1		1		Non-native	Year-round resident
House mouse *Mus musculus*	1	2	2				Non-native	Year-round resident
Coyote *Canis latrans*	1	2	3	3			Native	Year-round resident
Gray fox *Urocyon cinereoargenteus*	2	1	1				Native	Year-round resident
Red fox *Vulpes vulpes*	2	1	1				Non-native	Year-round resident
Ringtail *Bassariscus astutus*			2				Native	Year-round resident
Racoon *Procyon lotor*			1	1	2		Native	Year-round resident
Striped skunk *Mephitis mephitis*		2	1				Native	Year-round resident
River otter *Lutra canadensis*					2	1	Native	Year-round resident
Mountain lion *Felis concolor*		1	2				Native	Year-round resident
Bobcat *Lynx rufus*	2	1	2				Native	Year-round resident
Mule (Black-tailed) deer *Odocoileus hemionus*	2	1	1				Native	Year-round resident and migratory herd
Reptiles								
Western pond turtle *Actinemys marmorata*	2	3			1	1	Native	Year-round resident
Gilbert's skink *Plestiodon gilbertii*	2	1	2				Native	Year-round resident
Western fence lizard *Sceloporus occidentalis*	3	1	2				Native	Year-round resident
Southern alligator lizard *Elgaria multicarinata*	3	1	2				Native	Year-round resident
Rubber boa *Charina bottae*		3	3				Native	Year-round resident

	Habitat Association [a]							
Common and Scientific Name	**Annual Grassland**	**Oak Woodland**	**Riparian**	**Seasonal Wetlands**	**Permanent Wetland**	**Aquatic**	**Native or Non-native**	**Seasonal Occurrence at Beale AFB**
Western yellow-bellied Racer *Coluber constrictor*	1	2	2				Native	Year-round resident
California kingsnake *Lampropeltis californiae*	1	1	2				Native	Year-round resident
Pacific gopher snake *Pituophis catenifer catenifer*	1	1	2				Native	Year-round resident
Sierra garter snake *Thamnophis couchi*			2	2			Native	Year-round resident
Valley gartersnake *Thamnophis sirtalis fitchii*	2	2	1	2	1		Native	Year-round resident
Mountain gartersnake *Thamnophis elegans elegans*	1	2	3	2	1		Native	Year round resident
Northern Pacific rattlesnake Crutalus oreganus	1	1	2				Native	Year-round resident
Amphibians								
Sierra chorus frog *Psuedacris sierrae*	3	2	2	1	1	1	Native	Year-round resident
American Bullfrog *Lithobates catesbeiana*			2	2	1	1	Non-native	Year-round resident
Western Toad *Anaxyrus boreas*	2	1	3	2			Native	Year-round resident
Western Spadefoot *Spea hammondii*	1	3		1			Native	Year-round resident

[a] Habitats reflect those described in the Beale Air Force Base Ecosystem Study (Jones & Stokes Associates 1996a). Some classification types include several habitats as described below.
Riparian includes riparian scrub and riparian forest
Permanent wetland includes cattail marsh, tule marsh, and mixed marsh
Seasonal wetland includes vernal pool, swale, other seasonal wetlands, and disturbed seasonal wetlands
Aquatic includes ephemeral/intermittent drainage, perennial drainage, artificial drainage, and ponds/lakes/reservoirs
[b] Habitat Suitability (based on Beale Air Force Base Ecosystem Study). If blank, species occurrence is based on another source (see sources below) and habitat suitability not reported.
1. Optimum Habitat
2. Suitable Habitat
3. Marginal Habitat
[c] Seasonal Occurrence: Spring = March 21 - June 20, Summer = June 21 - September 22, Fall = September 23 - December 20, Winter = December 22 - March 20
Sources include: Beale Air Force Base Ecosystem Study, CSUS Bird Study (1998, 2001), Christmas Bird Count 2000, USDA Annual BASH Report for Beale AFB 2017, and Beale AFB staff anecdotal observations (current as of 2018).

APPENDIX J

Human Health Risk Assessment

HUMAN HEALTH RISK ASSESSMENT

FOR

NON-NATIVE AND NOXIOUS PLANT SPECIES MANAGEMENT ON BEALE AIR FORCE BASE AND LINCOLN RECEIVER SITE, CALIFORNIA

Contents

1.0 Introduction

The purpose of this analysis is to assess the risks to human health of using seven different herbicides for the control and eradication of invasive plants on Beale Air Force Base (AFB). The herbicide active ingredients assessed are aminopyralid, chlorsulfuron, glyphosate, imazamox, imazapyr, sulfometuron methyl, and triclopyr.

This risk assessment examines the potential health effects on all groups of people who might be exposed to any of the seven herbicides that might potentially be used in treating invasive plants in this area. Those potentially at risk fall into two groups: workers, and members of the public. Workers include applicators, supervisors, and other personnel directly involved in the application of herbicides. The public includes other base workers, visitors, and residents who could be exposed through the drift of herbicide spray droplets, through contact with sprayed vegetation, or by eating, or placing in the mouth, food items or other plant materials, such as berries or vegetation, by eating game or fish containing herbicide residues, or by drinking water that contains such residues.

The analysis of the potential human health effects of the use of chemical herbicides was accomplished using the methodology of risk assessment generally accepted by the scientific community (National Research Council 1983, U.S. EPA 1986). In essence, this pesticide risk assessment consists of comparing doses that people may get from applying the pesticides (worker doses) or from being near an application site (public doses) with the U.S. Environmental Protection Agency's (U.S. EPA) established Reference Doses (RfD), a level of exposure considered protective of lifetime or chronic exposures.

Details regarding the specific methods used to prepare the Syracuse Environmental Research Associates, Inc. (SERA) human health risk assessments referenced are documented in SERA (2007a, 2011c), while detailed explanations of specific methods for estimating occupational exposure are provided in SERA (1998). Basically, the risk assessment has five major sections: an introduction (Section 1); an identification of the hazards associated with each herbicide and its commercial formulations (Section 2); an assessment of potential exposure to the product (Section 3); an assessment of the dose-response relationships (Section 4); and a characterization of the risks associated with plausible levels of exposure (Section 5).

Risk assessments are usually expressed with numbers; however, the numbers are far from exact. Variability and uncertainty may be dominant factors in any risk assessment, and these factors should be expressed. Within the context of a risk assessment, the terms variability and uncertainty signify different conditions.

Variability reflects the knowledge of how things may change. Variability may take several forms. For this risk assessment, three types of variability are distinguished: statistical, situational, and arbitrary. Statistical variability reflects, at least, apparently random patterns in data. For example, various types of estimates used in this risk assessment involve relationships of certain physical properties to certain biological properties. In such cases, best or maximum likelihood estimates can be calculated as well as upper and lower confidence intervals that reflect the statistical variability in the relationships. Situational variability describes variations depending on known circumstances. For example, the application rate or the applied concentration of an herbicide will vary according to local conditions and goals. As discussed in the following section, the limits on this variability are known and there is some information to indicate what the variations are. In other words, situational variability is not random. Arbitrary variability, as the name implies, represents an attempt to describe changes that cannot be characterized statistically or by a given set of conditions that cannot be well defined. This type of variability dominates some spill scenarios involving either a spill of a chemical on to the surface of the skin or a spill of a chemical into water. In either case, exposure depends on the amount of chemical spilled and the area of skin or volume of water that is contaminated.

Variability reflects knowledge of or at least an explicit assumption about how things may change, while uncertainty reflects a lack of knowledge. For example, the focus of the human health dose-response assessment is an estimation of an “acceptable” or “no adverse effect” dose that will not be associated with adverse human health effects. For most chemicals, however, this estimation regarding human health must be based on data from experimental animal studies, which cover only a limited number of effects. Generally, judgment, not analytical methods, is the basis for the methods used to make the assessment. Although the judgments may reflect a consensus (i.e., be used by many groups in a reasonably consistent manner), the resulting estimations of risk cannot be proven analytically. In other words, the estimates regarding risk involve uncertainty. The primary functional distinction between variability and uncertainty is that variability is expressed quantitatively, while uncertainty is generally expressed qualitatively.

In considering different forms of variability, almost no risk estimate presented in this document is given as a single number. Usually, risk is expressed as a central estimate and a range, which is sometimes very large. Because of the need to encompass many different types of exposure as well as the need to express the uncertainties in the assessment, this risk assessment involves numerous calculations. Most of the calculations are relatively simple; however, some of the calculations are cumbersome. These calculations are contained in worksheets in the project file for this EA, and are based on the worksheets contained in the various SERA risk assessments.

Additives, or adjuvants, to the formulations that might be used when herbicides are applied are not considered in detail in this risk assessment. Additives might involve surfactants and colorants. Many of the formulated herbicides require the use of added surfactants; such information is on the herbicide label. Surfactants increase the ability of the herbicide to be absorbed into plant tissues. Colorants are used to indicate that a plant or area has been treated, for several reasons, including avoiding waste of materials by retreating, to allow people to avoid treated areas in short term, and to be more effective by treating all target vegetation.

The total number of gross acres projected for treatment is projected at about 20,000 in ten years, assuming a liberal estimate of potential spread within the planning area. The projected maximum annual use of herbicides is about 2,000 acres under the Preferred Alternative, based on current and historic funding. Less than 100 acres would be treated with herbicide annually under the No Action Alternative.

2.0 Hazard Analysis

The hazards associated with using each of the herbicides were determined by a thorough review of available toxicological studies. These reviews are contained in other documents and are referenced here as needed. A considerable body of information has been compiled in a group of risk assessments completed by SERA (authored by Dr. Patrick Durkin, PhD) under contract to the Forest Service, as well as in a risk assessment contained in the Environmental Assessment for Weed Eradication and Control on the El Dorado National Forest (Carroll 2012). The Eldorado National Forest Environmental Assessment has been referenced since similar weeds, treatment types, and ecosystems are represented as Beale AFB. Current peer-reviewed articles from the open scientific literature, as well as recent U.S. EPA documents are also used to update information contained in these documents. All of these documents are incorporated by reference into this risk assessment.

The toxicological database for each herbicide was reviewed for acute, sub-chronic, and chronic effects to test animals. Because of the obvious limitations on the testing of chemicals on humans, judgments about the potential hazards of pesticides to humans are necessarily based in large part on the results of toxicity tests on laboratory animals. Where such information is available, information on actual human poisoning incidents and effects on human populations supplement these test results. For a background discussion of the various toxicological tests and endpoints, refer to USDA (1989, pages F-7 to F18).

A note specific to impurities and metabolites - virtually no chemical synthesis yields a totally pure product. Technical grade herbicides, as with other technical grade products, undoubtedly contain some impurities. The EPA defines the term impurity as "*…any substance…in a pesticide product other than an active ingredient or an inert ingredient, including un-reacted starting materials, side reaction products, contaminants, and degradation products*" (40 CFR 158.153(d)). To some extent, concern for impurities in technical grade herbicides is reduced by the fact that the existing toxicity studies on these herbicides were conducted with the technical grade product. Thus, if toxic impurities are present in the technical grade product, they are likely to be encompassed by the available toxicity studies on the technical grade product. An exception to this general rule involves carcinogens, most of which are presumed to act by non-threshold mechanisms. Because of the non-threshold assumption, any amount of a carcinogen in an otherwise non-carcinogenic mixture is assumed to pose some carcinogenic risk. As with contaminants, the potential effect of metabolites on a risk assessment is often encompassed by the available *in vivo* toxicity studies under the assumption that the toxicological consequences of metabolism in the species on which toxicity studies are available will be similar to those in the species of concern, human in this case. Uncertainties in this assumption are encompassed by using an uncertainty factor in deriving the RfD and may sometimes influence the selection of the study used to derive the RfD. Unless otherwise specifically referenced, all data and test results are from the references listed at the herbicide heading.

2.1 Aminopyralid

(Reference: SERA 2007b)

Acute and Chronic Exposures - Because aminopyralid is a new herbicide, no information is available in the published literature on the toxicity of aminopyralid to humans or other mammalian species. The only information on aminopyralid that is available for assessing potential hazards in humans is a series of toxicity studies that have been submitted to and evaluated by the U.S. EPA's Office of Pesticides in support of the registration for aminopyralid.

Results of acute toxicity studies are usually expressed as LD_{50} values. Studies that are useful in estimating the LD_{50} involve testing at a number of different dose levels that result in mortality rates that bracket 50% of the treated animals. These data are then used to estimate the oral LD_{50} value. In the registration process, however, the U.S. EPA will accept limit tests in which the compound is tested at only a single high dose. If the compound does not cause substantial mortality – i.e., mortality rates of 50% or more – the requirement for a full study to determine the LD_{50} value may be waived. This latter case applies to aminopyralid. Two studies - on aminopyralid and on the triisopropanolamine (TIPA) salt of aminopyralid are limit tests. Both of these studies have been accepted by the U.S. EPA. In the study on aminopyralid, a single dose of 5000 mg a.e./kg bw in rats resulted in the death of only 1 of 10 animals. Signs of toxicity included decreased reactivity, loose or watery feces, and transient weight loss. In the one animal that died, observations included gas in the gastrointestinal tract and hemolyzed blood. These observations may simply reflect post-mortem changes. The study on the TIPA salt of aminopyralid yielded similar signs of toxicity at a dose of 2000 mg a.e./kg bw: loose/watery feces and transient weight loss.

Subchronic and chronic toxicity studies have failed to demonstrate any clear signs of systemic toxic effects. no effects have been observed in laboratory mammals at doses of 50 mg/kg/day or less on chronic or subchronic exposures to technical grade aminopyralid or the TIPA salt of aminopyralid. At doses of 500 mg/kg/day or greater, various effects have been observed in different species and different bioassays. These effects increased cecal weight, weight loss or lowered weight gain, changes in the weight of the liver, changes in urine chemistry and gastric effects.

Effects on the Skin and Eyes – Two studies are available on the ocular effects of aminopyralid. A study on the technical grade aminopyralid involved placing 100 mg of the powder into the conjunctival sac of rabbits. Severe irritation with corneal damage was observed in all animals and these effects persisted throughout the 36 day post-exposure observation period. Consequently, the U.S. EPA classified technical grade aminopyralid as a severe eye irritant (Category I). In the formulation study, aminopyralid TIPA in water was applied to the conjunctival sac of rabbits. Only slight redness of the conjunctiva was noted and this irritant effect lasted until only Day 2 of the study, by which time no irritant effects were evident. Consequently, the U.S. EPA classified this aminopyralid formulation as Category IV, the minimal classification for eye irritants.

Two acute dermal irritation studies are available, one with technical grade aminopyralid and one with a formulation. No dermal irritation was observed with the technical grade material, but slight erythema was observed in the assay of the formulation. Neither study evidenced marked irritation, and both studies have resulted in a Category IV classification – i.e., the lowest classification used by the U.S. EPA. While somewhat speculative, the irritation observed in the formulation study may be attributable to TIPA rather than aminopyralid since the occurrence of TIPA in the formulation is the only difference between technical grade aminopyralid and the formulation. As with dermal irritation, two dermal sensitization studies are available, one on technical grade aminopyralid and the other a formulation. Both studies yielded the same result, no evidence of any dermal sensitization.

In a subchronic dermal toxicity study in rats on technical grade aminopyralid no signs of frank toxicity were observed at dermal doses (6 hours/day) of 0, 100, 500, and 1000 mg a.e./kg bw/day for 28 days. The only responses were slight epidermal hyperplasia in at 500 and 1000 mg/kg.

Reproductive and Teratogenic Effects -Aminopyralid has also been subject to several bioassays for developmental toxicity in rabbits and rats. No adverse effects on offspring have been noted in these studies other than decreased body weight in offspring that is associated with decreased food consumption and decreased body weight in adult females. One gavage developmental study in rabbits noted decreased maternal food consumption and severe weight loss at 520 mg a.e./kg bw/day and extreme weight loss in one doe at 260 mg a.e./kg bw/day. The only fetal effect was a decrease in fetal weight (which appears to be secondary to maternal weight loss) at 520 mg a.e./kg bw/day. Based on this study, the U.S. EPA set the maternal NOEL at 104 mg a.e./kg bw/day and the developmental NOAEL at 260 mg a.e./kg bw/day. This study is considered in the derivation of an acute RfD.

Aminopyralid has been subject to one multi-generation reproduction study in rats, which involved dietary exposures at concentrations of 0, 50, 250, 1000 ppm (mg a.e./kg diet) for 10 weeks. The only effect noted was an increase in cecal weight. This effect was classified by the U.S. EPA as being not toxicologically significant. Consequently, the U.S. EPA classified the 1000 ppm dietary concentration as a NOAEL for both parental, reproductive, and developmental effects.

Carcinogenicity and Mutagenicity -Aminopyralid has been tested for mutagenicity in a number of different test systems and has been assayed *in vivo* for carcinogenic activity in rats and mice. The only positive response from the *in vitro* mutagenicity studies involved chromosomal aberrations in cultured rat lymphocytes at concentrations of 1000, 1400 and 1700 μg/mL. This response is characterized by the U.S. EPA as weak clastogenic activity secondary to cell toxicity. The U.S. EPA assessment states that the weak clastogenic activity occurred *…only at cytotoxic levels with metabolic activation*. This statement in the US EPA human health (HED) risk assessment appears to be a typographic error, as the data in the study indicate a clastogenic effect only in the absence of metabolic activation.

In terms of a quantitative significance to the human health risk assessment, carcinogenicity is an issue only if the data are adequate to support the derivation of a cancer potency factor. Since neither of the *in vivo* bioassays noted any carcinogenic activity, no cancer potency factor has been derived.

Based on the results of the mutagenicity screening studies and the *in vivo* bioassays, the U.S. EPA has concluded that aminopyralid is “not likely” to be carcinogenic to humans.

Other Toxic Endpoints - Except for studies on skin sensitization, specific studies on the effects of pesticides on immune function are not required for pesticide registration and no such studies are available on aminopyralid. While no specific studies are available on the immunologic effects of aminopyralid, limited information from the standard subchronic and chronic studies noted no remarkable effects in lymphoid tissue in these standard toxicity studies on aminopyralid.

Virtually any chemical, including aminopyralid, will cause signs of neurotoxicity in severely poisoned animals and thus can be classified as an indirect neurotoxicant. For aminopyralid, there is ample indication of indirect effects that might be associated with neurotoxicity but no indication of specific neurotoxicity. Signs of incoordination have been noted after gavage administration of technical grade aminopyralid.

Two studies have been conducted on aminopyralid: an acute neurotoxicity study and a neurologic evaluation after 12-months of dietary exposure that was conducted as part of the 2-year feeding study in rats. No adverse effects attributed to treatment were observed in either study and the U.S. EPA concluded that aminopyralid is not neurotoxic.

Several studies that report weight loss in experimental mammals after exposure to aminopyralid. While changes (increases or decreases) in body weights could be associated with effects on endocrine function, body weight loss is a very common observation in toxicity studies and could be due to a variety of other factors secondary to general adverse effects. In the absence of any indication of effects on endocrine tissue, there is no basis for asserting that decreases in body weights are associated with changes in endocrine function.

Multigeneration exposures are recommended for toxicological assessment of suspected endocrine disruptors. The one available multigeneration reproduction study on aminopyralid is discussed in Reproductive and Teratogenic Effects, above. Damage to gonadal tissue (an increase in absolute and relative ovary weights) were observed in female mice exposed to aminopyralid for 18 months. However, these changes were not considered to be treatment.

Although the U.S. EPA has yet to adopt standardized screen tests for endocrine disruptors, this endpoint is addressed in the U.S. EPA human health risk assessment of aminopyralid and the U.S. EPA has concluded that: *In the available toxicity studies on aminopyralid, there was no estrogen, androgen, and/or thyroid mediated toxicity.*

Inhalation Exposures – Two inhalation toxicity studies are available. Acute (4 hour) inhalation of aminopyralid at relatively high concentration levels in rats resulted in the animals exhibiting various signs associated with the very high exposures and the stress of the test – e.g., gasping and dropping eyes lids in the nose-only exposures and soiling of the fur in the whole body exposures. The only systemic effects were slight (1%-4.5%) and transient losses of body weight. Based on these two acute inhalation toxicity studies, the U.S. EPA classified aminopyralid as Category IV, the minimal classification for acute inhalation toxicity.

Impurities – The manufacturer has identified impurities in technical grade aminopyralid and these have been disclosed to the U.S. EPA. The submission, however, also contains information on production processes – i.e., methods of synthesis – and these are considered propriety. Virtually no chemical synthesis yields a totally pure product. Technical grade aminopyralid, as with other technical grade products, undoubtedly contains some impurities. To some extent, concern for impurities in technical grade aminopyralid is reduced by the fact that the existing toxicity studies on aminopyralid were conducted with the technical grade product. Thus, if toxic impurities are present in the technical grade product, they are likely to be encompassed by the available toxicity studies on the technical grade product.

Metabolites – Aminopyralid does not appear to be extensively metabolized by mammals – i.e., rats, cows, goats, or hens. In all of these organisms, the major product that is excreted is the parent compound and this accounts for over 95% of the excreted material. Only one minor metabolite was detected in goats and this accounted for less than 0.2% of the administered dose. As with many other pesticides, it seems reasonable to assert that the available *in vivo* toxicity studies will encompass the concerns with *in vivo* metabolites in both the human health and ecological risk assessments.

In the environment, aminopyralid will degrade to a number of different metabolites via aqueous photolysis and two specific metabolites have been identified – i.e., oxamic acid and malonamic acid. Other unidentified metabolites include 2 or 3 carbon acid amides. The importance of metabolites in the risk assessment of aminopyralid cannot be fully or well characterized with the information that is available. While there appears to be very little information on oxamic acid and malonamic acid and no inferences can be made on the potential risks of other unidentified metabolites, the U.S. EPA indicated that these metabolites are not of substantial concern to the human health risk assessment conducted by the Office of Pesticide Programs.

Inerts - The commercial formulation of aminopyralid that will be used (Milestone vm®) covered in this risk assessment contains only the triisopropanolamine (TIPA) salt of aminopyralid and water.

TIPA is classified by the U.S. EPA as a List 3 inert. Relatively little information is available on the toxicity of TIPA. On the Material Safety Data Sheets the rat LD_{50} for TIPA is listed as 4,730 mg/kg. Following the categorization system used by the U.S. EPA in human health risk assessments, TIPA would be classified as Category III (Caution), which applies to compounds with oral LD_{50} values in the range of >500 to 5,000 mg/kg. Following the classification system used by the U.S. EPA in ecological risk assessments, TIPA would be classified as Practically Nontoxic because the oral LD_{50} is >2000 mg/kg (SERA 2007b, Table 4-1). The MSDS also classifies TIPA as a moderate eye irritant that may cause corneal damage. TIPA may be a skin irritant (see effects to skin and eyes, above).

In a subchronic drinking water study, rats were dosed with 100, 300, 600, 1200 or 2000 milligrams TIPA/kg bw for 2 weeks. The only effect was increased kidney weight at doses of 300 mg/kg bw and higher. In a 13-week dietary study, dogs were exposed to TIPA in their diet at doses equivalent to 0, 16.8, 71.2, and 272 mg TIPA/kg body weight/day for males and 0, 19.7, 78.3, and 288 mg/kg for females. The summary of this study indicates that: There were no effects that were considered compound related or biologically significant in any of the parameters measured.

2.2 Chlorsulfuron

(Reference: SERA 2004a)

Acute and Chronic Exposures - Although no information is available on the toxicity of chlorsulfuron to humans, the toxicity of chlorsulfuron has been relatively well characterized in mammals. All of this information is contained in unpublished studies submitted to the U.S. EPA as part of the registration process for chlorsulfuron.

In experimental mammals, the acute oral LD_{50} for chlorsulfuron is greater than 5,000 milligrams per kilogram of body weight (mg/kg), which indicates a low order of oral toxicity. Acute exposure studies of chlorsulfuron and chlorsulfuron formulations give similar results, indicating that formulations of chlorsulfuron are not more toxic than chlorsulfuron alone.

Similar adverse effects are observed following both subchronic and chronic exposure to chlorsulfuron in tested mammals. The most common and sensitive signs of acute, subchronic, and chronic toxicity are weight loss and decreased body weight gain. The only other commonly noted effects are changes in various hematological parameters and general gross pathological changes to several organs. None of these changes, however, suggest a clear or specific target organ toxicity. While observations of weight loss and decreased weight gain suggest that chlorsulfuron could be associated with an underlying change in metabolism, studies specifically investigating the effects of chlorsulfuron on metabolism have not been conducted. The U.S. EPA used a 1-year feeding study in rats, with a NOEL of 5 mg/kg/day, to derive an RfD for chlorsulfuron; body weight loss and decreased weight gain were used as the most sensitive effects.

Effects on the Skin and Eyes - Chlorsulfuron is classified as a moderate eye irritant, but as a non-irritant to the skin. The results of several acute dermal studies show that formulations containing up to 80% chlorsulfuron produced only mild skin irritation. Dermal application of chlorsulfuron to intact and abraded skin produced mild redness in rabbits that resolved within 4-6 days. Dermal application of chlorsulfuron did not produce skin irritation or a sensitization response in guinea pigs. Application to the eyes of rabbits produced mild irritant effects to the cornea and conjunctiva. Transient, mild corneal clouding and mild to no conjunctival swelling and discharge were observed in rabbits following a single application of 0.1 milliliter (mL) of a 75% formulation. No signs of irritation of the iris were observed. In another study, a single application to the eyes produced transient slight corneal clouding, conjunctivitis, and swelling of the iris. Eyes returned to normal within 4 days. Studies on the systemic toxicity of chlorsulfuron following dermal exposure have been conducted in rabbits. Dermal exposure to doses up to 3,400 mg/kg were not associated with any signs of significant systemic toxicity in rabbits based on standard acute bioassays with 14-day observation periods. The only signs of systemic toxicity reported in these studies were an initial weight loss and diarrhea.

Reproductive and Teratogenic Effects - Two gavage teratogenicity studies have been conducted in rabbits and rats and two dietary reproduction studies have been conducted in rats. Chlorsulfuron is not teratogenic, but is toxic to embryos at high exposure levels. An increase in the number of fetal resorptions and a decrease in fetal viability, indicating embryo toxicity, were observed in rabbits exposed to 75 mg/kg/day. Teratogenic effects were not observed in any dose group. Exposure of rats for three-generations to chlorsulfuron did not result in significant treatment-related effects. The only adverse effect on reproductive function reported was a slightly decreased fertility index in rats exposed to 125 mg/kg/day. The NOEL for reproductive effects in rats is 25 mg/kg/day. Other than weight loss, no significant maternal toxicity was reported in these studies. Thus, chlorsulfuron does not appear to have significant adverse effects on reproductive function.

Carcinogenicity and Mutagenicity - Chlorsulfuron has been tested for mutagenicity in a number of different test systems and has been assayed for carcinogenic activity in rats and mice. No evidence of carcinogenic activity was found in any of the chronic toxicity studies conducted on chlorsulfuron. Chlorsulfuron was classified as having ``no evidence of carcinogenicity'' based upon lack of evidence of carcinogenicity in rats and mice (U.S. EPA 2002b).

Results of *in vitro* mutagenicity studies in several Salmonella typhimurium bacteria strains and in Chinese hamster ovary cells show that chlorsulfuron is not mutagenic, either with or without metabolic activation. Negative results were also obtained from genotoxicity studies in rat liver cell cultures. In addition, *in vivo* studies in rats show that chlorsulfuron at exposure levels up to 250 mg/kg/day for 10 weeks does not produce dominant lethal mutations.

Other Toxic Endpoints – There is very little direct information on which to assess the immunotoxic potential of chlorsulfuron. Results of long-term exposure studies in dogs and mice show that chlorsulfuron may produce changes to immune system function. Increases in lymphocytes and eosinophils (a type of white blood cell that can increase with allergy and other infections) were observed in female dogs exposed for 6 months to 25 or 125 mg/kg/day chlorsulfuron. Effects were not seen at the 5 mg/kg/day dose or in male dogs at any dose. In mice, neutrophilic granulocytes (a type of white blood cell) were decreased and lymphocyte counts were increased in female mice exposed to 250, or 375 mg/kg/day chlorsulfuron for 3 months. These effects were not observed in female mice at lower doses or in male mice at any dose. While results of these studies suggest that exposure to chlorsulfuron may produce changes in immune system parameters, the observations in these studies do not provide conclusive evidence supporting the immunotoxic potential of chlorsulfuron.

Virtually any chemical, including chlorsulfuron, will cause signs of neurotoxicity in severely poisoned animals and thus can be classified as an indirect neurotoxicant. This is the case for chlorsulfuron in that exposure to acute high doses of chlorsulfuron produces lethargy and weakness. This does not, however, implicate chlorsulfuron as a direct neurotoxicant.

Chronic, lifespan, and multigenerational bioassays in mammals and acute and subchronic studies on aquatic organisms and wildlife did not reveal endocrine effects. Any endocrine related effects would have been detected in this definitive array of required tests (U.S. EPA, 2002c). Both weight loss and weight gain are observed in animals treated with chlorsulfuron, implying a change in metabolic status. However, there is no evidence to suggest that changes in weight are due to effects of chlorsulfuron on the endocrine system. Decreased pituitary and thyroid weights were observed in male dogs exposed to chlorsulfuron for 26 weeks. However, these changes were not considered to be treatment related. With the exception of a slight decrease in the fertility index in rats exposed to125 mg/kg/day chlorsulfuron in a three-generation reproductive study, there is no evidence that chlorsulfuron produces adverse effects on the reproductive endocrine system. Thus, no evidence for chlorsulfuron producing direct effects on the endocrine system was found.

Inhalation Exposures – There is only one inhalation toxicity study of chlorsulfuron. Acute (4 hour) inhalation of chlorsulfuron at relatively high concentration levels (5.9 mg/L) in dust did not results in any systemic adverse effects to rats considered to be treatment related. While no systemic effects were noted from necropsy performed after exposure, microscopic changes to the mucus membrane in the nasal cavity, including atrophy of the secreting cells of the nasal gland and minor changes to the nasal cavity skin cells, were noted in some of the rats. These histological findings were consistent with chronic inflammation of the lining of the nose or with post-injury repair processes.

Impurities – No information has been encountered in the published or unpublished literature on impurities in chlorsulfuron.

Metabolites - The elimination of chlorsulfuron has been studied in rats, goats, dairy cows, and hens. In rats, chlorsulfuron exhibits first order elimination kinetics, with an estimated half-life of <6 hours. In all mammalian species studied, chlorsulfuron and its metabolites are extensively and rapidly cleared by a combination of excretion and metabolism. Most of the chlorsulfuron is excreted in urine or feces in the form of the unchanged compound. Due to its rapid elimination, metabolism of chlorsulfuron in animals is minimal. The major metabolite identified in the urine of rats is 2-chlorobenzenesulfonamide (a hydrolysis product), although other minor metabolites have also been identified in urine. Conjugation products, mainly N-glucuronides, have also been identified in the urine of goats. No studies investigating the toxicity of the chlorsulfuron metabolites produced by mammals were identified in the published literature or unpublished studies. There is no evidence that the metabolites of chlorsulfuron as identified in either the plant, or animal metabolism studies are of any toxicological significance (U.S. EPA, 2002c).

Inerts - The formulation of chlorsulfuron that will be used contains materials other than chlorsulfuron that are included as adjuvants to improve either efficacy or ease of handling and storage. The identity of these materials is confidential. The inerts were disclosed to the U.S. EPA and were reviewed in the preparation of SERA (2004a). All that can be disclosed explicitly is that none of the additives are classified by the U.S. EPA as toxic.

2.3 Glyphosate

(References: USDA 1984, USDA 1989, SERA 2011a, Williams et al. 2000)

Acute and Chronic Exposures - The toxicity of glyphosate is relatively well characterized in both experimental mammals and humans, although the mechanism of action is not clear. The acute toxicity of glyphosate is relatively low, with oral LD_{50} values in rats and mice ranging from approximately 2,000 to 6,000 mg/kg. Most of the human experience with glyphosate involves the consumption of large quantities of glyphosate during attempted suicides. The signs of toxicity are generally consistent with massive mucosal irritation and tissue degeneration. In addition, glyphosate may interfere with normal metabolic biochemical functions.

The chronic toxicity of glyphosate has been well characterized in laboratory mammals. One of the more consistent signs of subchronic or chronic exposure to glyphosate is loss of body weight. This effect has been noted in mice, rats, and rabbits. Other signs of toxicity seem general and non-specific. A few studies report changes in liver weight, blood chemistry that would suggest mild liver toxicity, or liver pathology. Changes in pituitary weight have also been observed. Signs of kidney toxicity, which might be expected based on the acute toxicity of glyphosate, have not been reported consistently and are not severe. As summarized by the National Toxicology Program (NTP) (1992; as referenced in SERA 2011a), various hematological changes have been observed but are not considered severe and are attributed to mild dehydration.

Effects on the Skin and Eyes - Glyphosate formulations that will be used are classified as either non-irritating or only slightly irritating to the skin and eyes in standard assays required for product registration. Based on several eye and skin irritation studies submitted to the U.S. EPA as part of the registration process, the U.S. EPA classifies glyphosate as mildly irritating to the eyes (Category III) and slightly irritating to the skin (Category IV). The free acid of glyphosate is severely irritating to the eyes but the isopropylamine (IPA) salt of glyphosate, the form that is in all formulations approved for use on Air Force land, is nonirritating to the skin and eyes. Although glyphosate is an irritant, there are no data indicating that the compound causes sensitization in animals or humans. POEA and other surfactants used in glyphosate formulations may be severely irritating to the eyes, skin, and other mucosal surfaces, such as the gastrointestinal tract and the lungs.

Carcinogenicity and Mutagenicity – Based on standard animal bioassays for carcinogenic activity *in vivo*, there is no basis for asserting that glyphosate is likely to pose a substantial risk. The Reregistration Eligibility Decision (RED) document on glyphosate indicates that glyphosate is classified as Group E: Evidence of non-carcinogenicity for humans. Tumors have been observed in some of the earlier chronic toxicity studies. U.S. EPA determined that the studies conducted before 1990 were insufficient for evaluating the potential carcinogenicity of glyphosate because the observed responses were equivocal or the dose levels were inappropriate (i.e., the highest dose used was not the maximum tolerated dose). A recent epidemiology study in Sweden (Hardell and Erikkson, 1999, as referenced in SERA 2011a) reported an increased cancer risk of non-Hodgkin lymphoma (NHL) in individuals in Sweden who have a history of exposure to glyphosate. The increased risk was not statistically significant. A review of the Hardell and Erikkson study was done by U.S. EPA, which concluded that the study does not change their risk assessment for the current uses of glyphosate.

According to the U.S. EPA classification of carcinogens and their assessment of the available data, glyphosate is not carcinogenic to humans. Given the marginal mutagenic activity of glyphosate and the failure of several chronic feeding studies to demonstrate a dose-response relationship for carcinogenicity and the limitations in the available epidemiology study, the Group E classification given by the U.S. EPA appears to be reasonable. As with any compound that has been studied for a long period of time and tested in a large number of different systems, some equivocal evidence of carcinogenic potential is apparent and may remain a cause of concern, at least in terms of risk perception. While these concerns are understandable, there is no compelling basis for challenging the position taken by the U.S. EPA and no quantitative risk assessment for cancer is conducted as part of the current analysis.

A formulation of glyphosate, Roundup®, has been shown to cause an increase in chromosomal aberrations in a plant (*Allium* spp.) associated with cell abnormalities in spindle fiber, DNA adduct formation in mice, and single strand breaks in mice. None of the *in vivo* studies using mammalian species or mammalian cell lines have reported mutagenic activity. Two studies (Vyse and Vigfusson 1979, Vigfusson and Vyse 1980, as referenced in SERA 2011a) report a significant increase in sister chromatid exchanges in human white blood cells *in vitro*. The authors of these studies conclude from their results that glyphosate is, at most, slightly mutagenic. In addition, some positive assays in the fruit fly have been reported as well as positive results in white blood cell cultures.

Based on the studies that EPA requires for pesticide registration, the agency has concluded that glyphosate is neither mutagenic or Clastogenic (U.S. EPA/OPP 2002, as referenced in SERA 2011a).

Two studies conducted in South America (Bolognesi et al. 2009; Paz-y-Mino et al. 2007, as referenced in SERA 2011a) suggest that applications of glyphosate formulations may be associated with signs of chromosomal damage in human populations. The study by Paz-y-Mino et al. has several limitations; nonetheless, the more detailed study by Bolognesi et al. suggests a temporal association between glyphosate exposure and chromosomal damage. Both of these studies involved application rates which, when expressed in units of glyphosate, are comparable to those used in Beale AFB programs—i.e., about 1-4 lb a.e./acre. Neither study, however, involved glyphosate formulations used in the United States and the relevance of these studies to U.S. formulations of glyphosate is questionable. In the absence of studies comparable to Bolognesi et al. but based on formulations directly relevant to this risk assessment, the study by Bolognesi et al. raises concern. Nonetheless, the study by Bolognesi et al. is not directly applicable to the hazard assessment for the current SERA risk assessment.

