412th Test Wing

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN

FOR EDWARDS AIR FORCE BASE

412 TW INRMP Plan 32-7064

(See INRMP signature pages for plan approval date)

412th Civil Engineer Group
Environmental Management Division
OPR: 412 CEG/CEV
Edwards Air Force Base, CA

UNITED STATES AIR FORCE

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN

EDWARDS AIR FORCE BASE

(See INRMP signature pages for plan approval date)

ABOUT THIS PLAN

This installation-specific Environmental Management Plan is based on the United States Air Force's (USAF) standardized Integrated Natural Resources Management Plan (INRMP) template. This INRMP has been developed in cooperation with applicable stakeholders, which includes *Sikes Act* cooperating agencies and/or local equivalents, to document how natural resources will be managed. Where applicable, external resources, including Air Force Instructions (AFIs); Department of Defense Instructions (DoDIs); USAF Playbooks; federal, state, and local requirements; Biological Opinions; and permits are referenced.

Certain sections of this INRMP begin with standardized, USAF-wide "common text" language that address USAF and Department of Defense (DoD) policy and federal requirements. This common text language is restricted from editing to ensure that it remains standard throughout all plans. Immediately following the USAF-wide common-text sections are installation sections. The installation sections contain installation-specific content to address local and/or installation-specific requirements. Installation sections are unrestricted and are maintained and updated by the approved plan owner.

NOTE: The terms "Natural Resources Manager," (NRM) and "NRM/Point of Contact" (NRM/POC) are used throughout this document to refer to the installation person responsible for the natural resources program, regardless of whether this person meets the qualifications within the definition of a natural resources management professional in DoDI 4715.03, Natural Resources Conservation Program.

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DOCUMENT CONTROL

Standardized INRMP Template

In accordance with (IAW) the Air Force Civil Engineer Center (AFCEC) Environmental Directorate Business Rule 08, *EMP* [Environmental Management Plan] *Review, Update, and Maintenance*, the standard content in this INRMP template is reviewed periodically, updated as appropriate, and approved by the Natural Resources Subject Matter Expert.

This version of the template is current as of 03 October 2018 and supersedes the 2015 version.

NOTE: Installations are not required to update their INRMPs every time this template is updated. When it is time for installations to update their INRMPs, they should refer to the eDASH EMP Repository to ensure they have the most current version.

Installation INRMP

Record of Review—The INRMP is updated no less than annually, or as changes to natural resource management and conservation practices occur, including those driven by changes in applicable regulations. IAW the *Sikes Act* and Air Force Manual (AFMAN) 32-7003 of 20 April 2020, *Environmental Conservation* (which supersedes AFI 32-7064, *Integrated Natural Resources Management*), the INRMP is required to be reviewed for operation and effect no less than every five years. An INRMP is considered compliant with the *Sikes Act* if it has been approved in writing by the appropriate representative from each cooperating agency within the past five years. Approval of a new or revised INRMP is documented by signature on a signature page signed by the Installation Commander (or designee), and a designated representative of the United States Fish and Wildlife Service (USFWS), state fish and wildlife agency, and, and the National Oceanic and Atmospheric Administration (NOAA) Fisheries and the Bureau of Land Management (BLM) when/where applicable (AFMAN 32-7003).

Annual reviews and updates are accomplished by the installation NRM, and/or a Section Natural Resources Media Manager. The installation shall establish and maintain regular communications with the appropriate federal and state agencies. At a minimum, the installation NRM (with assistance as appropriate from the Section Natural Resources Media Manager) conducts an annual review of the INRMP in coordination with internal stakeholders and local representatives of USFWS, state fish and wildlife agency, and NOAA Fisheries and BLM, where applicable, and accomplishes pertinent updates. Installations will document the findings of the annual review in an Annual INRMP Review Summary. By signing the Annual INRMP Review Summary, the collaborating agency representative asserts concurrence with the findings. Any agreed-upon updates are then made to the document, at a minimum updating the work plans.

INRMP APPROVAL/SIGNATURE PAGES

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN EDWARDS AIR FORCE BASE, CALIFORNIA

2020–2025

This *Integrated Natural Resources Management Plan* fulfills the requirements of the *Sikes Act* (as amended), Department of Defense Instruction 4715.03, *Natural Resources Conservation Program*, and Air Force Manual 32-7003, *Environmental Conservation*. This document was prepared and reviewed in coordination with the United States Fish and Wildlife Service and the California Department of Fish and Wildlife.

SCOTT SOBIECH

Digitally signed by SCOTT SOBIECH
Date: 2020.09.23 14:39:01 -07'00'

SCOTT SOBIECH
Field Supervisor
United States Fish and Wildlife Service
Carlsbad Fish and Wildlife Office

Date

INRMP APPROVAL/SIGNATURE PAGES

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DocuSigned by:
Julie Vance
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JULIE VANCE
Regional Manager—Central Region
California Department of Fish and Wildlife

10/1/2020
Date

INRMP APPROVAL/SIGNATURE PAGES

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN EDWARDS AIR FORCE BASE, CALIFORNIA

2020–2025

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MATTHEW W. HIGER
Brigadier General, USAF
Commander

6 Oct 2020
Date

EXECUTIVE SUMMARY

This five-year revision of the INRMP has been prepared for Edwards Air Force Base (AFB), California, as required by the *Sikes Act Improvement Act* of 1997 and AFMAN 32-7003, *Environmental Conservation*. The INRMP is based on ecosystem management principles and identifies responsibilities for management of natural resources, land use and mission activities and their potential effects on the environment, descriptions of the physical and ecosystem environments, mission impacts on natural resources, natural resources program management, and management goals and objectives. The INRMP also includes specific management methods, schedules of activities and projects, responsibilities of decision makers, monitoring systems, protection and enforcement, land-use restrictions, and biological resource and environmental requirements, as well as professional and technical manpower.

This INRMP will be used by Edwards AFB personnel in support of natural resources management. It will be the guiding document integrating natural resources stewardship with the Edwards AFB military mission. The *Sikes Act Improvement Act* of 1997 (16 United States Code [U.S.C.] 670a–670o) and DoDI 4715.03 require the DoD to manage the natural resources of each military reservation within the United States (U.S.) and to provide sustained multiple uses of those resources. To guide natural resources management, the Sikes Act requires preparation of an *Integrated Natural Resources Management Plan* for most military bases. The INRMP is a tool for managing natural resources on military installations that have natural resources requiring protection and management, such as habitat for protected species, aquatic resources, or any habitat that is suitable for conserving and managing wildlife.

The overall strategy of this INRMP is to sustain and enhance the natural environment or ecosystem through the use of an adaptive management process while integrating the natural resource program with the military mission. The INRMP assists the installation commander with the conservation and rehabilitation of natural resources consistent with the use of the installation to ensure military readiness. This is accomplished by defining and implementing natural resource management goals and objectives that collectively achieve habitat and species sustainability, thereby ensuring no net loss in the capability of the installation's lands to support the military mission with a realistic testing and training environment.

Management of the ecosystem is enhanced through partnerships with federal and state resource agencies to achieve common goals. Public involvement and communication with the agencies plays a role in the implementation of the INRMP. The best available scientific information will aid resource managers in implementing adaptive management strategies by selection of the most applicable technologies for management of natural resources.

The primary goals for natural resources management are as follows:

- Maintain professionally trained government natural resource management staff.
- Maintain and enhance quality and quantity of habitat.
- Provide a sustainable ecosystem by maintaining biodiversity.
- Provide natural resource-based outdoor recreational opportunities.
- Maintain an active Conservation Law Enforcement Program.
- Sustain populations of federally listed species in support of Endangered Species Act Recovery Programs.
- Sustain populations of at-risk species.
- Sustain hydrologic function of surface water flow within watersheds.
- Conserve and maintain the Piute Ponds Complex to accommodate Edwards AFB's operational mission requirements and Los Angeles County Sanitation District 14 waste water discharge requirements.

- Promote a cohesive conservation approach for maintaining developed landscapes.
- Minimize negative impacts of wildland fire on natural resources.
- Maintain, restore, and improve native habitat conditions by use of prescribed fire.
- Ensure public safety from predatory wildlife.
- Prevent the introduction of noxious and invasive plant species, and control their spread.
- Minimize bird/wildlife aircraft strikes.
- Foster natural resource awareness and education.
- Integrate geographic information systems into natural resources management.

Beneficial impacts from implementation of the INRMP are as follows.

- Sustain military mission by ensuring no net loss of natural training resources.
- Prevent disruption of the military mission by adhering to Endangered Species Act requirements.
- Prevent disruption of the military mission by adhering to Migratory Bird Treaty Act requirements.
- Reduce particulate matter emissions (dust).
- Conserve natural habitat and ecosystem biodiversity.
- Reduce spread of invasive plant species in developed areas and surrounding desert habitat,
- Reduce soil erosion.
- Increase recreational opportunities (e.g., birdwatching, fishing, hunting, and use of designated trails for biking and hiking).

Implementation of the INRMP goals will not be a significant change in management direction for the installation.

1.0 OVERVIEW AND SCOPE

This Integrated Natural Resource Management Plan (INRMP) was developed to provide for effective management and protection of natural resources. It summarizes the natural resources present on the installation and outlines strategies to adequately manage those resources. Natural resources are valuable assets of the United States Air Force (USAF). They provide the natural infrastructure needed for testing weapons and technology, as well as for training military personnel for deployment. Sound management of natural resources increases the effectiveness of USAF adaptability in all environments. The USAF has stewardship responsibility for the physical lands on which installations are located to ensure all natural resources are properly conserved, protected, and used in sustainable ways. The primary objective of the USAF natural resources program is to sustain, restore, and modernize natural infrastructure to ensure operational capability and no net loss in the capability of USAF lands to support the installation's military mission. The plan outlines and assigns responsibilities for natural resources management, discusses related concerns, and provides program management elements that will help to maintain or improve the natural resources within the context of the installation's mission. The INRMP is intended for use by all installation personnel. The Sikes Act is the legal driver for the INRMP.

1.1 Purpose and Scope

As part of the Department of Defense (DoD) critical defense mission, and for reasons of safety and security, military installations often encompass large land areas far from concentrations of civilian populations. Conservation of natural resources is important in maximizing effective military testing and training operations and ensuring military readiness. Realistic testing and training require environments in a natural setting. In addition, federal agencies are subject to compliance with federal regulations that protect and conserve natural resources. To meet these requirements, plans are developed in coordination with the United States Fish and Wildlife Service (USFWS) and the California Department of Fish and Wildlife (CDFW), and reflect the mutual understanding of the parties concerning conservation, protection, and management of fish and wildlife resources. Military installations must coordinate with the public on plans for the conservation, protection, management, and monitoring of natural resources on all of the lands that have been entrusted to the DoD.

It is DoD policy, in accordance with (IAW) Department of Defense Instruction (DoDI) 4715.03, to implement and maintain natural resource conservation programs to ensure access to its land, air, and water resources for realistic military training and testing. The management and conservation of natural resources within DoD control, including planning, implementation, oversight, and enforcement functions are addressed in DoDI 4715.03. This INRMP addresses resource management on all of the lands within the installation, including lands occupied by tenants or lessees or being used by others pursuant to a permit, license, right of way, or any other form of permission.

Section 101(b)(1)(I) of the Sikes Act states that each INRMP shall, to the extent appropriate and applicable and consistent with the use of the installation to ensure the preparedness of the Armed Forces, provide for "no net loss in the capability of military installation lands to support the military mission of the installation." Mission requirements and priorities identified in this INRMP will be integrated in other environmental programs and policies, as applicable. It is not the intent that natural resources are to be consumed by current mission requirements; they should be sustained for the use of future missions. To achieve this, all environmental programs and policies must have the goal of conserving the environment for the purpose of supporting future missions. Installation lands will be made available to the public for educational or recreational use of natural resources when such access is compatible with military mission activities, ecosystem sustainability, and with other considerations such as security, safety, personnel workload, and

fiscal constraints. Opportunities for such access shall be equitably and impartially allocated after such considerations have been taken into account.

1.2 Management Philosophy

An interdisciplinary approach was used to develop this INRMP, in compliance with the 1997 amendments of the Sikes Act. Military installations are required to develop and implement mutually agreed upon INRMPs through collaborative efforts and voluntary cooperative agreements between the DoD installation, USFWS, and the CDFW. The goal is for all agencies to agree on the INRMP. An INRMP is a planning document that allows DoD installations to manage their natural resources in coordination with the resource agencies and to remain in compliance with applicable laws and regulations. The INRMP is a tool to ensure that military operations and activities are integrated with management of natural resources to achieve good land stewardship and ensure the success of the military mission.

The INRMP focuses on the principles of ecosystem management. The INRMP provides for the management of natural resources, allows multipurpose use of natural resources, and provides for public access, while ensuring no net loss in the capability of the military mission.

The INRMP implements the following principles of ecosystem management for attaining a desired land condition while carefully considering the ecosystem management principles and guidelines stated in DoDI 4715.03 and Air Force Manual (AFMAN) 32-7003, *Environmental Conservation*.