Reproductive and Teratogenic Effects - Glyphosate has been subject to multi-generation reproduction studies as well as teratology studies. There is no indication from these studies that glyphosate induces teratogenic effects (i.e., birth defects) in soft tissues at doses up to 3,500 mg/kg/day. The only abnormal development was delayed bone development (ossification). In the teratology studies, the observed signs of toxicity - respiratory and gastrointestinal effects - were similar to those observed in acute toxicity studies and occurred at dose levels that were also comparable. In a multi-generation reproduction study in rats, effects to the kidney were observed in male pups at 30 mg/kg/day but not at 10 mg/kg/day. This effect is consistent with the acute toxicity of glyphosate rather than a specific reproductive effect. In a subsequent study, no such effects were observed at doses up to 1,500 mg/kg/day. In the glyphosate RED (U.S. EPA 1993), U.S. EPA concluded that the lack of renal effects in the second study indicated that the effects seen in the first study were not glyphosate-related. Previous to this, the U.S. EPA had based the RfD for glyphosate on the 10 mg/kg/day NOAEL for this effect. Based on this re-interpretation of results, the NOEL for developmental effects was set at 500 mg/kg/day. The multi-generation reproduction studies found no effect on reproductive capacity. In another study using rabbits, developmental toxicity was not observed at maternal doses up to 350 mg/kg/day, but maternal effects were seen at this dose. The maternal NOEL in this study was 175 mg/kg/day; this is the value U.S. EPA has used to establish the current RfD.

The only other specific and consistent effect of glyphosate involves effects on the testicles. In an NTP study, relative testicular weights in mice were increased. In rats, there was a 20% decrease in sperm counts at the two highest dose levels, 1,678 and 3,398 mg/kg/day. Given the absence of specific testicular pathology in either species, the NTP concluded that there was no evidence of adverse effects on the reproductive system of rats or mice. This finding is consistent with the bulk of other animal studies, in which no adverse effects on the testes are reported, although an increase in testicular weight - relative and absolute - was observed in mice at 3,465–7,220 mg/kg/day. A study by Yousef et al., (1995, as referenced in SERA 2011a) suggests that more serious effects are plausible. Substantial decreases in libido, ejaculate volume, sperm concentrations, semen initial fructose and semen concentration, as well as increases in abnormal and dead sperm were observed in rabbits. In contrast, in multi-generation reproduction studies, no effects on reproductive performance have been observed at dietary levels equivalent to doses of 1,500 mg/kg/day. The basis for the inconsistency between the Yousef et al., 1995 study and all other studies that have assessed the reproductive effects of glyphosate cannot be identified unequivocally. As discussed in Williams, et al, 2000, the authors describe the Yousef study as having serious deficiencies in design, conduct, and reporting, such that “the data from [the Yousef] study cannot be used to support any meaningful conclusions”. In addition, the method of administration of the glyphosate in the Yousef study is not representative of likely human exposures. In a subsequent study, Yousef also demonstrated a reduction in sperm motility after direct exposure of sperm to glyphosate. The mechanism of this effect is not clear, but may nay be related to the ability of glyphosate to inhibit cellular energy production.

Numerous epidemiological studies have examined relationships between pesticide exposures or assumed pesticide exposures in agricultural workers and reproductive outcomes. Very few studies, however, have attempted to characterize exposures, either qualitatively or quantitatively, to specific pesticides. Of those studies that have specifically addressed potential risks from glyphosate exposures, adverse reproductive effects have not been associated with glyphosate exposure.

Other Toxic Endpoints – No neurotoxic effects have been seen in any *in vivo* or *in vitro* studies. Glyphosate has been specifically tested for neurotoxicity in rats after both acute and chronic exposures and in hens. In all three assays, glyphosate was negative for signs of neurotoxicity. U.S. EPA has determined that there is no evidence of neurotoxicity in any of the exposure studies conducted (U.S. EPA 2000a). Large-scale controlled epidemiological studies of glyphosate exposure and neurological outcomes have not been reported. A small clinical investigation found no evidence for neurological effects among forest workers who mixed and sprayed Roundup during a workweek. The clinical case literature of acute glyphosate intoxication is reasonably extensive and does not provide evidence for glyphosate being an acute neurotoxicant in humans. Several long-term experimental studies examined various endpoints of neurotoxicity (brain morphology) in dogs, mice, or rats and did not find evidence of neurotoxicity. An acute study found no effect of glyphosate exposure on nervous system reflexes in dogs. Studies conducted in various bird species did not find evidence for neurological effects. One study reported a case of Parkinsonism in an adult male who was exposed to glyphosate (Barbosa et al 2001 as referenced in SERA 2011a). This study stands in contrast to the abundant case literature that suggests glyphosate is not a neurotoxicant in humans. Any direct connection between glyphosate exposure and onset of Parkinsonism from this one study cannot be established, as the effects could be coincidental. There appears to be no evidence for glyphosate being a neurotoxicant in humans or other species.

Schiffman et al. (1995, as referenced in SERA 2011a) conducted a study of the effects of glyphosate on taste response in gerbils. This study appears to be the only reported investigation of the effects of glyphosate on sensory mechanisms. Glyphosate (1 or 10 micromolar concentration (mM)) applied to the tongue of anesthetized gerbils decreased taste receptor response to table salt, sugars, and acids. These tests on glyphosate involved exposure periods of one minute and were conducted along with tests on ten other pesticides, with one-minute rinses between each agent. The mechanism of this effect on the taste response has not been investigated and the implications in terms of dietary preferences in the field cannot be assessed. The effect could have been produced by a general biochemical alteration in the epithelial cells of the tongue, including the specialized cells that detect taste (glyphosate has been shown to produce injury to the oral cavity), by chemical injury to the tongue, or by a direct neurotoxic effect on the sensory nerve endings. Thus, effects reported in Schiffman et al. (1995) cannot be classified clearly as a glyphosate-induced neurologic effect.

Based on results from the available studies in humans and experimental studies in rodents, glyphosate does not appear to be an immunotoxicant in humans or other animals. This conclusion is supported not only by an extensive set of standard mammalian bioassays on toxicity but also by an *in vivo* assay specifically designed to detected humoral immune response and an *in vitro* assay specifically designed to detect cell-mediated immune response.

Epidemiological studies and clinical cases have not found evidence for allergic reactions or sensitization to dermal exposures to glyphosate formulations. Two human experimental studies provide evidence that Roundup® is not a dermal allergen or sensitizing agent. Tests conducted in guinea pigs provide further support for glyphosate not being a dermal sensitizing agent. Several long-term experimental studies have examined the effects of exposure to glyphosate on lymphoid tissue morphology and blood leukocyte counts; treatment-related effects were not observed.

Three specific tests on the potential effects of glyphosate on the endocrine system have been conducted and all of these tests reported no effects. That glyphosate is not an endocrine disruptor is reinforced by epidemiological studies that have examined relationships between occupational farm exposures to glyphosate formulations and risk of spontaneous miscarriage, fecundity, sperm quality, and serum reproductive hormone concentrations. The studies have not found positive associations between exposure to glyphosate formulations and any reproductive or endocrine outcomes. The clinical case literature does not provide evidence for glyphosate being an endocrine active agent. Several long-term experimental studies have examined the effects of exposure to glyphosate on endocrine organ morphology, reproductive organ morphology, and reproductive function; treatment-related effects were not observed.

Notwithstanding the negative results on endocrine function, the current RfD for glyphosate is based on reproductive effects. In addition, glyphosate has not undergone an extensive evaluation for its potential to interact or interfere with the estrogen, androgen, or thyroid hormone systems (i.e., assessments on hormone availability, hormone receptor binding or post-receptor processing (EDSTAC 1998, as referenced in SERA 2011a)). Thus, the assessment of the potential endocrine effects of glyphosate cannot be overly interpreted.

Inhalation Exposures – Because of the low volatility rate for glyphosate and the available inhalation toxicity studies on a number of glyphosate formulations, the U.S. EPA waived the requirement of an acute inhalation study for technical grade glyphosate in the re-registration of glyphosate. The acute inhalation LC50 value of the isopropylamine salt of glyphosate is >6.37 mg/L – i.e., no mortality in any of five rats of each sex exposed to this concentration for four hours (Mcguirk 1999a, as referenced in SERA 2011a). The short-term (typically 4 hours) inhalation LC50 values for various glyphosate formulations range from >1.3 mg/L to >7.3 mg/L. The lowest LC50 value that is not designated with a greater than (>) symbol is 1.6 mg/L, the reported LC50 value for several glyphosate formulations (refer to SERA 2011a).

Impurities - Glyphosate contains small amounts of a nitrosamine, N-nitrosoglyphosate (NNG). Certain groups of nitrosoamines have served as model compounds in some of the classical studies on chemical carcinogenicity. While there is a general concern for the carcinogenic potential of nitroso compounds, the contribution of specific nitroso compounds to carcinogenic risk is difficult to quantify. Monsanto has conducted an apparently extensive series of tests on NNG. A summary of the studies stated that NNG is relatively non-toxic, is rapidly excreted without undergoing any chemical change, does not bioaccumulate, is not mutagenic, and does not cause birth defects or cancer in laboratory test species.

Metabolites – Glyphosate is metabolized to a minor extent in animals, to aminomethylphosphonate (AMPA). In mammals, only very small amounts of AMPA, less than 1% of the absorbed dose, are formed. In addition, AMPA is formed in environmental media such as water and soil as a breakdown product of glyphosate. The approach of examining the potential importance of the metabolism of a chemical agent by a mammal is common in the risk assessment of xenobiotics, which generally involve the formation of one or more mammalian metabolites, some of which may be more toxic than the parent compound. Usually, the parent compound is selected as the agent of concern because the toxicology studies and monitoring studies provide information about the agent. Thus, the dose measure for the risk assessment is most clearly expressed in terms of the parent compound. In cases where a toxic metabolite is known to be handled differently by humans, this simple approach may be modified. There is no indication that such a modification is necessary for glyphosate. Thus, in terms of assessing direct exposures to technical grade glyphosate, the inherent exposures to AMPA as a metabolite are encompassed by the existing toxicity data on glyphosate.

This approach does not, however, encompass concern for exposures to AMPA as an environmental metabolite. The U.S. EPA has assessed the potential consequences of exposures to AMPA as an environmental metabolite. Based on this review, the U.S. EPA concluded that only the glyphosate parent is to be regulated and that AMPA is not of toxicological concern regardless of its levels in food. The position taken by the U.S. EPA is supported by more extensive reviews. The position taken by U.S. EPA appears to be reasonable and is well supported. Consequently, in this risk assessment, AMPA is not quantitatively considered in the dose-response and exposure assessments.

Inerts –The only listed inert ingredient in Rodeo® and Roundup Pro® is water (46% to 59%), although it is likely that small amounts of isopropylamine and related organic acids of glyphosate also are present.

2.4 Imazamox

(Reference: SERA 2010, all studies as referenced in SERA 2010)

Acute and Chronic Exposures – The mechanism of action for imazamox is well characterized in plants. In terms of the human health risk assessment, however, mechanism of action may not be a meaningful concept, because imazamox does not appear to cause detectable signs of toxicity in mammals even at very high doses. Based on standard acute oral toxicity studies, the LD_{50} of imazamox cannot be determined—i.e., doses of up to 5000 mg/kg bw do not cause mortality or signs of toxicity in rats. The dose of 5000 mg/kg bw is a limit dose, a term used to designate the highest dose typically used in acute oral toxicity studies of pesticides.

Similarly, imazamox does not cause any signs of toxicity in chronic dietary studies at doses greater than 1000 mg/kg bw/day in mice, rats, and dogs. The only seemingly adverse effects noted in repeated dose toxicity studies are decreases in body weight and food consumption noted in reproduction studies at gavage doses of 600 mg/kg bw/day in rabbits and 500 mg/kg bw/day in rats. Gavage dosing—i.e., direct instillation of the test material into the stomachs of the test animals —is an inherently stressful procedure that often leads to animal responses unlikely to be observed in studies involving more typical and relevant routes of exposure—i.e., dietary or drinking water studies.

Effects on the Skin and Eyes and - Standard skin irritation studies were conducted on both technical grade imazamox (Fischer 1992b) as well as an 11.83% formulation of imazamox (Boczon 1994b). In both skin irritation studies, only minimal effects were noted. Based on these studies, U.S. EPA/OPP (2001a, p. 12) classifies imazamox as Category IV for skin irritation—i.e., non-irritating to the skin. Standard assays for skin sensitization in guinea pigs were conducted on both technical grade imazamox (Boczon 1994c) as well as an 11.83% formulation of imazamox (Glaza 1992), and both of these studies are classified as acceptable by the U.S. EPA/OPP. Skin sensitization was not observed in either study.

Standard assays for eye irritation in rabbits were conducted on technical grade imazamox (Fischer 1992a) as well as an 11.83% formulation of imazamox (Boczon 1994). No eye irritation was noted with the formulation (Category IV); however, technical grade imazamox caused moderate eye irritation (Category III).

Acute dermal toxicity studies were conducted on both technical grade imazamox (Fischer 1994) and an 11.83% formulation of imazamox. In addition, a standard subchronic toxicity study is available on technical grade imazamox (Blaszcak 1995). In the two acute toxicity studies, no mortality or gross signs of toxicity were observed at doses of 4000 mg/kg bw. In the acute assay using the imazamox formulation, porphyrin secretion into tears as well as slight dermal irritation and blood around the noses of some of the rats was observed from Day 3 to Day 11 of the study. In the subchronic study with technical grade imazamox, no signs of toxicity were observed at doses of up to 1000 mg/kg bw/day over the 4-week period of dosing.

Reproductive and Teratogenic Effects – In the developmental study in rabbits, gavage doses of 600 mg/kg bw/day were associated with decreases in food consumption (14% to 22%) and corresponding decreases in body weight (19% 36 to 21%). No effects, however, were noted in rabbits at gavage doses of 300 mg/kg bw/day (Hoberman 1995). Similarly, in the developmental study in rats, the only adverse effect noted was a decrease in body weight (97% of controls) and body weight gain (77% of controls), which was also accompanied by a decrease in food consumption (98% of controls). The only statistically significant ($p<0.05$) effect was the decrease in body weight gain at a dose of 1000 mg/kg bw/day. No effects were seen in rats at a dose of 500 mg/kg bw/day. Furthermore, no effects were noted in the offspring of either rabbits or rats at the highest doses tested—i.e., 900 mg/kg bw/day for rabbits and 1000 mg/kg bw/day for rats.

The U.S. EPA/OPP (1997) uses the NOAEL of 300 mg/kg bw/day as the basis of the RfD for imazamox. As discussed in U.S. EPA/OPP (2001b), however, a subsequent review of the developmental studies in rats and rabbits resulted in a reclassification of the LOAELs to NOAELs because "*decreased body weight gain was not considered biologically significant and thus not appropriate for endpoints of concern for regulatory purposes"* (U.S. EPA/OPP 2001b, p. 4).

A single 2-generation reproduction study in rats (Schroeder 1955) was submitted to and accepted by the U.S. EPA/OPP. A DER for this study is available. In this study, rats were fed diets containing imazamox at concentrations of 0, 1000, 10,000, or 20,000 ppm. As in the standard subchronic and chronic dietary studies, no adverse effects were noted in either generation of adult animals, and no signs of reproductive toxicity were noted at any exposure level. The dietary concentration of 20,000 ppm is considered a NOAEL and a limit dose by U.S. EPA/OPP. Based on measured food consumption and body weights, this exposure level corresponds to a dose of about 1500 mg/kg bw in male rats and 1700 mg/kg bw in female rats.

Carcinogenicity and Mutagenicity – As reviewed by U.S. EPA/OPP (2001b, pp. 6-7), imazamox has been subject to several standard assays for mutagenicity using both bacterial and mammalian cell cultures as well as an *in vivo* micronucleus assay in mice. All of these assays were accepted by the U.S. EPA/OPP, and none of the assays evidenced any mutagenic activity.

One study on the potential mutagenicity of imazamox was encountered in the open literature. Fragiorge et al. (2008) assayed imazamox and several other imidazolinone herbicides using a strain of fruit flies (*Drosophila melanogaster*) that are trans-heterozygous for the specific types of wing mutations. In this assay system, larvae were fed imazamox or other herbicides at various dietary concentrations. According to this assay system, imazamox tested positive for one type of mutation—i.e., large single spots on the wing—at a dietary concentration of 20.0 mM (≈ 6100 40 mg/L). While not providing specific details, Fragiorge et al. (2008) note that the high concentrations of imazamox were also associated with toxicity to the larvae.

In terms of a quantitative significance to the human health risk assessment, carcinogenicity is an issue only if the data are adequate to support the derivation of a cancer potency factor. A cancer potency factor is typically derived based on a dose-related increase in malignant tumors from a chronic toxicity study in mammals that encompasses a significant portion of the test animals' lifespan. Chronic dietary exposures were conducted over a substantial portion of the lifespan of mice and rats and no signs of carcinogenicity were observed in either of two bioassays. Based on the lack of carcinogenicity in these two bioassays, the EPA hazard identification for imazamox (U.S. EPA/OPP 2001b, p. 6) states: Imazamox is classified as a "not likely to be a human carcinogen" based on the lack of evidence for carcinogenicity in mice and rats.

Other Toxic Endpoints – For potential neurotoxins, the U.S. EPA may require a number specialized neurotoxicity studies for pesticide registration (U.S. EPA/OCSPP 2010). None of these studies were required for the registration of imazamox. As noted in U.S. EPA's hazard identification for imazamox: *There was no evidence of neurotoxic effects observed in acute, sub-chronic, developmental, reproduction or chronic studies. The NOAEL in almost all studies was the limit dose and the LOAEL was not established* (U.S. EPA/OPP 2001b, p. 8).

The subchronic and chronic toxicity studies on imazamox failed to note any adverse effects in blood or other tissue. Thus, there is no basis for suggesting that imazamox has an adverse effect on immune function. Similarly, the EPA found no basis for asserting that imazamox is likely to have an adverse effect on endocrine function (U.S. EPA/OPP 2001b, p. 8).

Inhalation Exposures – Two inhalation toxicity studies are available, one on technical grade imazamox (Hoffman 1994a) and the other on the 11.83% formulation of imazamox (Hoffman 1994b). The EPA classifies both studies as acceptable.

Both of these studies, are limit tests, each involving a 4-hour period of exposure to a single nominal air concentration of 6.3 mg/L of technical grade imazamox or 12 mg/L of the formulation. The study on technical grade imazamox appears to have involved whole-body exposures to the material as a dust with a median diameter of 4.8 μM. The assay on the formulation involved nose-only exposures—i.e., an inhalation tube connected to the nose of the exposed animal. A number of clinical signs indicative of stress were observed during a 2-hour period following the whole-body exposures to imazamox dust (Hoffman 1994a). In the nose-only exposures to the formulation, animals in both the control and test groups evidenced signs of stress associated with the exposure method. Over the 2-week post-exposure observation periods, no mortality and no signs of systemic toxicity were noted in either of the two bioassays.

Based on these two acute inhalation toxicity studies, the U.S. EPA classifies imazamox (both the a.e. and the formulation) as Category IV, the minimal classification for acute inhalation toxicity.

Impurities – There is no published information regarding the impurities in technical grade imazamox or any of its commercial formulations. Information on the impurities in technical grade imazamox were disclosed to the U.S. EPA (MRIDs 43193201, 43193204, 43876205, 43876233). This information is considered proprietary and has not been available in the conduct of the risk assessment. Nonetheless, all of the toxicology studies on imazamox involve technical grade imazamox, which is presumed to be the same as or comparable to the active ingredient in the formulation used on Beale AFB. Thus, any toxic impurities present in the formulated product are likely to be encompassed by the available toxicity studies conducted with technical grade imazamox.

Metabolites – As discussed in U.S. EPA/OPP (2002, p. 78232), the plant metabolites of imazamox are identical to the mammalian metabolites observed in treated rats, and these metabolites do not appear to be toxicologically significant.

The aqueous photolysis of imazamox has been examined in some detail, and there are proposed pathways for the photodecomposition of imazamox (Harir et al. 2007; Quivet et al. 2006). The degradates formed by aqueous photolysis differ from the mammalian and plant metabolites of imazamox. No toxicity data, however, have been encountered on the photodegradates of imazamox. As discussed in U.S. EPA/OPP (2008a, p. 25), laboratory measurements of the photolysis of imazamox indicate half-lives of about 6.8 hours, but there are no field studies available on the aquatic dissipation of imazamox. Accordingly, the extent to which photodegradates might form in the environment is unclear. Functionally, this approach treats photodegradation byproducts of imazamox as if the degradates were the parent compound. In the absence of toxicity data on the photodegradates, no alternative approach to considering the potential hazards of the photodegradates is apparent.

Inerts - The identities of inerts in pesticide formulations are generally considered trade secrets and need not be disclosed to the general public. Nonetheless, all inert ingredients as well as the amounts of the inerts in the formulations are disclosed to and reviewed by the U.S. EPA as part of the registration process. Some inerts are considered potentially hazardous and are identified as such on various lists developed by the federal government and state governments. The identity of these inerts must be listed on the Material Safety Data Sheet for the formulation. No hazardous substances are listed on the MSDS for Clearcast (BASF 2008), the only formulation of imazamox likely to be used by Beale AFB programs.

2.5 Imazapyr

(Reference: SERA 2011d, all studies as referenced in SERA 2011d)

Acute and Chronic Exposures – All of LD_{50} values for imazapyr formulations are non-definitive—i.e., the LD_{50} values are reported as >5000 mg/kg bw for all registrant-submitted studies and most formulations. For two formulations, Imazapyr SL from Alligare and Rotary SL, the LD_{50} values reported on the 25 MSDS are >2000 mg/kg. These LD_{50} values are presumably from one or more registrant-submitted studies which have not been identified. No oral LD_{50} values of >2000 mg/kg bw are cited in U.S. EPA/OPP risk assessments (U.S. EPA/OPP 2005, 2006, 2007a). It is possible that the LD_{50} values given as >2000 mg/kg bw are from studies in which 5000 mg/kg bw was the limit dose, and the MSDS reports the value as >2000 mg/kg bw to meet the U.S. EPA/OPP criteria for classifying compounds as “practically non-toxic”.

Information on the toxicity of imazapyr in humans is available from 6 reports of six cases of acute poisoning in Taiwan (Lee et al. 1999). The case reports from Lee et al. (1999) are consistent with the acute toxicity data in rats, in that none of the individuals died. Doses of about 340 to 1700 mg a./kg bw were, however, associated with relatively severe signs of toxicity.

Chronic dietary toxicity studies on imazapyr have been conducted in three species: dogs (Shellenberger 1987), mice (Auletta 1988; Hess 1992), and rats (Daly 1988; Hess 1992). The most remarkable aspect of all of the subchronic and chronic studies is the failure to note any adverse effects at doses of up to about 2000 mg/kg bw/day in rats and mice and about 250 mg/kg bw/day in dogs.

Effects on the Skin and Eyes – None of the available information on imazapyr formulations suggests the likelihood of severe skin irritation, which is consistent with the EPA classification of imazapyr as a Category IV skin irritant (U.S. EPA/OPP 2005, p. 15)—i.e., non-irritating to slight erythema and edema. This classification is the least severe of the categories for skin irritation used by U.S. EPA/OPP.

No signs of skin sensitization were observed in any of three registrant-submitted studies on skin sensitization in guinea pigs, including an assay on technical grade imazapyr (Ledoux 1983), an assay on Chopper RTU (American Cyanamid Co. 1988a), and an assay on a granular Arsenal formulation (Costello 1986). This is consistent with the EPA classification of imazapyr as negative for skin sensitization (U.S. 31 EPA/OPP 2005). Notwithstanding the above classification, the MSDS for three formulations of imazapyr explicitly considered in the SERA risk assessment indicate slight or mild skin sensitization (i.e., Chopper, Polaris SP, and Stalker). All of these formulations contain imazapyr at 22.6% (w/w) a.e and a concentration of 2 lbs a.e./gallon. While studies supporting this classification were not identified in the literature, there is no reason to question the information on the MSDS. Accordingly, slight to mild skin sensitization cannot be ruled out for at least some of the imazapyr formulations.

Neither studies assessed in the SERA report nor the data on the MSDS indicate that imazapyr or imazapyr formulations are severe eye irritants. Nonetheless, U.S. EPA/OPP (2005, p. 15) identifies two studies on 99.3% imazapyr powder [MRID 41551001 and 93048019] indicating that this material is severely irritating to the eyes and causes irreversible eye damage (Category I). This finding is not remarkable. Instilling the powder of a weak acid directly into the eye is likely to cause severe damage to the eyes. This finding is not directly relevant to the current risk assessment because individuals involved in applications on Beale AFB will not use concentrated imazapyr powder.

Reproductive and Teratogenic Effects – Standard developmental toxicity studies were conducted with rabbits (Salamon et al. 1993a, b) and rats (Salamon et al. 1993c, d). The available developmental studies are preliminary pilot studies (Salamon et al. 1993a, d) and full studies (Salamon et al. 1993b, c). While the studies in rats and rabbits yielded no signs of frank malformations, these types of studies are the only repeated dose studies that yield any signs of toxicity. In rats, the signs of toxicity are relatively mild, consisting only of increased salivation. In rabbits, however, the signs of toxicity are much more severe, consisting of mortality in both adult female rabbits and rabbit fetuses at a dose 1000 mg/kg bw/day in the pilot study (Salamon et al. 1993b). In the full study with rabbits (Salamon et al. 1993b), however, no signs of toxicity were evident at gavage doses of 400 mg/kg bw/day. By comparison, the comparable studies in rats noted no mortality in adult or fetal rats at doses of up to 2000 mg/kg bw/day. This is the only example of an apparent species difference in the sensitivity of imazapyr to mammals. Given the route of exposure (i.e., gavage rather than dietary) as well as the very high doses of imazapyr that were administered, this observation has little practical impact on the current risk assessment.

A single 2-generation reproduction study in rats (Robinson 1987) was submitted to and accepted by the EPA (U.S. EPA/OPP 2005, p. 20). This study involved dietary exposures of rats to imazapyr at concentrations of 0, 1000, 5000, or 10,000 ppm (mg ae/kg diet). No dose-related signs of toxicity were observed in either adults or offspring.

Carcinogenicity and Mutagenicity – Chronic dietary exposures were conducted over a substantial portion of the lifespan of mice (Auletta 1988) and rats (Daly 1988). The study in mice by Auletta (1988) was unequivocal with no indication of carcinogenic activity. In the study in rats by Daly (1988), however, the combined incidence of benign and malignant brain astrocytomas was increased. Analyses of the tumor conducted as part of the current risk assessment indicated a significant dose-response relationship based on the Cochran-Armitage trend test (p=0.0175) but no significant differences between the control response and any treated dose group (a minimum p-value of 0.2265). This analysis is consistent with the EPA analyses provided in U.S.

EPA/OPP (2005, p. 25). As detailed further in U.S. EPA/OPP (2005, pp. 26-27), the study in rats by Daly (1988) was reviewed in detail by U.S. EPA/OPP's Cancer Assessment Review Committee. The evaluation by the Cancer Assessment Review Committee included a review of the brain slides. The EPA concluded that the responses in rats offered "*equivocal evidence for carcinogenicity"* but: the EPA discussion also notes that one individual on the Cancer Assessment Review Committee did not concur with this decision.

Imazapyr was tested in several standard assays for mutagenicity, including reverse mutation assays in Salmonella, *in vitro* assays for mutagenic activity in mammalian cell cultures, *in vitro* chromosomal aberrations in Chinese hamster ovary cells, assays for unscheduled DNA synthesis, and an *in vivo* assay for dominant lethal mutations in mice. None of these assays is positive for mutagenic activity. Further support for lack of genotoxic activity comes from other mutagenicity studies conducted and submitted to U.S. EPA in support of the registration of imazapyr (Allen et al. 1983; Cortina 1984; Enloe et al. 1985; Johnson and Allen 1984; Sernau 1984). All of these studies demonstrate a negative response. More recently, both technical grade imazapyr and a Brazilian Arsenal formulation were negative in a mouse micronucleus assay, a common screening test for mutagenic activity (Grisolia 2002, 2004). While it is impossible, by definition, to prove the negative, the available data appear to be of sufficient quality and detail on which to base the assertion that imazapyr does not appear to be genotoxic or mutagenic.

Other Toxic Endpoints – In support of the Reregistration Eligibility Decision for imazapyr (U.S. EPA/OPP 2006a), the Health Effects Division of the U.S. EPA/OPP reviewed the available toxicity studies on imazapyr and concluded that there is no concern for neurotoxicity (U.S. EPA/OPP 2005, p. 18).

The subchronic and chronic toxicity studies on imazapyr failed to note any adverse effects in blood or other tissue. Although these studies did not focus on the immune system, changes in the immune system (which could be manifested as increased susceptibility to infection compared to controls) were not observed in any of the available long-term animal studies. Thus, there is no basis for suggesting that imazapyr has an adverse effect on immune function.

In the review of the mammalian toxicity data on imazapyr, U.S. EPA/OPP (2005, p. 29) concludes that "*there was no evidence of estrogen, androgen and/or thyroid agonistic or antagonistic activity shown. This conclusion is reasonable, based on the review of the available information conducted as part of the current risk assessment".*

Inhalation Exposures – Three inhalation toxicity studies are available on imazapyr, including one on technical grade imazapyr (Voss et al. 1983) and two on imazapyr formulations, Arsenal 4-AS (Hershman and Moore 1986) and a Chopper RTU (Werley 1987). All of these rat studies involved whole body exposures to concentrations in excess of 1 mg/L 44 (1000 mg/m3).

In the study by Voss et al. (1983) conducted with technical grade imazapyr, no mortality or signs of toxicity attributable to treatment were noted over the 14-day post-exposure observation period following a 4-hour exposure at a measured concentration of 1.3 mg a.e./L. During and immediately after exposure, animals evidenced signs of nasal irritation, which is not unusual in acute inhalation studies. All animals were normal by Day 2 of the study. Based on this study, the U.S. EPA/OPP (2005, p. 15) classifies imazapyr as Category 3—i.e., the second to the least-toxic classification.

Impurities –There is no information in the published literature concerning the manufacturing impurities in imazapyr. Nonetheless, virtually no chemical synthesis yields a totally pure product. Technical grade imazapyr, as with other technical grade products, contains some impurities. These impurities, which were disclosed to U.S. EPA, were reviewed as part of a SERA (2004b) risk assessment on imazapyr. Because specific information concerning impurities may provide insight into the manufacturing process used to synthesize imazapyr, such information is considered proprietary, is protected under FIFRA (Section 10), and is not discussed in this or the SERA (2004b) risk assessment.

To some extent, concern for impurities in technical grade imazapyr is reduced by the fact that the existing toxicity studies on imazapyr were conducted with the technical grade product or formulated products. Thus, if toxic impurities are present in the technical grade product, the toxic potential of the impurities is likely to be encompassed by the available toxicity studies on the technical grade product.

Metabolites – Information on the metabolites of imazapyr comes primarily from registrant-submitted studies, which are discussed in detail in U.S. EPA/OPP (2005). Very little information is available on the toxicity of most metabolites of imazapyr. One exception is nicotinic acid, also known as niacin or Vitamin B3. As noted in U.S. EPA/OPP (2005), high doses of nicotinic acid may be toxic, although nicotinic acid is an essential nutrient with a recommended daily allowance of 20 mg/kg bw/day. In the absence of information suggesting that any of the metabolites of imazapyr are substantially more toxic than imazapyr itself, the U.S. EPA/OPP (2005, Section 3.4.1) designates imazapyr as the only agent of concern for all routes of exposure.

Inerts - All of the technical formulations of imazapyr covered in this risk assessment involve the isopropylamine or isopropanolamine salts of imazapyr. Little toxicity data are available for these compounds. Isopropanolamine is classified in U.S. EPA (2007b) as a List 3 inert. These are compounds that the U.S. EPA cannot classify as hazardous or non-hazardous based on the available information. Isopropyl alcohol, isopropylamine, and numerous other derivatives of isopropanol are used as food additives and classified as GRAS (generally recognized as safe) compounds (Clydesdale 1997). Isopropyl alcohol is classified as a List 4B inert, andisopropanolamine as well as a number of related compounds are classified by U.S. EPA as List 3 inerts (U.S. EPA/OPP 2007).

The Northwest Coalition for Alternatives to Pesticides (NCAP) obtained information on the identity of the inerts in Arsenal AC from U.S. EPA, under the Freedom of Information Act. This listing is no longer posted on the NCAP web site; however, the information was reviewed in the SERA (2004b) risk assessment. The only inert other than water listed at NCAP site was glacial acetic acid (CAS No. 64-19-7). Dilute acetic acid is an approved food additive and is also classified as a GRAS compound (Clydesdale 1997). Acetic acid is a major component of vinegar and is a List 4B inert (U.S. EPA/OPP 2003).

2.5 Sulfometuron Methyl

(Reference: SERA 2004c, all studies as referenced in SERA 2004c)

Acute and Chronic Exposures – There are three acute oral studies in rats involving exposure to technical grade sulfometuron methyl (Dashiell and Hall 1980, Dashiell and Hinckle 1980c, Trivits 1979) and one acute oral study in rats involving exposure to the 75% sulfometuron methyl formulations Oust (Filliben 1995a) and Oust XP (Finlay 1999). Sulfometuron methyl doses in these studies ranged from 5,000 to 17,000 mg/kg. Results show that acute oral exposure to sulfometuron methyl has a low order of toxicity. Neither mortality nor overt signs of toxicity were observed in rats given single oral doses of up to 17,000 mg/kg (Dashiell and Hall 1980, Dashiell and Hinckle 1980, Trivits 1979). Thus, the LD_{50} value for sulfometuron methyl is > 17,000 mg/kg (Trivits 1979).

Qualitative assessments of toxicity were also made in all acute toxicity studies. The only effects commonly noted in the treated animals were weight loss and stained or wet perineal (genital) areas. Dashiell and Hall (1980) observed alopecia (hair loss) in male rats but not female rats, and the study by Dashiell and Hinckle (1980) reports an unspecified increase in lung weight in both male and female rats and 'pink thymus' in four of five female rats after a single gavage dose of 5000 mg/kg. It is not clear whether the changes in lung weight were relative to body weight or were absolute.

Comparison of acute toxicity studies of technical grade sulfometuron methyl and the formulations Oust and Oust XP show similar results. Oral administration of up to 5000 mg/kg Oust (3750 mg a.i./kg) to rats did not result in a single mortality (Filliben 1995a). The only clinical sign of toxicity observed in this study was alopecia in one female rat. Acute oral administration of 5000 mg/kg Oust XP (3750 mg a.i./kg) did not result in any mortalities, clinical signs of toxicity or gross lesions in any animal (Finlay 1999). Thus, like technical grade sulfometuron methyl, acute exposure to the 75% formulations Oust and Oust XP does not appear to result in any significant toxicity.

The subchronic or chronic toxicity of sulfometuron methyl to humans or mammals is not documented in the published literature, and all of the available toxicological data comes from unpublished studies that were conducted to support the registration of sulfometuron methyl as an herbicide. There are two subchronic exposure studies in rats (Hinckle 1979, Wood et al. 1980), and chronic exposure studies in rats (Mullin 1984), mice (Summers 1990a), and dogs (Wood and O'Neal 1983).

The most common signs of toxicity involve changes in blood (Wood and O'Neal 1983, Summers 1990a, Wood et al. 1980, Mullin 1984) and decreased body weight gain (Hoberman et al. 1981). The changes in the blood appear to be consistent with hemolytic anemia (i.e., a lysis or destruction of blood cells that results in a decreased number of red blood cells). In rats, changes in red blood cell parameters were observed following subchronic dietary exposure to 1000 ppm sulfometuron methyl for male rats (NOAEL = 100 ppm) (Wood et al. 1980). In a 2-year feeding study, a NOAEL of 50 ppm for decreased erythrocyte count and hematocrit was observed in male rats (Mullin 1984). A NOAEL of 100 ppm was reported for anemia in female mice exposed to dietary sulfometuron methyl for 18 months (Summers 1990a) and a NOAEL of 200 ppm was reported for hemolytic anemia in dogs exposed to dietary sulfometuron methyl for 1 year (Wood and O'Neal).

No other specific signs of toxicity were noted consistently among the different subchronic or chronic bioassays analyzed. Following exposure of six rats to 3400 mg/kg bw/day sulfometuron methyl for 14 days, the investigators observed reduced testicular size in one rat and mild testicular lesions in another (Hinckle 1979). No such effects were observed in any of the six control rats. In a 1-year dog feeding study, several effects in addition to those on the blood were observed in various dose groups; however, the effects were not considered by the authors to be clearly dose-related (Wood and O'Neal 1983). The potentially significant effects reported in this study include increased alkaline phosphatase activity, increased serum cholesterol (females only), and decreased serum albumin and creatinine. At dietary concentrations of 5000 ppm, the observed effects include increased absolute liver weights in females and increased relative liver weight in males and females, as well as increased absolute and relative thymus weights in females. Thymus weights were also increased in males at 200 and 1000 ppm but not at 5000 ppm. No pathological changes in the thymus were noted in either sex at any dose level.

Effects on the Skin and Eyes – Both sulfometuron methyl and the commercial formulations, Oust and Oust XP, were tested for irritant effects on the skin and eyes as well as for sensitization resulting from dermal exposure.

Results of studies in rabbits and rats show that single and repeated dermal application of sulfometuron methyl (Dashiell and Henry 1980a, Dashiell and Hinckle 1983, Dashiell and Silber 1980c, 1981, Sarver 1990b) and single dermal applications of Oust (Filliben 1995b, c) and Oust XP (Finlay 1999b,c) induced skin irritation characterized by mild erythema and mild edema. A direct comparison between the irritant effects of sulfometuron methyl and those of Oust is difficult to make because of dissimilarities in study protocols. Nonetheless, there appears to be no remarkable difference between the irritant effects of sulfometuron methyl and the commercial formulations. Mild skin irritation was observed in guinea pigs exposed to 50% sulfometuron methyl in dimethyl phthalate (Dashiell and Silber 1980b; Edwards 1979a). Neither sulfometuron methyl nor Oust caused sensitization in guinea pigs (Edwards 1979a, Dashiell and Silber 1980a, b, Moore 1995).