- Maintain or restore native ecosystem types across their natural range where practical and consistent with the military mission.
- Maintain or restore natural ecological processes such as fire and other disturbance regimes where practical and consistent with the military mission.
- Maintain or restore the hydrological processes in streams, floodplains, and wetlands when feasible and practical and consistent with military mission.
- Use regional approaches to implement ecosystem management on an installation by collaboration with other DoD components, as well as, other Federal, state and local agencies, and adjoining property owners.
- Provide for outdoor recreation and other practical utilization of the land and its resources, provided that such use does not inflict long-term ecosystem damage or negatively impact the Air Force mission.
- Use the best science available to maintain or reestablish native populations, and eradicate exotic and invasive species.
- Use adaptive management strategies.
- Revise objectives and goals when necessary, based on measurable data.
- Use benchmarks to monitor and evaluate the success of management strategies.
- Integrate management with other base installation plans and programs.

The INRMP is a key component plan of the *Installation Development Plan* developed IAW Air Force Instruction (AFI) 32-1015, *Integrated Installation Planning*. The INRMP identifies natural resource features that need to be considered and incorporated into the Installation Development Plan and other component plans in support of future installation development decisions.

Management issues and concerns, as well as goals and objectives, are developed from analysis of all the gathered information, and are reviewed by Edwards Air Force Base (AFB) personnel involved with or responsible for various aspects of natural resources management. The INRMP was developed using an interdisciplinary approach and is based on existing information of the physical and biotic environments, mission activities, and environmental management practices at Edwards AFB. Information was obtained

from a variety of documents, interviews with installation personnel, on-site observations, and communications with both internal and external stakeholders. Coordination and correspondence with these agencies is documented and satisfies a portion of the requirements of 32 Code of Federal Regulations (CFR) 989, *Environmental Impact Analysis Process* (EIAP). Goals and objectives require monitoring on a continuous basis and management strategies are updated whenever there are changes in mission requirements, adverse effects to or from natural resources, or changes in regulations governing management of natural resources.

1.3 Authority

This INRMP has been prepared, IAW the Sikes Act, as amended, (Section 670a–670o of title 16, United States Code [U.S.C.]). All DoD natural resource conservation program activities shall work to guarantee continued access to its land, air, and water resources for realistic military training and testing and to sustain the long-term ecological integrity of the resource base and the ecosystem services it provides. DoDI 4715.03 requires that INRMPs be developed and implemented for lands that have suitable habitats for conserving and managing natural resources. AFMAN 32-7003 provides guidance for the proper management of natural resources on Edwards AFB and other installations to comply with federal, state, and local laws and regulations.

In addition, the INRMP addresses compliance with the following legal requirements regarding natural resources.

- Endangered Species Act (ESA) of 1973, as amended (16 U.S.C. §1531 et seq.)
- Migratory Bird Treaty Act (MBTA) of 1918, as amended (16 U.S.C. §703 et seq.) and the Department of the Interior (DOI) Solicitor's Opinion M-37050
- Executive Order (EO) 13186, Responsibilities of Federal Agencies to Protect Migratory Birds, 10 January 2001
- Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. §668 et seq.)
- Migratory Bird Hunting and Conservation Stamp Act of 1934, as amended (16 U.S.C §718 et seq.)
- Federal Noxious Weed Act of 1974, as amended (7 U.S.C. §2801 et seq.)
- Plant Protection Act of 2000 (7 U.S.C. §7701 et seq.), which supersedes most of the Federal Noxious Weed Act of 1974
- EO 13112, Invasive Species, 3 February 1999
- Federal Insecticide, Fungicide, and Rodenticide Act of 1996, as amended (7 U.S.C. §136 et seq.)
- Soils and Water Resources Conservation Act of 1977, as amended (16 U.S.C. 2001 et seq.)
- Federal Water Pollution Control Act of 1972, as amended (33 U.S.C. §1251 et seq.)
- EO 11990, Protection of Wetlands, 24 May 1977
- EO 11988, Floodplain Management, 24 May 1977
- Clean Air Act of 1970, as amended (42 U.S.C. §7401 et seq.)
- EO 13423, Strengthening Federal Environmental, Energy, and Transportation Management, 24 January 2007

Per the Supremacy Clause of the Constitution and a long line of court cases starting with McCullough v. Maryland, the United States (U.S.) is not subject to state law unless there is a clear and specific waiver of sovereign immunity. The ESA (16 U.S.C. §1536, *Interagency Cooperation*) does not include empowerment of states to impose their own endangered species requirements on the federal government; thus, there is no requirement to comply with regulations associated with state lists of threatened and endangered species. In AFMAN 32-7003, however, it states that INRMPs should provide similar conservation measures for the protection and conservation of state-listed or protected species when practicable and consistent with the military. In other words, protection and conservation measures

are provided for by policy in AFMAN 32-7003, not by operation of state law. Per 10 U.S.C. 2671(a)(1), state hunting and fishing permits are generally required unless a clear and specific waiver of sovereign immunity supported by USAF policy is in place, as provided in AFMAN 32-7003. Likewise, hunters also must possess a valid Federal Hunting Stamp (see Migratory Bird Hunting and Conservation Stamp Act of 1934 above). (Additional federal public laws and executive orders, including annotations, that pertain to DoD installations may be found in Appendix A.

Installation-Specific Policies (including State and/or Local Laws and Regulations)	
Edwards AFB Instruction 32-7064, Management of Hunting and Fishing Program	Implements DoDI 4715.03, Natural Resources Conservation Program and Air Force Policy Directive (AFPD) 32-70, *Environmental Quality*. Identifies requirements for managing natural resources on USAF installations in accordance with applicable federal, state, and local laws and regulations. Applies to individuals at all levels who manage natural resources on USAF installations within the United States and its territories, including the Air Force Reserve, Air National Guard, and government-owned, contractor-operated facilities on USAF-controlled lands, except where noted otherwise.
California Fish and Game Code	Code Divisions 2-7 cover regulations about fish and wildlife or all taxa, as well as refuges. Code of particular importance for managing natural resources at Edwards AFB is called out in the two entries below.
California Endangered Species Act of 1970 (California Fish and Game Code, Division 3, Chapter 1.5)	States that all native vertebrates, invertebrates, and plants, as well as their habitats, that are threatened with extinction or declining significantly enough to risk becoming threatened or endangered will be protected and, if possible, restored to a more secure status.
Management of Fish and Wildlife on Military Lands (California Fish and Game Code, Division 4, Part 1, Chapter 2, Article 6)	States that the State of California encourages biologically sound management of fish and wildlife on DoD lands, and it authorizes the necessary coordination/cooperation with the DoD needed to develop plans and programs on DoD installations that integrate with the State's goals.
California Public Resources Code	Code Divisions 4 (Forests, Forestry and Range and Forage Lands), 5 (Parks and Monuments), 5.8 (California Wildlife, Coastal, and Park Land Conservation Act) 13 (Environmental Quality), 20.4 (Watershed, Clean Beaches, and Water Quality Act), 34 (Environmental Protection), and 43 (Safe Drinking Water, Water Quality and Supply, Flood Control, River and Coastal Bond Act of 2006). Code of particular importance for managing natural resources at Edwards AFB is called out in the entry below.
California Environmental Quality Act (California Public	California's broadest environmental legislation states that an environmental impact review and reporting process is required for public agency projects with potential to affect environmental quality. It is more restrictive that the National Environmental Policy Act in that it requires agencies to implement all feasible

Installation-Specific Policies (including State and/or Local Laws and Regulations)	
Resources Code, Division 13)	measures to mitigate projected impacts. Emphases on interagency cooperation and public disclosure/participation.
California Water Code	Code Divisions 2 (Water), 5 (Flood Control, including the Flood Control Act), 6 (specifically Chapter 1, California Water Plan), and 7 (Water Quality).
California Health and Safety Code	Code Division 26 (*Air Resources*).
Counties of Los Angeles, San Bernardino, and Kern	Edwards AFB overlaps these three counties, which also have regulations and permits that may apply to Edwards AFB activities, including solid and hazardous waste management and administration of the National Pollutant Discharge Elimination System and the Federal Clean Water Act.

1.4 Integration with Other Plans

The INRMP integrates common goals and objectives and management considerations with other local, state, and federal agency plans, working groups, and programs such as the *Edwards Air Force Base Installation Development Plan, Integrated Cultural Resources Management Plan* (ICRMP)*, Integrated Pest Management* (IPM) *Plan, Wildland Fire Management Plan* (WFMP), *Bird/Aircraft Strike Hazard* (BASH) *Plan,* and outdoor recreational programs.

2.0 INSTALLATION PROFILE

Office of Primary Responsibility	412th Civil Engineer Group, Environmental Management Division (412 CEG/CEV) has overall responsibility for implementing the Natural Resources Management program and is the lead organization for monitoring compliance with applicable federal, state and local regulations.
Natural Resources Manager/Point of Contact (PO mil C)	Name: Mr. Larry Zimmerman Phone: (661) 277-1418 Email: larry.zimmerman.3@us.af.
Sikes Act Cooperating Agency POCs	United States Fish and Wildlife Service: Brian Croft California Department of Fish and Wildlife: Abigail Gwinn
Total acreage managed by installation	308,180
Total acreage of wetlands	1,364 (biological wetlands, not jurisdictional wetlands)
Total acreage of forested land	0
Does installation have any Biological Opinions? (If yes, list title and date, and identify where they are maintained)	Yes, 1, Biological Opinion for Operations and Activities at Edwards Air Force Base, California (8-8-14-F-14) dated 11 March 2014
Natural Resources Program Applicability **(Place a checkmark next to each program that must be implemented at the installation. Document applicability and current management practices in Section 7.0)**	☒ Fish and Wildlife Management ☒ Outdoor Recreation and Access to Natural Resources ☒ Conservation Law Enforcement ☒ Management of Threatened, Endangered, and Host Nation-Protected Species ☒ Water Resource Protection ☒ Wetland Protection ☒ Grounds Maintenance ☐ Forest Management ☒ Wildland Fire Management ☐ Agricultural Outleasing ☒ Integrated Pest Management Program ☒ Bird/Wildlife Aircraft Strike Hazard (BASH) ☐ Coastal Zone and Marine Resources Management ☒ Cultural Resources Protection ☒ Outreach ☒ Geographic Information Systems (GIS)

2.1 Installation Overview

2.1.1 Location and Area

Edwards AFB encompasses approximately 308,180 acres in the Antelope Valley in southern California. The installation lies in the western Mojave Desert in portions of Kern, Los Angeles, and San Bernardino counties. The base is approximately 100 miles northeast of Los Angeles, about 90 miles northwest of San Bernardino, and about 80 miles southeast of Bakersfield (Appendix B, Figure 1 and Figure 2). Approximately 11,150 military and civilian personnel work at Edwards AFB, many of whom live either on the base or in nearby communities, such as California City, Lancaster, Palmdale, and Rosamond (412th Test Wing [412 TW] 2017).

The Antelope Valley's first main industry was agriculture. Historically known for its extensive alfalfa fields and fruit crops, farmers now grow a wider variety of crops, such as carrots, onions, lettuce, and potatoes.

Major development of housing tracts and population growth took off in 1983 in the Antelope Valley, substantially increasing the population of Palmdale. The population in neighboring Lancaster has increased since the early 1980s to around three times its former level.

Water use in the Antelope Valley for agricultural and development purposes depends primarily on pumping groundwater from the valley's aquifers and on importing additional water via aqueducts from the Antelope Valley East Kern (AVEK) Water Agency. Long-term groundwater pumping for agriculture, commercial, and residential development has lowered the water table. An AVEK Water Master is mandated to monitor the water basin to ensure that the amount of water pumped out of the basin can be sustained without it falling into overdraft. Water treatment for most of Lancaster is conducted by Los Angeles County Sanitation District 14 (hereafter, D14). Reuse of the treated water goes to local farms, construction work, and recreational facilities. Recreation reuse includes the Piute Ponds Complex at Edwards AFB.

The aerospace industry includes Air Force Plant 42 in northeast Palmdale, which is home to Lockheed Martin, Boeing Aerospace Engineering, and Northrop Grumman, among other aerospace-related companies. Notable projects assembled and or designed there include the Space Shuttle, B-2 Spirit Bomber, F-117 Nighthawk Fighter, F-35 Joint Strike Fighter, and Lockheed L1011 TriStar, a passenger jet aircraft. The newly dedicated Mojave Spaceport is located nearby, north of Palmdale, in the town of Mojave.

Installation / Geographically Separated Unit Location and Area Descriptions

Installation / Geographically Separated Unit	Main Use/ Mission	Acreage	Addressed in INRMP	Describe Natural Resource Implications
Edwards AFB	Test & Evaluation	308,180.00	INRMP Section 2.1	Natural Resource Management
Annex A-10	Test & Evaluation	9	WFMP[1]	None
Annex A-11	Test & Evaluation	27	WFMP	None
Annex T-6	Test & Evaluation	8	WFMP	None

Installation / Geographically Separated Unit	Main Use/ Mission	Acreage	Addressed in INRMP	Describe Natural Resource Implications
Boron NEXRAD Annex	Test & Evaluation	6	WFMP	None
Egan Range Microwave Relay Annex Site 1	Test & Evaluation	3	WFMP	None
Ely Radio Relay Annex Site 1	Test & Evaluation	50	WFMP	None
McPherson Peak Microwave Relay Annex	Test & Evaluation	1	WFMP	None
Mount Pinos Radio Relay Annex Site 1	Test & Evaluation	1	WFMP	None
Worthington Mountain Microwave Relay Annex	Test & Evaluation	3	WFMP	None

[1] WFMP=Wildland Fire Management Plan.