Applications of technical grade sulfometuron methyl to the eyes of rabbits produced transient, mild irritant effects to the cornea and conjunctiva, including redness, transient corneal cloudiness, discharge, and chemosis. (Dashiell and Henry 1980a, Edwards, 1979b, Malek 1990).

Although sulfometuron methyl, Oust and Oust XP all cause mild eye irritation, sulfometuron methyl caused transient corneal opacity in rabbits after ocular instillation of 61.8 mg ai (Dashiell and Henry 1980b), an effect not observed in rabbits exposed similarly to Oust at a dose of 46 mg or approximately 34.5 mg ai (Filliben 1995d) or Oust XP at a dose of 32 mg or approximately 24 mg ai (Finlay 1999b). In all studies, effects were resolved within 72 hours.

Studies on the systemic toxicity of sulfometuron methyl following dermal exposure have been conducted in rabbits and rats. Dermal exposure to doses up to 8000 mg/kg technical grade sulfometuron methyl were not associated with any signs of significant systemic toxicity in rabbits (Dashiell and Henry 1980a, Dashiell and Silber 1980c, 1981). Only 1 death, which was not considered to be treatment related, was reported (Dashiell and Silber 1980c). Thus, the LD_{50} for dermal exposure of chlorsulfuron in rabbits is >8000 mg/kg (Dashiell and Silber 1980c). Dermal exposure to 2000 mg/kg sulfometuron methyl (Dashiell and Silber 1980c; Dashiell and Silber 1981) caused weight loss similar to that observed in rats after acute oral exposure to 5000 mg/kg sulfometuron methyl (Trivits 1979). This effect, however, was not reported in a subchronic dermal study in which doses of up to 2000 mg/kg/day were applied to the intact skin of rabbits for 21 days (Dashiell and Hinckle 1983). Furthermore, none of the dermal studies that examined hematological changes noted any effects. Hematological effects are the most common effects observed after oral exposure to sulfometuron methyl. The results of the dermal studies with Oust in rabbits (Filliben 1995b, c) and Oust XP in rats (Finlay 1999c) suggest that there is no substantial difference between the dermal toxicity of the 75% sulfometuron formulations and technical grade sulfometuron methyl. The LC_{50} value for dermal applications for both sulfometuron methyl formulations was greater than 5000 mg/kg (equivalent to 3750 mg ai/kg).

Reproductive and Teratogenic Effects – Studies investigating the reproductive effects of sulfometuron methyl in humans or mammals are not documented in the published literature, and all of the available toxicological data comes from unpublished studies that were conducted to support the registration of sulfometuron methyl as a herbicide. Studies assessing the reproductive and teratogenic effects of sulfometuron methyl have been conducted in rats (Lu 1981, Mullin 1984, Wood et al.1980) and rabbits (Hoberman et al. 1981, Serota et al. 1981).

In the two teratogenicity studies in rabbits, sulfometuron methyl was administered by gavage. The study by Hoberman et al. (1981) was a range finding study with daily doses of 100-1000 mg/kg, while the study by Serota et al. (1981) involved lower dose levels of 30-300 mg/kg. In the Hoberman et al. (1981) study, signs of maternal toxicity, including death in some dams, were apparent at all dose levels. In the study by Serota et al. (1981), there were no signs of toxicity in the dams or offspring at any exposure level. At the 30 and 100 mg/kg dose levels, an increase in the incidences of fetal anomalies was observed; however, at the 300 mg/kg dose level, there were actually fewer incidences of fetal anomalies than were observed at 100 mg/kg dose level. The authors state that statistical evaluation of all parameters, including fetal anomalies, revealed no statistical differences between the control and sulfometuron methyl treated groups. Given the clear lack of dose-response relationship, the NOAEL for this study for both maternal and fetal toxicity is 300 mg/kg/day.

The three studies in rats involve dietary exposure to sulfometuron methyl (Wood et al.1980, Lu 1981, Mullin 1984). Decreases in maternal body weight gain associated with decreased food consumption (Lu 1981, Mullin 1984) and hematological changes (Mullin 1984, Wood et al. 1980) were the common effects observed in these studies. Gestational exposure of rats to 5000 ppm dietary sulfometuron methyl resulted in decreased maternal weight gain and decreased fetal weights, with NOAEL for the dams and fetuses of 1000 ppm (Lu 1981). Exposure of rats for 90 days to dietary levels of 5000 ppm was associated with a decreased number of pups in the first and second generations (Mullin 1984). In addition to these effects, mean absolute brain weights were significantly decreased in male rats, with an NOAEL of 500 ppm (Mullin 1984). No adverse effects on reproductive parameters were observed in rats exposed to dietary sulfometuron methyl at dietary concentrations up to 5000 ppm (Wood et al. 1980).

Carcinogenicity and Mutagenicity – Sulfometuron methyl has been tested for mutagenicity in a number of different test systems and has been assayed for carcinogenic activity in rats, mice and dogs. Rats were exposed to dietary sulfometuron methyl at concentrations up to 5000 ppm for one year (Mullin 1984), mice to concentrations up to 1000 ppm for 18 months, and dogs to concentrations up to 5000 ppm for 1 year. No evidence of carcinogenic activity was found in any sulfometuron methyl chronic exposure study. In all three studies, toxicity was indicated by hematological changes in the high dose groups. Also, the study by Mullin (1984) reports bile duct hyperplasia and fibrosis in female rats exposed to the two higher dose levels and a significant decrease in mean absolute brain weight in male rats exposed to the highest dose level. Each of these studies can be viewed as involving doses that approximate the maximum tolerated dose based on alterations in body weight and clinical blood indices.

Sulfometuron methyl did not show mutagenic activity in assays in Salmonella typhimurium strains TA 1535, TA 1537, TA 98, and TA 100 (Taylor 1979, Taylor and Krahn 1990) and Chinese hamster ovary cells (Krahn and Fitzpatrick 1981). Moreover, sulfometuron methyl did not induce chromosomal damage in Chinese hamster ovary cells (Galloway 1981) or unscheduled DNA synthesis in rat hepatocytes (Ford 1982). These data provide no evidence that exposure to sulfometuron methyl poses a carcinogenic risk to humans.

Other Toxic Endpoints – Virtually any chemical will cause signs of neurotoxicity in severely poisoned animals and thus can be classified as an indirect neurotoxicant. This is the case for sulfometuron methyl in that sulfometuron methyl was reported to cause signs of depression in rabbits exposed to up to 1000 mg/kg by gavage for 13 days (Hoberman et al. 1981). This report, however, does not implicate sulfometuron as a direct neurotoxicant.

There is very little direct information on which to assess the immunotoxic potential of sulfometuron methyl. Dermal studies in rabbits show that chlorsulfuron does not produce sensitization. Results of subchronic and chronic exposure studies show that sulfometuron methyl may produce changes to immune system function at high doses. In male rats exposed to 5000 ppm sulfometuron methyl in the diet for 90 days, elevated mean leukocyte and lymphocyte counts and decreased neutrophil count were reported (Wood et al. 1980). No effect on these parameters were observed at dietary concentrations of sulfometuron methyl of 100 and 1000 ppm. Increased thymus weights were observed in female dogs exposed to 5000 ppm and in male dogs exposed to 200 and 1000 ppm, but not 5000 ppm, dietary sulfometuron methyl for 1 year (Wood and O'Neal 1983). However, no pathological changes were observed in the thymus at any dose. While results of these studies suggest that exposure to sulfometuron methyl may produce changes in immune system parameters, the observations in these studies do not provide conclusive evidence supporting the immunotoxic potential of sulfometuron methyl.

A variety of sulfonylureas reduce blood glucose by stimulating the release of insulin from pancreatic B cells, and some sulfonylureas reduce the hepatic extraction of insulin. No studies investigating the effects of sulfometuron methyl on insulin release or metabolism were identified. Weight loss and decreased weight gain are observed in animals treated with sulfometuron methyl, implying a change in metabolic status. However, there is no evidence to suggest that changes in weight are due to effects of sulfometuron methyl on the endocrine system.

Following exposure of six rats to 3400 mg/kg/day sulfometuron methyl for 14 days, reduced testicular size in one rat and mild testicular lesions in another were reported (Hinckle 1979). In a 2-generation reproductive study, a decrease in reproductive performance was observed in rats 5000 ppm dietary sulfometuron methyl for 90 days, but not at dietary concentrations of 50 and 500 ppm (Mullin 1984). While results of these studies suggest that exposure to sulfometuron methyl may produce changes in the function of the reproductive endocrine system, the observations in these studies do not provide conclusive evidence.

The administration of 2000 mg/kg sulfonamide over a 15-day period caused dose-related changes to the thyroid gland and changes in circulating levels of T3 and T4 in rats (Nishikawa 1983a, b). Elevated serum thyroxine levels have been observed in female rats exposed to 100 and 1000 ppm, but not 5000 ppm, dietary sulfometuron methyl for 90 days (Wood et al. 1980). A decrease in tail resorption rates, a morphological biomarker of thyroid disruption, was observed in African clawed frogs to 0.001 and 0.01 mg/L sulfometuron methyl for 14 days (Fort 1998). Effects were partially reversed by the administration of thyroxine. Based on results of these studies, it appears that sulfometuron methyl has the potential to produce changes in thyroid gland function. No mechanism has been identified for effects of sulfonamides on thyroid gland function.

Inhalation Exposures – There is only one inhalation toxicity study on sulfometuron methyl (Kinney 1982), one inhalation toxicity study on Oust (Sarver 1995), and one on Oust XP

(Bamberger 1999). All three studies involve acute (4-hour) exposure to relatively high concentration levels (>5 mg/L or >5000 mg/m3). Although no toxic effects were observed in rats after head-only exposure to 6.4 or 11 mg/L sulfometuron methyl (Kinney 1982), irritant effects (nasal and ocular discharge) were observed in male rats after head only exposure to 5.1 mg/L Oust (Sarver 1995). Transient weight loss and wet perineum were also observed in the Oust study, which is consistent with the signs of sulfometuron methyl toxicity after oral exposure. Similar transient effects were observed with following 4-hour exposure to Oust XP at a concentration of 5.3 mg/L formulation or about 4 mg a.i./L (Bamberger 1999). The extremely limited data suggest only that sulfometuron methyl can induce irritant effects as well as systemic toxic effects at very high exposure levels. As discussed in Section 3.2, this finding is not directly relevant to this risk assessment because of the implausibility of exposure to such high concentrations of the compound.

Impurities – Virtually no chemical synthesis yields a totally pure product. Technical grade sulfometuron methyl, as with other technical grade products, undoubtedly contains some impurities. To some extent, concern for impurities in technical grade sulfometuron methyl is reduced by the fact that the existing toxicity studies on sulfometuron methyl were conducted with the technical grade product. Thus, if toxic impurities are present in the technical grade product, they are likely to be encompassed by the available toxicity studies on the technical grade product.

Metabolites – No studies investigating the toxicity of the sulfometuron methyl metabolites produced by mammals were identified in the published literature or unpublished studies. The toxicity of the metabolites of sulfometuron methyl is likely to be encompassed by the available mammalian toxicity studies. Metabolites of sulfometuron methyl are rapidly excreted and do not appear to concentrate in any tissue.

Inerts - The inerts in Oust XP were disclosed to the U.S. EPA (DuPont Agricultural Products 1999) and were reviewed in the preparation of this risk assessment. All that can be disclosed explicitly is that none of the additives in Oust XP are classified by the U.S. EPA as toxic. The identity of inert ingredients for the sulfometuron methyl formulation Oust have been disclosed. The Northwest Coalition for Alternatives to Pesticides (NCAP) has obtained information on the identity of the inerts in Escort from U.S. EPA under the Freedom of Information Act and, at the time, listed this information on the NCAP web site. This information is no longer available, but it was used in the SERA (2004c) analysis of sulfometuron methyl. The inerts listed in this web site are sucrose, sodium salt of naphthalene-sulfonic acid formaldehyde condensate, polyvinyl pyrrolidone, sodium salt of sulfated alkyl carboxylated and sulfated alkyl naphthalene, and hydroxypropyl methylcellulose. Sucrose (CAS No. 57-50-1) is classified by the U.S. EPA as a List 4 inert and therefore, is generally recognized as a safe compound and is approved as a food additive (U.S. EPA 2003). Hydroxypropyl methylcellulose (Cas No. 009004-65-3) is classified as a List 4a inert, which is generally recognized as safe (U.S. EPA 2003). There is no evidence to assert that either sucrose or hyrdoxypropyl methylcellulose will materially impact the risks associated with the use of sulfometuron methyl. Polyvinyl pyrrolidone (CAS No. 88-12-0) is classified as a List 3 inert (U.S. EPA 2003). In other words, there is insufficient information to categorize this compound as either hazardous (Lists 1 or 2) or non-toxic (List 4). Sodium naphthalene sulfonate-formaldehyde condensate and the mixture of a sulfate of alkyl carboxylate and sulfonated alkyl naphthalene (sodium salt) were not identified in the EPA Inert List (U.S. EPA 2003). Other naphthalene derivatives identified on the EPA Inert List are classified as List 3 or List 4; no naphthalene derivatives are classified as List 1 or List 2 inerts (U.S. EPA 2003). Thus, there is insufficient information available to assess the impact of either polyvinyl pyrrolidone or the naphthalene derivatives on the risks associated with the use of sulfometuron methyl. However, the toxicity of Oust and Oust XP appears to be comparable to that of technical grade sulfometuron methyl. Therefore, there is no plausible basis for asserting that these inerts are present in Oust or Oust XP in toxicological amounts.

2.6 Triclopyr

(References: USDA 1984; USDA 1989; SERA 2002, 2011b; U.S. EPA 1998)

Acute and Chronic Exposures - Triclopyr has a low order of acute lethal potency. Oral LD_{50} values range from 600 to 1,000 mg/kg. The signs and symptoms of acute oral intoxication generally include lethargy, impaired coordination, weakness, labored respiration, and tremors. Anorexia and diarrhea have also been observed in rodents and domestic animals. Similar signs and symptoms are associated with triclopyr acid, triclopyr butoxyethylester (BEE), and triclopyr triethylamine salt (TEA). The few available studies regarding histopathology and clinical chemistry data on triclopyr suggest that the liver and kidney are the primary target organs in acute intoxication.

The kidney appears to be the most sensitive target organ for triclopyr, and the dog was appears to be the most sensitive species. The lowest effect level for triclopyr is 2.5 mg/kg/day in the dog. In this study, this dose was associated with decreased urinary excretion, determined by means of a phenolsulfonphthalein (PSP) dye excretion test, as well as reduced absolute and relative kidney weights. The inhibition of PSP excretion in the dog could be attributed to competition between triclopyr and PSP for elimination via anion transport. In the absence of other toxic effects, the 2.5 mg/kg/day dose in the dog study was classified as a NOEL by U.S. EPA. This determination formed the basis of U.S. EPA's provisional acceptable daily intake of 0.025 mg/kg/day. In a follow-up study, the dose of 2.5 mg/kg/day was associated with a statistically significant increase in serum urea nitrogen and creatinine in male dogs. These effects were also evident but more pronounced at 5 mg/kg/day. The NOEL for this effect was 0.5 mg/kg/day. This resulted in the lowering of the provisional U.S. EPA/OPP RfD to 0.005 mg/kg/day using the 0.5 mg/kg/day dose group as the NOEL for effects on kidney function. However, in the 1998 triclopyr RED (U.S. EPA 1998), U.S. EPA determined that these two studies, while showing statistically significant results, did not represent a toxic response to triclopyr, but rather a physiologic response of the dog, based on the dog’s limited ability to excrete organic acids at higher plasma concentrations. They used the lack of histopathological changes in the kidneys as support for this decision.

In rodents, kidney effects - hematological and histopathological changes and increased kidney weight - have been observed after subchronic exposure to triclopyr doses as low as 70 mg/kg/day for 90 days. The highest NOEL below the 7 mg/kg/day AEL for kidney effects in rodents is 5 mg/kg/day for 90 days. This result is supported by additional NOAELs of 5 mg/kg/day for exposure periods ranging from 90 days to 2 years. All of these NOAELs are based on the lack of tissue pathology in the kidney rather than tests of kidney function. In 1998, U.S. EPA determined that the RfD would be based upon the NOEL of 5 mg/kg/day, from a two-generation reproduction study (U.S. EPA 1998).

The other general systemic toxic effects of triclopyr are un-remarkable. At high doses, signs of liver damage may be apparent as well as decreases in food consumption, growth rate, and gross body weight.

Effects on the Skin and Eyes - Exposure to triclopyr formulations may cause irritation to the skin and eyes. Technical grade triclopyr is classified as only slightly irritating (Category IV). Triclopyr TEA is not a primary skin irritant but has been shown to cause delayed contact sensitization in some studies. Triclopyr BEE causes more severe skin irritation than triclopyr acid or TEA. This may be due to the more rapid absorption of triclopyr BEE.

Ocular exposure appears to follow a different pattern with triclopyr TEA being much more irritating than triclopyr acid or triclopyr BEE. Eye irritation caused by exposure to the triclopyr TEA formulations is characterized variously as Irreversible/C, Corrosive/Irreversible, or simply Corrosive, although it is not clear whether these brief descriptions from the various MSDS reflect underlying differences in the studies on which these descriptions are based (SERA 2011b). The potential for eye irritation associated with handling triclopyr TEA formulations is clear. In a review of pesticide incidents associated with occupational exposures in California (Maddy et al. 1990, as referenced in SERA 2011b), note that the only adverse effect associated with triclopyr involved two cases of eye injury. While eye irritation is not treated quantitatively in the current risk assessment, eye irritation is a clear concern for occupational exposures.

Triclopyr is poorly absorbed by skin, and very high doses (>2,000 mg/kg) applied to the skin have not caused death or other signs of toxicity, except weight loss. This result suggests that triclopyr, like many herbicides, is less readily absorbed after dermal exposure than after oral exposure. After 72 hours, the extent of dermal absorption of triclopyr BEE for un-occluded preparations was 3.7% and 0.7% for rat and human preparations, respectively. Using occluded preparations, the corresponding values increased to 8.6% and 3.3% for rat and human preparations, respectively. These results in experimental mammals and with *in vitro* human skin preparations are consistent with an *in vivo* pharmacokinetics study using 5 volunteers and oral and dermal exposure to triclopyr. Dermal exposures consisted of placing Garlon 4 on the forearm so that the applied dose was 5 mg triclopyr/kg body weight. Based on the pharmacokinetics analysis, the best estimate of the absorption fraction was 1.65%.

Reproductive and Teratogenic Effects - Triclopyr has been subject to several teratogenicity studies, and two multi-generation reproduction studies. At sufficiently high doses, triclopyr can cause adverse reproductive effects as well as birth defects. A consistent pattern with triclopyr, however, is that adverse reproductive effects as well as teratogenic effects occur only at doses that are maternally toxic. At doses that do not cause maternal toxicity, there is no apparent concern for either reproductive or teratogenic effects.

The most significant study is the two-generation reproduction study by Vedula et al. (1995 as referenced in SERA 2011b). This study is the basis of the current RfD on triclopyr. In this study, male and female rats were exposed to triclopyr in the diet at concentrations resulting in doses of 0, 5, 25, or 250 mg/kg/day, except that the first generation males in the high dose group were exposed only to concentrations resulting in a daily dose of 100 mg/kg/day. The 5 mg/kg/day dose groups evidenced no adverse effects in parents or offspring. At 25 mg/kg/day, kidney effects were noted only in adult animals. At 250 mg/kg/day, parental effects included decreased food consumption and body weights as well as histopathologic changes in the liver and kidney. Fetotoxic effects – decreased pup survival and litter sizes – were noted only at 250 mg/kg/day.

This dose also resulted in decrease parental fertility. Because no effects were observed at this dose on spermatogenesis or the testes, the decreased fertility was attributed to effects on the female rats.

At substantially higher doses – i.e., greater than or equal to 100 mg/kg/day, triclopyr has been shown to result in birth defects. Most of the abnormalities have been indicative of delayed growth and have been associated with maternal toxicity. Based on several studies with triclopyr BEE and triclopyr TEA, these two forms of triclopyr appear to be equally toxic, consistent with the basic position adopted by U.S. EPA.

Carcinogenicity and Mutagenicity - In 1995, U.S. EPA's Carcinogenicity Peer Review Committee (CPRC) classified triclopyr as a Group D chemical (not classifiable as to human carcinogenicity). This decision was based on increases in mammary tumors in female mice and rats and adrenal tumors in male rats. The CPRC felt that the evidence was marginal (not entirely negative, but yet not convincing), and when combined with lack of genotoxicty and mutagenicity and lack of carcinogenicity of structural analogs, supported the Group D classification. The decision by U.S. EPA to classify triclopyr as Group D is accompanied automatically by a decision not to derive a cancer potency factor for triclopyr and hence, in terms of a risk assessment, the potential carcinogenicity of triclopyr is not considered quantitatively.

There is concern however, since triclopyr has been shown to cause the same type of tumors in two species. In addition, while all cancers are a public health concern, the particular tumor type noted in rats and mice (breast cancer) is a common and important form of cancer in humans. Nonetheless, it is worth noting that none of the dose groups in either rats or mice evidenced a statistically significant pair-wise increase in breast tumors. In other words, the magnitude of the response was not substantial. The other important factor considered by U.S. EPA is the apparent lack of mutagenic activity of triclopyr. Only one study indicated any form of mutagenic activity and the other standard assays for genotoxicity were negative. This is an important point because even if the U.S. EPA had decided to classify triclopyr as a carcinogen, it is plausible that a threshold dose-response assessment would be conducted. In the current risk assessment, a threshold-based approach is used for standard toxicity and this approach is based on the most sensitive endpoint – effects on the kidney. The Group D classification of triclopyr in terms of potential carcinogenicity was recently restated in the Agency's pesticide tolerances for triclopyr (U.S. EPA/OPP 2002a, as referenced in SERA 2011b). The current risk assessment will defer to the judgment of U.S. EPA and will not quantitatively consider the potential carcinogenic risk of triclopyr.

Other Toxic Endpoints - There is no evidence for triclopyr being a direct neurotoxicant in humans or other species (SERA 2002). Studies designed specifically to detect impairments in motor, sensory, or cognitive functions in mammals or other species exposed sub-chronically or chronically to triclopyr have not been reported. This is not surprising, since the undertaking of such studies on a substance for which the clinical and experimental toxicology experience provide no reason to suspect a neurotoxicity potential, would be highly unusual. Experiments conducted in fish suggest possible effects of triclopyr on behavior when exposures are at or near lethal levels. As is the case with mammals, these studies provide no evidence that triclopyr is a direct neurotoxicant.

Acute toxicity studies conducted in various mammalian species have observed lethargy, impaired coordination, weakness, labored respiration, and tremors in animals exposed to lethal or near-lethal dose levels of triclopyr. Direct neurotoxic activity is expected in longer-term experimental studies in which exposures were well below lethal levels. However, studies conducted in rodents, dogs, monkeys, birds, and amphibians have not provided evidence of direct neurotoxicity, even at the maximum tolerated dose. Neurological endpoints evaluated in these studies may have been limited to brain morphology and observation of the animals for gross abnormalities in movement or balance. Nevertheless, these studies suggest that the acute neurological effects of triclopyr observed at near lethal doses may indeed be secondary to cardiovascular trauma from treatment-induced injuries to other organs, possibly kidney and liver. Studies designed specifically to detect impairments in motor, sensory, or cognitive functions in mammals exposed sub-chronically or chronically to triclopyr have not been reported. Two studies found evidence for possible neurological effects of triclopyr in fish. The effects observed included lethargy, hypersensitivity to light stimuli, and avoidance behavior but were only observed at lethal or near-lethal exposure levels. In the absence of any signs of direct neurotoxicity in other species, these observations are consistent with indirect neurological effects secondary to general poisoning.

There is very little direct information on which to assess the immunotoxic potential of triclopyr. The only studies specifically related to the immune effects of triclopyr are skin sensitization studies conducted on triclopyr BEE and the triclopyr TEA salt. For both of these forms of triclopyr, skin sensitization was observed following standard protocols accepted by the U.S. EPA (1998). While these studies provide support for asserting that triclopyr may cause skin sensitization, they provide no information useful for directly assessing immune suppressive potential of triclopyr.

The toxicology of triclopyr has been examined in sub-chronic, chronic, and multi-generation studies in rodents and in sub-chronic studies in dogs. In these reviews of the toxicity of triclopyr, morphologic abnormalities in lymphoid tissues have not been reported. Triclopyr has not undergone evaluation for its potential to interact or interfere with the estrogen, androgen, or thyroid hormone systems (i.e., assessments on hormone availability, hormone receptor binding, or post-receptor processing). However, extensive testing in experimental animals provides reasonably strong evidence that triclopyr is not an endocrine disruptor. No epidemiological studies of health outcomes of triclopyr have been reported, and there is no clinical case literature on human triclopyr intoxication. Several long-term experimental studies in dogs, rats, and mice have examined the effects of exposure to triclopyr on endocrine organ morphology, reproductive organ morphology, and reproductive function; treatment-related effects on these endpoints were not observed.

Inhalation Exposures – There is very little information regarding the inhalation toxicity of triclopyr. Three studies on the inhalation toxicity of triclopyr have been reviewed involving technical grade triclopyr as well as triclopyr TEA. No mortality was observed in any animals. The only study not summarized in U.S. EPA (1998) is the recent report by Carter (2000, as referenced in SERA 2011b) on technical grade triclopyr. The results of this study – i.e., an LC50 of greater than 2.56 mg/L – is essentially equivalent to the reported LD_{50} value of 2.6 mg/L for triclopyr TEA. Based on these results, the U.S. EPA classified inhalation exposures to not be of toxicological concern.

Metabolites - Triclopyr is not extensively metabolized in humans or experimental mammals. In a study involving rats, >90% of the administered dose of triclopyr acid was recovered in the urine as un-metabolized triclopyr. The remainder was identified as the metabolite 3,5,6-trichloro-2-pyridinol (TCP) and possible conjugates. TCP acute and chronic toxicity is similar to triclopyr. TCP has an acute NOEL of 25 mg/kg/day, based on a developmental study in rabbits (compared to 30 mg/kg/day for triclopyr) and a chronic NOEL of 3 mg/kg/day, from a chronic study in dogs (compared to a NOEL of 5 mg/kg/day for triclopyr). TCP is also the major metabolite of the insecticide chlorpyrifos. Because of the toxicity of TCP, it will be considered in this risk assessment.

Inerts – As reviewed by U.S. EPA, triclopyr TEA dissociates extremely rapidly to triclopyr acid and triethanolamine, and triclopyr BEE hydrolyzes rapidly to triclopyr acid and 2- 3 butoxyethanol. There is an extensive database on the toxicity of 2- butoxyethanol, and much of the available information associated with potential human health effects is reviewed by ATSDR (1998). The acute oral MRL for 2- butoxyethanol is 0.4 mg/kg/day, and the intermediate MRL for 2-butoxyethanol is 0.07 mg/kg/day (ATSDR 2002). As detailed further in Section 3.3, the acute MRL for 2-butoxyethanol is on the same order as the acute RfD for triclopyr (1 mg/kg/day), and the intermediate MRL for 2-butoxyethanol is similar to the intermediate and chronic RfD for triclopyr (0.05 mg/kg/day).

Relatively little information is available on the toxicity of triethanolamine. This compound is classified as a list 3 inert by U.S. EPA. The List 3 classification reflects the limited toxicity data on triethanolamine and indicates that U.S. EPA was not able to classify this compound as toxic (List 1), potentially toxic (List 2), or essentially non-toxic (Lists 4a or 4b). In terms of a practical impact on the risk assessment, the most relevant factor is that triethanolamine will mineralize very rapidly in the environment – i.e., be completely degraded to CO2. This is not the case for triclopyr or TCP, a metabolite of triclopyr. Thus, the uncertainties associated with the toxicity of triethanolamine to triclopyr have relatively little impact on this risk assessment. Because triclopyr and the TCP metabolite of triclopyr persist in the environment much longer than triethanolamine, it is triclopyr and the TCP metabolite that are the major quantitative focus of the risk assessment. This approach is identical to the position taken by U.S. EPA.

Garlon® 3A contains the triethylamine salt of triclopyr (44.4%) as well as emulsifiers, surfactants, and ethanol. The toxicity of ethanol is extremely well characterized in humans, and the hazards of exposure include intoxication from acute exposure as well as liver cirrhosis and fetal alcohol syndrome. For chronic exposure, the alcohol contained in Garlon® 3A will not be of toxicological significance because of the rapid breakdown of alcohol in the environment and the relatively high levels of alcohol associated with chronic alcohol poisoning. Similarly, alcohol is not likely to pose an acute toxic hazard. Each milliliter (mL) of Garlon® 3A contains 0.01 mL of ethanol. Therefore, 1,480 mL, or approximately 1.5 liters (L), of Garlon® 3A must be consumed to equal the amount of alcohol contained in 1 ounce of an alcoholic beverage. The same amount of Garlon® 3A contains approximately a lethal dose for triclopyr in humans. Thus, compared with the active ingredient, which is triclopyr, the amount of ethanol in Garlon® 3A is not toxicologically significant in terms of potential toxicity.

Inferences concerning the toxicological significance of TEA, BEE, as well as other adjuvants used in triclopyr formulations can also be made based on a comparison of the toxicities of triclopyr acid, triclopyr BEE, triclopyr TEA, and triclopyr formulations. The acute oral LD_{50} of triclopyr acid is 729 mg a.e./kg bw in male rats and 630 mg 26 a.e./kg bw in female rats. These oral toxicity values are similar to the LD_{50} values of 828 mg a.e./kg in male rats and 594 mg a.e./kg for exposure to Garlon 3A. Similarly, the acute oral LD_{50} 28 values for triclopyr acid are very close to the reported LD50 of 578 mg a.e./kg bw for exposure to triclopyr BEE. In other words, based on a comparison of the acute oral LD_{50} values, triclopyr acid rather than the TEA or BEE moieties appears to account for the toxicity of the two active ingredients.

3.0 Exposure Assessment

3.1 Workers

Pesticide applicators are likely to be the individuals who are most exposed to a pesticide during the application process. Two types of worker exposure assessments are considered: general and accidental/incidental. The term general exposure assessment is used to designate those exposures that involve estimates of absorbed dose based on the handling of a specified amount of a chemical during specific types of applications. The accidental/incidental exposure scenarios involve specific types of events that could occur during any type of application.

This assessment uses an absorption-based model for worker exposure modeling, in which the amount of chemical absorbed is estimated from the amount of chemical handled. This was done because of two common observations from field studies. First, most studies that attempt to differentiate occupational exposure by route of exposure indicate that dermal exposure is the dominant route of exposure for pesticide workers. Second, most studies of pesticide exposure that monitored both dermal deposition and chemical absorption or some other method of bio-monitoring noted a very poor correlation between the two values (e.g., Cowell et al. 1991, Franklin et al. 1981, Lavy et al. 1982; all as referenced in SERA 2011c). In this exposure assessment for workers, the primary goal is to estimate absorbed dose so that the absorbed dose estimate can be compared with available information on the dose-response relationships for the chemical of concern.

Although pesticide application involves many different job activities, exposure rates can be defined for three categories: directed foliar applications (including cut surface, streamline, and direct sprays) involving the use of backpacks or similar devices, broadcast hydraulic spray applications, and broadcast aerial applications. While these may be viewed as crude groupings, the variability in the available data does not seem to justify further segmenting the job classifications - e.g., hack-and-squirt, injection bar.

See Tables F-3a to F-3g for the results of worker exposure calculations. (Actual calculations are displayed on worksheets contained in the project file and are based on the referenced SERA risk assessments).

General Exposures - As described in SERA (2011c), worker exposure rates are expressed in units of milligrams (mg) of absorbed dose per kilogram (kg) of body weight per pound of chemical handled (mg/kg/lb applied). The exposure rates used in this risk assessment are based on worker exposure studies on nine different pesticides with molecular weights ranging from 169 to 416 and the base-10 log of the octanol water coefficient (log Kow) values at pH 7 ranging from –2.90 to 6.50 (Table 1 in SERA 1998). The estimated exposure rates (Table F-1) are based on estimated absorbed doses in workers as well as the amounts of the chemical handled by the workers. Exposure rates are shown as milligrams of chemical per kilogram of body weight per pound of active ingredient (ai) applied. The molecular weight and log Kow of the six herbicides considered in this risk assessment are within the range of pesticides studied in SERA (1998).

As described in SERA (2007a), the ranges of estimated occupational exposure rates vary substantially among individuals and groups, (i.e., by a factor of 50 for backpack applicators and a factor of 100 for mechanical ground sprayers). It seems that much of the variability can be attributed to the hygienic measures taken by individual workers (i.e., how careful the workers are to avoid unnecessary exposures).

Table F-1: Estimated Exposure Rates from Herbicides used to Treat Noxious Weed (Source: SERA, 1998, Table 5.)

Job Category	Typical (mg/kg/lb ai)	Lower (mg/kg/lb ai)	Upper (mg/kg/lb ai)
Ground Application	0.003	0.0003	0.01

The number of hours worked per day is expressed as a range, the lower end of which is based on an 8-hour workday with 1 hour at each end of the workday spent in activities that do not involve herbicide exposure. The upper end of the range, 8 hours per day, is based on an extended (10-hour) workday, allowing for 1 hour at each end of the workday to be spent in activities that do not involve herbicide exposure. It is recognized that the use of 6 hours as the lower range of time spent per day applying herbicides is not a true lower limit. It is conceivable and perhaps common for workers to spend much less time in the actual application of an herbicide if they are engaged in other activities. Thus, using 6 hours can be regarded as conservative. In the absence of any published or otherwise documented work practice statistics to support the use of a lower limit, this conservative approach is used.

The range of acres treated per hour and hours worked per day is used to calculate a range for the number of acres treated per day. For this calculation as well as others in this section involving the multiplication of ranges, the lower end of the resulting range is the product of the lower end of one range and the lower end of the other range. Similarly, the upper end of the resulting range is the product of the upper end of one range and the upper end of the other range. This approach is taken to encompass as broadly as possible the range of potential exposures. The central estimate of the acres treated per day is taken as the arithmetic average of the range. Because of the relatively narrow limits of the ranges for backpack and boom spray workers, the use of the arithmetic mean rather than some other measure of central tendency, like the geometric mean, has no marked effect on the risk assessment.

The range of application rates and the typical application rate are based on label recommendations (See Table F-2), (Rates are expressed as either acid equivalents (ae) or active ingredient (ai)). The typical dilution rates are largely based on applicator judgement based on equipment type and vegetation type and height. The dilution rates used in this assessment are based on label recommendations for various scenarios.

Table F-2: Herbicide Application Rates to be used to Treat Invasive Plants

Herbicide	Application Rate Typical (lb/ac)	Application Rate Lowest (lb/ac)	Application Rate Highest (lb/ac)
Aminopyralid	0.11 ae	0.05 ae	0.22 ae*
Chlorsulfuron	0.12 ai	.024 ae	0.24 ae*
Glyphosate	3.0 ae	0.18 ae	8.0 ae
Imazamox	0.5 ae	0.12 ae	1.0 ae
Imazapyr	1.0 ae	0.25 ae	1.5 ae
Sulfometuron Methyl	0.281 ae	.035 ae	0.281 ae
Triclopyr	2 ae	0.75 ae	9.0 ae

*Spot treatment only, cannot treat more than 50% of the area within a given acre

The central estimate of the amount handled per day is calculated as the product of the central estimates of the acres treated per day and the application rate. The ranges for the amounts handled per day are calculated as the product of the range of acres treated per day and the range of application rates. Similarly, the central estimate of the daily-absorbed dose is calculated as the product of the central estimate of the exposure rate and the central estimate of the amount handled per day. The ranges of the daily-absorbed dose are calculated as the range of exposure rates and the ranges for the amounts handled per day. The lower and upper limits are similarly calculated using the lower and upper ranges of the amount handled, acres treated per day, and worker exposure rate.

Accidental Exposures - Typical occupational exposures may involve multiple routes of exposure (i.e., oral, dermal, and inhalation); nonetheless, dermal exposure is generally the predominant route for herbicide applicators. Typical multi-route exposures are encompassed by the methods used on general exposures. Accidental exposures, on the other hand, are most likely to involve splashing a solution of herbicides into the eyes or to involve various dermal exposure scenarios.

The available literature does not include quantitative methods for characterizing exposure or responses associated with splashing a solution of a chemical into the eyes; furthermore, there appear to be no reasonable approaches to modeling this type of exposure scenario quantitatively. Consequently, accidental exposure scenarios of this type are considered qualitatively in the risk characterization.

There are various methods for estimating absorbed doses associated with accidental dermal exposure. Two general types of exposure are modeled: those involving direct contact with a solution of the herbicide and those associated with accidental spills of the herbicide onto the surface of the skin. Any number of specific exposure scenarios could be developed for direct contact or accidental spills by varying the amount or concentration of the chemical on or in contact with the surface of the skin and by varying the surface area of the skin that is contaminated.

For this risk assessment, two exposure scenarios are developed for each of the two types of dermal exposure, and the estimated absorbed dose for each scenario is expressed in units of mg chemical/kg body weight.

Exposure scenarios involving direct contact with solutions of the chemical are characterized by immersion of the hands for 1 minute or wearing contaminated gloves for 1 hour. Generally, it is not reasonable to assume or postulate that the hands or any other part of a worker will be immersed in a solution of an herbicide for any period of time. On the other hand, contamination of gloves or other clothing is quite plausible. For these exposure scenarios, the key element is the assumption that wearing gloves grossly contaminated with a chemical solution is equivalent to immersing the hands in a solution. In either case, the concentration of the chemical in solution that is in contact with the surface of the skin and the resulting dermal absorption rate are essentially constant.