2.1.2 Installation History

Installation history background information is from the most recent EAFB ICRMP.

Humans have been frequenting the Antelope Valley for a few thousand years. This amount of time is known generally as the Prehistoric Period, and it is characterized by Native American lifestyles that relied almost exclusively upon hunting and gathering as a means of subsistence. This particular subsistence strategy causes relatively minimal impact to the natural environment. Evidence for Native American presence in the area is provided by the stone tools they produced.

The arrival of Europeans into the Antelope Valley marks the end of the Prehistoric Period and the beginning of the Contact/Ethnographic Period (AD 1770–Present). Spanish expeditions traversed areas that today encompass parts of Edwards AFB, but they recorded no Native American settlements and established none of their own. Instead, the Ethnographic Period is characterized primarily by an increase in anthropogenic activities and population growth throughout the Antelope Valley.

Starting in the 19th century, the area from present day Lancaster to Buckhorn Springs began attracting mining speculators and road builders. Mining occurred in and around the town of Rosamond (see Appendix B, Figure 1). Exploratory/prospect pits and mines were dug by early miners throughout Edwards AFB. Many on-base mining activities occurred in the Kramer Hills and on the lakebeds, especially in the northeast corner of Rogers Dry Lake. The clay mined from the lakebed was used as a sealant and lubricant for oil-exploration wells.

In 1911, settlers began establishing homesteads in the area that eventually would encompass Edwards AFB. Those settlers raised livestock and mined the local area for gold, borates, and copper, and traffic became a common sight between the towns of Rosamond and Boron. The early borate mining brought more settlers and increased travel across the dry lake areas, and settlements slowly grew to accommodate the developing commerce. By the mid-20th century, there were crop fields, livestock grazing, waterfowl hunt clubs, and transportation corridors within the boundary of what eventually would become Edwards AFB.

In 1931, a military mission established the Muroc Bombing and Gunnery Range on the east side of Rogers Dry Lake. By the end of 1942, the newly named Muroc Army Air Field consisted of 6,300 men, 1,090 temporary hutments, and 383 permanent hangars and support buildings on the western shore of Rogers Dry Lake. At the end of World War II, the facility contained hangars, administrative buildings, barracks, officers' quarters, a hospital, a post exchange and commissary, a library, two mess halls, two chapels, two theaters, two noncommissioned officers' clubs, two officers' clubs, and recreational buildings. In 1947, the government awarded Aerojet Engineering Corporation the contract to construct a USAF Experimental High-Thrust Rocket Test Station, and the United States Army Corps of Engineers (USACE) began creating the appropriate infrastructures. The Air Materiel Command formed a Rocket Branch on Edwards AFB in 1949 and the USACE constructed support facilities at Leuhman Ridge. In 1951, Aerojet Engineering Corporation began constructing buildings that housed technical operations.

Nearly every aircraft entering the USAF inventory over the past 50 years has been tested and developed at Edwards AFB. Historically, other DoD agencies have used Edwards AFB for developmental testing and evaluation of fixed- and rotary-wing aircraft. Edwards AFB also has been the site where lifting-body research flights helped the National Aeronautics and Space Administration (NASA) develop and design the space shuttle, and the base has played host to space shuttle approach and landing tests, as well as the first shuttle landing from space.

2.1.3 Military Missions

Military mission information is from the most recent Edwards AFB Installation Development Plan (412 TW 2017a).

Edwards AFB continues to support technological research that develops, acquires, and evaluates manned and unmanned aerospace vehicles. This research involves every aspect of aerospace vehicle testing, including: flight evaluation and vehicle recovery; development and testing of advanced avionics, range instrumentation, and aircraft aerodynamic decelerators; space and missile test support; and operation and command of the USAF Test Pilot School. Edwards AFB also hosts NASA and the Air Force Research Laboratory (AFRL), which provide staff and facilities for manned and unmanned aircraft testing and rocket component and propellant research, respectively

NASA/Armstrong Flight Research Center

The NASA/Armstrong mission is to plan, conduct, analyze, and report on all aeronautical disciplines associated with a wide variety of aircraft and aerospace vehicle flight research projects. NASA/Armstrong is the nation's preeminent aeronautical research facility, developing new technologies that will lead to improved aircraft flight-control components and systems. NASA/Armstrong also helps transfer new concepts to the U.S. aerospace industry for commercial and military applications. Historically, this included aerospace vehicle-handling qualities and flight loads; research on piloting problems; biomedical aspects of low- and high-performance aircraft; and investigations of problems associated with takeoff, landing, aircraft noise, low-speed flight, supersonic and hypersonic flight, and characteristics of aerospace vehicle reentry. NASA/Armstrong also works to identify and explore unpredicted phenomena encountered in flight, and it develops flight testing and in-flight simulation techniques.

Air Force Research Laboratory

The mission of the AFRL is to plan, formulate, present, and execute the USAF Science and Technology programs. At the Edwards AFB research site, there is an emphasis on rocket-propulsion concepts, propellants, components, and systems for both missile and space applications. The Edwards AFB research site also hosts sea level static and altitude test cells for full-scale rocket engine and motor testing. The AFRL

serves as the Air Force Materiel Command (AFMC) focal point for information in the assigned technical areas. An integral part of the AFRL mission entails executing assigned projects for, and working closely with, the Army, Navy, NASA/Armstrong, and other government agencies; supporting AFMC programs, ensuring the rapid application of research and technology to advanced systems; and assisting in the evaluation of foreign aerospace technology.

Other DoD Agencies

Department of the Army, Department of the Navy, U.S. Marine Corps, Reserve Components, Coast Guard, and other units may use base facilities to conduct their respective mission activities on Edwards AFB.

Listing of Tenants and Natural Resources Responsibility

Tenant Organization	Natural Resources Responsibility
NASA/Armstrong Flight Research Center	NASA responsible for lease area; projects outside lease area and within Edwards AFB coordinated with 412th Civil Engineer Group, Environmental Management Division (412 CEG/CEV).
Air Force Research Laboratory (AFRL)	Natural Resources responsibility shared between AFRL and 412th Civil Engineer Group, Environmental Management Division Assets Branch (412 CEG/CEVA).

2.1.4 Natural Resources Needed to Support the Military Mission

Stable soils and natural vegetation are needed to maintain clear visibility for aircraft flight test missions on runways near the lakebeds, on the lakebeds, in the sky above the base, and in the Precision Impact Range area. Long periods without rainfall and surface flow significantly contribute to drying soils that become erodible and easily blown away during high winds. The reduction in natural flooding may impede the growth of the microorganisms (soil crusts) that may bind lakebed soils, potentially resulting in increased soil erosion and airborne dust particles. This impact might have a cascading effect with increasing amounts of dust build-up in the surrounding vegetated habitats, smothering the cryptobiotic crusts within those habitats.

Functional watersheds that will drain sufficient amounts of surface flow from the headwaters into the lakebeds are needed to support the military mission into the future. Drainage patterns along the base of the surrounding mountains are being interrupted by development and water harvesting, restricting, or eliminating the flow of stormwater to the lakebeds. This is projected to continue as communities grow and need flood protection and more water. The Los Angeles County Significant Ecological Area (SEA) Program is trying to preserve these drainages through the SEA designation in the southern portion of the Edwards AFB. The current SEA, however, does not provide protection for all drainages in Los Angeles County that intersect with Edwards AFB. For instance, Big Rock and Little Rock creek drainages are both protected, but the Amargosa creek drainage is not (Appendix B, Figure 3). Furthermore, the SEA designations are only applicable to Los Angeles County, leaving the drainages in Kern and San Bernardino Counties with no obvious protection. Reducing stormwater flow could impact mission use of the lakebeds by degrading the surface area and increasing fugitive dust that impairs flight visibility and impacts other natural resources.

Piute Ponds Complex is the conduit through which treated water from D14 is delivered to Rosamond Dry Lake. This water source, however, is not sufficient to cover the lakebed and help to maintain its surface stability or prevent wind from eroding the usable operational surface for USAF flight missions and emergency landings. As the largest freshwater marsh in Los Angeles County, the Piute Ponds Complex also provides research capabilities and opportunities beneficial in many ways. For example, NASA uses Piute Ponds as part of its Air Surface Water Ocean Topography research on fresh water and ocean flows and associated impacts of climate change.

Potable and non-potable water are necessary for consumption by the base's population and for the industrial demands of various missions, respectively. A lack of water for urban and industrial use could limit the quantity and quality of mission activities on base. Potential restrictions on groundwater pumping or available State Water Project (SWP [of California]) water could limit mission activities.

2.1.5 Surrounding Communities

The communities surrounding Edwards AFB include Boron to the northeast, California City and North Edwards to the north, Lake Los Angeles to the south, Lancaster and Palmdale to the southwest, Mojave to the northwest, and Rosamond to the west (Appendix B, Figure 1 and Figure 2). Portions of the base boundary share borders with the towns of North Edwards, Boron, Rosamond, Mojave, and California City. Palmdale is located 26 miles southwest of Edwards AFB. Lake Los Angeles, Lancaster, and California City are located within 25 miles of the base. Populations of local communities range from approximately 1,050 to 260,100 people. The largest borax open pit mine in the world is located near Boron just northeast of the base boundary.

Urban development is an encroachment threat with local cities surrounding the installation on three sides (Appendix B, Figure 1 and Figure 2). Even though urban development has slowed due to economic issues, residential developments in the city of Rosamond to the west of Edwards AFB are already up against the base boundary in some places. To the north, California City and small towns such as North Edwards and Boron have expanded during the Southern California housing boom. To the south, the city of Lancaster's population is increasing and had approximately 160,100 people in 2019. In 2009, Lancaster initiated a reconsolidation effort to plan for rezoning rural areas south of Edwards AFB into commercial zones and the transfer of rural zones to the area west of Highway 14; this is now incorporated into their General Plan (City of Lancaster 2009).

For the most part, there is open desert land surrounding the base, with U.S. Highway 395 bordering the eastern boundary and State Route 58 bordering the northern boundary (Appendix B, Figure 2). With these major highways, future development surrounding the base boundary appears to be inevitable. In recent years, residential development of Rosamond has encroached on the western boundary of Edwards AFB, and although this development is not located near any major facilities or developed areas of the base, it provides the opportunity for illegal trespass by off-base personnel who cut fences and ride their motorcycles and off-road vehicles (ORVs) onto base property, thereby establishing new roads and trails that adversely affect the desert ecosystem. These types of development and associated activities reduce the diversity of existing plant and wildlife communities, impact sensitive plant populations, threaten the livelihood of the federally threatened desert tortoise (*Gopherus agassizii*), and generally have a negative impact on natural resources management.

2.1.6 Local and Regional Natural Areas

In close proximity to the base, there are five parks under the California Department of Parks and Recreation in the area. These include Red Rock Canyon State Park, located 35 miles north of Edwards AFB; Antelope

Valley California Poppy Reserve, home to California's state flower, located 15 miles west of Lancaster; Arthur B. Ripley Desert Woodland State Park, located 20 miles west of downtown Lancaster; and Antelope Valley Indian Museum State Historic Park and Saddleback Butte State Park, both located about 10 miles south of the base.

The Desert Tortoise Research Natural Area is located about five miles north of Edwards AFB. This area is jointly managed by the Bureau of Land Management (BLM), CDFW, and the Desert Tortoise Preserve Committee, a nonprofit group established to acquire and manage lands for the protection of the desert tortoise.

In 1999 the Los Angeles County General Plan (Meffe et al. 1997) initiated the SEA Program, which designated areas in Los Angeles County considered to have features beneficial to the ecology of the natural environment. One of these areas overlaps Edwards AFB along a large portion of the base's southern boundary (Appendix B, Figure 3). This area is known as the Antelope Valley SEA and contains unique botanical features including the only healthy stands of native mesquite trees in Los Angeles County. It also contains the Piute Ponds Complex fed with tertiary treated water and is the largest freshwater marsh in all of Los Angeles County, an important stopover location for birds migrating along the Pacific Flyway. Furthermore, the area south of Rosamond Dry Lake and in the Antelope Valley SEA contains excellent examples of shadscale scrub and alkali sink biotic communities. The habitat off-base links with the habitat on-base in the northern portion of the Antelope Valley SEA. Off-base development within saltbush habitat interspersed with mesquite trees is permitted by the Los Angeles County General Plan (Meffe et al. 1997), although only at very low densities and is subject to standards providing for resources protection. There are numerous other SEAs interspersed throughout Los Angeles to the south and west of Edwards AFB, none of which intersect the base.