For both scenarios (the hand immersion and the contaminated glove), the assumption of zero-order absorption kinetics is appropriate. Following the general recommendations of U.S. EPA (1992, as referenced in SERA 2007a), Fick's first law is used to estimate dermal exposure.

Exposure scenarios involving chemical spills on to the skin are characterized by a spill on to the lower legs as well as a spill on to the hands. In these scenarios, it is assumed that a solution of the chemical is spilled on to a given surface area of skin and that a certain amount of the chemical adheres to the skin. The absorbed dose is then calculated as the product of the amount of the chemical on the surface of the skin (i.e., the amount of liquid per unit surface area multiplied by the surface area of the skin over which the spill occurs and the concentration of the chemical in the liquid) the first-order absorption rate, and the duration of exposure. For both scenarios, it is assumed that the contaminated skin is effectively cleaned after 1 hour. As with the exposure assessments based on Fick's first law, this product (mg of absorbed dose) is divided by bodyweight (kg) to yield an estimated dose in units of mg chemical/kg body weight. The specific equation used in these exposure assessments is taken from SERA (2007a).

Table F-3a: Summary of Worker Exposure Scenarios – Aminopyralid

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
General Exposure (dose in mg/kg/day)			
Backpack application	0.0007	0.00004	0.0033
Accidental/Incidental Exposures (dose in mg/kg/event)			
Contaminated Gloves, 1 minute	10.0 E-08	2.4 E-08	4.2 E-07
Contaminated Gloves, 1 hour	6.0 E-06	1.4 E-06	2.5 E-05
Spill on hands,1 hour	2.3 E-05	4.4 E-06	0.00013
Spill on lower legs,1 hour	5.8 E-05	1.1 E-05	0.00031

Table F-3b: Summary of Worker Exposure Scenarios – Chlorsulfuron

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
General Exposure (dose in mg/kg/day)			
Backpack application	7.25E-04	4.32E-05	0.0036
Accidental/Incidental Exposures (dose in mg/kg/event)			
Contaminated Gloves, 1 minute	2.67E-07	9.16E-08	8.00E-07
Contaminated Gloves, 1 hour	1.60E-05	5.50E-06	4.80E-05
Spill on hands,1 hour	1.00E-05	1.95E-06	5.01E-05
Spill on lower legs,1 hour	2.47E-05	4.80E-06	1.23E-04

Table F-3c: Summary of Worker Exposure Scenarios – Glyphosate

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
General Exposure (dose in mg/kg/day)			
Backpack application	0.0181	0.0011	0.09
Accidental/Incidental Exposures (dose in mg/kg/event)			
Contaminated Gloves, 1 minute	4.31E-6	1.06E-06	1.812E-05
Contaminated Gloves,1 hour	0.0003	6.38E-05	0.0011
Spill on hands, 1 hour	0.0006	0.0002	0.0014
Spill on lower legs, 1 hour	0.0014	0.0004	0.0034

Table F-3d: Summary of Worker Exposure Scenarios – Imazamox

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
General Exposure (dose in mg/kg/day)			
Backpack application	0.0059	0.0026	0.0132
Accidental/Incidental Exposures (dose in mg/kg/event)			
Contaminated Gloves, 1 minute	0.0082	0.0048	0.0134
Contaminated Gloves,1 hour	0.4896	0.288	0.8064
Spill on hands, 1 hour	0.0379	0.0149	0.0906
Spill on lower legs, 1 hour	0.0935	0.0369	0.2234

Table F-3e: Summary of Worker Exposure Scenarios – Imazapyr

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
General Exposure (dose in mg/kg/day)			
Backpack application	0.0197	0.0007	0.12
Broadcast application	0.0336	0.001	0.2268
Accidental/Incidental Exposures (dose in mg/kg/event)			
Contaminated Gloves, 1 minute	0.0001	1.008E-05	0.0008
Contaminated Gloves,1 hour	0.006	0.0006	0.0475
Spill on hands, 1 hour	0.0009	7.601E-05	0.0100
Spill on lower legs, 1 hour	0.0023	0.0002	0.0247

Table F-3f: Summary of Worker Exposure Scenarios – Sulfometuron Methyl

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
General Exposure (dose in mg/kg/day)			
Backpack application	.0026	8.96E-05	.0159
Broadcast application	.0045	.0001	.0301
Accidental/Incidental Exposures (dose in mg/kg/event)			
Contaminated Gloves, 1 minute	1.63E-06	2.40E-07	1.25E-05
Contaminated Gloves,1 hour	9.79E-05	1.44E-05	.0007
Spill on hands, 1 hour	3.38E-05	2.76E-06	.0005
Spill on lower legs, 1 hour	8.33E-05	6.81E-06	.0011

Table F-3g: Summary of Worker Exposure Scenarios – Triclopyr

Scenario	Typical Dose (mg/kg/day)	Lower Range (mg/kg/day)	Upper Range (mg/kg/day)
General Exposure (dose in mg/kg/day)			
Backpack application	0.0091	0.0005	0.045
Accidental/Incidental Exposures (dose in mg/kg/event)			
Contaminated Gloves, 1 minute	3.45E-05	1.58E-05	7.77E-05
Contaminated Gloves, 1 hour	0.0021	0.0009	0.0047
Spill on hands, 1 hour	0.0006	0.0002	0.0018
Spill on lower legs, 1 hour	0.0015	0.0005	0.0044

3.2 General Public

Under normal conditions, members of the general public should not be exposed to substantial levels of any of these herbicides. Nonetheless, any number of exposure scenarios can be constructed for the general public, depending on various assumptions regarding application rates, dispersion, canopy interception, and human activity. Several highly conservative scenarios are developed for this risk assessment.

The two types of exposure scenarios developed for the general public includes acute exposure and longer-term or chronic exposure. All of the acute exposure scenarios are primarily accidental. They assume that an individual is exposed to the compound either during or shortly after its application. Specific scenarios are developed for direct spray, dermal contact with contaminated vegetation, as well as the consumption of contaminated fruit, water, and fish. Most of these scenarios should be regarded as extreme, some to the point of limited plausibility. The longer-term or chronic exposure scenarios parallel the acute exposure scenarios for the consumption of contaminated fruit, water, and fish but are based on estimated levels of exposure for longer periods after application. See Tables F-5a to F-5g for a summary of the general public exposure scenarios.

Direct Spray -- Direct sprays involving ground applications are modeled in a manner similar to accidental spills for workers. In other words, it is assumed that the individual is sprayed with a solution containing the compound and that an amount of the compound remains on the skin and is absorbed by first-order kinetics. As with the similar worker exposure scenarios, the first-order absorption kinetics are estimated from the empirical relationship of first-order absorption rate coefficients to molecular weight and octanol-water partition coefficients (SERA 2007a).

For direct spray scenarios, it is assumed that during a ground application, a naked child is sprayed directly with the herbicide. The scenario also assumes that the child is completely covered (that is, 100% of the surface area of the body is exposed), which makes this an extremely conservative exposure scenario that is likely to represent the upper limits of plausible exposure. An additional set of scenarios are included involving a young woman who is accidentally sprayed over the feet and legs. For each of these scenarios, some standard assumptions are made regarding the surface area of the skin and body weight.

Dermal Exposure from Contaminated Vegetation -- In this exposure scenario, it is assumed that the herbicide is sprayed at a given application rate and that an individual comes in contact with sprayed vegetation or other contaminated surfaces at on the same day. For these exposure scenarios, some estimates of dislodgeable residue and the rate of transfer from the contaminated vegetation to the surface of the skin must be available. No such data are directly available for these herbicides, and the estimation methods of Durkin et al. (1995, as referenced in SERA 2007a) are used. Other estimates used in this exposure scenario involve estimates of body weight, skin surface area, and first-order dermal absorption rates.

Contaminated Water - Water can be contaminated from runoff, as a result of leaching from contaminated soil, from a direct spill, or from unintentional contamination from applications. For this risk assessment, the two types of estimates made for the concentration of these herbicides in ambient water are acute/accidental exposure from an accidental spill and longer-term exposure to the herbicides in ambient water that could be associated with the typical application of this compound to a 100-acre treatment area.

The acute exposure scenario assumes that a young child (2- to 3-years old) consumes 1 L of contaminated water (a range of 0.6 to 1.5L) shortly after an accidental spill of 100 gallons (range of 20 to 200 gallons) of a field solution into a pond that has an average depth of 1 m and a surface area of 1000 m2 or about one-quarter acre. Because this scenario is based on the assumption that exposure occurs shortly after the spill, no dissipation or degradation of the herbicide is considered. This is an extremely conservative scenario dominated by arbitrary variability. The actual concentrations in the water would depend heavily on the amount of compound spilled, the size of the water body into which it is spilled, the time at which water consumption occurs relative to the time of the spill, and the amount of contaminated water that is consumed. It is also unlikely that ponds would be the waterbody receiving any herbicides in this project. Flowing streams are the more likely recipients, so dilution would occur.

The scenario for chronic exposure to these herbicides from contaminated water assumes that an adult (70 kg male) consumes contaminated ambient water for a lifetime. There are some monitoring studies available on many of these herbicides that allow for an estimation of expected concentrations in ambient water associated with ground applications of the compound over a wide area (glyphosate, hexazinone, and triclopyr). For the others, such monitoring data does not exist. For those herbicides without monitoring data, for this component of the exposure assessment, estimates of levels in ambient water were made based on the GLEAMS (Groundwater Loading Effects of Agricultural Management Systems) model.

GLEAMS is a root zone model that can be used to examine the fate of chemicals in various types of soils under different meteorological and hydro-geological conditions (Knisel et al. 1992, as referenced in SERA 2001). SERA (2001) illustrated the general application of the GLEAMS model to estimating concentrations in ambient water. The results of the GLEAMS modeling runs are displayed in the respective SERA risk assessments.

The specific estimates of short-term concentrations of the herbicides are summarized in Table F-4a, the longer-term concentrations are summarized in Table F-4b. These estimates are expressed as the water contamination rates (WCR) in mg/L (ppm) per pound of active ingredient or acid equivalent applied. The values in Tables F4a and F4b must be multiplied by the rates of application in Table F2. It is important to note that water monitoring conducted in the Forest Service Pacific Southwest Region since 1991 for forest plantation applications, involving glyphosate and triclopyr has not shown levels of water contamination as high as these for normal (i.e., not accidental) applications (USDA 2001). This indicates that, at least for these two herbicides, the assumptions in this risk assessment provide for a conservative (i.e. protective) assessment of risk.

Table F-4a: Short-Term Water Contamination Rates (WCR) of Herbicides and the Metabolite TCP (in mg/L per lb applied)

Herbicide	Typical WCR	Low WCR	High WCR
Aminopyralid	0.1	0.002	0.6
Chlorsulfuron	0.1	0.01	0.2
Glyphosate	0.011	0.0013	0.083
Imazamox	0.5	0.5	0.5
Imazapyr	0.02	0.000009	0.26
Sulfometuron Methyl	0.001	0.00006	0.02
Triclopyr (TEA)	0.003	0.000001	0.24
TCP	0.0009	0.00000001	0.028

Table F-4b: Longer-Term Water Contamination Rates (WCR) of Herbicides and the Metabolite TCP (in mg/L per lb applied)

Herbicide	Typical WCR	Low WCR	High WCR
Aminopyralid	0.04	0.001	0.26
Chlorsulfuron	0.0006	0.0001	0.0009
Glyphosate	0.00019	0.000088	0.0058
Imazamox	0.36	0.36	0.36
Imazapyr	0.007	0.000003	0.12
Sulfometuron Methyl	0.00004	0.00001	0.00007
Triclopyr (TEA)	0.001	0.0000000002	0.06
TCP	0.00005	0.000000000003	0.002

Oral Exposure from Contaminated Fish - Many chemicals may be concentrated or partitioned from water into the tissues of animals or plants in the water. This process is referred to as bio-concentration. Generally, bio-concentration is measured as the ratio of the concentration in the organism to the concentration in the water. For example, if the concentration in the organism is 5 mg/kg and the concentration in the water is 1 mg/L, the bio-concentration factor (BCF) is 5 L/kg. As with most absorption processes, bio-concentration depends initially on the duration of exposure but eventually reaches steady state. Details regarding the relationship of bio-concentration factor to standard pharmacokinetic principles are provided in Calabrese and Baldwin (1993, as referenced in SERA 2007a).

Most of the herbicides in this risk assessment have BCF values for fish of 1 or less. There are two with BCF values greater than 1: chlorsulfuron (1-12) and sulfometuron methyl (3-7). These values are generally determined from a standardized test that is required as part of the registration process.

For both the acute and longer-term exposure scenarios involving the consumption of contaminated fish, the water concentrations of the herbicides used are identical to the concentrations used in the contaminated water scenarios. The acute exposure scenario is based on the assumption that an adult angler consumes fish taken from contaminated water shortly after an accidental spill of 200 gallons of a field solution into a pond that has an average depth of 1 meter and a surface area of 1000 m^2 or about one-quarter acre. No dissipation or degradation is considered. Because of the available and well-documented information and substantial differences in the amount of caught fish consumed by the general public and Native American subsistence populations (U.S. EPA 1996, as referenced in SERA 2007a), separate exposure estimates are made for these two groups. The chronic exposure scenario is constructed in a similar way.

Dermal Exposure from Swimming in Contaminated Water -Swimming is prohibited in waterbodies on Beale AFB, but some sites include surface water in which members of the public might wade or kayak/boat. To assess the potential risks associated with being immersed in contaminated water, an exposure assessment is developed for a young woman swimming in surface water for 1 hour. Conceptually and computationally, this exposure scenario is virtually identical to the contaminated gloves scenario used for workers- i.e., a portion of the body is immersed in an aqueous solution of the compound at a fixed concentration for a fixed period of time.

As in the corresponding worker exposure scenario, the 1-hour period of exposure is somewhat, but not completely, arbitrary, given that longer periods of exposure are plausible. Nonetheless, the 1-hour period is intended as a unit exposure estimate. In other words, the exposure and consequently the risk will increase linearly with the duration of exposure. Thus, a 2-hour exposure would lead to a HQ that is twice as high as that associated with an exposure period of 1 hour. In cases in which this or other similar exposures approach a level of concern, further consideration is given to the duration of exposure in the risk characterization. In this scenario, the ingestion of water during swimming is not considered explicitly.

Oral Exposure from Contaminated Vegetation - Under normal circumstances and in most types of applications, it is extremely unlikely that humans will consume, or otherwise place in their mouths, vegetation contaminated with these herbicides. Nonetheless, any number of scenarios could be developed involving either accidental spraying of crops, gardens, the spraying of edible wild vegetation, like berries, or the spraying of plants collected by Native Americans for basket weaving or medicinal use. Again, in most instances and particularly for longer-term scenarios, treated vegetation would probably show signs of damage from herbicide exposure, thereby reducing the likelihood of consumption that would lead to significant levels of human exposure. And since Beale AFB is a closed base, no Native American vegetation use sites are in active use. Notwithstanding those assertions, it is conceivable that individuals could consume contaminated vegetation.

One of the more plausible scenarios involves the consumption of contaminated berries after treatment along a road or some other area in which wild berries grow. Two sets of accidental exposure scenarios are included for this exposure assessment: one for the consumption of contaminated fruit and the other for the consumption of contaminated broadleaf vegetation. In both scenarios, the concentration of herbicide on contaminated vegetation is estimated using the empirical relationships between application rate and concentration on vegetation developed by Hoerger and Kenaga (1972, as referenced in SERA 2007a) as modified by Fletcher et al (1994, as referenced in SERA 2011c). For the acute exposure scenario, the estimated residue level is taken as the product of the application rate and the residue rate. For the longer-term exposure scenario, a duration of 90 days is used and the dissipation on the vegetation is estimated based on the estimated or established foliar halftimes.

Although the duration of exposure of 90 days may appear to be somewhat arbitrarily chosen, it is intended to represent the consumption of contaminated vegetation that might be available over one season. Longer durations could be used for certain kinds of vegetation but would lower the estimated dose (i.e., would result in a less conservative exposure assessment). The central estimate of dose for the longer-term exposure period is taken as the time-weighted average of the initial concentration and concentration after 90 days.

Table F-5a: Summary of Public Exposure Scenarios – Aminopyralid

Scenario	Receptor	mg/kg/day or mg/kg/event		
		Central	Lower	Upper
Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	8.85E-04	8.09E-05	4.75E-02
Direct Spray of Woman, feet and lower legs	Adult Female	8.89E-05	8.12E-06	4.77E-03
Vegetation Contact, shorts and T-shirt	Adult Female	2.22E-04	4.15E-05	1.17E-03
Contaminated Fruit	Adult Female	2.59E-03	2.59E-03	4.11E-02
Contaminated Vegetation	Adult Female	3.56E-02	7.43E-03	2.97E-01
Water consumption, accidental spill	Child	3.02E-02	9.03E-03	4.52E-01
Water consumption, ambient	Child	1.65E-03	2.02E-05	1.49E-02
Swimming, ambient	Adult Female	5.46E-06	2.62E-08	1.37E-04
Fish consumption, accidental spill	Adult Male	9.06E-04	4.44E-04	9.06E-03
Fish consumption, accidental spill	Subsistence Populations	4.41E-03	2.17E-03	4.41E-02
Chronic/Longer Term Exposures (dose in mg/kg/day)				
Contaminate Fruit	Adult Female	5.50E-04	4.34E-04	1.05E-02
Contaminate Vegetation	Adult Female	7.58E-03	1.25E-03	7.59E-02
Water consumption	Adult Male	2.51E-04	4.40E-06	1.96E-03
Fish consumption	Adult Male	1.26E-06	3.14E-08	8.17E-06
Fish consumption	Subsistence Populations	1.02E-05	2.55E-07	6.62E-05

Table F-5b: Summary of Public Exposure Scenarios – Chlorsulfuron

Scenario	Receptor	mg/kg/day or mg/kg/event		
		Central	Lower	Upper
Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	2.74E-04	6.22E-06	2.38E-03
Direct Spray of Woman, feet and lower legs	Adult Female	2.75E-05	6.25E-07	2.39E-04
Vegetation Contact, shorts and T-shirt	Adult Female	4.58E-05	8.92E-06	2.27E-04
Contaminated Fruit	Adult Female	1.43E-03	1.43E-03	2.28E-02
Contaminated Vegetation	Adult Female	1.98E-02	4.12E-03	1.65E-01
Water consumption, accidental spill	Child	2.39E-02	1.70E-03	6.23E-02
Water consumption, ambient	Child	9.17E-04	5.60E-05	2.75E-03
Swimming, ambient	Adult Female	No exposure assessment		
Fish consumption, accidental spill	Adult Male	7.18E-04	8.37E-05	1.25E-03
Fish consumption, accidental spill	Subsistence Populations	3.50E-03	4.08E-04	6.08E-03
Chronic/Longer Term Exposures (dose in mg/kg/day)				
Contaminate Fruit	Adult Female	8.32E-03	1.73E-03	6.93E-02
Contaminate Vegetation	Adult Female	2.09E-06	2.44E-07	3.76E-06
Water consumption	Adult Male	1.57E-08	2.61E-09	2.35E-08
Fish consumption	Adult Male	1.27E-07	2.12E-08	1.91E-07
Fish consumption	Subsistence Populations	2.74E-04	6.22E-06	2.38E-03

Table F-5c: Summary of Public Exposure Scenarios – Glyphosate

Scenario	Receptor	mg/kg/day or mg/kg/event		
		Central	Lower	Upper
Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	1.78E-02	2.26E-03	8.70E-02
Direct Spray of Woman, feet and lower legs	Adult Female	1.79E-03	2.27E-04	8.74E-03
Vegetation Contact, shorts and T-shirt	Adult Female	1.03E-03	3.28E-04	2.50E-03
Contaminated Fruit	Adult Female	1.18E-02	5.38E-03	1.87E-01
Contaminated Vegetation	Adult Female	1.62E-01	1.13E-02	1.35
Water consumption, accidental spill	Child	3.42E-01	1.67E-02	2.05
Water consumption, ambient	Child	8.27E-04	5.96E-05	9.36E-03
Swimming, ambient	Adult Female	4.36E-09	1.27E-10	1.38E-07
Fish consumption, accidental spill	Adult Male	3.90E-03	3.12E-04	1.56E-02
Fish consumption, accidental spill	Subsistence Populations	1.90E-02	1.52E-03	7.59E-02
Chronic/Longer Term Exposures (dose in mg/kg/day)				
Contaminate Fruit	Adult Female	1.88E-03	8.60E-04	2.99E-02
Contaminate Vegetation	Adult Female	2.59E-02	1.80E-03	2.16E-01
Water consumption	Adult Male	5.43E-06	1.76E-06	1.99E-04
Fish consumption	Adult Male	1.03E-08	4.78E-09	3.15E-07
Fish consumption	Subsistence Populations	8.35E-08	3.87E-08	2.55E-06

Table F-5d: Summary of Public Exposure Scenarios – Imazamox

Scenario	Receptor	mg/kg/day or mg/kg/event		
		Central	Lower	Upper
Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	No exposure assessment		
Direct Spray of Woman, feet and lower legs	Adult Female	No exposure assessment		
Vegetation Contact, shorts and T-shirt	Adult Female	No exposure assessment		
Contaminated Fruit	Adult Female	No exposure assessment		
Contaminated Vegetation	Adult Female	No exposure assessment		
Water consumption, accidental spill	Child	6.83E-01	1.37E-01	2.31
Water consumption, ambient	Child	3.76E-02	2.29E-02	5.64E-02
Swimming, ambient	Adult Female	4.49E-05	2.64E-05	7.39E-05
Fish consumption, accidental spill	Adult Male	2.05E-03	6.77E-04	4.61E-03
Fish consumption, accidental spill	Subsistence Populations	9.99E-03	3.30E-03	2.25E-02
Chronic/Longer Term Exposures (dose in mg/kg/day)				
Contaminate Fruit	Adult Female	No exposure assessment		
Contaminate Vegetation	Adult Female	No exposure assessment		
Water consumption	Adult Male	1.03E-02	7.21E-03	1.24E-02
Fish consumption	Adult Male	5.15E-06	5.15E-06	5.15E-06
Fish consumption	Subsistence Populations	4.17E-05	4.17E-05	4.17E-05

Table F-5e: Summary of Public Exposure Scenarios – Imazapyr

Scenario	Receptor	mg/kg/day or mg/kg/event		
		Central	Lower	Upper
Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	3.59E-02	2.87E-03	3.78E-01
Direct Spray of Woman, feet and lower legs	Adult Female	3.61E-03	2.89E-04	3.80E-02
Vegetation Contact, shorts and T-shirt	Adult Female	4.27E-03	1.72E-03	1.10E-02
Contaminated Fruit	Adult Female	1.76E-02	8.06E-03	2.80E-01
Contaminated Vegetation	Adult Female	2.43E-01	1.69E-02	2.03
Water consumption, accidental spill	Child	2.56E-01	6.25E-03	3.07
Water consumption, ambient	Child	2.26E-03	6.19E-07	4.40E-02
Swimming, ambient	Adult Female	4.44E-07	9.98E-11	1.13E-05
Fish consumption, accidental spill	Adult Male	3.84E-03	1.54E-04	3.08E-02
Fish consumption, accidental spill	Subsistence Populations	1.87E-02	7.49E-04	1.50E-01
Chronic/Longer Term Exposures (dose in mg/kg/day)				
Contaminate Fruit	Adult Female	7.42E-03	1.91E-03	1.35E-01
Contaminate Vegetation	Adult Female	1.02E-01	3.99E-03	9.79E-01
Water consumption	Adult Male	3.00E-04	9.00E-08	6.17E-03
Fish consumption	Adult Male	7.50E-07	3.21E-10	1.29E-05
Fish consumption	Subsistence Populations	6.08E-06	2.60E-09	1.04E-04

Table F-5f: Summary of Public Exposure Scenarios – Sulfometuron Methyl

Scenario	Receptor	mg/kg/day or mg/kg/event		
		Central	Lower	Upper
Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	1.28E-03	1.04E-04	1.71E-02
Direct Spray of Woman, feet and lower legs	Adult Female	1.28E-04	1.05E-05	1.71E-03
Vegetation Contact, shorts and T-shirt	Adult Female	9.54E-05	2.09E-05	4.21E-04
Contaminated Fruit	Adult Female	2.34E-03	2.34E-03	3.71E-02
Contaminated Vegetation	Adult Female	3.22E-02	6.72E-03	2.69E-01
Water consumption, accidental spill	Child	9.11E-02	2.08E-02	4.10E-01
Water consumption, ambient	Child	1.50E-05	5.48E-07	4.49E-04
Swimming, ambient	Adult Female	No exposure assessment		
Fish consumption, accidental spill	Adult Male	8.20E-03	3.08E-03	2.46E-02
Fish consumption, accidental spill	Subsistence Populations	4.00E-02	1.50E-02	1.20E-01
Chronic/Longer Term Exposures (dose in mg/kg/day)				
Contaminate Fruit	Adult Female	3.74E-04	3.74E-04	5.94E-03
Contaminate Vegetation	Adult Female	5.16E-03	1.07E-03	4.30E-02
Water consumption	Adult Male	2.27E-07	3.98E-08	4.78E-07
Fish consumption	Adult Male	3.98E-09	9.95E-10	6.97E-09
Fish consumption	Subsistence Populations	3.22E-08	8.06E-09	5.64E-08

Table F-5g: Summary of Public Exposure Scenarios – Triclopyr TEA

Scenario	mg/kg/day or mg/kg/event		
	Central	Lower	Upper
Acute/Accidental Exposures			
Direct Spray of Child, whole body	0.0229	0.0078	0.0677
Direct Spray of Woman, feet and lower legs	0.0023	7.86E-04	0.0068
Water consumption (spill), Child	0.2046	0.025	0.6139
Fish consumption (spill), Adult Male	3.69E-04	7.37E-05	7.37E-04
Fish consumption (spill), Subsistence Populations	0.0018	3.59E-04	0.0036
Non-Accidental Acute Exposures			
Vegetation Contact, shorts and T-shirt, Adult Female	0.0034	0.0018	0.0099
Contaminated Fruit, Adult Female	0.0176	0.0081	0.2799
Contaminated Vegetation, Adult Female	0.243	0.0169	2.025
Swimming, one hour, Adult Female	2.85E-08	4.36E-12	5.13E-06
Water consumption, Child	3.38E-04	6.88E-08	0.0406
Fish consumption, Adult Male	6.09E-07	2.03E-10	4.88E-05
Fish consumption, Subsistence Populations	2.97E-06	9.90E-10	2.38E-04
Chronic/Longer Term Exposures			
Contaminated Fruit, Adult Female	0.0069	0.0021	0.1883
Contaminated Vegetation, Adult Female	0.0241	0.0007	0.4793
Water consumption, Adult Male	1.13E-04	1.38E-11	0.0102
Fish consumption, Adult Male	1.29E-08	2.57E-15	7.71E-07
Fish consumption, Subsistence Populations	1.04E-07	2.08E-14	6.25E-06

4.0 Dose Response Assessment

4.1 Aminopyralid

The Office of Pesticide Programs of the U.S. EPA has derived a chronic RfD of 0.5 mg/kg/day for aminopyralid. This RfD is based on a chronic rat NOAEL of 50 mg/kg/day. This chronic RfD is based on a NOAEL of 50 mg a.e./kg/day from a 2-year feeding study in rats. This study involved dietary exposures equivalent to doses of 0, 5, 50, 500, 1000 mg a.e./kg bw/day over a 2-year period. No effects were observed in either of the two lower dose groups. At 500 mg a.e./kg bw/day, effects included a slight decrease in body weight with a slight increase in food consumption in male rats, a substantial increase in cecal weights in females, as well as changes in urine chemistry. While these effects were used to classify the 500 mg a.e./kg bw/day exposure as a LOAEL, these effects not severe or substantial. The RfD of 0.5 mg a.e./kg/day was derived by dividing the NOAEL of 50 mg a.e./kg bw/day by an uncertainty factor of 100. This uncertainty factor consists of two components: a factor of 10 for extrapolating from animals to humans and a factor of 10 for extrapolating to sensitive individuals within the human population.

The Office of Pesticide Programs has also derived an acute RfD of 1 mg/kg bw/day based on a NOAEL from a reproduction study of 100 mg/kg/day. Rabbits were dosed at rates equivalent to doses of 0, 104, 260, 520 mg a.e./kg bw/day from days 7 to 21 of gestation. At the higher doses, effects included incoordination, decreased maternal food consumption and body weight as well as a spontaneous abortion in 1/26 female rats. In addition, three adult females were euthanized due to extreme weight loss. No adverse effects that could be associated with treatment were noted the dose of 104 mg a.e./kg bw/day and this dose was accepted by the U.S. EPA as a NOAEL.

4.2 Chlorsulfuron

The U.S. EPA derived a chronic RfD for chlorsulfuron of 0.05 mg/kg/day. This RfD is currently listed on the U.S. EPA IRIS web site. This RfD is based on a two-year rat feeding study. The rats were given chlorsulfuron in the diet at concentrations of 100, 500 and 2,500 ppm for two years. Treatment related adverse effects of decreases in mean body weights and weight in male rats occurred at the 500 ppm and 2,500 ppm dose level. No frank signs of toxicity were seen at the 100 ppm or higher dose levels. Dose related effects on various hematological parameters were observed in males; however, these effects were observed during the first year. The investigators indicated that although the findings suggest the presence of reticulocytosis, reticulocyte counts were not measured. Consequently, the investigators concluded that in the absence of clarifying data, the biological significance of these hematological effects is unclear. No other behavioral, nutritional, clinical, hematological, gross, or histopathological abnormalities were observed. In deriving the RfD, the U.S EPA accepted the 100 ppm dose as a NOAEL and estimated the daily intake as 5 mg/kg/day and used an uncertainty factor of 100.

The U.S. EPA Office of Pesticide Programs has recently proposed a lower chronic RfD of 0.02 mg/kg/day, which appears to be based on the identical study used by U.S. EPA in deriving the RfD of 0.05 mg/kg/day. The difference in the two RfDs is accounted for by an additional uncertainty factor required under the FQPA. Citing a three-generation reproduction study in which effects "...considered of questionable toxicological significance..." were noted at 125 mg/kg/day, the U.S. EPA selected an FQPA uncertainty factor of 3. Thus, the chronic NOAEL of 5 mg/kg/day was divided by 300 – factors of 10 for extrapolating from animals to humans, 10 for extrapolating to sensitive individuals within the human population, and 3 for accounting for differences in children as required by FQPA. This value was rounded to one significant decimal to yield the RfD of 0.02 mg/kg/day. For this risk assessment, the lower and more recent RfD of 0.02 mg/kg/day will be used to characterize all risks involving chronic or longer-term exposures. The NOAEL of 5 mg/kg/day for chronic toxic effects is below the NOAEL of 25 mg/kg/day for reproductive effects. Thus, doses at or below the RfD will be below the level of concern for reproductive effects.

The U.S. EPA did not explicitly derive an acute/single dose RfD for chlorsulfuron. Nonetheless, for several short-term exposure scenarios the U.S. EPA recommends that an acute RfD be 0.25 mg/kg/day. This acute RfD appears to be based on a developmental study in rabbits with decreased body weight gains at 200 mg/kg/day. As with the chronic RfD, the NOAEL of 75 mg/kg/day was divided by an uncertainty factor of 300. Consistent with U.S. EPA, this risk assessment will use the short term RfD of 0.25 mg/kg/day to characterize all risks acute or short-term exposures.

Chlorsulfuron is listed by the state of California on its Groundwater Protection List and is a reproductive toxicant under Proposition 65 (the Safe Drinking Water and Toxic Enforcement Act of 1986).

4.3 Glyphosate

The U.S. EPA Office of Pesticide Programs has established a provisional RfD of 2 mg/kg/day for glyphosate (U.S. EPA 2000a). This is based on the maternal NOAEL of 175 mg/kg/day from a rabbit developmental study and an uncertainty factor of 100 (10 for sensitive individuals and 10 for species to species extrapolation). The RfD of 2 mg/kg/day is a rounding of the 1.75 mg/kg/day value to one significant digit.

The U.S. EPA has also derived an RfD for glyphosate of 0.1 mg/kg/day (U.S. EPA/IRIS 1990, as referenced in SERA 2011a). This RfD was originally derived in 1990 by the U.S. EPA Integrated Risk Information System (IRIS) workgroup and is the current RfD posted on IRIS. This RfD is based on a dietary 3-generation reproduction study. In this study, rats were exposed to glyphosate in the diet with resulting dose rates of 0, 3, 10 and 30 mg/kg/day. No signs of maternal toxicity were observed. The only effect in offspring was an increase in the incidence of unilateral renal tubular dilation in male pups from the F3b mating. Thus, the NOAEL was identified as 10 mg/kg/day and an uncertainty factor of 100 was applied to derive an RfD of 0.1 mg/kg/day.

Unlike the two RfD values proposed by the U.S. EPA, the ADI proposed by WHO (1994, as referenced in SERA 2011a) is not based on a reproductive toxicity study. Instead, WHO (1994) selected a life-time feeding study in rats. This study involved dietary concentrations of 0, 30, 100, or 300 ppm for 26 months which corresponded to approximate daily doses of 0, 3.1, 10.3, or 31.5 mg/kg/day for males and 0, 3.4, 11.3, or 34.0 mg/kg/day for females. No effects were seen at any dose levels and thus WHO (1994) used a NOAEL of 31.5 mg/kg/day and uncertainty factor of 100. Rounding to one significant digit, the recommended ADI was set at 0.3 mg/kg/day.

The U.S. EPA/OPP will sometimes derive acute RfD values that can be used to assess risks associated with very short-term exposures – i.e., accidental spills. No acute RfD has been proposed, however, for glyphosate.

For the current risk assessment, the RfD of 2 mg/kg/day derived by U.S. EPA/OPP (1993, as referenced in SERA 2011a) will be used as the basis for characterizing risk from longer term exposures in this risk assessment. For short-term exposures, the value of 2 mg/kg/day recommended by U.S. EPA/ODW (1992, as referenced in SERA 2011a) will be used. Since this is identical to the chronic RfD, this approach is equivalent to applying the same RfD to be short-term and long-term exposures. Given the lack of a significant dose-duration relationship for glyphosate, this approach seems appropriate.

The U.S. EPA Office of Water has established a lifetime health advisory level (HA) of 0.7 mg/L (700 ppb) and a 10-day HA of 20 mg/L (20 ppm) for glyphosate in drinking water (U.S. EPA 2004). The lifetime HA is an estimate of acceptable drinking water levels for a contaminant at which adverse health effects would not be expected to occur, even over a lifetime of exposure. The 10-day HA is designed to be protective of a child consuming 1 liter of water a day. These are not legally enforceable Federal standards, but serve as technical guidance to assist others. In addition, U.S. EPA has set a Maximum Contaminant Level (MCL) of 0.7 mg/L. This is an enforceable standard for drinking water quality. The state of California has also established a Public Health Goal (PHG) of 1 mg/L (1 ppm), based on a similar analysis as U.S. EPA (CalEPA 1997). The PHG describes a level of contamination at which adverse health effects would not be expected to occur, even over a lifetime of exposure.

4.4 Imazamox

The dose-response assessment for imazamox is highly atypical because endpoints of concern for imazamox cannot be identified. In other words, imazamox does not appear to be toxic to mammals, and potential hazards to humans cannot be identified. U.S. EPA/OPP (1997) proposes an RfD of 3 mg/kg bw/day for imazamox based on a developmental study in rabbits, which is essentially rescinded in U.S. EPA/OPP (2008). The doses of 600 and 900 mg/kg bw from the developmental study in rabbits which are classified as LOAELs in U.S. EPA/OPP (1997) are reclassified as NOAELs in U.S. EPA/OPP (2008). Although it appears that the reclassification by U.S. EPA/OPP is appropriate, the current risk assessment uses the RfD of 3 mg/kg bw/day proposed in U.S. EPA/OPP (1997) as a tool to quantitatively characterize risks by developing HQs. It is noted that a higher RfD of up to about 10 mg/kg bw/day could be justified based on the NOAELs summarized above by U.S. EPA/OPP (2001b). This argument is not given further consideration because the RfD of 3 mg/kg bw/day does not lead to any HQs that exceed the level of concern (HQ=1).

4.5 Imazapyr

The dose-response assessment for imazapyr is relatively straightforward, and the toxicity data base is reasonably complete and unambiguous. The U.S. EPA/OPP derived a chronic RfD of 2.5 mg/kg/day using a dog NOAEL of 250 mg/kg/day and an uncertainty factor of 100. The NOAEL selected by the U.S. EPA appears to be the most appropriate and is supported by additional NOAELs in rats and mice as well as a number of studies on potential reproduction and developmental effects. Consistent with the approach taken in U.S. EPA/OPP (2005) in the most recent human health risk assessment, no acute RfD is derived in the SERA risk assessment and the chronic RfD of 2.5 mg/kg/day is used to characterize the risks of both acute and longer-term exposures. Because doses clearly associated with adverse effects have not been identified and because none of the hazard quotients exceeds the level of concern, considerations of dose-severity relationships cannot be made and are not necessary.

4.5 Sulfometuron Methyl

The U.S. EPA (2008) has established an RfD of 0.275 mg/kg/day for both acute and chronic exposure scenarios. Both the acute and chronic RfD values were taken from the chronic dog feeding study. A NOAEL of 27.5 mg/kg/day was selected from this study. The LOAEL of 148.5 mg/kg/day was based on decreases in body weight in males, and hemolytic anemia in both sexes. The NOAEL value was combined with the uncertainty factor of 100X (10 interspecies; 10 intraspecies) to produce an RfD of 0.275 mg/kg/day.