Within Los Angeles County, there are officially designated SEAs regulated through the land use process to conserve genetic and physical diversity. These areas represent the wide-ranging biodiversity of the County and contain some of the County's most important biological resources. The County's SEA Ordinance establishes the permitting, design standards, and review process for development within SEAs (Title 22 zoning regulations), while balancing preservation of the County's natural biodiversity with private property rights. The General Plan goals and policies are intended to ensure that privately held lands within the SEAs retain the right of reasonable use while avoiding activities and developments that are incompatible with the ability of SEAs to thrive in the long term (Los Angeles County 2019).

Area of Critical Environmental Concern (ACEC) is a special land designation authorized by Congress in the Federal Land Policy and Management Act of 1976. The number of ACECs in BLM's California Desert District is currently 124. The ACEC status provides them with special management and protection for cultural, biological, botanical, scenic, and historical sites (BLM 2019). The ACECs near Edwards AFB include habitat for the Mojave fringe-toed lizard (*Uma scoparia*) and the Barstow Woolly Sunflower (*Eriophyllum mohavense*); they also include Fremont-Kramer Desert Wildlife Management Area, Harper Dry Lake, Black Mountain, Desert Tortoise Research Natural Area, Western Rand Mountains, Red Mountain Springs, Steam Well, and several others (BLM 2019). These areas support Mohave ground squirrel (*Xerospermophilus mohavensis*) and desert tortoise populations as well as other sensitive plants and animals.

Other federal lands that encompass important natural resources in the surrounding area include Death Valley National Park, Joshua Tree National Park, and the Mojave National Preserve. All of these are located in the Mojave Desert.

2.2 Physical Environment

2.2.1 Climate

Edwards AFB is located in the Mojave desert, where the climate is characterized by hot, dry summers and cool to cold winters, consistent with what Köppen (1884) describes as a semi-arid climate. Major climatic factors affecting ecosystems at Edwards AFB are the extremes in rainfall, wind, and day versus night temperatures.

Rainfall, wind conditions, and temperatures have been recorded at Edwards AFB since 1942. The average annual precipitation at Edwards AFB, as measured at the NASA Armstrong Flight Research Center weather station, is 4.92 inches (125 millimeters), whereas modeled precipitation for the entire installation is 5.9 inches (150 millimeters) (Center for Environmental Management of Mililtary Lands [CEMML] 2019a), most of which falls from September through April, primarily in January and February. Snowfall is very infrequent, typically results in a few inches or less, and melts quickly. Summer rainfall occurs infrequently but amounts are widely variable and can have significant effects on annual rainfall amounts; that is, variation in summer rainfall can result in extremely high annual amounts of precipitation (Appendix B, Figure 4). Rainfall effectiveness, which influences seed germination, varies by rainfall event. For example, 2 inches of rainfall over the landscape in 4 days versus 2 inches of rainfall over the landscape in a 60-day period produce entirely different effects on soil moisture required for seed germination.

Wind strongly affects the desert environment. Winds of up to 30 miles per hour are common and gusts can be as high as 75 miles per hour. From March through August, winds blow 90–95 percent of the time, with May through July typically being the windiest months. Gentler winds are typical from September through February, with December and January being the calmest months. High winds increase the evaporation rates in ponded areas inundated by rainfall events. In years of low or trace amounts of rainfall, high winds will evaporate most ponded water by April or May, whereas in years of high rainfall amounts, ponding may occur across the landscape until mid to late August.

The average annual temperature at Edwards AFB is 63.1 °F (17.3 °C). During July and August, daytime temperatures are typically in the low to mid 90s, but occasionally they reach highs of 110–115 °F, and typical nighttime temperatures are 65–75 °F. December and January are the coldest months, when daytime temperatures average 55–60 °F and nighttime temperatures average 25–35 °F and occasionally drop into single digits. Temperature extremes between day and night typically vary 25–30 °F.

2.2.2 Landforms

The topography of Edwards AFB is marked by broad expanses of flat-to-gently-sloping plains interspersed with broad domes and, in a few places, more resistant hills that rise sharply above the surrounding plains (Appendix B, Figure 5). The domes and hills consist of mostly outcrops of granite and quartz monzonite, with volcanic rock forming some of the smaller features. Elevations on base range from 2,267 feet above mean sea level (MSL) at Rogers Dry Lake to 3,424 feet above MSL at Red Buttes near the eastern boundary.

The base can be characterized as having three distinct physiographic areas. The first is an upland area in the northwest portion of the base north of Rosamond Dry Lake and west of Rogers Dry Lake. This area is characterized by low, rounded hills, including the Rosamond and Bissell Hills, with elevations ranging between 2,270 and 3,200 feet above MSL.

The second physiographic area occupies the central and southwestern parts of the base. These lowland areas include Rosamond Dry Lake, Buckhorn Dry Lake, and Rogers Dry Lake and the intervening area. This

region extends from the southern to the northern boundary of the base and has a relief of approximately 400 feet, with elevations ranging from 2,270 to 2,675 feet above MSL.

The third physiographic area is the highlands east of Rogers Dry Lake and extends to the eastern boundary of Edwards AFB. This upland area is similar to that in the northwestern corner of the base except for two prominent relief features: Leuhman Ridge and Haystack Butte, both over 3,400 feet above MSL. Elevations in this area range from approximately 2,400 to over 3,400 feet above MSL and are the highest of the three physiographic areas on the base.

2.2.3 Geology and Soils

The western Mojave Desert is fairly level with broad valleys and relatively small mountain ranges. Typical topographic features on base include hills, alluvial fans, valley floors, and basins. These features are inundated by mostly gravel and sandy washes. The alluvial fans and valleys are covered with soil material eroded from the nearby hills. The basins are comprised of clay playas within a saltbush (*Atriplex* spp.) plant community.

Edwards AFB is characterized by the three large dry lakebeds of Rosamond Dry Lake, Rogers Dry Lake, and Buckhorn Dry Lake. Over the years, the lakebeds have started to fill with soil, primarily sand. The sand deposits have been worked by wind and water action to form beach ramps and various types of sand dunes (Appendix B, Figure 6).

The most common parent material on base is granite. Granite is a coarse-grained rock primarily made up of quartz, feldspar, and ferromagnesian metals. The quartz forms sand and adds rapid drainage characteristics to the soil. The feldspars break down and add some fertility to the soil, and the ferromagnesian minerals add metallic micronutrients to the soil.

Edwards AFB does not encompass any large faults; however, the relative motion of the San Andreas and Garlock Faults are responsible for the formation of a series of minor parallel faults in the central Mojave Desert and, to a lesser extent, in the western Mojave Desert (Appendix B, Figure 6; Norris 1995).

Soil Characteristics

Desert soils are generally coarse-textured, light in color, well-drained, and low in organic matter. Except for clay pans and playas, most desert soils are well-drained and are easily eroded. In general, desert soils are low in nutrients, slightly high in dissolved salts, and highly alkaline. The soil surface may be entirely covered with or contain sections of biological and non-biological crusts (Neal 1968, Pietrasiak et al. 2013). Both types of soil crust are essential for aggregating mineral particles at the soil surface.

Biological Crusts

Biological soil crusts contain microbial communities of diverse taxa, such as bryophytes, lichens, eukaryotic algae, cyanobacteria, fungi and/or bacteria, and their byproducts. The microscopic biocrust communities function ecologically to stabilize soils, fix nitrogen and carbon, regulate water cycling in an out of soils, capture dust, accumulate organic matter, supply nutrients to vascular plants, enhance and/or reduce seedling establishment, promote chemical and physical weathering, provide wildlife habitat, and regulate interactions between soils and food webs (Belnap et al. 2001, Johansen and Schubert 2001, Shepherd et al. 2002, West 1990, Williams et al. 2012).

Non-biological or Inorganic Crusts

Non-biological or inorganic soil crusts are common features of soil surfaces in arid and semiarid ecosystems. Physical or chemical processes, or a combination of both, lead to their formation (Belnap et al. 2001). These sealed crust surfaces are associated with reduced water infiltration and increased run off (Valentin 1991). Seedling establishment and root penetration may be impeded (Wood et al. 1982); however, plant growth may be promoted in adjacent non-crusted areas if these areas receive additional water from runoff (Wood et al. 2005).

Physical Crusts

In general, these compact soil crusts can be classified into structural and depositional physical crusts (Valentin 1991, Valentin and Bresson 1992). Structural crusts form *in situ* (Valentin and Bresson 1992), and commonly develop after rain splash breaks up surface aggregates and causes slaking. Often, vesicular porosity can be observed. Depositional crusts form from the settling out of soil particles that were transported to a topographical low point by runoff or by the deposition of particles in standing water (Valentin and Bresson 1992). Fine stratification or platy structure results. Depositional crust formation may be linked to natural wetting and drying events. In addition, activities associated with agricultural land uses, such as use of heavy agricultural machinery, irrigation techniques, or livestock operations, can lead to the development of depositional crusts. In these cases, the anthropogenic activities result in compaction of the soil surface layers, greater sediment transport in overland flow, and ponding at topographic low points where particles settle out to form a laminar depositional crust (Valentin 1991).

Chemical Crusts

The most common chemical soil crusts develop on the surface of soils with high salt content. When saline water evaporates at the soil surface, salt crystals precipitate and are left behind on the surface. At first sight, salt crusts can closely resemble biological crusts; however, no biological filaments (hyphae or algal filaments) can be detected by viewing a chemical soil crust with a hand lens (Belnap et al. 2001).

Soil characteristics are important for determining flood and erosion hazards. They determine the ability of rainwater to penetrate the soil surface and percolate through the various soil layers. The soil surface of each soil series has an erodibility index based on natural cementing agents such as roots, bacteria, and other microorganisms, organic matter, and natural chemical cementing agents. Soils become more easily eroded when the surface is disturbed. Disturbance may be natural from disasters such as fire, which denudes vegetation, or from human activity (e.g., grading, off-road vehicle [ORV] use, etc.). Once the soil surface is disturbed, the surface is vulnerable to both wind and water erosion. Wind erosion occurs much more frequently on base than water erosion.

Soil Recovery

Recovery from surface disturbance is a long, slow process in the desert. Soils cannot form until vegetation reduces wind speeds and creates barriers to the movement of soil particles. The size of the disturbance affects the rate of recovery. One of the greatest factors in recovery is the presence of mycorrhiza, a fungi interrelationship with plant roots. Many native species require this relationship for growth and survival. Species that do not require this relationship are usually Eurasian weeds or native pioneering species, such as burrobrush (*Ambrosia salsola*), buckwheat (*Eriogonum* sp.), cottonthorn (*Tetradymia* sp.), rabbitbrush (*Ericameria nauseosa*) and rayless goldenhead (*Acamptopappus sphaerocephalus*); these are often the first shrubs to recolonize disturbed soils.

Soil Classification

A preliminary soil survey conducted in 1987 to 1988 delineated soil types in the Main Base, family housing, and NASA/Armstrong areas. Surveys conducted in 1996 by the United States Natural Resource Conservation Service (NRCS) classified 50 soil series or types on the entire base (Appendix B, Figure 7; NRCS 1996, 1997). Soils at Edwards AFB are typically alkaline (basic), with potential for pH values ranging from seven to eight for most soils and greater than eight on lakebed soils. The high salinity and exchangeable sodium ion content of some soils, particularly soils in the lakebed basins, inhibit plant growth. The *Grazing and Cropland Management Plan* (NRCS 1996) was a study that identified five groups of landforms ranging from playas at the lowest elevation to hills and rock pediments, based on soil types. These landform groups and associated soils are briefly described in the following paragraphs.

Lakebeds

Lakebeds are most often about 95 percent covered by Wherry soils. These areas include Rogers Dry Lake, Rosamond Dry Lake, and Buckhorn Dry Lake. Wherry soils are deep and poorly drained, with a clay texture and slopes of zero to one percent. The soil is barren with high saline/sodic content, and is subject to wind erosion and flooding.

Alluvial Fans

Alluvial fans in the areas surrounding the lakes are composed primarily of Leuhman, Norob, and Voyager soils. They are deep and moderately well to well drained, with textures of fine sand to clay loam. Slopes range from zero to five percent. These soils are saline and sodic, and subject to wind erosion and flooding.

Dunes and Sand Sheets

Dunes and sand sheets around the lakes are an intermediate form between the alluvial flats and fan piedmonts. They primarily consist of Cajon soil with smaller proportions of Challenger and other soils. Slopes range from 0 to 15 percent. These soils are deep, moderately-well to excessively drained, with textures of sand to loamy sand, subject to wind erosion.

Fan Piedmonts

Fan piedmonts contain mostly Helendale soil, with smaller proportions of Lavic, Destazo, Helendale Taxadjunct, and Cajon soils. These soils are deep and moderately well to well drained, with textures of loamy coarse sand to fine sandy loam. Slopes range from zero to nine percent. These soils are subject to wind erosion and occasional flooding.

Rock Pediments and Hills

Rock pediments and hills consist of Randsburg, Hi Vista, Machone, Muroc, and Sparkhule soils, interspersed with rock outcrops. These soils can be very shallow to moderately deep and are well drained, with textures of sandy loam and gravel. Slopes range from 2 to 50 percent. These soils are subject to wind and water erosion.