4.6 Triclopyr

The U.S. EPA has established a chronic RfD for triclopyr at 0.05 mg/kg/day (U.S. EPA 1998). The U.S. EPA has concluded that the triethylamine acid (TEA) and butoxyethyl ester (BEE) of triclopyr are toxicologically equivalent; thus, this RfD is applicable to both forms of triclopyr. The RfD is based on a two-generation reproduction study in rats, with a NOEL of 5.0 mg/kg/day, the lowest dose tested. At the next dose level (25 mg/kg/day), an increased incidence of proximal tubular degeneration of the kidneys was observed in parental rats. An uncertainty factor of 100 was applied to this NOEL.

Under the Food Quality Protection Act (FQPA), the U.S. EPA is required to evaluate whether or not an additional uncertainty factor is required for the protection of children. The parental NOAEL of 5 mg/kg/day is below any adverse reproductive effects. Consequently, the U.S. EPA (1998) has determined that no additional FQPA uncertainty factor is required.

In the triclopyr RED, U.S. EPA considers a value of 30 mg/kg/day as a measure of acute dietary risk, based on a developmental toxicity study in rabbits administered triclopyr BEE (U.S. EPA 1998). At the next highest dose (100 mg/kg/day), effects included parental mortality as well as decreased number of live fetuses, increased number of fetal deaths, and increased number of fetal and/or litter incidence of skeletal anomalies and variants. The 30 mg/kg/day NOEL is supported by a number of other teratogenicity studies as well as a multi-generation reproduction study. In the most recent pesticide tolerance for triclopyr, the U.S. EPA has recommended an explicit acute RfD of 1 mg/kg/day for the general population. This appears to be based on the NOAEL of 100 mg/kg/day from a study in which rats were administered gavage doses of triclopyr BEE on days 6 through 15 of gestation. At 300 mg/kg/day, toxic responses included signs of marked maternal toxicity, overt clinical signs in a few dams, mean body weight loss and decreased mean body weight gain, decreased mean feed consumption, increased mean water consumption, and increased mean liver and kidney weights. In addition, fetal effects included both skeletal and soft-tissue malformations. This acute RfD is not applicable to females between the ages of 13-50 years – i.e., of childbearing age. For these individuals, the U.S. EPA recommends an acute RfD of 0.05 mg/kg/day, equivalent to the chronic RfD.

For risk characterization, the current risk assessment will adopt the most recent RfD values recommended by U.S. EPA – i.e., 1 mg/kg for acute exposures in the general population and 0.05 mg/kg/day for exposure scenarios of one month to a lifetime. Also consistent with the approach taken by U.S. EPA, the acute RfD of 1 mg/kg/day will be applied to the general population but not to women of child-bearing age.

Some exposure scenarios for the general public and workers yield estimates that are above the current chronic (and adult female acute) RfD of 0.05 mg/kg/day or above the acute RfD of 1.0 mg/kg/day for the general population. Consequently, some attempt must be made to characterize the consequences of exposures above the RfD. The RfD is intended to be a conservative estimate and does not explicitly incorporate information on dose-duration or dose-severity relationships. In other words, doses below the RfD, regardless of the duration of exposure, are of no substantial concern as long as the RfD is based on a sound set of data. The assumption that exposures above the RfD will result in adverse human health effects is not necessarily correct, particularly when the duration of exposure is substantially less than a lifetime. All exposure scenarios considered in this risk assessment are less than lifetime. Triclopyr rapidly dissipates or degrades, and high levels of exposure generally occur only over short periods. Workers may be exposed repeatedly during an application program in a particular season and may use triclopyr formulations over the course of a career but exposures at occupational levels will be intermittent and less than lifetime.

The most sensitive effect, and the effect on which the chronic RfD is based, involve kidney toxicity. All of the kidney effects noted in rats are based on histopathological changes or increased kidney weight. The effect and no effect levels based on changes in kidney weight in rats after chronic exposure are very similar to those for subchronic exposures.

The issue of species sensitivity is important in assessing the use of a 10-fold factor for species-to-species extrapolation, as used in the RfD for triclopyr. For many chemicals, differences in species sensitivity are apparent and generally indicate that small animals are less sensitive than large animals. Triclopyr does not follow this pattern: there is no apparent relationship between body weight and toxicity measured as acute oral LD_{50} values. The lack of consistent species differences in sensitivity suggests that U.S. EPA's use of an uncertainty factor of 10 for species-to-species extrapolation may be conservative. For assessing effects of exposures, an uncertainty factor of three will also be used as a range-bounding value.

Using data from acute studies on various species, including cattle and ponies, SERA (1996) concluded that taking an approach analogous to that for the RfD, 60 mg/kg might be taken as a conservative 1-day NOAEL. Dividing by 100, as is done with the RfD, yields the adjusted value of 0.6 mg/kg for a reference 1-day exposure that should not be associated with adverse effects. As with the RfD, a 3-fold higher value, 1.8 mg/kg, could be proposed based on a less conservative but still protective species extrapolation.

From SERA (1996), the AEL of 75 mg/kg, based on the data in cattle, yields a corresponding AEL range for humans of 0.75-2.25 mg/kg. This range of doses would not be associated with acute signs of toxicity but would be regarded as undesirable because adverse effects on the kidney might occur. The minimum dose associated with mortality in experimental mammals is 252 mg/kg in rabbits. After applying an uncertainty factor of 100, the estimated dose associated with concern for acute lethal effects in humans is 2.5 mg/kg, with an upper range of 7.5 mg/kg.

Dose-severity relationships used for triclopyr risk characterization.

Dose (mg/kg/day)	Plausible Effect
2.5 – 7.5	potentially lethal doses, especially at upper end of range, overt signs or symptoms of toxicity after acute exposures
0.75 to 2.25	with longer term exposure, probable effects on kidneys, offspring; acute exposures at upper end may also result in kidney effects, other clinical effects
0.05 to 0.75	nature and severity of toxic effects for chronic exposures are uncertain in general population; potential developmental effects in offspring of women
≤1.8	no effects anticipated with one-time exposures
≤0.05	no effects anticipated with chronic exposures.

TCP is of concern to the human health risk assessment both because it is a metabolite of triclopyr and because the aggregate risks of exposure to TCP from the breakdown of both triclopyr and chlorpyrifos must be considered. While the U.S. EPA has not derived a formal RfD for TCP, the RED on triclopyr (U.S. EPA 1998, p. 31) as well as the RED on chlorpyrifos (U.S. EPA 2001b, as referenced in SERA 2011b) use a chronic value of 0.03 mg/kg/day for the risk characterization for TCP. In the more recent pesticide tolerances for triclopyr (U.S. EPA 2002a), a somewhat lower value is used for the risk characterization of TCP: a dose of 0.012 mg TCP/kg/day derived using an uncertainty factor of 1000 and data from a chronic study in dogs in which changes in clinical chemistry at a dose of 48 mg/kg/day (LOAEL) but no effects at 12 mg/kg/day (NOAEL). For acute effects, the pesticide tolerances for triclopyr (U.S. EPA 2002a) use an acute value of 0.025 mg/kg/day based on a developmental toxicity study in rabbits with NOAEL of 25 mg/kg/day and a corresponding LOAEL of 100 mg/kg/day in which an increased incidence of hydrocephaly and dilated ventricles were noted in rabbits.

For both acute and chronic exposures the uncertainty factor for TCP is set at 1000. This value is comprised of the factors of 10 to account for uncertainties in species-to-species extrapolation and another factor of 10 to encompass sensitive individuals in the population as well as an additional factor of 10 for the potentially higher sensitivity of children – i.e., the FQPA uncertainty factor. For the current risk assessment, the values used for risk characterization are identical to the most recent and conservative values proposed by U.S. EPA: 0.025 mg/kg/day for acute exposures and 0.012 mg/kg/day for chronic exposures.

5.0 Risk Characterization

A quantitative summary of the risk characterization for workers associated with exposure to these herbicides is presented in Tables F-6a-1 to F-6g-1. The quantitative risk characterization is expressed as the hazard quotient, which is the ratio of the estimated exposure doses from Tables F-3a to F-3g to the RfD. The quantitative hazard characterization for the general public associated with exposure to these herbicides is summarized in Tables F-6a-2 to F-6h-2. Like the quantitative risk characterization for workers, the quantitative risk characterization for the general public is expressed as the hazard quotient, which again is the ratio of the estimated exposure doses from Tables F-5a to F-5g to the RfD. Based on this the level of concern is an HQ of 1 or greater.

As a standard for formatting, numbers .01 or greater are expressed in standard decimal notation and smaller numbers are expressed in scientific notations - e.g., 7 E-7 equivalent to 7×10-7 or 0.0000007.

The only reservation attached to this assessment is that associated with any risk assessment: Absolute safety cannot be proven and the absence of risk can never be demonstrated. No chemical has been studied for all possible effects and the use of data from laboratory animals to estimate hazard or the lack of hazard to humans is a process that contains uncertainty. Prudence dictates that normal and reasonable care should be taken in the handling of these herbicides.

5.1 Aminopyralid

Workers – The hazard quotients for acute exposure are based on an acute oral RfD of 1.0 mg/kg/day and the hazard quotients for chronic exposures are based on a chronic RfD of 0.5 mg/kg/day. For workers, no exposure scenarios, acute or chronic, exceeds the RfD at the upper bound of the estimated dose associated with the highest anticipated application rate of 0.11lb a.e./acre, or the maximum label application rate of 0.22lb a.e./acre. The hazard quotients for directed ground spray are below the level of concern by a factor of at least 50 over the range of application rates considered in this risk assessment.

Given the very low hazard quotients for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios approach a level of concern.

General Public – As with the corresponding worksheet for workers, the hazard quotients for acute exposure are based on an acute oral RfD of 1.0 mg/kg/day and the hazard quotients for chronic exposures are based on a chronic RfD of 0.5 mg/kg/day.

For the general public, no exposure scenarios, acute or chronic, exceeds the RfD at the upper bound of the estimated dose associated with the highest anticipated application rate of 0.11lb a.e./acre. None of the exposure scenarios approach a level of concern.

None of the hazard quotients associated with acute/accidental exposure scenarios exceed the level of concern even that the upper bounds of the hazard quotients at the maximum application rate. Exposure resulting from the consumption of contaminated vegetation is of greatest concern. This exposure scenario has a hazard quotient of 0.15, at the upper level, which is well below the level of concern. Exposure as the result of consuming water contaminated from a spill is 0.22 for a child, however this is a very unlikely scenario and still below the level of concern. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially.

None of the longer-term exposure scenarios approach a level of concern. Although there are several uncertainties in the longer-term exposure assessments for the general public, the upper limits for hazard quotients are sufficiently far below a level of concern that the risk characterization is relatively unambiguous: based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that the general public will be at any substantial risk from longer-term exposure to aminopyralid.

The risk characterization given in this risk assessment is qualitatively similar to that given by the U.S. EPA: no risks to workers or members of the general public are anticipated. The current risk assessment derives somewhat higher hazard quotients than those in the U.S. EPA human health risk assessment because the current risk assessment uses a number of extreme exposure scenarios that are not used by the U.S. EPA.

Table F-6a-1: Summary of Risk Characterization for Workers – Aminopyralid

Risk Characterization for Workers at Highest Anticipated Application Rate				
Chemical: Aminopyralid Chronic RfD = 0.5 mg/kg/day Acute RfD = 1.0 mg/kg	**Application Rate**		0.11	lbs a.e./ac
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Accidental/Incidental Exposures (dose in mg/kg/event)				
Contaminated Gloves, 1 min.	Worker	4.9E-08	5.9E-09	2.0E-06
Contaminated Gloves, 1 hour	Worker	2.9E-06	3.5E-07	1.2E-04
Spill on Hands, 1 hour	Worker	1.1E-05	1.1E-06	6.2E-04
Spill on lower legs, 1 hour	Worker	2.8E-05	2.6E-06	1.5E-03
General Exposures (dose in mg/kg/day)				
General exposure	Backpack	2.9E-03	9.9E-05	0.02
General exposure	Ground Spray	4.9E-03	1.5E-04	0.03

Table F-6a-2: Summary of Risk Characterization for the Public – Aminopyralid

Risk Characterization for General Public at Highest Anticipated Application Rate				
Chemical: Aminopyralid Chronic RfD = 0.45 mg/kg/day Acute RfD = 0.1 mg/kg		**Application Rate**	0.11	lbs a.e./acre
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	4.34E-04	4.04E-05	0.02
Direct Spray of Woman, feet and lower legs	Adult Female	4.36E-05	4.06E-06	2.34E-03
Vegetation Contact, shorts and T-shirt	Adult Female	1.04E-04	1.95E-05	5.47E-04
Contaminated Fruit	Adult Female	1.29E-03	1.29E-03	0.02
Contaminated Vegetation	Adult Female	0.02	3.71E-03	0.15
Water consumption, accidental spill	Child	0.02	4.51E-03	0.22
Water consumption, ambient	Child	8.27E-04	1.01E-05	7.44E-03
Swimming, ambient	Adult Female	2.73E-06	1.31E-08	6.83E-05
Fish consumption, accidental spill	Adult Male	4.44E-04	2.22E-04	4.44E-03
Fish consumption, accidental spill	Subsistence Populations	2.17E-03	1.08E-03	0.02
Chronic/Longer Term Exposures (dose in mg/kg/day)				
Contaminate Fruit	Adult Female	5.50E-04	4.34E-04	0.01
Contaminate Vegetation	Adult Female	7.58E-03	1.25E-03	0.08
Water consumption	Adult Male	2.51E-04	4.40E-06	1.96E-03
Fish consumption	Adult Male	1.26E-06	3.14E-08	8.17E-06
Fish consumption	Subsistence Populations	1.02E-05	2.55E-07	6.62E-05

5.2 Chlorsulfuron

Workers -The toxicity data on chlorsulfuron allows for separate dose-response assessments for acute and chronic exposures. For acute exposures, the hazard quotients are based on U.S. EPA's recommended acute RfD of 0.25 mg/kg/day. For chronic exposures, the hazard quotients are based on the proposed chronic RfD from U.S. EPA of 0.02 mg/kg/day.

Given the very low hazard quotients for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios approach a level of concern.

While the accidental exposure scenarios are not the most severe one might imagine, they are representative of reasonable accidental exposures. Given that the highest hazard quotient for any of the accidental exposures is a factor of about 2,000 below the level of concern, more severe and less plausible scenarios would be required to suggest a potential for systemic toxic effects.

The hazard quotients for general occupational exposure scenarios are somewhat higher than those for the accidental exposure scenarios. The upper limit of the hazard quotients (HQ=0.92) approach the level of concern - i..e., a hazard quotient of 1. However, as previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. The simple verbal interpretation of this quantitative characterization of risk is that even under the most conservative set of exposure assumptions, workers would not be exposed to levels of chlorsulfuron that are regarded as unacceptable. Under typical application conditions, levels of exposure will be far below levels of concern.

Mild irritation to the skin and eyes can result from exposure to relatively high levels of chlorsulfuron- i.e., placement of chlorsulfuron directly onto the eye or skin. From a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling chlorsulfuron. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of the compound.

General Public – As with the corresponding worksheet for workers, the hazard quotients for acute exposure are based on an acute oral RfD of 0.25 mg/kg/day and the hazard quotients for chronic exposures are based on a proposed chronic RfD of 0.02 mg/kg/day.

None of the acute scenarios exceed a level of concern. The consumption of contaminated vegetation has a hazard quotient of 0.7, at the upper level. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially.

The longer-term consumption of contaminated vegetation after application of the highest dose yields a hazard quotient that is greater than unity (HQ= 3.5) at the highest dose. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. This is a common pattern with herbicides or any pesticide applied directly to plants. The scenario for the longer-term consumption of contaminated vegetation is also an extremely conservative assumption in that most plants treated with an herbicide at the highest application rate would show some signs of damage and humans would not be likely to consume the plant over a prolonged period of time.

Table F-6b-1: Summary of Risk Characterization for Workers – Chlorsulfuron

Risk Characterization for Workers at Highest Anticipated Application Rate				
Chemical: Chlorsulfuron Chronic RfD = 0.02 mg/kg/day Acute RfD = 0.25 mg/kg	**Application Rate**		0.122	lbs a.e./ac
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Accidental/Incidental Exposures (dose in mg/kg/event)				
Contaminated Gloves, 1 min.	Worker	7.7E-07	3.1E-08	4.0E-06
Contaminated Gloves, 1 hour	Worker	4.6E-05	1.9E-06	2.4E-04
Spill on Hands, 1 hour	Worker	2.9E-05	6.6E-07	2.5E-04
Spill on lower legs, 1 hour	Worker	7.2E-05	1.6E-06	6.2E-04
General Exposures (dose in mg/kg/day)				
General exposure	Backpack	0.08	2.7E-03	0.49
General exposure	Ground Spray	0.14	4.0E-03	0.92

Table F-6b-2: Summary of Risk Characterization for the Public – Chlorsulfuron

Risk Characterization for General Public at Highest Anticipated Application Rate				
Chemical: Chlorsulfuron Chronic RfD = 0.02 mg/kg/day Acute RfD = 0.25 mg/kg		**Application Rate**	0.122	lbs a.e./acre
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	1.1E-03	2.5E-05	9.5E-03
Direct Spray of Woman, feet and lower legs	Adult Female	1.1E-04	2.5E-06	9.6E-04
Vegetation Contact, shorts and T-shirt	Adult Female	1.8E-04	3.6E-05	9.1E-04
Contaminated Fruit	Adult Female	5.7E-03	5.7E-03	0.09
Contaminated Vegetation	Adult Female	0.08	0.02	0.66
Water consumption, accidental spill	Child	0.10	6.8E-03	0.25
Water consumption, ambient	Child	3.7E-03	2.2E-04	0.01
Fish consumption, accidental spill	Adult Male	2.9E-03	3.3E-04	5.0E-03
Fish consumption, accidental spill	Subsistence	0.01	1.6E-03	0.02
Chronic/Longer Term Exposures (dose in mg/kg/day)				
Contaminate Fruit	Adult Female	0.03	0.03	0.48
Contaminated Vegetation	Adult Female	0.42	0.09	**3.47**
Water consumption	Adult Male	1.0E-04	1.2E-05	1.9E-04
Fish consumption	Adult Male	7.8E-07	1.3E-07	1.2E-06
Fish consumption	Subsistence Populations	6.4E-06	1.1E-06	9.5E-06

5.3 Glyphosate

Workers - Given the low hazard quotients for both general occupational exposures as well as accidental exposures, the risk characterization for workers is unambiguous. None of the exposure scenarios exceed a level of concern.

While the accidental exposure scenarios are not the most severe one might imagine, they are representative of reasonable accidental exposures. Given that the highest hazard quotient for any of the accidental exposures is a factor of about 100 below the level of concern, more severe and less plausible scenarios would be required to suggest a potential for systemic toxic effects. The hazard quotients for these acute occupational exposures are based on a chronic RfD. This adds an additional level of conservatism and, given the very low hazard quotients for these scenarios, reinforces the conclusion that there is no basis for asserting that systemic toxic effects are plausible.

The hazard quotients for general occupational exposure scenarios are somewhat higher than those for the accidental exposure scenarios. Nonetheless, the upper limit of the hazard quotients are below the level of concern - i.e., a hazard index of 1. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. The simple verbal interpretation of this quantitative characterization of risk is that even under the most conservative set of exposure assumptions, workers would not be exposed to levels of glyphosate that are regarded as unacceptable.

Glyphosate and glyphosate formulations are skin and eye irritants. Quantitative risk assessments for irritation are not normally derived, and, for glyphosate specifically, there is no indication that such a derivation is warranted. As discussed in SERA 2003, glyphosate with the POEA surfactant, is about as irritating as standard dishwashing detergents, all purpose cleaners, and baby shampoos.

General Public - None of the longer-term exposure scenarios approach a level of concern. Although there are several uncertainties in the longer-term exposure assessments for the general public, the upper limits for hazard quotients are sufficiently far below a level of concern that the risk characterization is relatively unambiguous: based on the available information and under the foreseeable conditions of application, there is no route of exposure or scenario suggesting that the general public will be at any substantial risk from longer-term exposure to glyphosate.

For the acute scenarios, the consumption of contaminated vegetation after application of the highest dose yields a hazard quotient that is greater than unity (HQ= 2) at the highest dose. At typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. In addition, signs at likely access points informing the public that an area has been sprayed would reduce the potential that freshly sprayed material would be consumed.

The other highest hazard quotient for these other acute exposure scenarios is 5.1, from the consumption of contaminated water by a child after an accidental spill of 200 gallons of a field solution of glyphosate. It is important to realize that the exposure scenarios involving contaminated water are arbitrary scenarios: scenarios that are more or less severe, all of which may be equally probable or improbable, easily could be constructed. All of the specific assumptions used to develop this scenario have a simple linear relationship to the resulting hazard quotient. Thus, if the accidental spill were to involve 20 rather than 200 gallons of a field solution of glyphosate, all of the hazard quotients would be a factor of 10 less. A further conservative aspect to the water contamination scenario is that it represents standing water, with no dilution or decomposition of the herbicide. This scenario would require a child to drink 1.5 liters of contaminated water from a non-potable standing water source. Nonetheless, this and other acute scenarios help to identify the types of scenarios that are of greatest concern and may warrant the greatest steps to mitigate. For glyphosate, such scenarios involve oral (contaminated water and vegetation) rather than dermal (spills or accidental spray) exposure.

Table F-6c-1: Summary of Risk Characterization for Workers – Glyphosate

Risk Characterization for Workers at Highest Anticipated Application Rate				
Chemical: Glyphosate RfD = 2.0 mg/kg	**Application Rate**		3	lbs a.e./ac
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Accidental/Incidental Exposures (dose in mg/kg/event)				
Contaminated Gloves, 1 min.	Worker	5.4E-06	5.2E-07	4.5E-05
Contaminated Gloves, 1 hour	Worker	3.2E-04	3.1E-05	2.7E-03
Spill on Hands, 1 hour	Worker	7.1E-04	8.7E-05	3.5E-03
Spill on lower legs, 1 hour	Worker	1.7E-03	2.2E-04	8.5E-03
General Exposures (dose in mg/kg/day)				
General exposure	Backpack	.02	6.8E-04	0.12
General exposure	Broadcast Spray	0.03	9.9E-04	0.23

Table F-6c-2: Summary of Risk Characterization for the Public – Glyphosate (Broadcast)

Risk Characterization for General Public at Highest Anticipated Application Rate				
Chemical: Glyphosate RfD = 2.0 mg/kg Application Method: Broadcast Spray		**Application Rate**	3	lbs a.e./acre
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Accidental Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	0.01	1.7E-03	0.22
Direct Spray of Woman, feet and lower legs	Adult Female	1.0E-03	1.7E-04	0.02
Water consumption, accidental spill	Child	0.20	0.01	**5.12**
Fish consumption, accidental spill	Adult Male	2.3E-03	2.3E-04	0.04
Fish consumption, accidental spill	Subsistence Populations	0.01	1.1E-03	0.19
Non-Accidental Acute Exposures and Chronic/Longer Term Exposures values same as backpack sprayer application method (see Table F-6c-3).				

Table F-6c-3: Summary of Risk Characterization for the Public – Glyphosate (Backpack Sprayer)

Risk Characterization for General Public at Highest Anticipated Application Rate				
Chemical: Glyphosate RfD = 2.0 mg/kg Application Method: Backpack Sprayer		**Application Rate**	3	lbs a.e./acre
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Accidental Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	0.03	3.3E-03	0.13
Direct Spray of Woman, feet and lower legs	Adult Female	2.7E-03	3.3E-04	0.01
Water consumption, accidental spill	Child	0.51	0.02	**3.07**
Fish consumption, accidental spill	Adult Male	5.8E-03	4.5E-04	0.02
Fish consumption, accidental spill	Subsistence Populations	0.03	2.2E-03	0.11
Non-Accidental Acute Exposures (dose in mg/kg/event)				
Vegetation Contact, shorts and T-shirt	Adult Female	1.7E-03	5.4E-04	4.1E-03
Contaminated Fruit	Adult Female	0.02	8.1E-03	0.28
Contaminated Vegetation	Adult Female	0.24	0.02	**2.03**
Swimming, one hour	Adult Female	6.5E-09	1.9E-10	2.1E-07
Water consumption	Child	1.2E-03	8.9E-05	0.01
Fish Consumption	Adult Female	1.4E-05	1.7E-06	1.1E-04
Fish consumption	Subsistence Populations	6.9E-05	8.2E-06	5.2E-04
Chronic/Longer Term Exposures (dose in mg/kg/day)				
Contaminate Fruit	Adult Female	2.8E-03	1.3E-03	0.04
Contaminate Vegetation	Adult Female	0.04	2.7E-03	0.32
Water consumption	Adult Male	8.1E-06	2.6E-06	3.0E-04
Fish consumption	Adult Male	1.5E-08	7.2E-09	4.7E-07
Fish consumption	Subsistence Populations	1.3E-07	5.8E-08	3.8E-06

5.4 Imazamox

Workers – The risk characterization for workers is simple and unambiguous: there is no basis for asserting that workers are likely to be at risk in applications of imazamox. The highest HQ for general exposures—i.e., exposure levels anticipated in the normal use of imazamox—is 0.004. If the RfD of 3 mg/kg bw/day is taken as the level of concern, this HQ is below the level of concern by a factor of over 250. The highest accidental HQ is 0.3, the upper bound of the HQ for a worker involved in aquatic applications wearing contaminated gloves for 1 hour.

General Public - The risk characterization for members of the general public is essentially identical to the risk characterization for workers: there is no basis for asserting that members of the general public are likely to be at risk due to applications of imazamox. Based on the RfD of 3 mg/kg bw/day, the highest HQs are those associated with an accidental spill of imazamox into a small pond and the subsequent consumption of contaminated water by a small child. For this exposure scenario the HQ is 0.2 (0.05 to 0.8) for aquatic applications. For most pesticides, HQs in the range of 0.3 to 0.8 might be characterized as “approaching a level of concern”. This is not the case for imazamox. As discussed in the dose-response assessment, the dose of imazamox that might actually pose a risk to humans has not been determined. The RfD of 3 mg/kg bw/day may be regarded as a dose that will not lead to adverse effects in humans; however, the same may be said for higher doses of imazamox. The RfD of 3 mg/kg bw/day is used as a convenience to quantitatively illustrate that the use of imazamox is not likely to pose any identifiable risk to humans.

Table F-6d-1: Summary of Risk Characterization for Workers – Imazamox

Risk Characterization for Workers at Highest Anticipated Application Rate				
Chemical: Imazamox RfD = 3 mg/kg	**Application Rate**		0.5	ppm
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Accidental/Incidental Exposures (dose in mg/kg/event)				
Contaminated Gloves, 1 min.	Worker	2.7E-03	1.6E-03	4.5E-03
Contaminated Gloves, 1 hour	Worker	0.16	0.10	0.27
Spill on Hands, 1 hour	Worker	0.01	5.0E-03	0.03
Spill on lower legs, 1 hour	Worker	0.03	0.01	0.07
General Exposures (dose in mg/kg/day)				
General exposure	Worker	2.0E-03	8.8E-04	4.4E-03

Table F-6d-2: Summary of Risk Characterization for the Public – Imazamox

Risk Characterization for General Public at Maximum Application Rate				
Chemical: Imazamox RfD = 3 mg/kg		**Application Rate**	0.5	ppm
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Accidental Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	No exposure assessment.		
Direct Spray of Woman, feet and lower legs	Adult Female	No exposure assessment.		
Water consumption, accidental spill	Child	0.23	0.05	0.77
Fish consumption, accidental spill	Adult Male	6.8E-04	2.3E-04	1.5E-03
Fish consumption, accidental spill	Subsistence Populations	3.3E-03	1.1E-03	7.5E-03
Non-Accidental Acute Exposures (dose in mg/kg/event)				
Vegetation Contact, shorts and T-shirt	Adult Female	No exposure assessment.		
Contaminated Fruit	Adult Female	No exposure assessment.		
Contaminated Vegetation	Adult Female	No exposure assessment.		
Swimming, one hour	Adult Female	1.5E-05	8.8E-06	2.5E-05
Water consumption	Child	0.01	7.6E-03	0.02
Fish Consumption	Adult Female	3.8E-05	3.8E-05	3.8E-05
Fish consumption	Subsistence Populations	1.8E-04	1.8E-04	1.8E-04
Chronic/Longer Term Exposures (dose in mg/kg/day)				
Contaminate Fruit	Adult Female	No exposure assessment.		
Contaminate Vegetation	Adult Female	No exposure assessment.		
Water consumption	Adult Male	3.4E-03	2.4E-03	4.1E-03
Fish consumption	Adult Male	1.7E-06	1.7E-06	1.7E-06
Fish consumption	Subsistence Populations	1.4E-05	1.4E-05	1.4E-05

5.5 Imazapyr

Workers - The risk characterization for workers is simple and unambiguous: there is no basis for asserting that workers are likely to be at risk in applications of imazapyr. The highest HQ for general exposures—i.e., exposure levels anticipated in the normal use of imazapyr —is 0.06, the upper bound of the HQ for workers involved in ground broadcast applications of imazapyr. If the RfD of 2.5 mg/kg bw/day (HQ=1) is taken as the level of concern, this HQ is associated with a dose which is below the level of concern by a factor of about 17. The highest accidental HQ is 0.01, the upper bound of the HQ for a worker wearing contaminated gloves for 1 hour.

Risks are explicitly characterized only for workers involved in ground or aerial broadcast applications or direct applications to water. Other application methods, including various forms of cut surface and basal bark treatments may be used for control of some species. Exposure assessments for workers involved in these types of treatments have not been developed, because adequate worker exposure studies are not available. The highest documented worker exposure rates are associated with directed foliar applications. On Beale AFB, considering cut surface and basal bark treatments, it may be reasonable to use worker exposure rates for directed foliar applications with the amount of imazapyr that will be handled to approximate worker exposures.

Some cut surface applications may involve handling highly concentrated solutions of imazapyr (i.e., up to about 480 mg a.e./L), which are more concentrated than imazapyr solutions used in foliar applications (24 mg a.e./L) by a factor of about 20. As noted above, the highest HQ for workers involved in foliar or aquatic applications is 0.01 associated with wearing contaminated gloves for 1 hour. If a worker involved in hack and squirt applications were to apply a 480 mg a.e./L solution of imazapyr and wear contaminated gloves for 1 hour, the corresponding HQ would be about 0.2, below the level of concern by a factor of 5. Because the exposure period is directly proportional to the HQ, the HQ for gloves contaminated by a 480 mg a.e./L solution of imazapyr would reach a level of concern (HQ=1) at 5 hours. However extreme this exposure scenario may seem; it would seem prudent to caution workers who use highly concentrated solutions of imazapyr to exercise particular caution to prevent prolonged skin contact with the concentrated solutions.

Some formulations of imazapyr may cause eye irritation. From a practical perspective, mild to moderate eye irritation is likely to be the only overt effect as a consequence of mishandling imazapyr. This effect can be minimized or avoided by prudent industrial hygiene practices, including exercising care to reduce splashing and wearing goggles, while handling concentrated solutions of imazapyr. As with skin contact, the risks of eye irritation would probably be greatest for workers handling very concentrated solutions of imazapyr during cut surface applications.

General Public - As with the quantitative risk characterization for workers, the quantitative risk characterization for the general public is expressed as the hazard quotient 34 using the chronic RfD of 2.5 mg/kg/day for both acute and longer-term exposures.

The risk characterization for members of the general public is essentially identical to the risk characterization for workers: there is no basis for asserting that members of the general public are likely to be at risk due to applications of imazapyr. Based on the RfD of 2.5 mg/kg bw/day, the highest HQs are those associated with an accidental spill of imazapyr into a small pond and the subsequent consumption of contaminated water by a small child. For this exposure scenario the highest HQs is 0.8 for both terrestrial and aquatic applications. For imazapyr as well as most other chemicals, a large spill into a small body of water should lead to steps to prevent the consumption of the contaminated water. Nonetheless, the current risk assessment suggests that only very severe accidental spills would approach a level of concern. As discussed in the dose-response assessment, the dose of imazapyr that might actually pose a risk to humans has not been determined. The RfD of 2.5 2 mg/kg bw/day may be regarded as a dose that will not lead to adverse effects in humans; however, the same may be said for higher doses of imazapyr. The

RfD of 2.5 mg/kg bw/day is used as a convenience to quantitatively illustrate that the use of imazapyr is not likely to pose any identifiable risk to humans.

The highest HQ for members of the general public associated with expected (i.e., non-accidental) exposure scenarios is 0.5, the upper bound of the acute HQ for the consumption of contaminated vegetation. For any pesticide applied directly to vegetation, this is an extraordinarily conservative exposure scenario which typically leads to HQs that exceed the level of concern. For imazapyr, no risks can be identified.

Each of the HQs summarized in Tables F-6e-1 and F-6e-2 involves a single exposure scenario. In some cases, individuals could be exposed by more than one route. In such cases risks can be approximated simply by adding the HQs for different exposure scenarios. For imazapyr, consideration of multiple exposure scenarios has little impact on the risk assessment. For example, based on the upper bounds of HQs for being directly sprayed on the lower legs (HQ=0.01), staying in contact with contaminated vegetation for 1 hour (HQ=0.003), eating contaminated vegetation (HQ=0.5), drinking contaminated surface water (HQ=0.01), and consuming contaminated fish at rates characteristic of subsistence populations (HQ=0.0006) leads to a combined HQ of 0.53 [0.01 + 0.003 + 0.5 + 0.01 + 0.006]. In other words, for imazapyr, the predominant route of exposure will involve the consumption of contaminated vegetation. This pattern is also apparent in most pesticide risk assessments involving foliar applications.

Table F-6e-1: Summary of Risk Characterization for Workers – Imazapyr

Risk Characterization for Workers at Highest Anticipated Application Rate				
Chemical: Imazapyr RfD = 2.5 mg/kg bw	**Application Rate**		1	lbs a.e./ac
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Accidental/Incidental Exposures (dose in mg/kg/event)				
Contaminated Gloves, 1 min.	Worker	2.7E-05	2.7E-06	2.1E-04
Contaminated Gloves, 1 hour	Worker	1.6E-03	1.6E-04	1.3E-02
Spill on Hands, 1 hour	Worker	2.5E-04	2.0E-05	2.7E-03
Spill on lower legs, 1 hour	Worker	6.2E-04	5.0E-05	6.6E-03
General Exposures (dose in mg/kg/day)				
General exposure	Backpack	5.3E-03	1.8E-04	0.03
General exposure	Ground Spray	9.0E-03	2.6E-04	0.06

Table F-6e-2: Summary of Risk Characterization for the Public – Imazapyr

Risk Characterization for General Public at Highest Anticipated Application Rate				
Chemical: Imazapyr RfD = 2.5 mg/kg bw		**Application Rate**	1	lbs a.e./acre
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Accidental Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	9.6E-03	7.7E-04	0.10
Direct Spray of Woman, feet and lower legs	Adult Female	9.6E-04	7.7E-05	0.01
Water consumption, accidental spill	Child	0.07	1.7E-03	0.82
Fish consumption, accidental spill	Adult Male	1.0E-03	4.1E-05	8.2E-03
Fish consumption, accidental spill	Subsistence	5.0E-03	2.0E-04	0.04
Non-Accidental Acute Exposures (dose in mg/kg/event)				
Vegetation Contact, shorts and T-shirt	Adult Female	1.1E-03	4.4E-04	2.8E-03
Contaminated Fruit	Adult Female	4.7E-03	2.2E-03	0.07
Contaminated Vegetation	Adult Female	0.06	4.5E-03	0.54
Swimming, one hour	Adult Female	1.2E-07	2.7E-11	3.0E-06
Water consumption	Child	6.0E-04	1.7E-07	0.01
Fish Consumption	Adult Female	9.0E-06	4.1E-09	1.2E-04
Fish consumption	Subsistence	4.4E-05	2.0E-08	5.7E-04
Chronic/Longer Term Exposures (dose in mg/kg/day)				
Contaminate Fruit	Adult Female	2.0E-03	5.1E-04	0.04
Contaminate Vegetation	Adult Female	0.03	1.1E-03	0.26
Water consumption	Adult Male	8.0E-05	2.4E-08	1.6E-03
Fish consumption	Adult Male	2.0E-07	8.6E-11	3.4E-06
Fish consumption	Subsistence	1.6E-06	6.9E-10	2.8E-05

5.6 Sulfometuron Methyl

Workers - No exposure scenarios, acute or chronic, exceeds the RfD at the upper bound of the estimated dose associated with the highest anticipated application rate of 0.199 lb a.i./acre. At this application rate the highest HQ is associated with general exposure at the upper limits of broadcast spraying (HQ of 0.11), well below the threshold of concern. The highest hazard quotient for the upper ranges for general exposure associated with the maximum application rate of 0.281 lb a.i./acre, is still only 0.2. These upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions are modified (e.g., the compound is applied at the typical rather than the maximum application rate) the hazard indices would be less. Given the conservative nature of the RfD itself, it is unlikely that there would be any signs of toxicity in workers applying sulfometuron methyl.

While the accidental exposure scenarios are not the most severe one might imagine (e.g., complete immersion of the worker or contamination of the entire body surface for a prolonged period of time) they are representative of reasonable accidental exposures. None of these hazard quotients approach a level of concern at the upper ranges, even when considering the level of concern associated with an application rate of 0.281 lbs a.i./acre. The simple verbal interpretation of this quantitative characterization of risk is that under the most protective set of exposure assumptions, workers would not be exposed to levels of sulfometuron methyl that are regarded as unacceptable so long as reasonable and prudent handling practices are followed.

Irritation and damage to the skin and eyes can result from exposure to relatively high levels of sulfometuron methyl. From a practical perspective, eye or skin irritation is likely to be the only overt effect as a consequence of mishandling sulfometuron methyl. These effects can be minimized or avoided by prudent industrial hygiene practices during the handling of sulfometuron methyl.

General Public - For members of the general public, two exposure scenarios result in a hazard quotient greater than 1 at the upper bounds at the application rates of 0.199 lb a.i./acre and 0.281 lb a.i./acre: the consumption by a child of contaminated water from a small pond immediately after an accidental spill (HQ = 1.5/2), and consumption of contaminated vegetation by an adult female (HQ = 1/1.4). As discussed previously, these are extremely conservative estimates and often unlikely scenarios. The contaminated water scenario would require a child to drink 1.5 liters of contaminated water from a non-potable standing water source. Sulfometuron methyl will not be applied to any desirable forage plants, so vegetation consumption is unlikely. The vegetation consumption scenario does not consider the effects of washing contaminated vegetation in reducing doses. In addition, signs at likely access points informing the public that an area has been sprayed would reduce the potential that freshly sprayed material would be consumed.

For chronic exposure, all upper limits are below the level of concern for the maximum application rate of 0.281 lb a.i./acres. This means that under most conditions, sulfometuron methyl does not pose a significant risk to the public, and risks can be further reduced by following best management practices.

Table F-6f-1: Summary of Risk Characterization for Workers – Sulfometuron Methyl

Risk Characterization for Workers at Highest Anticipated Application Rate				
Chemical: Sulfometuron Methyl Chronic RfD = 0.275 mg/kg Acute RfD = 0.275 mg/kg	**Application Rate**		.199	lbs a.e./ac
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Accidental/Incidental Exposures (dose in mg/kg/event)				
Contaminated Gloves, 1 min.	Worker	5.9E-06	8.7E-07	4.5E-05
Contaminated Gloves, 1 hour	Worker	3.6E-04	5.2E-05	2.7E-03
Spill on Hands, 1 hour	Worker	1.2E-04	1.0E-05	1.6E-03
Spill on lower legs, 1 hour	Worker	3.0E-04	2.5E-05	4.0E-03
General Exposures (dose in mg/kg/day)				
General exposure	Backpack	9.5E-03	3.3E-04	0.06
General exposure	Ground Spray	0.02	4.8E-04	0.11

Table F-6f-2: Summary of Risk Characterization for the Public – Sulfometuron Methyl

Risk Characterization for General Public at Highest Anticipated Application Rate				
Chemical: Sulfometuron Methyl Chronic RfD = 0.275 mg/kg Acute RfD = 0.275 mg/kg		**Application Rate**	.199	lbs a.e./acre
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	4.6E-03	3.8E-04	0.06
Direct Spray of Woman, feet and lower legs	Adult Female	4.7E-04	3.8E-05	6.2E-03
Vegetation Contact, shorts and T-shirt	Adult Female	3.5E-04	7.6E-05	1.5E-03
Contaminated Fruit	Adult Female	8.5E-03	8.5E-03	0.14
Contaminated Vegetation	Adult Female	0.12	2E-02	**1.0**
Water consumption, accidental spill	Child	0.33	8E-02	**1.5**
Water consumption, ambient	Child	5E-05	2E-06	2E-03
Fish consumption, accidental spill	Adult Male	0.03	0.01	0.09
Fish consumption, accidental spill	Subsistence Populations	0.15	0.05	0.44
Chronic/Longer Term Exposures (dose in mg/kg/day)				
Contaminated Fruit	Adult Female	1.4E-03	1.4E-03	0.02
Contaminated Vegetation	Adult Female	0.02	3.9E-03	0.2
Water consumption	Adult Male	8.3E-07	1.4E-07	1.7E-06
Fish consumption	Adult Male	1.4E-08	3.6E-09	2.5E-08
Fish consumption	Subsistence Populations	1.2E-07	2.9E-08	2.1E-07

5.7 Triclopyr

Workers – The toxicity data on triclopyr TEA allows for separate dose-response assessments for acute and chronic exposures. For acute exposures, the hazard quotients are based on an acute NOAEL of 100 mg/kg/day from a gestational study in rats resulting in a provisional acute RfD of 1 mg/kg/day. For women of childbearing age, the acute RfD is based on the reproductive study resulting in the NOAEL of 5 mg/kg/day - the basis for the chronic RfD. For chronic exposures, the hazard quotients are based on the provisional chronic RfD from U.S. EPA of 0.05 mg/kg/day.

None of the general occupational exposure scenarios, acute or chronic, exceed the RfD at the upper bound of the estimated dose associated with the highest application rate. The highest hazard quotient at the upper exposure level, approaches, but does not exceed the level of concern. Nonetheless, the upper limit of the hazard quotients (HQ = 0.9) is below the level of concern - i..e., a hazard quotient of 1. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. The simple verbal interpretation of this quantitative characterization of risk is that even under the most conservative set of exposure assumptions, workers would not be exposed to levels of triclopyr TEA that are regarded as unacceptable. Under typical application conditions, levels of exposure will be well below levels of concern.

None of the accidental scenarios for workers, involving triclopyr TEA exceed a level of concern based on the acute RfD of 1 mg/kg/day. However, this acute RfD is not applied to women of childbearing age and the chronic RfD of 0.05 mg/kg/day is used. Thus, for female workers, the level of concern would be 0.05 rather than unity. Even with this more conservative criterion, none of the hazard quotients for accidental scenarios for triclopyr TEA formulations exceed a level of concern.

As described above, ocular exposure to the triclopyr TEA formulations is characterized in MSDS' variously as Irreversible/C, Corrosive/Irreversible, or simply Corrosive. The Garlon 3A label carries a Danger signal word for eye effects, among other effects. The potential for eye irritation associated with handling triclopyr TEA formulations is clear. While eye irritation is not treated quantitatively in the current risk assessment, eye irritation is a clear concern for occupational exposures.

General Public – As with the corresponding worksheet for workers, the hazard quotients for acute exposure are based on acute RfD of 1.0 mg/kg/day and the hazard quotients for chronic exposures are based on the chronic RfD from U.S. EPA of 0.05 mg/kg/day. For women of childbearing age, the acute RfD is 0.05 mg/kg/day.

Several acute/accidental scenarios lead to hazard quotients that are above the level of concern. The consumption of contaminated fruit exceeds the level of concern at the upper level of exposure (HQ = 6), while the consumption of contaminated vegetation exceeds the level of concern at the central (HQ = 5) and upper estimate of exposure (HQ = 41). None of the other acute/accidental scenarios led to hazard quotients that are above the level of concern. These findings suggest that in the event that someone consumed broadleaf vegetation sprayed with triclopyr from the Forest, or from a vegetable garden that had been sprayed with triclopyr, adult females who consume the vegetation could be at risk. At the typical level of exposure, the consumption of contaminated vegetation could lead to acute exposures where the nature and severity of effects are uncertain. At the upper level of exposure, the consumption of contaminated vegetation could lead to a one-time dose of 2.0 mg/kg which could result in overt signs or symptoms of toxicity after acute exposures. The plausibility of this scenario is limited by several important factors. First, most areas proposed for treatment with triclopyr are well removed from private residences, and hence, vegetable gardens. Secondly, unless the triclopyr contamination were to occur immediately before picking, it is plausible that the accidental contamination would kill the plants or diminish their capacity to yield consumable vegetation. Thirdly, this scenario is extremely conservative in that it does not consider the effects of washing contaminated vegetation in reducing doses. Finally, signs at likely access points informing the public that an area has been sprayed would reduce the potential that freshly sprayed material would be consumed.

Similarly, adult females who consume contaminated fruit could be exposed triclopyr residues. At the upper level of exposure, the consumption of contaminated fruit could lead to acute exposures where the nature and severity of effects are uncertain (a one-time dose of 0.28 mg/kg). At the typical and lower levels of exposure, this scenario yields hazard quotients below a level of concern. This scenario is conservative in that it does not consider the effects of washing contaminated fruit in reducing doses and unless the triclopyr contamination were to occur immediately before picking, it is plausible that the accidental contamination would kill the plants or diminish their capacity to yield consumable vegetation. In addition, signs at likely access points informing the public that an area has been sprayed and the presence of dye on vegetation would reduce the potential that freshly sprayed material would be consumed.

The same longer-term exposure scenarios (consumption of contaminated fruit and vegetation) exceed a level of concern (HQ of 4 and 10, respectively) at the upper levels of exposure. None of the other longer-term scenarios lead to hazard quotients that are above the level of concern. As previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. This is a standard scenario used in Forest Service risk assessments and is extremely conservative – i.e., it assumes that vegetation or fruit that has been directly sprayed is harvested and consumed for a prolonged period of time. In addition, this scenario does not consider the effects of washing contaminated vegetation or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term.

TCP- Similar to triclopyr TEA, scenarios of concern involving exposures to 3,5,6-trichloro-2-pyridinol (TCP) are also limited to the consumption of contaminated vegetation. The upper bound of the acute exposure scenario for the consumption of contaminated vegetation by a young woman is 15, lower than corresponding upper bounds for general exposures in workers applying triclopyr TEA, based on chronic RfD.

Potential exposures to TCP also exceed the level of concern at the upper bound of the HQs for both the acute and longer-term consumption of contaminated vegetation and fruit. For TCP, the upper bound of HQs for acute exposures is less than the upper bound of the HQs for longer-term exposures. For the central estimates and the lower bounds, the opposite pattern is apparent. While this may seem incongruous, the calculations are correct and reflect the interplay of the lower chronic RfD and the different half-lives used to estimate the longer-term time-weighted average doses. As indicated in the worksheets, the 90-day time-weighted average doses for TCP are below the estimated acute doses of TCP.

The qualitative interpretation of the HQs for TCP is similar to that of the HQs for triclopyr. In the event members of the general public consume contaminated fruit or vegetation, these people could be at risk.

The plausibility of the acute scenario is limited by several important factors. First, most areas proposed for treatment with triclopyr are well removed from private residences, and hence, vegetable gardens. Secondly, unless the triclopyr contamination were to occur immediately before picking, it is plausible that the accidental contamination would kill the plants or diminish their capacity to yield consumable vegetation. Thirdly, this scenario is extremely conservative in that it does not consider the effects of washing contaminated vegetation in reducing doses. Finally, signs at likely access points informing the public that an area has been sprayed would reduce the potential that freshly sprayed material would be consumed.

For the longer-term scenario, as previously discussed, these upper limits of exposure are constructed using the highest anticipated application rate, the highest anticipated number of acres treated per day, and the upper limit of the occupational exposure rate. If any of these conservative assumptions were modified the hazard quotients would drop substantially. This scenario assumes that vegetation or fruit that has been directly sprayed is harvested and consumed for a prolonged period of time. In addition, this scenario does not consider the effects of washing contaminated vegetation or the likelihood that such treated vegetation in older treated areas are expected to be dead, dying, chlorotic, brittle or deformed and hence undesirable to consume in the long-term.

Table F-6g-1: Summary of Risk Characterization for Workers – Triclopyr

Risk Characterization for Workers at Highest Anticipated Application Rate				
Chemical: Triclopyr TEA Chronic RfD = 0.05 mg/kg/day Acute RfD = 1.0 mg/kg/day (Man or child), 0.5 mg/kg/day (woman)	**Application Rate**		2	lbs a.e./ac
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Accidental/Incidental Exposures (dose in mg/kg/event)				
Contaminated Gloves, 1 min.	Worker	3E-05	2E-05	8E-05
Contaminated Gloves, 1 hour	Worker	2E-03	9E-04	5E-03
Spill on Hands, 1 hour	Worker	6E-04	2E-04	2E-03
Spill on lower legs, 1 hour	Worker	1E-03	5E-04	4E-03
General Exposures (dose in mg/kg/day)				
General exposure	Backpack	0.2	0.01	0.9

Table F-6g-2: Summary of Risk Characterization for the Public – Triclopyr

Risk Characterization for General Public at Maximum Application Rate				
Chemical: Triclopyr TEA Chronic RfD = 0.05 mg/kg/day Acute RfD = 1.0 mg/kg/day (Man or child), 0.5 mg/kg/day (woman)		**Application Rate**	2	lbs a.e./acre
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Accidental Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	2E-02	8E-03	7E-02
Direct Spray of Woman, feet and lower legs	Adult Female	5E-02	2E-02	0.1
Water consumption, accidental spill	Child	0.2	2E-02	0.6
Fish consumption, accidental spill	Adult Male	4E-04	7E-05	7E-04
Fish consumption, accidental spill	Subsistence Populations	2E-03	4E-04	4E-03
Non-Accidental Acute Exposures (dose in mg/kg/event)				
Vegetation Contact, shorts and T-shirt	Adult Female	7E-02	2E-02	0.2
Contaminated Fruit	Adult Female	0.4	0.2	**6**
Contaminated Vegetation	Adult Female	**5**	0.3	**41**
Swimming, one hour	Adult Female	6E-07	9E-11	1E-04
Water consumption	Child	3E-04	7E-08	4E-02
Fish Consumption	Adult Female	6E-07	2E-10	5E-05
Fish consumption	Subsistence Populations	3E-06	1E-09	2E-04
Chronic/Longer Term Exposures (dose in mg/kg/day)				
Contaminate Fruit	Adult Female	0.1	4E-02	**4**
Contaminate Vegetation	Adult Female	0.5	1E-02	**10**
Water consumption	Adult Male	2E-03	3E-10	0.2
Fish consumption	Adult Male	3E-07	5E-14	2E-05
Fish consumption	Subsistence Populations	2E-06	4E-13	1E-04

Table F-6h-2: Summary of Risk Characterization for the Public – TCP

Risk Characterization for General Public at Maximum Application Rate				
Chemical: TCP Chronic RfD = 0.012 mg/kg/day Acute RfD = 0.025 mg/kg/day		**Application Rate**	n/a	lbs a.e./acre
Scenario	**Receptor**	**Hazard Quotient**		
		Central	**Lower**	**Upper**
Accidental Acute Exposures (dose in mg/kg/event)				
Direct Spray of Child, whole body	Child	No exposure assessment.		
Direct Spray of Woman, feet and lower legs	Adult Female	No exposure assessment.		
Water consumption, accidental spill	Child	2E-02	7E-04	0.6
Fish consumption, accidental spill	Adult Male	1E-02	3E-03	3E-02
Fish consumption, accidental spill	Subsistence Populations	7E-02	1E-02	0.1
Non-Accidental Acute Exposures (dose in mg/kg/event)				
Vegetation Contact, shorts and T-shirt	Adult Female	No exposure assessment.		
Contaminated Fruit	Adult Female	0.1	6E-02	**2**
Contaminated Vegetation	Adult Female	1.8	0.1	**15**
Swimming, one hour	Adult Female	2E-04	1E-09	1E-02
Water consumption	Child	4E-03	3E-08	0.2
Fish Consumption	Adult Female	7E-06	8E-11	2E-04
Fish consumption	Subsistence Populations	4E-05	4E-10	1E-03
Chronic/Longer Term Exposures (dose in mg/kg/day)				
Contaminate Fruit	Adult Female	0.2	8E-02	**4**
Contaminate Vegetation	Adult Female	**1.0**	3E-02	**19**
Water consumption	Adult Male	5E-04	2E-11	3E-02
Fish consumption	Adult Male	5E-08	3E-15	2E-06
Fish consumption	Subsistence Populations	4E-07	3E-14	2E-05

5.8 Cumulative Effects

The proposed use of herbicides could result in cumulative doses of herbicides to workers or the general public. Cumulative doses to the same herbicide result from (1) additive doses via various routes of exposure resulting from the management scenarios presented in the Proposed Action and (2) additive doses if an individual is exposed to other herbicide treatments.

Additional sources of exposure include: use of herbicides on adjacent agricultural lands or home use by a worker or member of the general public. Table F-7 displays the total numbers of pounds of a.e./a.i. used annually in Yuba County.

Table F-7 Reported Herbicide Use (lbs active ingredient) within Yuba County (2015-2017)

Chemical	2015 lbs/total	2016 lbs/total	2017 lbs/total	Total	Annual Average
Aminopyralid	130	89	194	413	138
Chlorsulfuron	5	6	5	16	5.3
Glyphosate	66,297	56,388	53,624	176,309	58,770
Imzazamox	4	0	0	4	1.3
Imazapyr	426	458	457	1,341	447
Sulfometuron Methyl	48	16	33	97	32.3
Triclopyr	6,803	6,711	6,057	19,571	6,524
Annual lbs Total	73,713	63,668	60,370	197,751	65,917

Source - California Department of Pesticide Regulation, Annual (2015-2017) Pesticide Use Reports for Yuba County accessed on line at http://www.cdpr.ca.gov/docs/pur/purmain.htm on June 21, 2019.

Under the Proposed Action, it is estimated that up to 2,000 acres would be treated annually. The No Action Alternative would not involve any new herbicide use. Based on the pesticide use from 2015-2017 displayed in Table F-7, the Proposed Action would result in at most a 6% increase in herbicide use for the county [Average annual use (lbs) from Table F-7 = 65,917 (2,000 acres in Proposed Action at 2 lbs/acre = 4,000 lbs.) 4,000/65,917 = 0.061 or approximately 6%.]. This is an overestimation, as the rates for most of the herbicides proposed for use are less than 2 lbs/ acre.

Aminopyralid is primarily used in pastures and landscape maintenance. Glyphosate is primarily used in on crops, right-of-way, and landscape maintenance. Chlorsulfuron is primarily used in right-of-way and landscape maintenance. Imazapyr is primarily used in forests/timberland. Sulfometuron methyl is primarily used for right-of-way. Triclopyr is primarily used in rice, right-of-way, and landscape maintenance. Imazamox was used on alfalfa.

Additional sources of exposure on Beale AFB could come from herbicides applied by the Beale AFB pest management shop, base groundkeepers and on utility right-of-ways. Most of this application is small-scale along roadsides and fence lines. The pest management shop applies glyphosate to treat starthistle infestations on the airfield. In 2016, 666 acres of yellow starthistle in and around Dragon Town were treated with Milestone® (aminopyralid).

It is conceivable that workers or members of the public could be exposed to herbicides as a result of treatments on surrounding public or private lands. Where individuals could be exposed by more than one route, the risk of such cases can be quantitatively characterized by simply adding the hazard quotients for each exposure scenario. For example, using glyphosate as an example, the typical levels of exposure for a woman being directly sprayed on the lower legs, staying in contact with contaminated vegetation, eating contaminated fruit, and consuming contaminated fish leads to a combined hazard quotient of 0.02. Similarly, for all of the chronic glyphosate exposure scenarios, the addition of all possible pathways lead to hazard quotients that are substantially less than one. Similar scenarios can be developed with the other herbicides. This risk assessment specifically considers the effect of repeated exposure in that the chronic RfD is used as an index of acceptable exposure. Consequently, repeated exposure to levels below the toxic threshold should not be associated with cumulative toxic effects.

Since these herbicides persist in the environment for a relatively short time (generally less than 1 year), do not bio-accumulate, and are rapidly eliminated from the body, additive doses from re-treatments in subsequent years are not anticipated. According to recent work completed by the California Department of Pesticide Regulation, some plant material contained triclopyr residues up to 1.5 years after treatment (glyphosate, up to 66 weeks), however, these levels were less than 1 part per million (Segawa et al. 2001). Based on the re-treatment schedule in the proposed action, it is possible that residues from the initial herbicide application could still be detectable during subsequent re-treatments, but these plants would represent a low risk to humans as they would show obvious signs of herbicide effects as so would be undesirable for collection.

In order to consider the cumulative effects of these other uses, U.S. EPA has developed the theoretical maximum residue contribution (TMRC). The TMRC is an estimate of maximum daily exposure to chemical residues that a member of the general public could be exposed to from all published and pending uses of a pesticide on a food crop (Table F-8). Adding the TMRC to this project's chronic dose estimates can be used as an estimate of the cumulative effects of this project with theoretical background exposure levels of these herbicides. The result of doing this does not change the risk conclusions based on the project-related HQ values.

Table F-8: Theoretical Maximum Residue Contribution (TMRC) values for US population as a whole

Herbicide	TMRC (mg/kg/day)	% of RfD	Data Source
Aminopyralid	0.0033*	6.0	US EPA 2005
Chlorsulfuron	0.00386	19.3	US EPA 2002c
Glyphosate	0.02996	1.5	US EPA 2000b
Imazamox	exempt	-	68 FR 7433, Feb 14, 2003
Imazapyr	<0.025	<1	62 FR 17096, Apr 9, 1997
Sulfometuron Methyl	0.00169**	0.6	US EPA 2008
Triclopyr	0.00105	2.1	US EPA 2002a

*Short-term dietary and non-dietary exposure estimate for children 1-2 years old
**Based on drinking water contamination rates, herbicide is non-food/non-feed only

Cumulative effects can be caused by the interaction of different chemicals with a common metabolite or a common toxic action. With the exception of triclopyr and chlorpyrifos discussed below, none of the other herbicides have been demonstrated to share a common metabolite with other pesticides.

As previously stated, the primary metabolite of triclopyr is TCP. TCP is also the primary metabolite of an insecticide called chlorpyrifos. U.S. EPA (1998, 2002a) considered exposures to TCP from both triclopyr and chlorpyrifos in their general dietary and drinking water exposure assessments. The U.S. EPA estimated dietary exposures at the upper 99.5% level for a young woman – i.e., the most sensitive population in terms of potential reproductive effects, the endpoint of greatest concern for triclopyr.

The upper range of acute exposure to triclopyr was estimated at 0.012 mg/kg/day and the upper range of exposure to chlorpyrifos was estimated at 0.016 mg/kg/day. Thus, making the assumption that both triclopyr and chlorpyrifos are totally converted to TCP, the total exposure is about 0.028 mg/kg/day, a factor of 8.9 below the level of concern. For chronic exposures, the U.S. EPA based the risk assessment on infants – i.e., individuals at the start of a lifetime exposure. The dietary analysis indicated that the total exposure expressed as a fraction of the RfD was 0.044 for TCP from triclopyr and 0.091 for TCP from chlorpyrifos for a total of 0.135 or a factor of about 7.4 below the level of concern [1÷0.135 = 7.4]. Based on this assessment, the U.S. EPA (1998) concluded that:

> *…the existing uses of triclopyr and chlorpyrifos are unlikely to result in acute or chronic dietary risks from TCP. Based on limited available data and modeling estimates, with less certainty, the Agency concludes that existing uses of triclopyr and chlorpyrifos are unlikely to result in acute or chronic drinking water risks from TCP. Acute and chronic aggregate risks of concern are also unlikely to result from existing uses of triclopyr and chlorpyrifos.* – U.S. EPA (1998, p. 34).

This conclusion, however, is based primarily on the agricultural uses of triclopyr – i.e., estimated dietary residues – and does not specifically address potential exposures from wildland application. In wildland applications, the primary concern would be the formation of TCP as a soil metabolite. TCP is more persistent than triclopyr in soil and TCP is relatively mobile in soil (U.S. EPA 1998) and could contaminate bodies of water near the site of application. In order to assess the potential risks of TCP formed from the use of triclopyr, the TCP metabolite was modeled in the SERA risk assessment (SERA 2011b) along with triclopyr. The results for TCP are summarized in SERA (2011b) Table 26 and used in the worksheets for TCP.

Notwithstanding the above assessment in U.S. EPA (1998, 2002a), this risk assessment does specifically include a consideration of exposures to TCP that may result from activities in the use of triclopyr. Thus, oral exposures to TCP which may result from the use of triclopyr are addressed in in this risk assessment, and the risks that might be associated with these exposures are discussed the risk characterization for triclopyr, above.

As noted by the U.S. EPA/OPP:

> *Because of the low toxicity of imazamox and its metabolic degradates, there is no concern regarding the potential for cumulative effects of imazamox and its degradates with other substances with a common mode of action. Imazamox belongs to the imidazolinone class of chemistry. The herbicidal activity of the imidazolinones is due to the inhibition of acetohydroxy acid synthase (AHAS), an enzyme only found in plants. AHAS is part of the biosynthetic pathway leading to the formation of branched-chain amino acids. Animals lack AHAS and this biosynthetic pathway. This lack of AHAS contributes to the low toxicity of imazamox in mammals. We are aware of no information to indicate or suggest that imazamox has any toxic effects on mammals that would be cumulative with those of any other chemical* (U.S. EPA/OPP 2002)

Given the low toxicity of imazamox, concern for cumulative effects is minimal.

Imazapyr is strikingly similar to imazamox in that doses that cause clear signs of toxicity have not been determined (SERA 2010). While this apparent lack of mammalian toxicity is a similarity, this particular similarity is not a basis for enhanced concern for cumulative effects. The EPA decision not to assume a common mechanism of action in assessing imazapyr relative to other imidazolinone herbicides appears to be a reasonable and justified approach (U.S. EPA/OPP 2006a).

The risk assessment for sulfometuron methyl (SERA 2004c) specifically considers the effect of both single and repeated exposures. Based on the hazard quotients generated there is no indication that repeated exposures will exceed the threshold for toxicity.

5.9 Inert Ingredients

The issue concerning inert ingredients and the toxicity of formulations is discussed in USDA (1989, pages 4-116 to 4-119). The approach used in USDA (1989), the SERA Risk Assessments, and this analysis to assess the human health effects of inert ingredients and full formulations has been to: (1) compare acute toxicity data between the formulated products (including inert ingredients) and their active ingredients alone; (2) disclose whether or not the formulated products have undergone chronic toxicity testing; and (3) identify, with the help of U.S. EPA and the chemical companies, ingredients of known toxicological concern in the formulated products and assess the risks of those ingredients.

Researchers have studied the relationships between acute and chronic toxicity and while the biological end-points are different, relationships do exist and acute toxicity data can be used to give an indication of overall toxicity (Zeise, et al. 1984). The court in NCAP v. Lyng, 844 F.2d 598 (9th Cir 1988) decided that this method of analysis provided sufficient information for a decision-maker to make a reasoned decision. In SRCC v. Robertson, Civ.No. S-91-217 (E.D. Cal., June 12, 1992) and again in CATs v. Dombeck, Civ. S-00-2016 (E.D. Cal., Aug 31, 2001) the district court upheld the adequacy of the methodology used in USDA, 1989 for disclosure of inert ingredients and additives.

The U.S. EPA has categorized approximately 1200 inert ingredients into four lists. Lists 1 and 2 contain inert ingredients of toxicological concern. List 3 includes substances for which U.S. EPA has insufficient information to classify as either hazardous (List 1 and 2) or non-toxic (List 4). List 4 contains non-toxic substances such as corn oil, honey and water. Use of formulations containing inert ingredients on List 3 and 4 is preferred.

Since most information about inert ingredients is classified as “Confidential Business Information” (CBI) the Forest Service asked U.S. EPA to review the thirteen herbicides for the preparation of USDA 1989 (includes glyphosate, and triclopyr) and the commercial formulations and advise if they contained inert ingredients of toxicological concern (Inerts List 1 or 2)(USDA 1989, Appendix F, Attachment B). The U.S. EPA determined that there were no inerts on List 1 or 2, with the exception of kerosene in certain formulations of triclopyr. In addition, the CBI files were reviewed in the development of most of the SERA risk assessments. Information has also been received from the companies who produce the herbicides and spray additives.

Comparison of acute toxicity (LD_{50} values) data between the formulated products (including inert ingredients) and their active ingredients alone shows that the formulated products are generally less toxic than their active ingredients (USDA 1989, USDA 1984, SERA risk assessments).

While these formulated products have not undergone chronic toxicity testing like their active ingredients, the acute toxicity comparisons, the U.S. EPA review, and our examination of toxicity information on the inert ingredients in each product leads to the conclusion that the inert ingredients in these formulations do not significantly increase the risk to human health and safety over the risks identified for the active ingredients.

5.10 Adjuvants

There is a considerable range of adjuvants that might be considered for use including. A brief discussion of oil-based surfactants is below. An analysis of the ingredients in these adjuvants did not identify any of specific toxic concern with the exception of the ingredients discussed in this risk assessment. None were on U.S. EPA Inerts Lists 1 or 2.

The primary summary statement that can be made is that the more common risk factors for the use of these adjuvants are through skin or eye exposure. These adjuvants all have various levels of irritancy associated with skin or eye exposure. This points up the need for good industrial hygiene practices while utilizing these products, especially when handling the concentrate, such as during mixing. The use of chemical resistant gloves and goggles, especially while mixing, will be employed as a best management practice.

Oils

Adjuvants that are primarily oil-based have been gaining in popularity especially for the control of grassy weeds. Oil additives function to increase herbicide absorption through plant tissues and increase spray retention. They are especially useful in applications of herbicides to woody brush or tree stems to allow for penetration through the bark. Oil adjuvants are made up of either petroleum, vegetable, or methylated vegetable or seed oils plus an emulsifier for dispersion in water.

Vegetable Oils – The methylated seed oils are formed from common seed oils, such as canola, soybean, or cotton. They act to increase penetration of the herbicide. These are comparable in performance to crop oil concentrates.

The U.S. Food and Drug Administration (FDA) considers methyl and ethyl esters of fatty acids produced from edible fats and oils to be food grade additives (CFR 172.225). Because of the lack of exact ingredient statements on these surfactants, it is not always clear whether the oils that are used in them meet the U.S. FDA standard.

5.11 Synergistic Effects

Synergistic effects are those effects resulting from exposure to a combination of two or more chemicals that are greater than the sum of the effects of each chemical alone (additive). Refer to USDA (1989 pages 4-111 to 4-114) for a detailed discussion on synergistic effects.

Instances of chemical combinations that cause synergistic effects are relatively rare at environmental exposure levels. Reviews of the scientific literature on toxicological effects and toxicological interactions of agricultural chemicals indicate that exposure to a mixture of pesticides is more likely to lead to additive rather than synergistic effects (US EPA 2000c; ATSDR 2004; Kociba and Mullison 1985). The literature review by ATSDR (2004) cited several studies that found no synergistic effects for mixtures of four, eight, and nine chemicals at low (sub-toxic) doses. In assessing health risk associated with drinking water, Crouch et al. (1983) reach a similar conclusion when they stated:

> *"...in most cases we are concerned with small doses of one pollutant added to a sea of many pollutants. For those small doses a multiplicative effect is not expected."*

U.S. EPA (1986) concludes:

> *"There seems to be a consensus that for public health concerns regarding causative (toxic) agents, the additive model is more appropriate [than a multiplicative model]."*

Synergism has rarely been observed in toxicological tests involving combinations of these herbicides with other commercial pesticides. The herbicide mixtures proposed for this project have not shown synergistic effects in humans who have used them in forestry and other agricultural applications. However, synergistic toxic effects of herbicide combinations, combinations of the herbicides with other pesticides such as insecticides or fertilizers, or combinations with naturally occurring chemicals in the environment are not normally studied. Based on the limited data available on pesticide combinations involving these herbicides, it is possible, but unlikely, that synergistic effects could occur as a result of exposure to the herbicides considered in this analysis.

However, even if synergistic or additive effects were to occur as a result of the proposed treatment, these effects are dose dependent (Dost 1991). This means that exposures to the herbicide plus any other chemical must be significant for these types of effects to be of a biological consequence. As Dost explains:

> *"While there is little specific published study of forestry herbicides in this particular regard, there is a large body of research on medical drugs, from which principles arise that govern such interactions. Amplifications of effect are not massive; one chemical cannot change the impact of another by hundreds or thousands of times. Rarely will such change be more than a few fold. This difference can be dangerous when dealing with drugs that are already at levels intended to significantly alter bodily functions, but is insignificant when both compounds are at the very low levels of exposure to be found associated with an herbicide treatment."*

It is not anticipated that synergistic effects would be seen with the herbicides and the adjuvants that might be added to them. Based on a review of several recent studies, there is no demonstrated synergistic relationship between herbicides and surfactants (Abdelghani et al 1997; Henry et al 1994; Lewis 1992; Oakes and Pollak 1999, 2000 as referenced in USDA 2002).

Although the combination of surfactant and herbicide might indicate an increased rate of absorption through the skin, a review of recent studies indicates this is not often true (Ashton et al 1986; Boman et al 1989; Chowan and Pritchard 1978; Dalvi and Zatz 1981; Eagle et al 1992; Sarpotdar and Zatz 1986; Walters et al 1993, 1998; Whitworth and Carter 1969 as referenced in USDA 2002). For a surfactant to increase the absorption of another compound, the surfactant must affect the upper layer of the skin. Without some physical effect to the skin, there will be no change in absorption as compared to the other compound alone. The studies indicate that in general non-ionic surfactants have less of an effect on the skin, and hence absorption, then anionic or cationic surfactants. Compound specific studies indicate that the alkylphenol ethoxylates generally have little or no effect on absorption of other compounds. In several studies, the addition of a surfactant actually decreased the absorption through the skin. It would appear that there is little support for the contention that the addition of surfactants to herbicide mixtures would increase the absorption through the skin of these herbicides.

5.12 Sensitive Individuals

The uncertainty factors used in the development of the RfD takes into account much of the variation in human response. The uncertainty factor of 10 for sensitive subgroups is sufficient to ensure that most people will experience no toxic effects. “Sensitive” individuals are those that might respond to a lower dose than average, which includes women and children. As stated in National Academy of Sciences (NAS 1993), the quantitative differences in toxicity between children and adults are usually less than a factor of approximately 10-fold. An uncertainty factor of 10 for sensitive subgroups may not cover all individuals that may be sensitive to herbicides because human susceptibility to toxic substances can vary by two to three orders of magnitude. Factors affecting individual susceptibility include diet, age, heredity, preexisting diseases, and life style. Individual susceptibility to the herbicides proposed in this project cannot be specifically predicted. Unusually sensitive individuals may experience effects even when the HQ is equal to or less than 1.

Further information concerning risks to sensitive individuals can be found in USDA (1989, pages 4-114 through 4-116).

There is no information to suggest that specific groups or individuals may be especially sensitive to the systemic effects of aminopyralid. Due to the lack of data in humans, the critical effect of aminopyralid in humans, if any, cannot be identified. It is not clear that aminopyralid has any remarkable systemic toxic effects. The most common effects in experimental mammals involve effects on the gastrointestinal tract which may be viewed as portal of entry effects. These effects are variable among different species of mammals and appear to be associated with levels of exposure that are substantially higher than any likely human exposures. Thus, it would seem highly speculative to suggest that individuals with gastrointestinal diseases might be more susceptible than other individuals to aminopyralid.

There is no information to suggest that specific groups or individuals may be especially sensitive to the systemic effects of chlorsulfuron. Due to the lack of data in humans, the likely critical effect of chlorsulfuron in humans cannot be identified clearly. In animals the most sensitive effect of chlorsulfuron appears to be weight loss. There is also some evidence that chlorsulfuron may produce alterations in hematological parameters. However, it is unclear if individuals with pre-existing diseases of the hematological system or metabolic disorders would be particularly sensitive to chlorsulfuron exposure. Individuals with any severe disease condition could be considered more sensitive to many toxic agents.

The 1996 Food Quality Protection Act requires that U.S. EPA evaluate an additional 10X safety factor, based on data uncertainty or risks to certain age/sex groupings. U.S. EPA has evaluated chlorsulfuron against this standard and has recommended a 3X additional safety factor be used for the protection of infants and children. This additional 3X safety factor is factored into the acute and chronic RfD’s of this risk assessment as it applies to chlorsulfuron.

No reports were encountered in the glyphosate literature leading to the identification of sensitive subgroups. There is no indication that glyphosate causes sensitization or allergic responses, which does not eliminate the possibility that some individuals might be sensitive to glyphosate as well as many other chemicals (SERA 2011a).

No hazards to members of the general population associated with exposure to imazamox have been identified. Because no mechanism of toxicity for imazamox in humans can be identified, subgroups within the human population that might be sensitive to imazamox cannot be identified.

Because no mechanism of toxicity for imazapyr in humans can be identified, subgroups within the human population that might be sensitive to imazapyr cannot be identified. Notwithstanding, imazapyr is a weak acid. Imazapyr would influence and be influenced by other weak acids excreted by the kidney; however, this effect would occur only at high doses at which the ability of the kidney to excrete weak acids might be saturated or nearly so. Given the very low HQs for imazapyr, there appears to be no basis for asserting that this or other adverse effects in a specific subgroup are plausible. U.S. EPA/OPP (2005) judges that infants and children are not likely to be more sensitive than adults to imazapyr. Given the number of studies available on reproductive and developmental effects and the unremarkable findings from these studies, this judgement appears appropriate.

There is no information to suggest that specific groups or individuals may be especially sensitive to the systemic effects of sulfometuron methyl. Due to the lack of data in humans, the likely critical effect of sulfometuron methyl in humans cannot be identified clearly. The most sensitive effect reported in animals for chronic sulfometuron methyl exposure appears to involve changes in blood that are consistent with hemolytic anemia. Thus, individuals with pre-existing anemia could potentially be at an increased risk. It appears that sulfometuron methyl has the potential to alter thyroid gland function. Individuals with pre-existing thyroid dysfunction may, therefore, be at increased risk. However, there are no data to directly support these speculations.

Because triclopyr may impair glomerular filtration, individuals with pre-existing kidney diseases are likely to be at increased risk (SERA 1996). Because the chronic RfD for triclopyr is based on reproductive effects, women of child-bearing age are an obvious group at increased risk (SERA 2011c). This group is given explicit consideration and is central to the risk characterization.

5.13 Worksheets

All worksheets related to the information noted in this document can be found in the Project Record and are hereby incorporated by reference.

6.0 Glossary

Absorption -- The process by which the agent is able to pass through the body membranes and enter the bloodstream. The main routes by which toxic agents are absorbed are the gastrointestinal tract, lungs, and skin.