2.2.4 Hydrology

Surface Water

Historical and Current Surface Water Resources

Surface water hydrology at Edwards AFB is driven by rainfall, the patterns of which follow the basic desert model of extremes: dry and wet years. Based on averaging across several years, the annual amount of

rainfall at Edwards AFB is approximately five inches; however, it is the "effective rainfall events" that determine the natural surface hydrology across the landscape. That is, they are the events that result in surface flows in channels and sheets across the landscape, as well as ponding. They are also the events that provide enough water for plants to germinate. Here, an effective rainfall event is defined as more than one inch of rainfall during consecutive days. An isolated, one-day rainfall event of less than 0.56 inches typically will not initiate surface flow (North State Resources ([NSR] 2012), although it may result in some local ponding that can be highly beneficial to the flora and fauna around that ponded area.

Edwards AFB is situated at the bottom of Antelope Valley, within a closed basin of approximately 2,400 square miles known as the Antelope Valley Watershed. Edwards AFB consists of 20 individual watersheds (Appendix B, Figure 8). There are four large playa lakebeds (Buckhorn Dry Lake, Rich Dry Lake, Rogers Dry Lake, and Rosamond Dry Lake) located on Edwards AFB (French et al. 2004, 2009). The lakebeds are the remnants of a Pleistocene Lake Thompson. Lake Thompson is believed to have been 18 meters deep in the late Quaternary period and then stabilizing sometime in the mid-Holocene at a depth of 10 meters (Lichvar et al. 2000, when Rogers Dry Lake, Buckhorn Dry Lake, and Rosamond Dry Lake were independent water bodies (Lichvar et al. 2000). Rich Dry Lake was classified as a back-barrier lagoon (Orme 2002) and an individual lakebed and watershed (French et al. 2003). The authors based their classification on three factors: continuous topographic divide as well as differences in precipitation gradient, vegetation, and land use. In the past, it is likely that the Rosamond Dry Lake, Buckhorn Dry Lake, and Rogers Dry Lake playas were permanent lakes inundated by perennial streams. As the regional climate changed, they became dry lakebeds fed by ephemeral washes.

Because Edwards AFB is at the lowest point in the Antelope Valley, it receives surface water flow from numerous washes that flow from the surrounding mountains, as well as local surface water flow from the valley floor. Some of these were once perennial waterways but, for at least the last 100 years, diversion activities have caused the washes to become ephemeral and now they flow to Edwards AFB on average only every five years, depending on the level of rainfall.

Lichvar and Sprecher (1996) mapped 351 separate ephemeral washes totaling 487 miles traveling from headwaters and local areas to Edwards AFB; an additional 10 channels with a total linear footage of 14.1 miles, occur within the main base and housing area. They documented 2,732 clay pans from 0.01 to 307 acres in size, with most being between 0.01 to 2.5 acres. Besides those documented individually, 11 clay pan zones were created in areas where clay pans were numerous. These zones reflect most of the flood-prone areas on the base. Five playas (4 of which are the main lakebeds) were documented totaling 45,728 acres.

Major wash systems that flow to Edwards AFB are Mojave Creek, Big Rock Creek, Amargosa Creek, Little Cottonwood Creek, Oak Creek, and Little Rock Creek. Two separate studies determined that the upper and lower portions of Mojave Creek are not hydrologically linked (Sullivan et al. 2017, Heintz and Miller 2020). Rogers Dry Lake (28,160 acres) is fed primarily by Mojave and Big Rock Creeks (ephemeral) along with other small, ephemeral, unnamed drainages from the north, south, and east. Rosamond Dry Lake Watershed is bounded on the west and south by the San Gabriel Mountains. Rosamond Dry Lake (12,930 acres) receives water flow from Amargosa, Little Rock, Cottonwood, Oak Creeks, and various other unnamed ephemeral drainages. Buckhorn Dry Lake (1,616 acres) receives water flow primarily from Little Rock, Big Rock Creek, and from unnamed ephemeral drainages to the north and south. It is unknown whether Buckhorn Dry Lake receives water from Rosamond Dry Lake. Rich Dry Lake (1,945 acres) receives water flow from the Rich Dry Lake Watershed along the northern base boundary and off-base slopes. In some years during major storms, water in Rich Dry Lake overtops Lakeshore Drive and flows into the northern portion of Rogers Dry Lake (French et al. 2003, 2004; Miller and French 2004; French and Miller 2009).

The Piute Ponds Complex (including a portion of Rosamond Dry Lake) encompasses approximately 9,089 acres (Appendix B, Figure 9 and Figure 10). The Piute Ponds Complex receives water from the D14 Lancaster Water Reclamation Plant and, depending on the particular pond, may be perennially or seasonally flooded. There are other seasonally flooded wetlands outside of this Water Management Area that receive water from natural ephemeral surface water as it flows to the lakebed.

Other bodies of surface water on Edwards AFB include a pond at Branch Memorial Park, a pond at the Muroc golf course, two complexes of evaporation ponds, and some stormwater ponds. The pond at Branch Memorial Park is located along Lancaster Boulevard, just north of South Gate (Appendix B, Figure 2). It is approximately six acres in size and it is fed by a deep water well. The pond at the Muroc golf course is approximately 0.6 acres in size, and it is fed by the base potable water system. The South Base Evaporation Ponds complex is located on the western edge of Rogers Dry Lake, and the other complex is located at the AFRL, west of Downfall Road (Appendix B, Figure 2). Both of these complexes are part of the waste water treatment facilities. The total number of stormwater ponds is unknown, but various stormwater ponds are and have been in use throughout the main base and AFRL.

Flooding

All natural flow paths on Edwards AFB are ephemeral. Combined with the highly variable amounts of precipitation, high losses to evaporation, and moderate to very high soil permeability, flows are highly unpredictable compared to that of perennial streams (Bowers and Meyer 2002). Several types of flooding occur at Edwards AFB; channels, shallow flooding, and inundation caused by ponding (Bowers and Meyer 2002). Shallow flooding is also referred to as sheet flow—water that overflows the banks of braided channels joining with other overbanking areas and moving across the landscape as a wide flood no longer within a definable channel. Many ephemeral flow paths within the clay pan/dune areas and lakebeds have impermeable clay soil beds and banks, which allows for ponding to occur as the water moves through and inundates the main hydrological features within Edwards AFB (Rosamond Dry Lake, Buckhorn Dry Lake, Rogers Dry Lake, and Rich Dry Lake). The hydrological system within Edwards AFB presents challenges in delineating floodplains reliably. Over 30 studies have been conducted on base to try to capture this information (French et al. 2003, 2004; Miller and French 2004; French and Miller 2009; GRW Engineers, Inc. 1993; NSR 2012).

The surface flow study (NSR 2012) is the only one that has measured and documented real-time, on-the-ground surface flow during a flooding event. The results of this study documented the continuous hydrological connection of surrounding washes to the lakebed. Between 18 and 23 January 2010, NSR (2012) collected surface flow runoff data during a four-day set of rainstorms that resulted in five days of runoff, setting off a five-year flood event. Over this period, there were about 2.5 inches of rainfall; 0.36–0.56 inches of rainfall in the first 24 hours were required to saturate the soils and initiate surface flow runoff. The total measured volume of flow was 1.17 ± 0.23 meters per square kilometer (946 ± 189 acre feet) (NSR 2012). Approximately 946 acre feet of flood water inundated Rosamond Dry Lake. Measurements were taken in the channels leading into the lakebed, but not all water flowing into the lakebed could be measured. At the height of the storm the channels were observed overtopping their banks at Shuttle Road and Avenue C, joining with adjacent channels and creating a sheet flow across the landscape, making it impossible for the equipment to measure all the water flowing onto the lakebed. It is unknown whether other channels also overtopped their banks, but it was likely.

To provide a better picture of the entire floodplain and help with floodplain management, delineating the floodplains by both geomorphological and channel geometry characteristics together is being considered. Floodplains include the lakebeds and connecting flood-prone areas (Lichvar and Sprecher 1996; United

States Geological Survey [USGS] 2002; French et al. 2003, 2004; Miller and French 2004; French and Miller 2009).

Groundwater

The USGS compiled historical annual groundwater consumption data at Edwards AFB from 1947 through 1996. Consumption peaked at 7,500 acre feet per year (AFY) in 1965 and averaged 6,000 AFY from 1967 through 1988. From 1989 to 2004, consumption averaged slightly above 5,000 AFY. Since that time, consumption has declined somewhat due to a decrease in base population and a reduction in irrigated landscape areas.

The USGS also summarized annual historical water production, by well field, at Edwards AFB from 1947 to 1996. During the period of maximum water consumption, the North Base well field (now abandoned) and the AFRL well field (and Mary's Wells at that time) were producing in excess of 1,000 AFY and 800 AFY above their average rates, respectively. These well fields supplied water mainly for industrial uses.

Historically, the Antelope Valley Groundwater Basin was divided into two primary aquifers, an upper unconfined aquifer known locally as the Principal Aquifer and a Deep Aquifer overlain and confined by lacustrine deposits known as the blue clay layer. More recently, however, the USGS developed a conceptual model that divides the Lancaster and North Muroc subbasins (Appendix B, Figure 11) into an Upper, Middle, and Lower Aquifer on the basis of age and permeability (Leigton and Phillips 2003). The upper aquifer consists of younger alluvium and varies from confined to unconfined, depending on the presence and extent of the lacustrine deposits. The upper aquifer is the major source of ground water supply for most municipal and agricultural users in the Antelope Valley. The middle aquifer consists of older alluvium and is generally considered confined below the lacustrine deposits. The middle aquifer is the primary source of ground water supply for Edwards AFB where it extends from about 250 to 750 feet below grade. The lower aquifer consists of continental deposits and is able to store and transmit only small quantities of water, as it becomes increasingly consolidated with depth.

Groundwater quality within the Antelope Valley Groundwater Basin is generally good within the principal aquifer, with concentrations of total dissolved solids averaging about 300 milligrams/liter. The water quality, however, degrades toward the north. Arsenic is the main contaminant of concern in the Antelope Valley Region (Antelope Valley Integrated Regional Water Management Plan [AVIRWMP] 2013). Groundwater sources tend to contain higher levels of arsenic surface water sources. Naturally occurring arsenic in concentrations above the maximum contaminant level of 10 micrograms/liter are common. The demand on groundwater from municipal systems and private drinking water wells may cause water levels to drop and release arsenic from rock formations. Arsenic is an emerging contaminant of concern in the Antelope Valley Region and has been observed in the Los Angeles County Waterworks Districts-District 40, Palmdale Water District, and Quartz Hill Water District wells. Research conducted by the Los Angeles County Waterworks Districts and the USGS has shown that the problem arises primarily from the deep aquifer, and it is not anticipated that the existing arsenic problem will lead to future loss of groundwater as a water supply resource for the Antelope Valley Region (AVIRWMP 2013).

The total storage capacity of the Antelope Valley Groundwater Basin has been reported to be approximately 70 million acre-feet. The basin is recharged mainly by deep percolation of runoff through the alluvial fans of Big Rock, Littlerock, and Amargosa Creeks at the base of the San Gabriel Mountains and Oak Creek and Cottonwood Creek in the Tehachapi Mountains. Little recharge occurs beyond these areas, and surface flows that do reach Rosamond Dry Lake and Rogers Dry Lake are generally lost to evaporation (California Department of Water Resources [CDWR] 2004).

There are several estimates of natural recharge for the Antelope Valley Groundwater Basin. The CDWR (2004) reports an average natural recharge rate of 48,000 AFY and a range of 31,200–59,100 AFY. The USGS estimates range 30,300–81,400 AFY (Leigton and Phillips 2003). The Antelope Valley Technical Committee (2008) estimated a long-term average natural recharge of about 60,000 AFY, a native sustainable yield (i.e., pumping that can be supported by natural recharge) of 82,000 AFY, and a total sustainable yield (i.e., pumping supported by natural recharge augmented by supplemental water) of 110,000 AFY.

Edwards AFB has two public water systems permitted by the California Department of Public Health. The Main Base system (#1510701) serves approximately 13,400 people and the AFRL system (#1510702) serves almost 1,200. The Main Base system uses groundwater and the SWP water supplied by AVEK Water Agency to meet potable (municipal) and non-potable (agricultural and industrial) demands. The AFRL system is currently using groundwater to meet total demands. The AVEK Water Agency deliveries to the AFRL system were discontinued due to the high arsenic concentrations that result when SWP water is delivered through the city of Boron water system.

Edwards AFB began using SWP water supplied by AVEK Water Agency to supplement demand in 1992. The current annual allotment from AVEK Water Agency is 2,688 acre-feet; however, only about 70–80 percent of that volume is presently being used. There are 12 active water-production wells that serve the Main Base. The wells are located within the following four well fields: Branch Park, Graham Ranch, South Base, and South Track. The well fields are bounded to the north by the El Mirage Fault and to the south by the Willow Springs Fault. The Graham Ranch well field is further isolated to the east by the Antelope Valley Fault Zone. There are three active water production wells at AFRL. The AFRL well field is located east of Rogers Dry Lake and north of the El Mirage Fault. All of the wells are completed in the Middle Aquifer of the Lancaster Sub basin (Appendix B, Figure 11).