Acute exposure -- A single exposure or multiple exposures occurring within a short time (24 hours or less).

Additive effect -- A situation in which the combined effects of two chemicals is equal to the sum of the effect of each chemical given alone. The effect most commonly observed when two chemicals are given together is an additive effect.

Adjuvant(s) -- Formulation factors used to enhance the pharmacological or toxic agent effect of the active ingredient.

Adrenergic -- A type of nerve that uses an adrenaline like substance as a neurotransmitter.

Adsorption -- The tendency of one chemical to adhere to another material.

Adverse-effect level (AEL) -- Signs of toxicity that must be detected by invasive methods, external monitoring devices, or prolonged systematic observations. Symptoms that are not accompanied by grossly observable signs of toxicity. In contrast to Frank-effect level.

Alkaline phosphatase – An enzyme that occurs in various normal and malignant tissues. The activity of the enzyme in blood is useful in diagnosing many illnesses.

Allometric -- pertaining to allometry, the study and measure of growth. In toxicology, the study of the relationship of body size to various physiological, pharmacological, pharmacokinetic, or toxicodynamic processes among species.

Assay -- A kind of test (noun); to test (verb).

Ataxia –inability to coordinate muscle activity; loss of balance

Bioconcentration factor (BCF) -- The concentration of a compound in an aquatic organism divided by the concentration in the ambient water of the organism.

Biologically sensitive -- A term used to identify a group of individuals who, because of their developmental stage or some other biological condition, are more susceptible than the general population to a chemical or biological agent in the environment.

Cancer potency parameter -- A model-dependent measure of cancer potency (mg/kg/day)-1 over lifetime exposure. [Often expressed as aq1 * which is the upper 95% confidence limit of the first dose coefficient (q1) from the multistage model.]

Carcinogen -- A chemical capable of inducing cancer.

Carcinoma -- A malignant tumor.

Carrier -- In commercial formulations of insecticides or control agents, a substance added to the formulation to make it easier to handle or apply.

Chronic exposure -- Long-term exposure studies often used to determine the carcinogenic potential of chemicals. These studies are usually performed in rats, mice, or dogs and extend over the average lifetime of the species (for a rat, exposure is 2 years).

Connected actions -- Exposure to other chemical and biological agents in addition to exposure to the control agent during program activities to control vegetation.

Contaminants -- For chemicals, impurities present in a commercial grade chemical. For biological agents, other agents that may be present in a commercial product.

Controls -- In toxicology or epidemiology studies, a population that is not exposed to the potentially toxic agent under study.

Creatine – An organic acid composed of nitrogen. It supplies the energy required for muscle contraction.

Creatinine – The end product of the metabolism of creatine. It is found in muscle and blood and is excreted in the urine.

Cumulative exposures -- Exposures that may last for several days to several months or exposures resulting from program activities that are repeated more than once during a year or for several consecutive years.

Dams – A term used to designate females of some species such as rats.

Degraded -- Broken down or destroyed.

Dermal -- Pertaining to the skin.

Dislodgeable residues – The residue of a chemical or biological agent on foliage as a result of aerial or ground spray applications, which can be removed readily from the foliage by washing, rubbing or having some other form of direct contact with the treated vegetation.

Dose-response assessment -- A description of the relationship between the dose of a chemical and the incidence of occurrence or intensity of an effect. In general, this relationship is plotted by statistical methods. Separate plots are made for experimental data obtained on different species or strains within a species.

Drift -- That portion of a sprayed chemical that is moved by wind off a target site.

EC50 -- A concentration that causes 50% inhibition or reduction. As used in this document, this value refers to a 50% inhibition of growth.

EC100 -- A concentration that causes complete inhibition or reduction. As used in this document, this value refers to a complete inhibition of growth.

Empirical -- Refers to an observed, but not necessarily fully understood, relationship in contrast to a hypothesized or theoretical relationship.

Endogenous – Growing or developing from or on the inside.

Enzymes -- A biological catalyst; a protein, produced by an organism itself, that enables the splitting (as in digestion) or fusion of other chemicals.

Epidemiology study -- A study of a human population or human populations. In toxicology, a study which examines the relationship of exposures to one or more potentially toxic agent to adverse health effects in human populations.

Estrogenic – a substance that induces female hormonal activity.

Exposure assessment -- The process of estimating the extent to which a population will come into contact with a chemical or biological agent.

Extrapolation -- The use of a model to make estimates outside of the observable range.

Fetal anomaly – An abnormal condition in a fetus, which is usually the result of a congenital defect.

Formulation -- A commercial preparation of a chemical including any inerts or contaminants.

Frank effects -- Obvious signs of toxicity.

Frank-effect level (FEL) -- The dose or concentration of a chemical or biological agent that causes gross and immediately observable signs of toxicity.

Gavage -- The placement of a toxic agent directly into the stomach of an animal, using a gastric tube.

Genotoxic -- Causing direct damage to genetic material. Associated with carcinogenicity.

Geometric mean -- The measure of an average value often applied to numbers for which a log normal distribution is assumed.

Gestation -- The period between conception and birth; in humans, the period known as pregnancy.

Half-time or half-life -- For compounds that are eliminated by first-order kinetics, the time required for the concentration of the chemical to decrease by one-half.

Hazard quotient (HQ) -- The ratio of the estimated level of exposure to the RfD or some other index of acceptable exposure.

Hazard identification -- The process of identifying the array of potential effects that an agent may induce in an exposed human population.

Hematological -- Pertaining to the blood.

Hematology -- One or more measurements regarding the state or quality of the blood.

Henry's law constant -- An index of the tendency of a compound to volatilize from aqueous solutions.

Herbicide -- A chemical used to control, suppress, or kill plants, or to severely interrupt their normal growth processes.

Histopathology -- Signs of tissue damage that can be observed only by microscopic examination.

Humoral – of, or related to, elements in the blood.

Hydrolysis -- Decomposition or alteration of a chemical substance by water.

Hydroxylation -- The addition of a hydrogen-oxygen or hydroxy (-OH) group to one of the rings. Hydroxylation increases the water solubility of aromatic compounds. Particularly when followed by conjugation with other water-soluble compounds in the body, such as sugars or amino acids, hydroxylation greatly facilitates the elimination of the compound in the urine or bile.

Hymolytic anemia – A medical condition in which the number of red blood cells is decreased due to intravascular fragmentation or destruction.

Hyperplasia – An abnormal increase in the number of cells composing a tissue or organ.

Immunotoxic – damaging to the immune system.

In vivo -- Occurring in the living organism.

In vitro -- Isolated from the living organism and artificially maintained, as in a test tube.

Inerts -- Adjuvants or additives in commercial formulations of pesticides that are not readily active with the other components of the mixture.

Interpolation -- The use of mathematical models within the range of observations

Intraperitoneal -- Injection into the abdominal cavity.

Invertebrate -- An animal that does not have a spine (backbone).

Irritant effect -- A reversible effect, compared with a corrosive effect.

LC_{50} (lethal concentration$_{50}$) -- A calculated concentration of a chemical in air or water to which exposure for a specific length of time is expected to cause death in 50% of a defined experimental animal population.

LD_{50} (lethal dose$_{50}$) -- The dose of a chemical calculated to cause death in 50% of a defined experimental animal population over a specified observation period. The observation period is typically 14 days.

Lowest-observed-adverse-effect level (LOAEL) -- The lowest dose of a chemical in a study, or group of studies, that produces statistically or biologically significant increases in frequency or severity of adverse effects between the exposed population and its appropriate control.

Lymphatic – Pertaining to lymph, a lymph vessel, or a lymph node.

Lymph – A clear water fluid containing white blood cells. Lymph circulates throughout the lymphatic system, removing bacteria and certain proteins from body tissue. It also is responsible for transporting fat from the small intestine and supplying mature lymphocytes to the blood.

Lymphocyte – white blood cell involved in immune system.

Malignant -- Cancerous.

Margin of safety (MOS) -- The ratio between an effect or no effect level in an animal and the estimated human dose.

Metabolite -- A compound formed as a result of the metabolism or biochemical change of another compound.

Metameter -- Literally, the unit of measure. Used in dose-response or exposure assessments to describe the most relevant way of expressing dose or exposure.

Microorganisms -- A generic term for all organisms consisting only of a single cell, such as bacteria, viruses, and fungi.

Microsomal -- Pertaining to portions of cell preparations commonly associated with the oxidative metabolism of chemicals.

Minimal risk level (MRL) -- A route-specific (oral or inhalation) and duration- specific estimate of an exposure level that is not likely to be associated with adverse effects in the general population, including sensitive subgroups.

Mitochondria -- Subcellular organelles involved in the conversion of food to stored chemical energy.

Most sensitive effect -- The adverse effect observed at the lowest dose level, given the available data. This is an important concept in risk assessment because, by definition, if the most sensitive effect is prevented, no other effects will develop. Thus, RfDs and other similar values are normally based on doses at which the most sensitive effect is not likely to develop.

Multiple chemical sensitivity -- A syndrome that affects individuals who are extremely sensitive to chemicals at extremely low levels of exposure.

Mutagenicity -- The ability to cause genetic damage (that is damage to DNA or RNA). A mutagen is substance that causes mutations. A mutation is change in the genetic material in a body cell. Mutations can lead to birth defects, miscarriages, or cancer.

Non-target -- Any plant or animal that a treatment inadvertently or unavoidably harms.

No-observed-adverse-effect level (NOAEL) -- The dose of a chemical at which no statistically or biologically significant increases in frequency or severity of adverse effects were observed between the exposed population and its appropriate control. Effects may be produced at this dose, but they are not considered to be adverse.

No-observed-effect level (NOEL) -- The dose of a chemical at which no treatment-related effects were observed.

Normal distribution -- One of several standard patterns used in statistics to describe the way in which variability occurs in populations.

Octanol-water partition coefficient (Kow) -- The equilibrium ratio of the concentrations of a chemical in n-octanol and water, in dilute solution.

Ocular -- Pertaining to the eye.

Oxidative phosphorylation -- A metabolic process in which the metabolism of molecules in or derived from nutrients is linked to the conversion (phosphorylation) of ADP to ATP, a major molecule for storing energy in all living things.

Parenteral -- Any form of injection.

Partition -- In chemistry, the process by which a compound or mixture moves between two or more media.

Pathogen – A living organism that causes disease; for example, a fungus or bacteria.

Pathway -- In metabolism, a sequence of metabolic reactions.

Permeability – The property or condition of being permeable. In this risk assessment, dermal permeability refers to the degree to which a chemical or herbicide in contact with the skin is able to penetrate the skin.

pH -- The negative log of the hydrogen ion concentration. A high pH (>7) is alkaline or basic and a low pH (<7) is acidic.

pKa -- The negative log of the hydrogen ion concentration or pH at which 50% of a weak acid is dissociated.

Pharmacokinetics -- The quantitative study of metabolism (i.e., the processes of absorption, distribution, biotransformation, elimination).

Prospective -- looking ahead. In epidemiology, referring to a study in which the populations for study are identified prior to exposure to a presumptive toxic agent, in contrast to a retrospective study.

Pup – The offspring or young of various animal species.

Reference dose (RfD) -- Oral dose (mg/kg/day) not likely to be associated with adverse effects over a lifetime exposure, in the general population, including sensitive subgroups.

Reproductive effects -- Adverse effects on the reproductive system that may result from exposure to a chemical or biological agent. The toxicity of the agents may be directed to the reproductive organs or the related endocrine system. The manifestations of these effects may be noted as alterations in sexual behavior, fertility, pregnancy outcomes, or modifications in other functions dependent on the integrity of this system.

Resorption -- Removal by absorption. Often used in describing the unsuccessful development and subsequent removal of post-implantation embryos.

Retrospective -- looking behind. In epidemiology, referring to a study in which the populations for study are identified after exposure to a presumptive toxic agent, in contrast to a prospective study.

RfD -- A daily dose which is not anticipated to cause any adverse effects in a human population over a lifetime of exposure. These values are derived by the U.S. EPA.

Route of exposure -- The way in which a chemical or biological agent enters the body. Most typical routes include oral (eating or drinking), dermal (contact of the agent with the skin), and inhalation.

Scientific notation -- The method of expressing quantities as the product of number between 1 and 10 multiplied by 10 raised to some power. For example, in scientific notation, 1 kg = 1,000 g would be expressed as 1 kg = 1 x 103 g and 1 mg = 0.001 would be expressed as 1 mg = 1 x 10-3 .

Sensitive subgroup -- Subpopulations that are much more sensitive than the general public to certain agents in the environment.

Sensitization – A condition in which one is or becomes hypersensitive or reactive to an agent through repeated exposure.

Species-to-species extrapolation -- A method involving the use of exposure data on one species (usually an experimental mammal) to estimate the effects of exposure in another species (usually humans).

Subchronic exposure -- An exposure duration that can last for different periods of time, but 90 days is the most common test duration. The subchronic study is usually performed in two species (rat and dog) by the route of intended use or exposure.

Substrate -- With reference to enzymes, the chemical that the enzyme acts upon.

Synergistic effect -- A situation is which the combined effects of two chemicals is much greater than the sum of the effect of each agent given alone.

Systemic toxicity -- Effects that require absorption and distribution of a toxic agent to a site distant from its entry point at which point effects are produced. Systemic effects are the obverse of local effects.

Teratogenic -- Causing structural defects that affect the development of an organism; causing birth defects.

Teratology -- The study of malformations induced during development from conception to birth.

Terrestrial – Anything that lives on land as opposed to living in an aquatic environment.

Threshold -- The maximum dose or concentration level of a chemical or biological agent that will not cause an effect in the organism.

Thymus – A small gland that is the site of T-cell production. The gland is composed largely of lymphatic tissue and is situated behind the breastbone. The gland plays an important role in the human immune system.

Toxicity -- The inherent ability of an agent to affect living organisms adversely.

Uncertainty factor (UF) -- A factor used in operationally deriving the RfD and similar values from experimental data. UFs are intended to account or (1) the variation in sensitivity among members of the human population; (2) the uncertainty in extrapolating animal data to the case of humans; (3) the uncertainty in extrapolating from data obtained in a study that is less than lifetime exposure; and (4) the uncertainty in using LOAEL data rather than NOAEL data. Usually each of these factors is set equal to 10.

Vehicle -- A substance (usually a liquid) used as a medium for suspending or dissolving the active ingredient. Commonly used vehicles include water, acetone, and corn oil.

Vertebrate -- An animal that has a spinal column (backbone).

Volatile -- Referring to compounds or substances that have a tendency to vaporize. A material that will evaporate quickly.

Xenobiotic – A substance not naturally produced within an organism; substances foreign to an organism.

Xenoestrogen – An estrogen not naturally produced within an organism.

7.0 References

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APPENDIX K

Ecological Risk Assessment

ECOLOGICAL RISK ASSESSMENT

FOR

NON-NATIVE AND NOXIOUS PLANT SPECIES MANAGEMENT ON BEALE AIR FORCE BASE AND LINCOLN RECEIVER SITE, CALIFORNIA

CONTENTS

1.0 METHODOLOGY

This analysis of effects to wildlife from herbicides and the associated surfactants proposed for use in the Control of Non-Native and Invasive Plant Species on Beale Air Force Base (AFB) and the Lincoln Receiver Site (LRS), utilizes excel worksheets created for U.S. Forest Service Human Health and Ecological Risk Assessments. Workbooks were created to accompany reports created by Syracuse Environmental Research Associates, Inc. (SERA 2004-2011c). The worksheets allow users to enter project-specific herbicide application rates and conditions. The maximum allowable herbicide application rate (as indicated on the product label) was used in this analysis. This reflects the most extreme possible exposure scenario, and actual herbicide application rates are likely to be much lower.

The SERA Human Health and Ecological Risk Assessment reports (SERA 2004-2011c) utilize the best available science to describe the level of herbicide expected to be introduced, persist, and transport within the base environment, and to evaluate the likelihood of adverse ecological effects. These SERA risk assessments used peer-reviewed articles from the open scientific literature and current EPA documents. The likelihood that an animal will experience adverse effects from an herbicide depends on: (1) toxicity of the chemical, (2) the amount of chemical to which an animal is exposed, (3) the amount of chemical actually received by the animal (dose), and (4) the inherent sensitivity of the animal to the chemical, all of which are evaluated in SERA risk assessments. There is insufficient data on species-specific responses to herbicides for free-ranging wildlife, so wildlife species were placed into groups based on taxa type (e.g. bird, mammal), with similar body size and diet.

When enough data was available for a particular type of animal, an exposure scenario was developed, and a quantitative estimate of dose received by the animal type in the scenario was calculated as described in the SERA (2004-2011c) risk assessments. The quantitative estimates of dose were compared to available toxicity data to determine potential adverse impacts. Because of the uncertainty with regard to how accurately a surrogate species may represent other wildlife, the SERA risk assessments use the most sensitive endpoint from the most sensitive species tested as the toxicity index for the entire group of animals (e.g. large birds, large mammals, small birds, reptiles, etc.).

The following definitions apply to this analysis:

Exposure Scenario - The mechanism by which an organism (person, animal, fish) may be exposed to herbicides active ingredients or additives. The application rate and method influence the amount of herbicide to which an organism may be exposed. Wildlife herbicide exposure scenarios include direct spray, consumption of contaminated food items, consumption of contaminated water, or (in the case of aquatic wildlife) contamination of the water body it lives in. There are a number of arbitrary assumptions associated with these scenarios (animal bodyweight, amount of water or vegetation consumed, size and type of waterbodies, etc.). In general, these assumptions are very conservative and reflect a "worst case scenario".

Toxicity Index - is derived from studies of the herbicide and may be the levels at which there were "no observed adverse effect" (NOAEL) or "no observed effect" (NOEL) measured in milligrams per kilogram of bodyweight (mg/kg/bw). For aquatic species it is the "no observed effect concentration" (NOEC), typically measured in milligrams per liter (mg/L) or parts per million (ppm) or billion (ppb) of water. This the level where research has shown no statistically significant effect when compared to animals not exposed to the chemical.

Hazard Quotient (HQ) - The ratio of the estimated level of exposure to an herbicide for a given scenario (by dermal absorption, consumption, inhalation, etc.) to an index of acceptable exposure. The HQ is dependent upon the application rate and concentration of an herbicide solution. The application rate is in pounds (lbs) of acid equivalent (a.e.) or active ingredient (a.i.) per acre. The central, lower, and upper HQs reflect the field concentration of the herbicide mixture, determined by the number of gallons of water an herbicide is mixed with. The concentration is based on application method and desired strength. So, the lower hazard quotient would be associated with the highest application volume and most dilute solution and the upper reflects the lowest volume or most concentrated solution. Lower application volumes are generally used for areal herbicide applications and are unlikely to apply to Beale AFB projects. Hazard quotients for aquatic organisms are developed for scenarios involving an accidental spill, peak Estimated Environmental Concentration (EEC), and longer-term EEC (which gives chronic effects from herbicide exposure). HQs exceeding 1 are indicated in red in the tables in the following sections.

Threshold of Concern – Is considered an HQ of 1.0. HQs greater than 1.0 exceed the threshold of concern if the hazard quotient for a scenario is greater than 1.0, it means that the anticipated level of exposure or dose of herbicide exceeds the level considered safe and may have a negative impact to a species under that scenario. An HQ less than or equal to one indicates an extremely low level of risk. The probability of harmful effects increases with greater HQ values. HQs exceeding 1 are indicated in red in the tables in the following sections.

2.0 EXPOSURE SCENARIOS

2.1 Terrestrial Wildlife

Terrestrial animals might be exposed to any applied herbicide from direct spray, the ingestion of contaminated media (vegetation, prey species, or water), grooming activities, or indirect contact with contaminated vegetation, and these sources of exposure were considered in the risk assessments used for this analysis. Risk assessments show that the highest exposures for terrestrial vertebrates would occur after the consumption of contaminated vegetation or contaminated prey. Direct spray with herbicides may have adverse effects to terrestrial insects from herbicide toxicity or surfactant-induced drowning. Other routes of exposure, including dermal contact with contaminated vegetation, ingestion of contaminated water, or the consumption of contaminated fish, lead to levels of exposure below the level of concern for all species groups and all herbicides being considered in this project.

2.2 Aquatic Wildlife

Aquatic wildlife may be exposed to herbicides from accidental spills, direct application, overspray, or runoff into the body of water that they are inhabiting. A review of risk assessments for aquatic species shows that most of the concern for aquatic species is associated with exposures scenarios for an accidental spill.

2.3 Federal T&E Species Exposure Scenarios

Hazard Quotients to use for special status species found on Beale:

- Contaminated insect - small bird (10 g): YBCU (55-65 g)
- Direct spray – honey bee: VELB, monarch butterfly
- Aquatic Invertebrates – sensitive – all scenarios: VPFS, VPTS
- Fish – sensitive species – all scenarios: CV steelhead, (Chinook salmon)

3.0 RISK CHARACTERIZATION

3.1 Aminopyralid (Reference SERA 2007)

The only aminopyralid exposure scenarios that generated a HQ greater than 1, is in the consumption of a contaminated insect by a small bird (HQ = 1.8), or the consumption of contaminated vegetation by a large bird (HQ = 1.2) (Table 1). Only the consumption of a contaminated insect by a small bird (HQ = 1.8) applies to T&E species on Beale AFB (YBCU). The acute avian toxicity value is based on a NOAEL of 14 mg/kg/bw, derived from a gavage study using bobwhite quail. The scenario assumes a 10 g bird consumes a contaminated insect, and ingests a dose of 24.8 mg/kg/bw of aminopyralid. The Cornell *All about Birds* website (www.allaboutbirds.org) gives weight range for YBCU as 55-65 g, making this a very conservative exposure estimate. If the scenario is run for the YBCU weight range, the resulting dose is 14.3-11.5 mg/kg/bw. This is still at or approaching a level of concern. The risk can be mitigated by using a lower application rate (0.11 lbs/acre) in areas that may be used by YBCU for foraging during time periods when these species may be present on the base. If applied at a rate of 011 lbs a.e./acre the HQ for this scenario is 0.6 or a dose of 12.4 mg/kg/bw for a 10 g bird. No aquatic exposure scenarios for aminopyralid resulted in HQs greater than 1 (Table 2).

Table 1. Aminopyralid Risk Characterization for Terrestrial Animals.

Application Rate (spot treatment):		0.22	lbs. a.e./acre		
Scenario	**Receptor**	**Hazard Quotient**			**Toxicity Value**
		Central	**Lower**	**Upper**	
Acute/Accidental Exposures (mg/kg/event)					mg/kg/bw
Direct Spray					
first-order absorption	Small mammal	5.6E-04	1.1E-04	3.0E-03	104
100% absorption	Small mammal	0.05	0.05	0.05	104
100% absorption	Honey Bee	0.03	0.03	0.03	1075
Contaminated Vegetation					
Fruit	Small Mammal	2.6E-03	2.6E-03	5.7E-03	104
Grass	Small Mammal	0.03	0.03	0.09	104
Grass	Large Mammal	0.04	0.04	0.10	104
Grass	Large Bird	0.42	0.42	**1.2**	14
Contaminated Water					
Accidental spill	Small Mammal	5.6E-04	2.8E-04	5.6E-03	104
Expected Peak Conc.		3.1E-05	6.2E-07	1.9E-04	104
Contaminated Insects					
	Small Mammal	0.05	0.05	0.15	104
	Small Bird	0.59	0.59	**1.8**	14
Consumption of contaminated Fish					
Accidental spill	Fish-eating bird	2.9E-03	7.0E-04	0.04	14
Consumption of contaminated small mammal					
	Carnivorous mammal	4.4E-03	4.4E-03	4.4E-03	104
	Carnivorous bird	0.05	0.05	0.05	14
Chronic/Longer Term Exposures (dose in mg/kg/day)					
Contaminated Vegetation					
On-site	Small Mammal	1.2E-04	4.6E-05	6.0E-04	50
Off-Site		1.2E-06	2.7E-07	1.1E-05	50
On-Site	Large Mammal	4.8E-03	1.3E-03	0.05	50
Off-Site		1.6E-04	7.4E-05	1.0E-03	50
On-Site	Large Bird	2.1E-03	5.4E-04	0.02	184
Off-Site		6.9E-05	3.1E-05	4.3E-04	184
Contaminated Water					
Water consumption	Small Mammal	2.6E-05	6.4E-07	1.7E-04	50
Consumption of contaminated Fish					
chronic	Fish-eating bird	4.8E-06	6.0E-08	4.7E-05	184

Table 2. Aminopyralid Summary of Aquatic Hazard Quotients.

Application Rate (spot treatment):		0.22*	lbs a.e./acre		
Summary of Concentration in Water					
		Concentrations (mg/L)			
	Scenario	**Central**	**Lower**	**Upper**	
	Accidental Spill	0.40121	0.19682	4.0121	
	Peak EEC	0.022	0.00044	0.132	
	Longer-term EEC	0.0088	0.00022	0.0572	
Summary of Risk Characterizations					
Receptor	**Scenario**	**Hazard Quotients**			**Toxicity Values** (mg/L)
		Central	**Lower**	**Upper**	
Fish					
Sensitive Species					
	Accidental Spill	8.0E-03	3.9E-03	0.08	50
	Peak EEC	4.4E-04	8.8E-06	2.6E-03	50
	Longer-term EEC	6.5E-03	1.6E-04	0.04	1.36
Tolerant Species					
	Accidental Spill	4.0E-03	2.0E-03	0.04	100
	Peak EEC	2.2E-04	4.4E-06	1.3E-03	100
	Longer-term EEC	6.5E-03	1.6E-04	0.04	1.36
Aquatic invertebrate					
Sensitive Species					
	Accidental Spill	4.5E-03	2.2E-03	0.05	89
	Peak EEC	2.5E-04	4.9E-06	1.5E-03	89
	Longer-term EEC	8.6E-05	2.2E-06	5.6E-04	102
Tolerant Species					
	Accidental Spill	4.1E-03	2.0E-03	0.04	98.6
	Peak EEC	2.2E-04	4.5E-06	1.3E-03	98.6
	Longer-term EEC	8.6E-05	2.2E-06	5.6E-04	102
Amphibian					
Sensitive Species					
	Accidental Spill	4.2E-03	2.1E-03	0.04	95.2
	Peak EEC	2.3E-04	4.6E-06	1.4E-03	95.2
	Longer-term EEC	9.2E-05	2.3E-06	6.0E-04	95.2
Tolerant Species					
	Accidental Spill	4.2E-03	2.1E-03	0.04	95.2
	Peak EEC	2.3E-04	4.6E-06	1.4E-03	95.2
	Longer-term EEC	9.2E-05	2.3E-06	6.0E-04	95.2

3.2 Chlorsulfuron (Reference SERA 2004a)

The only application scenario for chlorsulfuron that generated a HQ greater than 1 was the direct spray of a honey bee (HQ = 1.5) (Table 3). This scenario applies to VELB and monarch butterflies. The scenario assumes that 50% of a honey bee's body is sprayed and absorbs 100% of the chemical in the application solution. At an application rate of 0.24 lbs/acre this results in a dose of approximately 38.5 mg/kg/bw. Honeybees are smaller than VELB or monarch butterflies, but these species have a larger surface area, making it difficult to estimate if they would absorb a greater or lesser dose of chemical than honey bees if sprayed directly. This risk will be mitigated by implementing the species-specific herbicide application AMMs.

Consumption of on-site contaminated vegetation by a large mammal reached the threshold of concern for the most extreme exposure scenario. These scenarios used the label maximum application rate. For chlorsulfuron this application rate is only allowed for spot treatment of ½ or less of the area of each acre treated. In addition, none of the target plant species are considered high-quality forage for deer or other herbivores. Therefore, it is unlikely that a large mammal would consume sufficient spot-treated vegetation to ingest the dose required to exceed the threshold of concern.

No aquatic exposure scenarios for chlorsulfuron resulted in HQs greater than 1 (Table 4).

Table 3. Chlorsulfuron Risk Characterization for Terrestrial Animals.

Application Rate:		0.24*	lbs/acre		
Scenario	**Receptor**	**Hazard Quotient**			**Toxicity Value**
		Central	**Lower**	**Upper**	
Acute/Accidental Exposures (mg/kg/event)					mg/kg/bw
Direct Spray					
first-order absorption	Small mammal	3.3E-04	6.5E-05	1.7E-03	75
100% absorption	Small mammal	0.08	0.08	0.08	75
100% absorption	Honey Bee	**1.5**	**1.5**	**1.5**	25
Contaminated Vegetation					
Fruit	Small Mammal	4.0E-03	4.0E-03	8.6E-03	75
Grass	Large Mammal	0.06	0.06	0.16	75
Grass	Large Bird	4E-03	4E-03	0.01	1686
Contaminated Water					
Accidental spill	Small Mammal	1.2E-03	1.4E-04	2.1E-03	75
Expected Peak Conc.		4.7E-05	4.7E-06	9.4E-05	75
Contaminated Insects					
	Small Mammal	0.07	0.07	0.22	75
	Small Bird	5.4E-03	5.4E-03	0.02	1686
Consumption of contaminated Fish					
Accidental spill	Fish-eating bird	1E-04	6E-06	2E-04	1686
Consumption of contaminated small mammal					
	Carnivorous mammal	6.7E-03	6.7E-03	6.7E-03	75
	Carnivorous bird	4.6E-04	4.6E-04	4.6E-04	1686
Chronic/Longer Term Exposures (dose in mg/kg/day)					
Contaminated Vegetation					
On-site	Small Mammal	2.5E-03	1.3E-03	0.01	5
Off-Site		2.6E-05	7.3E-06	2.0E-04	5
On-Site	Large Mammal	0.1	3E-02	**1.0**	5
Off-Site		3.5E-03	2.0E-03	0.02	5
On-Site	Large Bird	5.8E-03	1.9E-03	0.05	140
Off-Site		2.0E-04	1.1E-04	1.0E-03	140
Contaminated Water					
Water consumption	Small Mammal	4.2E-06	7.0E-07	6.3E-06	5
Consumption of contaminated Fish					
chronic	Fish-eating bird	1.2E-06	1.0E-07	2.8E-06	140

*Maximum spot-treatment label rate, total application area may not exceed 50% of a given acre

Table 4. Chlorsulfuron Summary of Aquatic Hazard Quotients.

Application Rate:		0.24*	lbs/acre		
Summary of Concentration in Water					
		Concentrations (mg/L)			
	Scenario	**Central**	**Lower**	**Upper**	
	Accidental Spill	0.62	0.07	1.06	
	Peak EEC	0.02	2.4E-03	0.05	
	Longer-term EEC	1.4E-04	2.4E-05	2.2E-04	
Summary of Risk Characterizations					
Receptor	**Scenario**	**Hazard Quotients**			**Toxicity Values** (mg/L)
		Central	**Lower**	**Upper**	
Fish					
Sensitive Species					
	Accidental Spill	0.02	2.4E-03	0.04	30
	Peak EEC	8.0E-04	8.0E-05	1.6E-03	30
	Longer-term EEC	4.5E-05	7.5E-06	6.8E-05	3.2
Tolerant Species					
	Accidental Spill	2.1E-03	2.4E-04	3.5E-03	300
	Peak EEC	8.0E-05	8.0E-06	1.6E-04	300
	Longer-term EEC	4.5E-06	7.5E-07	6.8E-06	32
Aquatic invertebrate					
Sensitive Species					
	Accidental Spill	0.06	7E-03	0.1	10
	Peak EEC	2.4E-03	2.4E-04	4.8E-03	10
	Longer-term EEC	7.2E-06	1.2E-06	1.1E-05	20
Tolerant Species					
	Accidental Spill	0.02	2.1E-03	0.03	35
	Peak EEC	6.9E-04	6.9E-05	1.4E-03	35
	Longer-term EEC	2.1E-06	3.4E-07	3.1E-06	70

3.3 Glyphosate (Reference SERA 2011a)

3.3.1 Glyphosate Higher Toxicity Formulations (Roundup Pro, Ranger Pro, Razor Pro, Glyphos Pro)

There are a number of commercially available glyphosate formulations which, for the purpose of this analysis, have been characterized as more or less toxic. While some formulations cannot be easily classified as more or less toxic, the general approach is: formulations that contains a polyoxyethyleneamine (POEA) surfactant should be regarded as more toxic, unless there is compelling evidence to the contrary. Studies have found that the toxicity of the original Roundup and similar formulations containing POEA surfactants is greater than the toxicity of technical grade glyphosate, Rodeo, or other formulations that do not contain surfactants. Aquatic animals appear to be the most sensitive to the effects of POEA-containing formulations.

A number of exposure scenarios for higher toxicity formulations yielded HQs greater than 1 for both terrestrial and aquatic animals (Tables 5 and 6). The scenario of consumption of a contaminated insect by a small bird resulted in a HQ = 1.7 at the highest estimated residue rate. This scenario applies to YBCU. A NOAEL of 540 mg/kg/bw for birds exposed to higher toxicity formulations of glyphosate is based on multiple studies using species including mallards, chickens, and bobwhite quails. The scenario assumes a 10 g bird consumes a contaminated insect, ingesting a dose of glyphosate of 905 mg/kg/bw at the highest estimated residue rate. As discussed in the section on aminopyralid, YBCU are larger than 10 g. If the scenario is run for birds 40-75 g the dose is calculated to be 523-408 mg/kg/bw at the highest estimated residue rate, below the NOAEL for birds.

The scenario of direct spray of 50% of a honey bee's body from 0 feet away also resulted in HQs greater than 1. The scenarios assumed different percentages of "foliar interception". No foliar interception resulted in a HQ = 2.1, 50% interception HQ = 1.1, 90% interception HQ = 0.2. The HQ also decreases as the distance between the insect and the sprayer increases. At 25 feet downwind no HQs were greater than 1. These exposure scenarios apply to VELB and monarch butterfly. Both VELB and monarch butterflies are larger than honey bees, but their surface area is also greater.

The accidental acute exposure scenarios (spills) generated for aquatic animals all yielded HQs greater than 1, as did a number of the non-accidental acute exposure scenarios.

Because traditional glyphosate formulations (that contain POEA surfactants) pose a higher risk to aquatic wildlife, they will not be used in or around aquatic resources (including vernal pools). Glyphosate binds to soil, and so has a low runoff potential. For this reason, adherence to the buffers for aquatic resources specified on the product label should be sufficient to prevent herbicide exposure to listed species. If glyphosate is used in or around aquatic resources, only formulations approved for aquatic use, that do not contain surfactants, will be used (discussed below).

Table 5. Glyphosate (non-aquatic formulation – Roundup Pro) Summary of Hazard Quotients for the Terrestrial Animals.

Application Rate:	8	lb a.e./acre			
Scenario	**Receptor**	**Hazard Quotients**			**Toxicity Value**
		Central	**Lower**	**Upper**	
Accidental Acute Exposures					mg/kg/bw
Direct Spray					
first-order absorption	Small mammal	0.01	3.5E-03	0.03	175
100% absorption	Small mammal	**1.1**	**1.1**	**1.1**	175
Direct Spray	Honey Bee	0.2	**1.1**	**2.1**	
Contaminated Water					
Spill	Small Mammal	0.03	2.4E-03	0.1	175
Spill	Canid	0.02	1.4E-03	0.07	175
Spill	Large Mammal	0.01	1.1E-03	0.05	175
Spill	Small Bird	0.02	1.4E-03	0.07	540
Spill	Large Bird	2.5E-03	2.0E-04	0.01	540
Consumption of contaminated Fish					
Spill	Fish-eating bird	3.5E-03	1.4E-04	2.1E-02	540
Non-Accidental Acute Exposures					
Contaminated Vegetation					
Fruit	Small Mammal	0.05	0.02	0.12	175
Grass	Small Mammal	0.65	0.23	**1.8**	175
Grass	Large Mammal	0.86	0.30	**2**	175
Grass	Large Bird	0.44	0.15	**1.2**	540
Contaminated Water					
	Small Mammal	7.4E-05	8.7E-06	5.6E-04	175
	Canid	4.2E-05	5.0E-06	3.2E-04	175
	Large Mammal	3.3E-05	3.8E-06	2.5E-04	175
	Small Bird	4.4E-05	5.2E-06	3.3E-04	540
	Large Bird	6.1E-06	7.2E-07	4.6E-05	540
Contaminated Insects					
	Small Mammal	**1.1**	0.4	**3**	175
	Small Bird	0.6	0.2	**1.7**	540
Consumption of small mammal (after direct spray) by predator					

	Carnivorous mammal	0.10	0.10	0.10	175
	Carnivorous bird	0.05	0.05	0.05	540
Consumption of contaminated Fish					
	Fish-eating bird	8.5E-06	5.0E-07	9.6E-05	540
Chronic/Longer Term Exposures					
Contaminated Vegetation					
On-site	Small Mammal	8.6E-04	2.0E-04	3.7E-03	175
Off-Site		3.7E-06	4.7E-07	3.1E-05	175
On-Site	Large Mammal	0.04	4.8E-03	0.39	175
Off-Site		5.9E-04	1.2E-04	3.2E-03	175
On-Site	Large Bird	0.26	0.03	**2**	43
Off-Site		3.8E-03	7.5E-04	0.02	43
Contaminated Water					
	Small Mammal	1.3E-06	5.9E-07	3.9E-05	175
	Canid	7.3E-07	3.4E-07	2.2E-05	175
	Large Mammal	5.6E-07	2.6E-07	1.7E-05	175
	Small Bird	9.5E-06	4.4E-06	2.9E-04	43
	Large Bird	1.3E-06	6.1E-07	4.0E-05	43
Consumption of contaminated Fish					
	Fish-eating bird	1.8E-06	4.3E-07	8.4E-05	43

Table 6. Glyphosate (non-aquatic formulation – Roundup Pro) Summary of Hazard Quotients for Aquatic Species.