The California Department of Public Health recommended that the Main Base and AFRL water supply wells be maintained in operable conditions at all times as part of a Six- Month Contingency Plan to address short- and long-term disruptions in SWP water supplies.

2.3 Ecosystems and the Biotic Environment

2.3.1 Ecosystem Classification

Edwards AFB is located within the Dry Domain, Tropical/Subtropical Desert Division, and the Mojave Desert Section (USGS 2013). Ecosystems in most of the Tropical/Subtropical Desert Division are arid and characterized by high air and soil temperatures. This section lies within the American Semidesert and Desert Province and forms its own Section (Bailey 1995, Carpenter et al. 2007). A Section is a large land area of relatively homogeneous physical and biological components that interact to form environments of similar productive capabilities, response to disturbances, and potentials for resource management. In the Mojave Desert Section, the terrain consists of small-scale plains, playas, basins, and dunes (Carpenter et al. 2007).

The Mojave Desert Section is bounded by other Provinces; these include the Intermountain Semi-Desert and Desert to the north, Colorado Plateau Semi-Desert to the east, and California Coastal Range Open Woodland-Shrub-Coniferous Forest-Meadow and Sierran Steppe-Mixed Forest-Coniferous Forest-Alpine Meadow to the west. The Mojave Desert lies within the borders of four western states, and extends from southwestern Utah across to southern Nevada to southeastern California, and over to western and northwestern Arizona (USGS 2013).

2.3.2 Vegetation

Historical Vegetation Cover

For the most part, the historical vegetative cover on Edwards AFB has not changed over the years. The main plant communities of creosote bush (*Larrea tridentata*) scrub, saltbush (*Atriplex* spp.) scrub, Joshua tree (*Yucca brevifolia*), and mesquite (*Prosopis* spp.) bosques are still present on the base. These habitats were disturbed by settlers who came to the Antelope Valley in the 1800s to establish small ranches where they could raise cattle and sheep and grow crops for their livelihoods.

Current Vegetation Cover

The NRCS mapped plant associations as part of the soil mapping project of 1996 (NRCS 1996). At that time, 50 plant associations were identified on Edwards AFB, with approximately half being upland associations (Appendix B, Figure 12).

Plant communities within upland habitats consist of creosote bush scrub, saltbush scrub, and Joshua tree woodland (Appendix B, Figure 13). Table 1 and Table 2 in Appendix C list plant-community acreages and the plants found, respectively, at Edwards AFB. The plant communities and more common plant species are discussed in the following sections, as detailed in several reports (Holland 1986; Charlton 2010).

Zonal Habitats

Zonal habitats consist of lakebeds, creosote bush scrub, halophytic saltbush scrub, xerophytic saltbush scrub, and Joshua tree woodland. Delineations of the zonal plant communities are based primarily on elevation and typically contain drier soils. Vegetation in the upland areas on base consists of two main plant communities: creosote bush scrub and Joshua tree woodland. Lowland communities consist of the alkali sink and saltbush communities. Much of the surface of each of these communities is covered with a thin veneer of sand formed from decomposed granite. The sand arrived by fluvial action from Big and Little Rock Creeks in the south and from Mojave Creek in the northwest. The sand was then redeposited locally by wind action. The combination of wind and water has created beach ramps, several kinds of sand dunes, and sand sheets or sand fields.

Past vegetation mapping has divided the various saltbush communities into two plant communities: xerophytic and halophytic communities. The xerophytic communities are dominated by desert saltbush (*Atriplex polycarpa*) and spinescale saltbush (*A. spinifera*) and are generally located north of the lakebeds. Halophytic saltbush communities are dominated by shadscale (*A. confertifolia*), Joshua trees (*Yucca brevifolia*), and bush seepweed (*Suaeda nigra*), and occur south of the lakebeds. Many studies distinguish these two as separate saltbush plant communities.

Joshua Tree Woodland

The Joshua tree, an iconic symbol of the Mojave Desert, generally occurs in coarse sands, very fine silts, gravel, or sandy loams on gentle alluvial fans, ridges, or gentle to moderate slopes (Sawyer et al. 2009). The largest expanse of Joshua tree woodland on base is located on the Precision Impact Range Area (PIRA) (Cione 2008b, 2008d). Joshua tree woodland has an open to intermittent canopy with an open to intermittent shrub layer, in which Joshua trees are evenly distributed and represent at least one percent of the vegetative cover (Sawyer et al. 2009). The main understory shrub vegetation on Edwards AFB is saltbush or creosote bush. Annual plant diversity in this community is normally high (Cione 2008b). Guilds of wildlife species are attracted to Joshua trees, including pollinators and other insects, reptiles, and many bird species.

Halophytic Saltbush

Salt-tolerant (halophytic) scrublands of shrubs, trees, and grasses provide valuable wildlife forage within some of California's most arid and saline lands. Halophytic saltbush communities are dominated by shadscale (*Atriplex confertifolia*) or spinescale saltbush (*A. spinifera*) and occur adjacent to lakebeds, clay pans, and drainages. The depth of sand deposits determines the diversity of plant species in the saltbush communities (USACE 2004). The areas nearest the lakebed and areas scoured by floods are dominated by heavy clay soils and support spinescale. Plants such as alkali sacaton (*Sporobolus airoides*), Joshua trees, and fourwing saltbush (*A. canescens*) are commonly found within this plant community (Cione and Clark 2011).

Xerophytic Saltbush

The xerophytic communities are dominated by allscale saltbush (*Atriplex polycarpa*) (Cione 2008c). These plant communities are generally located at elevations slightly higher than those where halophytic communities are found. This community is composed of alkali (adapted to soils with high pH values) scrub plant assemblages. The xerophytic phase is composed of open stands of very short to moderately tall (0.25–2.0 meters; 0.8–6.6 feet) subshrubs and shrubs characterized as spinescent (with spines), leptophyllous (plants with slender leaves), and microphyllous (plants with small leaves with unbranched veins). Plants in this ecosystem are usually uniform, widely spaced, and occur on relatively dry soils (Rowlands 1982).

Creosote Bush

Approximately 40 percent of the natural vegetation community on Edwards AFB is creosote scrub (Cione 2008a). In general, the creosote scrub community tends to occur on soils that are well drained and range from sandy loam to rock and cobble. Shrub composition within this community varies widely and appears to depend on soil type. Species in this community grow in well-drained soils, and under very high summer temperatures. The creosote scrub community usually tends to have large shrub interspaces with a high density of annuals in the spring.

Azonal Habitats

Azonal habitats are areas within the zonal plant communities. They are determined by soil texture and chemistry and include desert washes, alkaline meadows, mesquite bosques, sand dunes, ruderal habitats, and clay pans.

Desert Washes

The numerous long and narrow sandy washes that occur throughout the base represent a unique habitat type with specialized plant and animal species. Also, braided washes can have mixes of species typically found in washes and on alluvial fans. More common shrubs found in wash habitat include Thurber's sandpaper plant (*Petalonyx thurberi*), bladder sage (*Salazaria neomexicana*), rubber rabbitbrush (*Chrysothamnus nauseosus*), and peach thorn (*Lycium cooperi*).

Alkaline Meadows

The main alkaline seep areas are dominated by grasses and grass-like plants. They occur on the north side of Piute Ponds and, to a lesser extent, other areas adjacent to the ponds. Seepage and water from the spillway result in a dense carpet of saltgrass (*Distchlis spicata*) and Mexican rush (*Juncus balticus* ssp. *mexicanus*). During a series of wet years, saltgrass also begins growing in cracks on the small playas and clay drainages in the halophytic saltbush scrub. Meadows also can develop near water outfall pipes and ditches along Main Base and in the housing areas. The bunch grass, alkali sacaton, also may be locally common in meadows

and at springs. Another species common in the meadows is common tarweed (*Centromadia pungens* ssp. *pungens*).

Mesquite Bosques

Western honey mesquite (*Prosopis glandulosa*) visually dominates some of the largest drainages along Big and Little Rock Creeks as they approach Rogers Dry Lake. The treelike spiny shrubs form habitat for some riparian woodland species of wildlife. This habitat is identified by rubber rabbitbrush (*Ericameria nauseosus* var. *mohavensis*), alkali mariposa lily (*Calochortus striatus*), and the local endemic subspecies of big sagebrush (*Artemisia tridentata parishii*).

Sand Dunes

Sand dunes occur primarily around the lakebeds within the halophytic and xerophytic saltbush plant communities.

Rock Outcrops

Rock outcrops occur primarily in the Bissell Hills and throughout the AFRL. Smaller rock outcrops occur in various locations throughout the base.

Caves and Mines

There are several mine shafts located on Edwards AFB, primarily on AFRL and the PIRA. There are no known caves on base.

Ruderal Habitats

Areas of highly disturbed and weedy vegetation are referred to as ruderal habitats and include locations like bomb targets and solar fields. Several species of shrubs and annuals are common after an area is bladed or cleared of vegetation. Also, many weedy species only occur in previously disturbed areas such as roadsides. Many of the common weeds are not considered noxious but represent a management concern on Edwards AFB.

Turf and Landscaped Areas

Urban

The cantonment and housing areas have been landscaped with lawns and trees, forming grasslands and urban woodland habitats not natural to the Mojave Desert. Native. Nonnative ornamental trees include Fremont's cottonwood (*Populus fremontii* ssp. *fremontii*), Mexican ash (*Fraxinus uhdei*), Aleppo pine (*Pinus halepensis*), velvet mesquite (*Prosopis velutina*), honey locust (*Gleditsia triacanthos*), and Siberian elm (*Ulmus pumila*). These landscaped areas, along with the golf course, ball fields, and school playground areas, comprise the urban habitats. Much of the new housing has xerophytic landscaping with trees and shrubs planted that require less water than those in the older landscaped areas, there is and hardscaping (with ornamental rock) instead of grass lawns. The xerophytic landscaping will be expanded to common areas and cantonment areas.

Abandoned Buildings

There are abandoned buildings throughout the installation. Past and current efforts, however, have greatly reduced their number.

2.3.3 Fish and Wildlife

Baseline surveys have been conducted for many species on Edwards AFB. Terrestrial macroarthropod surveys were conducted from 1996 to 1998 (Pratt 2000), and from 1995 to 1996 Miller and Payne (2000) evaluated aquatic habitats for macroinvertebrates. Several different studies provided data on eubranchiopods (Branchiopod Research Group 1993, Miller and Payne 2000, Perez and Donn 2009, Sullivan et al. 2017). Bird studies were conducted between 2000 and 2005 (AMEC Earth and Environmental 2006, Feenstra 2018, Corvus Ecological Consulting 2018, Colorado State University 2019). Surveys also were completed for reptiles and amphibians (Tetra Tech 1996, 2010; AMEC Earth and Environmental 2008, Steele et al. 2019) and butterflies (Pratt 2000). Appendix C provides a complete list of fish and wildlife species known or expected to occur at Edwards AFB or in the immediate vicinity.

Insects and Arthropods

Approximately 1,500 distinct invertebrate species have been documented on Edwards AFB (Pratt 2000). Commonly observed insect groups include wasps, ants, bees, flies, grasshoppers, moths, butterflies, and beetles. In 1997 and 1998, over 400 new species were added to the Edwards AFB species list. Of these species, over 80 percent belonged to the four major insect orders: Coleoptera, Lepidoptera, Diptera, and Hymenoptera. An additional 14 percent belonged to the next four major insect orders: Orthoptera, Homoptera, Hemiptera, and Neuroptera. At least three new, undescribed species of Gryllacrididae and two Scarabaeidae were found. There may be other unrecognized species. Many range extensions were found during this survey; for example, of the four Cicindela species collected, two represented major range extensions for their species (Pratt 2000). Insects are an integral part of all food webs and are a major source of protein for many other wildlife species. Pollination is one of the main positive roles played by insects in ecosystems and healthy systems have a diversity of pollinator fauna. They also serve as a food resource for many wildlife species. Pollinators of the rarest plant species occurring on Edwards AFB were not documented and further invertebrate surveys are needed. Overall, this group of organisms is not well studied.

Arthropods are not only/necessarily insects and typically include spiders (tarantulas and wolf spiders), scorpions, and fairy shrimp, a significant food resource for migratory birds. Branchiopod Research Group (1993) found five species of shrimp that occur in the playas and clay pan areas where ponded water collects from rainfall. These included three species of fairy shrimp, *Branchinecta gigas, B. mackini,* and *B. lindahli*; one species of tadpole shrimp, *Lepidurus lemmoni;* and one species of common clam shrimp, *Eocyzicus digueti* (Branchiopod Research Group 1993). Perez and Donn (2009) reported these same five species as well as Colorado fairy shrimp (*B. coloradensis*), which were present at just one site, and an unidentified clam shrimp (*Cyzicus* sp.). In 2017, Sullivan et al. reported the same species that Perez and Donn (2009) had reported, and there were detections of Colorado fairy shrimp in the same general area in the northwest portion of the base. There are no known threatened or endangered shrimp species on base.

Branchiopod Research Group (1993) and Sullivan et al. (2017) also found Chironomids (true flies), Amphipods (small crustaceans), leeches, and Oligochaetes (worms) in Piute Pond, Branch Memorial Park Pond, and multiple ephemeral claypans east of Branch Memorial Park Pond. Copepods, ostracods, backswimmers (*Notonecta* and *Buenoa* spp.), snails, dragonfly and damselfly nymphs, and caddis flies also were found. Macroinvertebrates are typically monitored as indicators of changes in water quality, as several orders are sensitive to pollution. The macroinvertebrate communities in most of the ponds surveyed contained amphipods, cladocerans, and odonates, which are ubiquitous among freshwater habitats in which the water quality ranges from acceptable to good. While the number of pollution-sensitive organisms found

in the ponds is low, the presence of Trichoptera in Branch Memorial Park Pond and Ephemeroptera in Piute Pond indicates that water quality is adequate for supporting small populations of these species. Overall ponds on Edwards AFB support a productive but simple aquatic invertebrate community of mostly ubiquitous species. This is to be expected of desert ponds where stressful conditions, including moderately high water temperatures and slightly brackish water, are inherent.

Fish

Fish do not occur in the tertiary-treated effluent in Piute Ponds or other aquatic areas on base, except for the ponds at Branch Park, which is stocked with fish, and the golf course. Bluegill (*Lepomis macrochirus*), largemouth bass (*Micropterus salmoides*), and rainbow trout (*Oncorhynchus mykiss*.) are stocked in Branch Memorial Park Pond, all of which the Aquaculture Permit allows for restocking; the permit also allows restocking of channel catfish (*Ictalurus punctatus*. Goldfish are sometimes placed in the golf course pond and in the ponds at the AFRL and Downfall, usually without coordination with natural resource personnel. They do provide some aesthetic value and may help to control insects, such as mosquitoes. During water draw-downs at Branch Memorial Park Pond, fish may be taken to the pond at the AFRL fire department. The County Public Health Department occasionally puts mosquitofish (*Gambusia* sp.) in the Piute Ponds Complex ponds to control mosquitoes and they have survived, despite the large population of African clawed frogs (*Xenopus laevis*) there.

Amphibians

Based on previous surveys and incidental sightings, at least four species of amphibians occur on Edwards AFB. These include two native species, the Pacific treefrog (*Pseudacris regilla*) and western toad (*Anaxyrus boreas*), and two non-native species, the African clawed frog and American bullfrog (*Lithobates catesbeianus*) (AMEC Earth and Environmental 2008). Tree frogs are common and native to wetlands and wetland areas throughout California and western toads are common in the housing areas and at Piute Ponds. Bullfrogs (found only at Branch Memorial Park Pond) and African clawed frogs (found only at Piute Ponds and surrounding areas) are very aggressive. They can impact many species of native wildlife. AMEC Earth and Environmental (2008) attempted to document several potential sensitive species, including the federally threatened California red-legged frog and arroyo toad, and neither was found.

Reptiles

Reptile surveys were conducted to document the common species observed in the various plant communities (Tetra Tech 1993, AMEC Earth and Environmental 2008). In the first survey, 13 different reptile species were observed. In 2005, AMEC took photographs of several seldom seen nocturnal reptiles, such as the glossy snake (*Arizona elegans*) and night snake (*Hypsiglena torquata*). In AMEC's 2008 report, 22 reptile species were documented during field surveys that took place in February and October of 2003 and 2004, one of which—the Painted turtle (*Chrysemys picta*)—was a non-native. Aquatic seining and dip-netting, drift fences, coverboards, and visual surveys were the methods used to survey for reptiles. Specific areas appeared to support higher numbers of individuals and species than may otherwise be expected. Eighteen of the 22 (82 percent) of the reptile species known to occur on Edwards AFB were found in creosote bush scrub, 9 species (41 percent) were found in halophytic saltbush, 7 species (32 percent) were found in Joshua tree woodland, 2 species, or 9 percent, were found in mesquite bosques, and 6 species (27 percent) were found in xerophytic saltbush scrub (AMEC Earth and Environmental 2008). Four species were found at only a one location. The federally threatened desert tortoise (*Gopherus agassizii*), a resident species found on base, is discussed in more detail in section 2.3.4 below. AMEC Earth and Environmental (2008) attempted to document presence of several sensitive reptile species, including

coast horned lizard (*Phrynosoma coronatum*), two-striped garter snake (*Thamnophis hammondii*), and western pond turtle (*Actinemys marmorata*). One sighting of a western pond turtle was reported at Piute Ponds in July 2015. Eleven western pond turtles, including two juveniles, were captured in Shuttle Pond at the Piute Ponds Complex in 2019 (Gomez 2020a). In general, habitat quality on base is good for reptiles.

Birds

Birds have been surveyed as part of other wildlife studies and during focused studies and recreational birding. At least 300 species of birds have been observed on base (Appendix C, Table 3). Most recreational birding occurs at Piute Ponds, a bird checklist for which is available online (www.piuteponds.org). Seasonal sampling of avian population density and movements were conducted between 2000 and 2005 to compile essential baseline information used to guide management efforts for improved flight safety and resource management at Edwards AFB (AMEC Earth and Environmental 2006). The study design included point counts, bird banding, and the collection of supplemental data, such as daily bird activity, site habitat characterization, weather, wind speed, and factors thought to influence birds and their behaviors. Other information recorded included avian flight altitudes and notable migratory bird pathways, as determined by analyses of quantitative data. As a result of the study, and other associated research, a total of 276 bird species were confirmed on the base. Heavily used migration corridors have definable and distinctive boundaries that generally follow visible landmarks, such as water, mountain peaks, and trees that were readily visible when seasonal observations were plotted in a geographic information system (GIS). Statistical analyses also provided clues about bird behavior, density, and distribution, and factors that influence these parameters, such as where and when (season, time of day) species were present, and weather (temperature, wind speed, and precipitation). Mobile radar units and WSR-88D NEXRAD weather radar were used to track migration movements of birds (AMEC Earth and Environmental 2006).

Bird banding efforts were conducted at Edwards AFB from fall 2001 through spring 2002, during which a total of 150 birds were captured and banded (AMEC Earth and Environmental 2006). Additionally, 286 point count locations were established and surveyed 10 times each year over a 2-year period, during which more than 15,000 birds were observed. Focused surveys accounted for an additional 64,000 bird observations. Seasonal abundance varied for all species, with increases occurring in spring and fall. The number of birds detected differed by habitat type. Ponds supported a disproportionately high number of detectable birds (i.e., 74 percent). Aquatic areas are of special concern because in the western Mojave Desert they are a very limited resource. The Piute Ponds Complex, Branch Memorial Park Pond, South Base Sewage, Housing Area, AFRL Fire Station, and AFRL Sewage Ponds can be considered important use areas for waterfowl, shorebirds, and species that inhabit marsh environments, such as the marsh wren (*Cistothorus palustris*), yellow-headed blackbird (*Xanthocephalus xanthocephalus*), sora (*Porzana carolina*), red-winged blackbird (*Agelaius phoenicius*), tricolored blackbird (*Agelaius tricolor*), and yellow-billed cuckoo (*Coccyzus americanus*). Playas, xerophytic scrub, creosote scrub, and Joshua tree woodland habitats each supported two percent of the average number of birds observed, whereas mesquite bosque, urban landscape, and halophytic scrub habitats supported an average of six to seven percent of all birds observed. Migratory birds contribute to resident populations during spring and fall, causing local population fluctuations (AMEC Earth and Environmental 2006).

In 2019, CEMML provided a final report on a data compilation and analysis project regarding golden eagles at Edwards AFB and 14 other military installations (CEMML 2019b). Historically, there were 26 golden eagle (*Aquila chrysaetos*) nests known to be within 10 miles of Edwards AFB, but none were known to be located within the base's boundary. CEMML recommended conducting a basewide assessment of utility infrastructure to determine the risk of eagle electrocutions at Edwards AFB. It was also recommended that, if the need arises, surveys using remote cameras be conducted in potential eagle foraging areas. CEMML

found no potential issues of compliance with the Bald and Golden Eagle Protection Act at Edwards AFB (CEMML 2019b).

Site-specific surveys for 14 target avian species were conducted between spring 2015 and winter 2017 (Feenstra 2018). These surveys were conducted at areas on base known to have water (i.e., Piute Ponds Complex, Branch Memorial Park Pond, waste water treatment plants, etc.) and in the mesquite woodlands. Of the 14 target species, 10 were detected during formal surveys; cinnamon teal (*Spatula cyanoptera*; formerly *Anas cyanoptera*), redhead (*Aythya americana*), American bittern (*Botaurus lentiginosus*), white-faced ibis (*Plegadis chihi*), northern harrier (*Circus hudsonius*), snowy plover (*Charadrius nivosus*), Forster's tern (*Sterna forsteri*), willow flycatcher (*Empidonax traillii*), tricolored blackbird, and yellow-headed blackbird. A short-eared owl (*Asio flammeus*) also was detected incidentally. Least bittern (*Ixobrychus exilis*), least Bell's vireo (*Vireo bellii pusillus*), and black rail (*Laterallus jamaicensis coturniculus*) were not detected during the surveys; however, recreational birders reported detecting least bittern and least Bell's vireo during the same survey period. In addition, breeding was confirmed for cinnamon teal, redhead, white-faced ibis, snowy plover, tricolored blackbird, and yellow-headed blackbird. A comprehensive list of 241 bird species was compiled for the entirety of this project (Feenstra 2018).

Mammals

Thirty mammal species have been documented on base. Some of the more common herbivores include the desert cottontail (*Sylvilagus auduboni*), black-tailed jackrabbit (*Lepus californicus*), and white-tailed antelope squirrel (*Ammospermophilus leucurus*). Common carnivores include coyote (*Canis latrans*), desert kit fox (*Vulpes macrotis arsipis*), bobcat (*Lynx rufus*), and American badger (*Taxidea taxus*). In the Mojave Desert, a number of terrestrial mammal species are killed by vehicular traffic, especially at night when mammals are most active.

One major bat survey was conducted on base between 1994 and 1996 (Brown-Berry 1998). Seven large areas on base were surveyed by diurnal inspection of potential roosts for bats and guano, acoustic monitoring of echolocation signals, inspection of roosting and foraging areas with night vision equipment, and mist-netting of water sources and potential roost entrances. Five species were confirmed and include California myotis (*Myotis californicus*), canyon bat (*Parastrellus hesperus*), hoary bat (*Lasiurus cinereus*), pallid bat (*Antrozous pallidus*), and Mexican free-tailed bat (*Tadarida brasiliensis*). At least one California myotis maternity roost was detected, and a pregnant canyon bat (*Parastrellus hesperus*) was captured around the AFRL Fire Station pond. Bat activity occurred mostly around water sources but also in occupied and abandoned buildings and rock outcrops. The relatively limited distribution of bat fauna could be a result of the limited amount of appropriate roosting habitat available on the base.

Between spring and fall of 2017, the Center for Integrated Research on the Environment conducted passive bat surveys on 47 Air Force installations throughout the U.S. (Schwab 2018). On Edwards AFB, the project used five Kaleidoscope Pro audio detectors and recorded all positive bat detections. Based on detections alone, confirmed species included the big brown bat (*Eptesicus fuscus*), Brazilian free-tailed bat (*Tadarida brasiliensis*), California myotis, canyon bat, hoary bat, western small-footed myotis (*Myotis ciliolabrum*), and Yuma myotis (*Myotis yumanensis*). It is possible that a number of other species were detected but could not be confirmed during manual review. These included the fringed myotis (*Myotis thysanodes*), little brown bat (*Myotis lucifugus*), long-eared myotis (*Myotis evotis*), long-legged myotis (*Myotis volans*), pallid bat, spotted bat (*Euderma maculatum*), Townsend's big-eared bat (*Corynorhinus townsendii*), California mastiff bat (*Eumops perotis*; also known as the western bonneted bat or greater bonneted bat), and the western red bat (*Lasirurs blossevillii*). In spring 2020, a follow-up project was initiated to find evidence at Edwards AFB of the species that could not be confirmed manually in the prior study.

2.3.4 Threatened and Endangered Species and Species of Concern

A list of flora and fauna Species of Interest (Appendix C, Table 4) specific to Edwards AFB is updated annually. This list identifies species of special status and concern to the USFWS and the state of California. DoD Partners in Flight Mission-Sensitive Species (DoD 2019) and DoD Partners in Amphibian and Reptile Conservation At-Risk Herpetofauna Species (DoD 2020) also are identified on the Species of Interest list.

Federal Listings

Flora

Joshua Tree (Not Warranted for Listing)

The Joshua tree was petitioned for listing in 2015, primarily on the basis of climate change effects. A 12-month status review completed in 2019 determined listing was not warranted (USFWS 2019).

The Species Status Assessment completed in 2019 reviewed two species of Joshua trees, *Yucca brevifolia* and *Yucca jaegeriana*, the former being the species present on Edwards AFB. Threats identified in the Species Status Assessment included altered fire regimes and invasive plants, climate change, and habitat loss. The Species Status Assessment specifically discussed the presence of the plant on Mojave Desert military installations and the beneficial measures included in INRMPs. Currently, 12 percent of the mapped distribution in the *Yucca brevifolia* South population falls within military installations and 12.5 percent of the *Yucca brevifolia* North population falls within military installations. The Species Status Assessment anticipated loss of suitable habitat and individual plant mortality possibly occurring in recent expansion areas. However, these installations have developed INRMPs that incorporate avoidance and minimization measures that could reduce individual fatalities of *Yucca brevifolia* and disturbance of their habitat. INRMPS also have the potential to implement monitoring activities to improve our understanding of future *Yucca brevifolia* demographic trends and population resiliency (USFWS 2019).