Application Rate:	8	lb a.e./acre			
Exposures		**Concentrations** (mg/L)			
	Scenario	**Central**	**Lower**	**Upper**	
	Accidental Spill	36.3	2.9	143.8	
	Peak EEC	0.09	0.01	0.66	
	Chronic	1.5E-03	7.0E-04	0.05	
Receptor	**Type**	**Hazard Quotients**			**Toxicity Value**
		Central	**Lower**	**Upper**	
Accidental Acute Exposures					mg/L
Fish	Sensitive	**757**	**60**	**2,996**	0.048
	Tolerant	**73**	**6**	**288**	0.5
Amphibian	Sensitive	**908**	**72**	**3,596**	0.04
	Tolerant	**14**	**1.1**	**55**	2.6
Invertebrate	Sensitive	**484**	**38**	**1,918**	0.075
	Tolerant	**16**	**1.3**	**63**	2.3
Non-Accidental Acute Exposures					
Fish	Sensitive	**1.8**	0.22	**14**	0.048
	Tolerant	0.18	0.02	**1.3**	0.5
Amphibian	Sensitive	**2**	0.26	**17**	0.04
	Tolerant	0.03	4.0E-03	0.26	2.6
Invertebrate	Sensitive	**1.2**	0.14	**9**	0.075
	Tolerant	0.04	4.5E-03	0.29	2.3
Chronic/Longer Term Exposures					
Fish	Sensitive	0.03	0.01	**1.0**	0.048
	Tolerant	3.0E-03	1.4E-03	0.09	0.5
Amphibian	Sensitive	0.04	0.02	**1.2**	0.04
	Tolerant	5.8E-04	2.7E-04	2E-02	2.6
Invertebrate	Sensitive	0.02	9.4E-03	0.62	0.075
	Tolerant	6.6E-04	3.1E-04	0.02	2.3

3.3.2 Glyphosate Lower Toxicity Formulations (Rodeo, Roundup Custom)

Glyphosate will not be applied directly to water for any projects on Beale AFB, but there is the potential for run-off, overspray, or drift when it is applied to riparian or wetland vegetation. If a glyphosate-based herbicide will be used in riparian areas or around vernal pools a lower toxicity, aquatic-safe formulation will be used. These formulations do not contain any surfactants, if a surfactant is needed a non-ionic surfactant approved for aquatic use will be added to the tank mix prior to application.

The only terrestrial animal exposure scenarios that yielded an HQ greater than 1 are the consumption of a contaminated insect by a small mammal, and the long-term consumption of contaminated vegetation by a large bird (Table 7). There are no listed mammal or large herbivorous bird species on Beale AFB, so this scenario does not pose a risk to any federally listed species.

A number of accidental exposure (spill) scenarios generated HQs greater than 1 for aquatic wildlife including both sensitive fish and aquatic invertebrate species (Table 8). These scenarios apply to CV steelhead, VPTS, and VPFS. The risk of herbicide exposure from spills will be minimized by following the herbicide mixing and storage Best Management Practices (BMPs). When herbicide will be applied in areas with dense vernal pools, the project will be monitored and access routes that avoid vernal pools will be designated by a USFWS approved biologist. One non-accidental acute exposure scenario resulted in a HQ greater than 1 – the direct exposure of a sensitive fish species to spray from a highly concentrated field solution (HQ = 1.3).

Of the many studies available on glyphosate and glyphosate IPA, the only clearly documented toxicity study on Rodeo was conducted by Mitchell et al (1987) and reports an LC_{50} of 429 mg a.e./L for trout. However, Rodeo and similar formulations require the use of surfactants. The surfactants used with Rodeo and similar formulations are less toxic than POEA surfactants, but even these less toxic surfactants will enhance the toxicity of glyphosate. Three surfactants would be classified as Practically Nontoxic to fish (LC_{50} values >100 mg/L)—i.e., Agri-Dex, LI 700, and Geronol CF/AR.

Another complicating factor to this analysis is that the toxicity of glyphosate to fish is strongly connect to water pH. Wan et al. (1989) conducted assays at pH values ranging from 6.3 to 8.2. The test species least sensitive to pH variance were Coho salmon, as indicated by the range of LC_{50} values (27 mg a.e./L at pH 6.3 to 174 mg a.e./L at pH 8.2) which varied by a factor of about 6. Rainbow trout were the test species most sensitive to pH variance, with LC_{50} values ranging from 10 mg a.e./L at pH 6.3 to 197 mg a.e./L at pH 8.2—i.e., a factor of nearly 20. The differences in sensitivity among the five test species are relatively minor at the same pH. In other words, pH appears to be a more important factor in acute lethal toxicity, relative to species differences.

The toxicity value for aquatic invertebrates used in the risk scenario is based on a number of studies using daphnia, copepods, and freshwater mussels. Rodeo (i.e., essentially an aqueous solution of the IPA salt of glyphosate) and other equivalent formulations are among the least toxic formulations, with LC_{50} values ranging from about 200 to over 4,000 mg a.e./L. Rodeo is much less toxic to aquatic invertebrates than traditional Roundup formulations and other formulations of glyphosate that contain surfactants.

Brausch et al. (2007) conducted a series of bioassays on several pesticide formulations in fairy shrimp (*Thamnocephalus platyurus*). This study found a LC_{50} = 0.38 mg a.e./L, the lowest LC_{50}

identified for any Roundup formulation in aquatic invertebrates. However, this study used Roundup Super Concentrate, which Brausch et al. (2007) believed to contain a POEA surfactant, and as such may not applicable to lower toxicity formulations. In addition, the units for the LC_{50} could not be identified as being expressed in acid equivalents, active ingredient, or formulation. For this reason, this LD_{50} could not be reliably used to determine a NOAEC.

Glyphosate will never be applied directly to water, but it may be used to spray riparian vegetation adjacent to water. If glyphosate is used near Dry Creek or Best Slough it will be done during the time of year when CV steelhead are not likely to be present. In addition, the recommended application rate for target weed species near Dry Creek is 4 lb a.e./acre or less (not the 8 lb a.e./acre used for the risk characterization).

Table 7. Glyphosate (aquatic formulation/non-POEA) Risk Characterization for Terrestrial Animals.

Application Rate:	8	lb a.e./acre			
Scenario	**Receptor**	**Hazard Quotients**			**Toxicity Value**
		Central	**Lower**	**Upper**	
Accidental Acute Exposures					mg/kg/bw
Direct Spray					
first-order absorption	Small mammal	3.8E-03	1.2E-03	9.2E-03	500
100% absorption	Small mammal	0.39	0.39	0.39	500
Contaminated Water					
Spill	Small Mammal	4.2E-03	4.2E-04	0.07	500
Spill	Canid	2.4E-03	2.4E-04	0.04	500
Spill	Large Mammal	1.9E-03	1.9E-04	0.03	500
Spill	Small Bird	2.6E-03	2.6E-04	0.04	1500
Spill	Large Bird	3.6E-04	3.6E-05	6.0E-03	1500
Consumption of contaminated Fish					
Spill	Fish-eating bird	5.0E-04	2.5E-05	0.01	1500
Non-Accidental Acute Exposures					
Contaminated Vegetation					
Fruit	Small Mammal	0.02	0.01	0.04	500
Grass	Small Mammal	0.23	0.08	0.65	500
Grass	Large Mammal	0.30	0.11	0.85	500
Grass	Large Bird	0.16	0.06	0.44	1500
Contaminated Water					
	Small Mammal	1.7E-04	8.6E-05	4.3E-04	500
	Canid	9.9E-05	5.0E-05	2.5E-04	500
	Large Mammal	7.6E-05	3.8E-05	1.9E-04	500
	Small Bird	1.1E-04	5.3E-05	2.6E-04	1500
	Large Bird	1.5E-05	7.3E-06	3.7E-05	1500
Contaminated Insects					
	Small Mammal	0.37	0.12	**1.1**	500
	Small Bird	0.20	0.07	0.6	1500
Consumption of small mammal (after direct spray) by predator					
	Carnivorous mammal	0.03	0.03	0.03	500
	Carnivorous bird	0.02	0.02	0.02	1500
Consumption of contaminated Fish					
	Fish-eating bird	2.0E-05	5.1E-06	7.6E-05	1500
Chronic/Longer Term Exposures					
Contaminated Vegetation					
On-site	Small Mammal	3.0E-04	6.9E-05	1.3E-03	500
Off-Site		1.3E-06	1.7E-07	1.1E-05	500
On-Site	Large Mammal	0.01	1.7E-03	0.14	500
Off-Site		2E-04	4.1E-05	1.1E-03	500
On-Site	Large Bird	0.20	0.02	**1.8**	58
Off-Site		2.8E-03	5.5E-04	0.02	58
Contaminated Water					

	Small Mammal	2.8E-05	5.5E-06	2.5E-04	500
	Canid	1.6E-05	3.2E-06	1.4E-04	500
	Large Mammal	1.2E-05	2.4E-06	1.1E-04	500
	Small Bird	4.4E-04	8.8E-05	3.9E-03	58
	Large Bird	6.1E-05	1.2E-05	5.4E-04	58
Consumption of contaminated Fish					
	Fish-eating bird	8.4E-05	8.5E-06	1.1E-03	58

Table 8. Glyphosate (aquatic formulation – Rodeo/Roundup Custom) Risk Characterization for Aquatic Species.

Application Rate:	8	lb a.e./acre			
Exposures		**Concentrations** (mg/L)			
	Scenario	**Central**	**Lower**	**Upper**	
	Accidental Spill	14.4	1.4	242.2	
	Peak EEC	0.09	0.01	0.66	
	Chronic	1.5E-03	7.0E-04	0.05	
Receptor	**Type**	**Hazard Quotients**			**Toxicity Value**
		Central	**Lower**	**Upper**	
Accidental Acute Exposures (Spill)					mg/L
Fish	Sensitive	**29**	**3**	**484**	0.5
	Tolerant	0.68	0.07	**12**	21
Amphibian	Sensitive	0.04	4.2E-03	0.7	340
	Tolerant	0.03	3.1E-03	0.5	470
Invertebrate	Sensitive	**5**	0.5	**90**	2.7
	Tolerant	0.07	6.8E-03	**1.2**	210
Non-Accidental Acute Exposures					
Fish	Sensitive	0.18	0.02	**1.3**	0.5
	Tolerant	4.2E-03	5.0E-04	0.03	21
Amphibian	Sensitive	2.6E-04	3.1E-05	2.0E-03	340
	Tolerant	1.9E-04	2.2E-05	1.4E-03	470
Invertebrate	Sensitive	0.03	3.9E-03	0.25	2.7
	Tolerant	4.2E-04	5.0E-05	3.2E-03	210
Chronic/Longer Term Exposures					
Fish	Sensitive	3.0E-03	1.4E-03	0.09	0.5
	Tolerant	7.2E-05	3.4E-05	2.2E-03	21
Amphibian	Sensitive	8.4E-04	3.9E-04	0.03	1.8
	Tolerant	8.4E-04	3.9E-04	0.03	1.8
Invertebrate	Sensitive	1.5E-03	7.0E-04	0.05	1
	Tolerant	7.2E-06	3.4E-06	2.2E-04	210

3.4 Imazamox (Reference SERA 2010)

None of the exposure scenarios for imazamox result in HQs greater than 1 (Tables 9 and 10). Imazamox would only be used for aquatic applications on Beale AFB, therefore the scenarios are limited to exposure risks from contact with or consumption of contaminated water. There is no toxicity data available for sensitive fish and aquatic invertebrate species, so the risk to CV steelhead, VPTS, and VPFS are unknown. Imazamox applications will not have the potential to affect listed vernal pool shrimp species because it will not be applied in or near vernal pools. If imazamox is applied to waters that drain into Dry Creek or Best Slough it would be done when CV steelhead are not likely to be present.

Table 9. Imazamox Risk Characterization for Terrestrial Animals.

Application Rate:	0.5	ppm			
Scenario	**Receptor**	**Hazard Quotients**			**Toxicity Value**
		Central	**Lower**	**Upper**	
Accidental Acute Exposures					mg/kg/bw
Direct Spray					
first-order absorption	Small mammal	No exposure assessment.			
100% absorption	Small mammal	No exposure assessment.			
Contaminated Water					
Spill	Small Mammal	4.4E-03	1.5E-03	0.01	300
Spill	Canid	2.6E-03	8.4E-04	5.7E-03	300
Spill	Large Mammal	2.0E-03	6.5E-04	4.4E-03	300
Spill	Small Bird	1.4E-03	4.8E-04	3.2E-03	1700
Spill	Large Bird	2.0E-04	6.6E-05	4.5E-04	1700
Consumption of contaminated Fish					
Spill	Fish-eating bird	5.3E-05	8.8E-06	1.8E-04	1700
Non-Accidental Acute Exposures					
Contaminated Vegetation					
Fruit	Small Mammal	No exposure assessment.			
Grass	Small Mammal	No exposure assessment.			
Grass	Large Mammal	No exposure assessment.			
Grass	Large Bird	No exposure assessment.			
Contaminated Water					
	Small Mammal	2.4E-04	2.4E-04	2.4E-04	300
	Canid	1.4E-04	1.4E-04	1.4E-04	300
	Large Mammal	1.1E-04	1.1E-04	1.1E-04	300
	Small Bird	7.9E-05	7.9E-05	7.9E-05	1700
	Large Bird	1.1E-05	1.1E-05	1.1E-05	1700
Contaminated Insects					
	Small Mammal	No exposure assessment.			
	Small Bird	No exposure assessment.			
Consumption of small mammal (after direct spray) by predator					
	Carnivorous mammal	No exposure assessment.			
	Carnivorous bird	No exposure assessment.			
Consumption of contaminated Fish					
	Fish-eating bird	2.9E-06	1.5E-06	4.4E-06	1700
Chronic/Longer Term Exposures					
Contaminated Vegetation					
On-site	Small Mammal	No exposure assessment.			
Off-Site		No exposure assessment.			
On-Site	Large Mammal	No exposure assessment.			
Off-Site		No exposure assessment.			
On-Site	Large Bird	No exposure assessment.			
Off-Site		No exposure assessment.			
Contaminated Water					
	Small Mammal	1.8E-04	1.8E-04	1.8E-04	300
	Canid	1.0E-04	1.0E-04	1.0E-04	300
	Large Mammal	7.8E-05	7.8E-05	7.8E-05	300
	Small Bird	5.1E-04	5.1E-04	5.1E-04	190
	Large Bird	7.1E-05	7.1E-05	7.1E-05	190
Consumption of contaminated Fish					
	Fish-eating bird	1.9E-05	9.5E-06	2.8E-05	190

Table 10. Imazamox Summary of Hazard Quotients for Aquatic Species.

Application Rate:	0.5	ppm			
Exposures		**Concentrations** (mg/L)			
	Scenario	**Central**	**Lower**	**Upper**	
	Accidental Spill	9.1	3.0	20.4	
	Peak EEC	0.50	0.50	0.50	
	Chronic	0.36	0.36	0.36	
Receptor	**Type**	**Hazard Quotients**			**Toxicity Value**
		Central	**Lower**	**Upper**	
Accidental Acute Exposures					mg/L
Fish	Sensitive	No toxicity data.			N/A
	Tolerant	0.08	0.03	0.18	115
Amphibian	Sensitive	No toxicity data.			N/A
	Tolerant	No toxicity data.			N/A
Invertebrate	Sensitive	No toxicity data.			N/A
	Tolerant	0.08	0.03	0.18	115
Non-Accidental Acute Exposures					
Fish	Sensitive	No toxicity data.			N/A
	Tolerant	4.3E-03	4.3E-03	4.3E-03	115
Amphibian	Sensitive	No toxicity data.			N/A
	Tolerant	No toxicity data.			N/A
Invertebrate	Sensitive	No toxicity data.			N/A
	Tolerant	4.3E-03	4.3E-03	4.3E-03	115
Chronic/Longer Term Exposures					
Fish	Sensitive	No toxicity data.			N/A
	Tolerant	No toxicity data.			N/A
Amphibian	Sensitive	No toxicity data.			N/A
	Tolerant	No toxicity data.			N/A
Invertebrate	Sensitive	No toxicity data.			N/A
	Tolerant	No toxicity data.			N/A

3.5 Imazapyr (Reference SERA 2011b)

Three exposure scenarios for terrestrial wildlife resulted in HQs greater than 1. Two were acute exposure scenarios - the consumption of contaminated vegetation by a small mammal (HQ = 1.4) or a small bird (HQ = 1.0) at the highest estimated residue rate (Table 11). The other was a chronic exposure scenario of consumption of contaminated vegetation by a small bird. Because there are no listed mammals or small herbivorous birds on Beale AFB these scenarios will not affect listed species. The imazapyr risk assessment worksheets did not include honey bees, but in both the oral and contact toxicity studies, the LD_{50} for imazapyr is >100 µg/bee, or approximately 860 mg/kg/bw. This dose is comparable to the NOAEL values reported in experimental mammals and birds. This similarity suggests that the toxicity of imazapyr to terrestrial invertebrates may be similar to the toxicity of this compound to terrestrial vertebrates.

One exposure scenario for aquatic wildlife resulted in a HQ greater than 1 – the exposure of a sensitive fish species from an herbicide spill of the most concentrated field tank mixture (HQ = 3) (Table 12). This scenario applies to CV steelhead. Toxicity values are based on the most recent EPA ecological risk assessment, which uses a 96-hour LC_{50} of >100 mg a.e./L in trout for acute exposures and a NOAEC of 43.1 mg a.e./L in trout for longer-term exposures (U.S. EPA 2007). A concern with the EPA dose-response assessment for fish involves the greater toxicity of the Arsenal formulation, relative to imazapyr acid and the isopropylamine salt of imazapyr. For this reason, the imazapyr formulation Habitat or an equivalent formulation will be used if application is required near aquatic resources. The risk of herbicide exposure from spills will be minimized by following herbicide mixing and storage BMPs.

Table 11. Imazapyr Summary of Hazard Quotients (Toxicity) for the Terrestrial Animals.

Application Rate:	1.5	lb a.e./acre			
Scenario	**Receptor**	**Hazard Quotients**			**Toxicity Value**
		Central	**Lower**	**Upper**	
Accidental Acute Exposures					mg/kg/bw
Direct Spray					
first-order absorption	Small mammal	1.3E-03	5.2E-04	3.3E-03	738
100% absorption	Small mammal	0.05	0.05	0.05	738
Contaminated Water					
Spill	Small mammal	6.8E-04	2.7E-05	5.4E-03	738
Spill	Larger Mammal	5.0E-04	2.0E-05	4.0E-03	738
Spill	Canid	1.1E-03	4.6E-05	9.2E-03	250
Spill	Large Mammal	3.0E-04	1.2E-05	2.4E-03	738
Spill	Small bird	3.7E-04	1.5E-05	2.9E-03	2510
Spill	Large Bird	5.1E-05	2.0E-06	4.1E-04	2510
Consumption of contaminated Fish					
Spill	Large Mammalian Carnivore	6.8E-05	2.7E-07	3.1E-03	738
Spill	Canid	2.9E-04	1.2E-06	0.01	250
Spill	Fish-eating bird	3.4E-05	1.3E-07	1.5E-03	2510
Non-Accidental Acute Exposures					
Contaminated Fruit (Lowest Residue Rate)					
	Small mammal	0.03	4.4E-03	0.12	738
	Larger Mammal	7.4E-03	1.0E-03	0.03	738
	Large Mammal	4.2E-03	5.8E-04	0.02	738
	Small bird	0.02	2.8E-03	0.08	2510
	Large Bird	2.4E-03	3.2E-04	8.6E-03	2510
Contaminated Vegetation (Short Grass - Highest Residue Rate)					
	Small mammal	0.29	0.03	**1.4**	738
	Larger Mammal	0.07	7.1E-03	0.32	738
	Large Mammal	0.04	4.0E-03	0.18	738
	Small bird	0.21	0.02	**1.0**	2510
	Large Bird	0.02	2.6E-03	0.12	2510
Contaminated Water					
	Small mammal	6.0E-06	2.7E-09	7.7E-05	738
	Larger Mammal	4.4E-06	2.0E-09	5.7E-05	738
	Canid	1.0E-05	4.6E-09	1.3E-04	250
	Large Mammal	2.6E-06	1.2E-09	3.4E-05	738
	Small bird	3.2E-06	1.5E-09	4.2E-05	2510
	Large Bird	4.5E-07	2.0E-10	5.8E-06	2510
Contaminated Insects					
	Small mammal	0.04	3.9E-03	0.20	738
	Larger Mammal	8.9E-03	8.9E-04	0.05	738
	Small bird	0.03	2.6E-03	0.13	2510
Consumption of small mammal (after direct spray) by predator					
	Canid	0.02	0.02	0.02	250
	Carnivorous bird	1.9E-03	1.9E-03	1.9E-03	2510
Consumption of contaminated Fish					
	Large Mammalian Carnivore	6.0E-07	2.7E-11	4.4E-05	738
	Canid	2.6E-06	1.1E-10	1.9E-04	250
	Fish-eating bird	3.0E-07	1.3E-11	2.2E-05	2510
Chronic/Longer Term Exposures					
Contaminated Fruit (Lowest Residue Rate)					
	Small mammal	0.01	1.0E-03	0.06	738
	Larger Mammal	3.1E-03	2.4E-04	0.01	738
	Large Mammal	1.8E-03	1.4E-04	0.01	738
	Small bird	3.6E-02	2.8E-03	0.15	610

	Large Bird	4.1E-03	3.2E-04	0.02	610
Contaminated Vegetation (Short Grass - Highest Residue Rate)					
	Small mammal	0.1	7.3E-03	0.68	738
	Larger Mammal	0.03	1.7E-03	0.15	738
	Large Mammal	0.02	9.5E-04	0.09	738
	Small bird	0.4	0.02	**2**	610
	Large Bird	0.04	2.5E-03	0.2	610
Contaminated Water					
	Small mammal	2.1E-06	8.9E-10	3.6E-05	738
	Larger Mammal	1.5E-06	6.6E-10	2.6E-05	738
	Canid	3.5E-06	1.5E-09	6.1E-05	250
	Large Mammal	9.2E-07	3.9E-10	1.6E-05	738
	Small bird	4.6E-06	2.0E-09	8.0E-05	610
	Large Bird	6.4E-07	2.8E-10	1.1E-05	610
Consumption of contaminated Fish					
	Large Mammalian Carnivore	2.1E-07	9.0E-12	2.0E-05	738
	Canid	8.9E-07	3.8E-11	8.7E-05	250
	Fish-eating bird	4.3E-07	1.8E-11	4.1E-05	610

Table 12. Imazapyr Risk Characterization for Aquatic Species.

Application Rate:	1.5	lb a.e./acre			
Exposures		**Concentrations** (mg/L)			
	Scenario	**Central**	**Lower**	**Upper**	
	Accidental Spill	3.4	0.14	27.2	
	Peak EEC	0.03	1.4E-05	0.39	
	Chronic	0.01	4.5E-06	0.18	
Receptor	**Type**	**Hazard Quotients**			**Toxicity Value**
		Central	**Lower**	**Upper**	
Accidental Acute Exposures (Spill)					mg/L
Fish	Sensitive	0.33	0.01	**3**	10.4
	Tolerant	No toxicity data.			N/A
Amphibian	Sensitive	No toxicity data.			N/A
	Tolerant	No toxicity data.			N/A
Invertebrate	Sensitive	No toxicity data.			N/A
	Tolerant	0.08	3E-03	0.66	41
Non-Accidental Acute Exposures					
Fish	Sensitive	2.9E-03	1.3E-06	0.04	10.4
	Tolerant	No toxicity data.			N/A
Amphibian	Sensitive	No toxicity data.			N/A
	Tolerant	No toxicity data.			N/A
Invertebrate	Sensitive	No toxicity data.			N/A
	Tolerant	7.3E-04	3.3E-07	0.01	41
Chronic/Longer Term Exposures					
Fish	Sensitive	2.6E-03	1.1E-06	0.05	4
	Tolerant	8.8E-04	3.8E-07	0.02	12
Amphibian	Sensitive	No toxicity data.			N/A
	Tolerant	No toxicity data.			N/A
Invertebrate	Sensitive	No toxicity data.			N/A
	Tolerant	8.8E-04	3.8E-07	0.02	12

3.6 Sulfometuron Methyl (Reference SERA 2004b)

Two exposure scenarios for terrestrial animals generated HQs greater than 1 – chronic exposure through consumption of contaminated vegetation by a large mammal (HQ = 1.1) or a large bird (HQ = 1.7) at the highest estimated residue rate (Table 13). There are no listed mammals or large herbivorous birds on Beale AFB so these scenarios will not impact listed species.

The only exposure scenarios with HQs greater than 1 for aquatic species are in the case of an amphibian exposed to herbicide from a spill of a field tank mixture (Table 14). The HQs are greater than 1 for all estimated concentrations (HQ = 1.7-13). There are no listed amphibians present on Beale AFB, but western spadefoot toads (*Spea Hammondii*; a California Species of Special Concern) occur on the LRS and potentially Beale AFB. The risk of herbicide exposure from spills will be minimized by following herbicide mixing and storage BMPs.

Table 13. Sulfometuron Methyl Summary of Hazard Quotients for Terrestrial Animals.

Application Rate:		0.281	lbs/acre		
Scenario	**Receptor**	**Hazard Quotient**			**Toxicity Value**
		Central	**Lower**	**Upper**	
Acute/Accidental Exposures (mg/kg/event)					mg/kg/bw
Direct Spray					
first-order absorption	Small mammal	4.1E-04	9.0E-05	1.8E-03	87
100% absorption	Small mammal	0.08	0.08	0.08	87
100% absorption	Honey Bee	0.04	0.04	0.04	1075
Contaminated Vegetation					
Fruit	Small Mammal	4.0E-03	4.0E-03	8.7E-03	87
Grass	Large Mammal	0.06	0.06	0.16	87
Grass	Large Bird	0.02	0.02	0.07	312
Contaminated Water					
Accidental spill	Small Mammal	3E-03	1E-03	9E-03	87
Expected Peak Conc.		5E-07	3E-08	9E-06	87
Contaminated Insects					
	Small Mammal	0.07	0.07	0.22	87
	Small Bird	0.03	0.03	0.10	312
Consumption of contaminated Fish					
Accidental spill	Fish-eating bird	3.7E-03	7.1E-04	0.02	312
Consumption of contaminated small mammal					
	Carnivorous mammal	6.8E-03	6.8E-03	6.8E-03	87
	Carnivorous bird	2.9E-03	2.9E-03	2.9E-03	312
Chronic/Longer Term Exposures (dose in mg/kg/day)					
Contaminated Vegetation					
On-site	Small Mammal	2.8E-03	1.4E-03	0.01	2
Off-Site		2.8E-05	8.1E-06	2.3E-04	2
On-Site	Large Mammal	0.12	0.04	**1.1**	2
Off-Site		3.9E-03	2.2E-03	0.02	2
On-Site	Large Bird	0.18	0.06	**1.7**	2
Off-Site		6.1E-03	3.5E-03	0.03	2
Contaminated Water					
Water consumption	Small Mammal	8.2E-07	2.1E-07	1.4E-06	2
Consumption of contaminated Fish					
chronic	Fish-eating bird	3.4E-06	4.2E-07	8.9E-06	2

Table 14. Sulfometuron Methyl Risk Characterization for Aquatic Species.

Application Rate:		0.281	lbs/acre		
Summary of Concentration in Water					
		Concentrations (mg/L)			
	Scenario	**Central**	**Lower**	**Upper**	
	Accidental Spill	1.7	0.64	5.1	
	Peak EEC	2.8E-04	1.7E-05	5.6E-03	
	Longer-term EEC	1.1E-05	2.8E-06	2.0E-05	
Summary of Risk Characterizations					
Receptor	**Scenario**	**Hazard Quotients**			**Toxicity Values**
		Central	**Lower**	**Upper**	
Fish					mg/L
Sensitive Species					
	Accidental Spill	0.23	0.09	0.69	7.3
	Peak EEC	3.8E-05	2.3E-06	7.7E-04	7.3
	Longer-term EEC	9.6E-06	2.4E-06	1.7E-05	1.17
Tolerant Species					
	Accidental Spill	0.01	4.2E-03	0.03	150
	Peak EEC	1.9E-06	1.1E-07	3.7E-05	150
	Longer-term EEC	9.6E-06	2.4E-06	1.7E-05	1.17
Aquatic invertebrate					
Sensitive Species					
	Accidental Spill	0.02	8.5E-03	0.07	75
	Peak EEC	3.7E-06	2.2E-07	7.5E-05	75
	Longer-term EEC	5.9E-05	1.5E-05	1.0E-04	0.19
Tolerant Species					
	Accidental Spill	9.3E-04	3.5E-04	2.8E-03	1800
	Peak EEC	1.6E-07	9.4E-09	3.1E-06	1800
	Longer-term EEC	1.8E-06	4.6E-07	3.2E-06	6.1
Amphibian					
	Accidental Spill	**4**	**1.7**	**13**	0.38
	Peak EEC	7.4E-04	4.4E-05	0.01	0.38
	Longer-term EEC	0.01	3.7E-03	0.03	0.00075

3.7 Triclopyr (Reference SERA 2011c)

The risk characterization for non-target organisms is concerned with triclopyr acid, triclopyr TEA, and triclopyr BEE, in addition to TCP a metabolite of triclopyr. In terrestrial animals, triclopyr TEA and triclopyr BEE appear to be bioequivalent to triclopyr. For terrestrial plants and most groups of aquatic organisms, however, triclopyr BEE is much more toxic than triclopyr TEA or triclopyr acid. TCP is a concern because it is more toxic than triclopyr (including triclopyr BEE, triclopyr TEA, and triclopyr acid) to most groups of non-target organisms.

A different risk characterization worksheet was used for triclopyr (Pesticide Research Institute 2019) than the other herbicides, so fewer scenarios were analyzed. Because triclopyr BEE is more toxic to aquatic organisms than triclopyr TEA the two are analyzed separately when characterizing the risk to aquatic organisms.

3.7.1 Triclopyr butoxyethyl ester (BEE)

Several exposure scenarios for terrestrial animals resulted in HQs significantly greater than 1 for triclopyr BEE at the highest estimated residue rate (Table 15). These were the chronic consumption of contaminated vegetation by a large mammal at the central (HQ = 7.4) and highest estimated residue rate (HQ = 250) or large bird at the highest residue rate (HQ = 26), and the consumption of a contaminated insect by a small bird at the highest residue rate (HQ = 7.2). The vegetation consumption scenarios do not apply to any listed species on Beale AFB, but the contaminated insect scenario applies to YBCU. As stated before, this scenario assumes a 10 g bird, which is smaller than YBCU. It was not possible to change the weight used in the exposure scenario with the worksheet used for this risk characterization. However, given the high HQ it is likely the HQ for larger birds would still be greater than 1. The toxicity value used is based on studies using quail, mallards, and zebra finch. The studies found a difference in sensitivity to triclopyr BEE among the species tested with mallards having the greatest tolerance (LC_{50} >3385 and >6689 ppm a.e) and zebra finch having the lowest tolerance (LC_{50} = 1383 ppm a.e.).

Two triclopyr BEE exposure scenarios resulted in HQs greater than 1 for aquatic animals – exposure to "first flush" runoff after herbicide application at the highest tank mix concentration for both fish (HQ = 2.6) and aquatic invertebrates (HQ = 5.3) (Table 16). These scenarios apply to CV steelhead, VPTS and VPFS. Acute LC_{50} values for triclopyr BEE range from 0.2 to 1.5 mg a.e./L based on studies using a number of different species including salmonids. Listed aquatic species will not be affected, because triclopyr BEE will not be used within 250 feet of aquatic resources when wet and 75 feet when dry, including vernal pools.

Table 15. Triclopyr BEE Risk Characterization for Terrestrial Animals.

Application Rate:		8	lbs/acre		
Scenario	**Receptor**	**Hazard Quotient**			**Toxicity Value**
		Central	**Lower**	**Upper**	
Acute/Accidental Exposures					mg/kg/bw
Direct Spray					
100% absorption	Honey Bee	0.26	0.15	0.89	620
Contaminated Vegetation					
Fruit	Small Mammal	6.4E-03	1.0E-03	0.05	440
Contaminated Insects					
	Small Mammal	0.09	0.01	0.94	440
	Small Bird	0.72	0.08	**7.2**	126
Chronic Exposures					
Contaminated Vegetation					
Grass	Large Mammal	**7.4**	0.23	**250**	0.4
Grass	Large Bird	0.75	0.02	**26**	7.5

Table 16. Triclopyr BEE Risk Characterization for Aquatic Species.

Application Rate:		8	lbs/acre		
Summary of Concentration in Water					
	Scenario	**Central**	**Lower**	**Upper**	
Peak Runoff Concentration (mg/L)		3.2E-03	1.2E-06	0.24	
Summary of Risk Characterizations					
Receptor	**Scenario**	**Hazard Quotients**			**Toxicity Values** (mg/L)
		Central	**Lower**	**Upper**	
Fish (Sensitive Species)	Peak Runoff	0.04	1.3E-05	**2.6**	0.091
Aquatic invertebrate (Sensitive Species)	Peak Runoff	0.07	2.7E-05	**5.3**	0.045

3.7.2 Triclopyr Triethylamine Acid (TEA)

The same toxicity values were used for triclopyr BEE and TEA for risk characterization for terrestrial animals. However, the maximum application rate for triclopyr TEA is 9 lbs/acre compared to 8 lbs/acre of triclopyr BEE. For this reason, the risk characterization for triclopyr TEA generated higher HQs than for triclopyr BEE. Chronic consumption of contaminated vegetation by a large mammal was greater than 1 for both the central (HQ = 12.6) and greatest estimated residue rate (HQ = 281), and for a large bird at the central (HQ = 1.3) and highest estimated residue rate (HQ = 29). The consumption of a contaminated insect at the highest estimated residue rate by a small mammal (HQ = 1.1) or a small bird (HQ = 8.1) also exceed an HQ of 1. The direct spray of a honey bee, with no foliar interception generated an HQ = 1 (Table 17).

The consumption of a contaminated insect by a small bird applies to YBCU. The direct spray of a honey bee applies to VELB and monarch butterflies. Toxicity values for triclopyr TEA in birds were tested in two bioassays which reported LC_{50} values of 3000 and >4465 ppm a.e. There was some indication that mallards have a higher tolerance than quail, but it was not conclusive. Acute contact toxicity studies in honey bees are available on triclopyr acid and triclopyr TEA (U.S. EPA 1998). In both bioassays, the LD_{50} values were greater than 0.1 mg/bee. No triclopyr TEA exposure scenarios for aquatic animals resulted in HQs greater than 1 (Table 18).

Table 17. Triclopyr TEA Risk Characterization for Terrestrial Animals.

Application Rate:		9	lbs/acre		
Scenario	**Receptor**	**Hazard Quotient**			**Toxicity Value**
		Central	**Lower**	**Upper**	
Acute/Accidental Exposures					mg/kg/bw
Direct Spray					
100% absorption	Honey Bee	0.29	0.17	**1.0**	620
Contaminated Vegetation					
Fruit	Small Mammal	7.2E-3	1.0E-03	0.05	440
Contaminated Insects					
	Small Mammal	0.11	0.01	**1.1**	440
	Small Bird	0.81	0.09	**8.1**	126
Chronic Exposures					
Contaminated Vegetation					
Grass	Large Mammal	**12.6**	0.12	**281**	0.4
Grass	Large Bird	**1.3**	0.06	**29**	7.5

Table 18. Triclopyr TEA Risk Characterization Aquatic Species.

Application Rate:		9	lbs/acre		
Summary of Concentration in Water					
	Scenario	**Central**	**Lower**	**Upper**	
Peak Runoff Concentration (mg/L)		0.03	9.0E-06	2.2	
Summary of Risk Characterizations					
Receptor	**Scenario**	**Hazard Quotients**			**Toxicity Values** (mg/L)
		Central	**Lower**	**Upper**	
Fish (Sensitive Species)	Peak Runoff	1.4E-03	4.5E-07	0.11	20
Aquatic invertebrate (Sensitive Species)	Peak Runoff	1.1E-03	3.6E-07	0.09	25

3.7.3 3,5,6-trichloro-2-pyridinol (TCP)

No risk characterization worksheet was available for TCP. Neither the data in the EPA review nor the data found in the open literature permits an assessment of species sensitivity to TCP for mammals. Consequently, the NOAELs of 25 mg/kg bw for acute exposures and 12 mg/kg bw for longer-term term exposures are used to characterize risks to all mammalian receptors associated with exposures to TCP. Toxicity studies did not find TCP to be significantly more toxic to birds that triclopyr itself.

The toxicity of triclopyr or TCP to reptiles or terrestrial phase amphibians is not addressed in the available literature. Likewise, a dose-response assessment of the toxicity of TCP to terrestrial invertebrates cannot be proposed due to the lack of pertinent data. The data on the toxicity of TCP to aquatic arthropods consists of a single acute LC_{50} of 10.9 mg/L and a single chronic NOAEC of 0.058 mg/L. Both of these values are for water flea (*Daphnia magna*).

Data on the acute toxicity of TCP to fish come from the open literature study by Wan et al. (1987) and two MRID submissions. The six LC_{50} values reported by Wan et al. (1987) range from 1.5 to 2.7 mg/L and the MRID submissions report much higher LC_{50} values of 12.5 and 12.6 mg/L. LC_{50} values for rainbow trout are reported by both Wan et al. (1987)—i.e., 1.5 mg/L—and one of the MRID studies—i.e., 12.6 mg/L. These two sets of studies are obviously inconsistent and reflect experimental variability or other unidentified factors rather than any differences in species sensitivity.

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