In 2017, Edwards AFB conducted a GIS-based analysis to determine Joshua tree population trends on the base from 1992 to 2015 with the use of 1992/1995 photogrammetry and 2008/2015 Light Detection and Ranging (LIDAR) data. The analysis suggested that Joshua tree populations on Edwards AFB are stable to increasing; however, certain limitations, such as the difficulty of identifying small Joshua trees and Joshua trees missed in the photogrammetry, elevate the uncertainty of the results (412th Civil Engineer Group, Environmental Management Division Assets Branch [412 CEG/CEVA] 2017a). Also during 2017, a GIS-based analysis, literature review, and field survey were conducted based on information from 1992 to 2017 to evaluate Joshua tree survivorship and/or regeneration in a burn that occurred in 1999 at Edwards AFB. The Joshua tree population in the burn area appeared to be stable. Their demographics, however, changed significantly in that there were mostly younger Joshua trees resprouting from older ones that were dead or dying (412 CEG/CEVA 2017b). Across its range, however, there is little information about trends in Joshua tree abundance and distribution, although it is known that exacerbated drought conditions and increased temperatures can inhibit the trees' growth and limit their distribution (Cole et al. 2011).

Fauna

A number of federally listed species are known to reside year-round, pass through regularly (migrants) or rarely (vagrants), and/or nest at Edwards AFB. Seventeen Bird Species of Conservation Concern also have been observed on Edwards AFB.

California Least Tern (Federally Endangered)

The California least tern (*Sternula antillarum browni*) was designated as an endangered species by the USFWS in 1970 (Frost 2017).

The California least tern is found from San Francisco to Baja California, Mexico and is considered a vagrant species at Edwards AFB. Nesting colonies are established in open areas on beaches, lagoons, lakes, rivers, and estuaries. The terns arrive at these locations in late April and begin nesting in mid-May. There can be a second breeding period if the first clutch is lost (Elliot et al. 2007). Ground cover from vegetation is usually less than 20%, with some denser vegetation nearby to allow chicks to hide from predators and environmental factors (Frost 2017). Protective enclosures are necessary in some areas of southern California to increase nesting success. The pacific coast of South America is suspected as being their winter location (Rigney and Granholm. 2005).

The Edwards AFB GIS database includes only one sighting in 1999 of this species.

Desert Tortoise (Federally Threatened)

In April 1990, the Mojave population of the desert tortoise was listed as federally threatened (USFWS 1990) in response to habitat loss and degradation; increased predation by common ravens (*Corvus corax*) and other natural predators, and feral dogs; disease; and collection by humans. In June 1994, the USFWS published a recovery plan and designated critical habitat for the tortoise (USFWS 1994a, 1994b). The recovery plan is the basis and key strategy for conservation, recovery, and delisting of the desert tortoise. Designated critical habitat encompasses the physical and biological features essential to the species' conservation, including space, food, water, nutrition, cover, shelter, reproductive sites, and special habitats (USFWS 2014a). Areas of designated critical habitat were delineated in all four states where the species occurs (USFWS 1994b). Portions of Edwards AFB are within the Fremont-Kramer Critical Habitat Unit of the Western Mojave Recovery Unit. Since the initial recovery plan was published, a five-year status review (USFWS 2010) and a revised recovery plan (USFWS 2011) have been published. Designated critical habitat for desert tortoise has not been revised since its original designation in 1994. There are about 65,569 acres of tortoise designated critical habitat in the eastern and southeastern portions of Edwards AFB, including portions of the AFRL and the PIRA (Appendix B, Figure 14). These generally consist of desert scrub composed of creosote bush, Joshua trees, and saltbush shrubs.

The desert tortoise, a large terrestrial, herbivorous reptile found in portions of the California, Arizona, Nevada, and Utah deserts, is a year-round resident at Edwards AFB and considered an 'indicator' of desert ecosystem health (Stebbins 2003). These animals spend much of their existence in burrows to escape extreme desert conditions, generally becoming most active during spring and early summer when annual plants are most abundant, and when they search for mates in the fall; however, they may be found aboveground during other seasons when climatic conditions are favorable (e.g., following thunderstorms and in warmer winters). Studies of desert tortoise habitat and soil requirements, food preferences, maturity, reproduction, survivability, and mortality have been published for many years. Further information on the species' range, biology, and ecology can be found in Burge and Bradley (1976), Burge (1978), Luckenbach (1982), Turner and Brown (1982), Schamberger and Turner (1986), Weinstein et al. (1987), Hovik and Hardenbrook (1989), Germano (1992), Morin and Wilbur (1998),and USFWS (2010, 2011).

Least Bell's Vireo (Federally Endangered)

The least Bell's vireo was listed as federally endangered in 1986. Critical habitat was designated in 1994.

The least Bell's vireo, a migratory species that nests in California, has not been observed on Edwards AFB, but it has been recorded in nearby Lancaster, CA.

Southwestern Willow Flycatcher (Federally Threatened)

The southwestern willow flycatcher (*Empidonax traillii extimus*), a subspecies of the willow flycatcher, was listed as a federally endangered species in 1995 and a recovery plan completed in 2002. Critical habitat was revised in January 2013 following previous designations in 1997 and 2005.

Willow flycatchers are small, migratory, and rare to locally uncommon passerines that historically nested throughout California where the species' primary habitat, riparian willow thickets, occurred (Bombay 2003). The bird most often occurs in broad, open river valleys or large mountain meadows with lush growth of shrubby willows (Serena 1982). The species has been reported on base as an uncommon migrant from March through November (AMEC Earth and Environmental 2006). Records in eBird indicate that this species is common or not frequently observed on base and all sightings are recorded during May and June (eBird 2020).

The southwestern willow flycatcher is generally paler than other willow flycatcher subspecies and differs from them somewhat in morphology (Unitt 1987, Sogge 1997; Browning 1993), distinguishing these differences requires considerable training and experience for reliable field identification (USFWS 2002).

Western Snowy Plover (Federally Threatened)

In 1993, the species Pacific coast population of the western snowy plover (*Charadrius nivosus nivosus*) was designated as threatened by the USFWS. Only the Distinct Population Segment within 50 miles of the Pacific coast is designated as threatened. (USFWS 2020).

The range of the western snowy plover spans from Washington to Baja California, Mexico. This species breeds in Oregon and California from March to September along the shores, estuaries, and rivers of the Pacific Coast (Audubon 2020). The western snowy plover has many natural predators, as well as those that have become a problem resulting from anthropogenic activities, including ravens, crows, domestic dogs and others. As a result of these factors and decreased availability of suitable habitat, the Pacific coast population of this species was designated as threatened.

The Edwards AFB GIS database does not include any sightings of this species, but it is unofficially known to have been sighted at the Piute Ponds complex and is considered to be a vagrant on base. This subspecies is not listed separately in eBird, but sightings of the snowy plover have been recorded in multiple locations on base, mainly in-and-around the Piute Ponds Complex (eBird 2020).

Western Yellow-Billed Cuckoo (Federally Threatened)

In July 2001, the western U.S. population of the yellow-billed cuckoo was accorded candidate status under the ESA and, in October 2014, the Distinct Population Segment of the yellow-billed cuckoo that breeds in the western U.S. was listed as federally threatened. Of the proposed critical habitat areas, the nearest to Edwards AFB is Lake Isabella. In June 2018, however, the USFWS acknowledged a petition to delist the western Distinct Population Segment on the basis of significant information that the action may be warranted. As a result, a species status assessment is under way, with findings anticipated in 2020.

The yellow-billed cuckoo is considered a vagrant species at Edwards AFB.

Monarch Butterfly (12-Month Status Review)

In 2014, the USFWS was petitioned to list the monarch butterfly (*Danaus plexippus*), and it was determined that federal protection may be warranted. The USFWS subsequently published a 90-day substantial finding (USFWS 2014b), and a listing decision is due in December 2020.

The monarch butterfly) is a migratory species at Edwards AFB.

Western Pond Turtle (12-Month Status Review)

The USFWS was petitioned in July 2012 to list the western pond turtle. In April 2015, it was found that action may be warranted (USFWS 2015), resulting in a 12-month status review. The 12-month status review is scheduled to be completed in fiscal year (FY) 2021. A listing determination is anticipated in FY23. The USFWS finalized a Western Pond Turtle Rangewide Management Strategy in 2020.

In 2015, there was a chance sighting of a western pond turtle at the Piute Ponds Complex. Environmental Management contracted CEMML to trap western pond turtles at the complex, and, in spring 2019, 11 western pond turtles, including 2 juveniles, were caught in Shuttle Pond (Gomez 2020a). Subsequently, an additional trapping effort including DNA testing was initiated in 2020. In 2020, trapping efforts were delayed and initiated in late July resulting in one capture and three sightings of basking western pond turtles (Gomez 2020b). In 2020, a basking raft was established in Shuttle Pond.

Tricolored Blackbird (Petitioned but not Warranted for Listing)

The USFWS was petitioned in 2004 to list the tricolored blackbird, but the 90-day finding indicated that the petition did not present substantial scientific or commercial information to warrant a status review (USFWS 2006). The USFWS was petitioned again in 2015, and the 90-day review found that an action may be warranted (USFWS 2015), resulting in a 12-month status review. In 2019, the 12-month status review found that listing was not warranted (USFWS 2019).

The tricolored blackbird is a medium-sized, migratory blackbird, the males of which differ from the females in plumage, size, and behavior. It is native to California, where more than 95 percent of the population occurs. Tricolored blackbirds are highly colonial and form the largest breeding colonies of any North American passerine (perching bird) species. Breeding colonies can attract thousands of birds to a single site. Tricolored blackbirds have three basic requirements in selecting a breeding colony site: (1) open and accessible water; (2) a protective nesting substrate, such as flooded, spiny, or thorny vegetation; and (3) a suitable foraging area within a few kilometers of the nesting site to provide adequate food such as insects (USFWS 2006).

Historically, there were tricolored blackbird breeding colonies at Branch Memorial Park Pond and the Piute Ponds Complex; however, breeding has not been observed at Piute Ponds since the 1990s. In 2014 and 2015, breeding tricolored blackbirds were observed at Branch Memorial Park Pond, but the colony was abandoned in late April 2016 before breeding successfully (Feenstra 2017a). Tricolored blackbirds returned to Branch Memorial Park Pond to breed again in the breeding seasons of 2017–2019 (Feenstra 2017b, Feenstra 2018, Causey and Feenstra 2019). A two-year field survey and analysis of tricolored blackbird breeding activity from 2014–2020 at Branch Memorial Park Pond was initiated in 2018, the report is expected in 2020.

Threats to tricolored blackbirds on Edwards AFB are minimal. Blackbird management activities include maintaining successional cattail (*Typha* spp.)/common tule (*Schoenoplectus acutus* var. *occidentalis*), marsh at the Piute Ponds Complex and Branch Memorial Park Pond and conducting surveys to monitor

the population. The habitat management activities also include maintaining a spatial and temporal distribution of different habitat types to meet breeding, feeding, and nesting needs for wetland-dependent species, increasing vertical habitat structure (i.e., trees), and water management. At a minimum, ongoing mechanical maintenance of the cattail/common tule marsh at Branch Memorial Park Pond will be required.

Mohave Ground Squirrel (Petitioned but not Warranted for Listing)

The status of the Mohave ground squirrel has been reviewed several times under the auspices of the federal Endangered Species Act, but in 2011 the 12-month finding was that listing was unwarranted at that time (USFWS 2011).

The Mohave ground squirrel is a medium-sized ground squirrel whose range includes portions of Inyo, Kern, Los Angeles, and San Bernardino counties in the western Mojave Desert. The species has been observed in creosote bush scrub, saltbush scrub, desert sink scrub, and Joshua tree woodland habitats and on sandy, alluvial soils, although it is also found in gravely, and occasionally rocky, soils. It feeds primarily on leaves and seeds of forbs and shrubs. Studies of their diet, habitat requirements, and other aspects of their life history have been conducted by Harris et al. (1995), Bartholomew and Hudson (1996), and Leitner and Leitner (1998).

The primary reason for the species' decline is habitat loss resulting from conversion to urban and suburban neighborhoods, agriculture, military uses, historical grazing by cattle and sheep, and ORV use (Gustafson 1993). The USFWS estimated that 62 percent of the Mohave ground squirrel's range is on lands under federal jurisdiction. About 57 percent of those lands is managed, at least in part, for Mohave ground squirrel habitat, including Edwards AFB, which encompasses about 5.8 percent of the species' known range. In fact, the Mohave ground squirrel is widely distributed on base (see Appendix B, Figure 15) and, for the most part, it is found in the more remote, undeveloped areas, primarily east, west, and south of Rogers Dry Lake and west of North Base, though some likely occur in other locations.

Trapping of Mohave ground squirrel populations on Edwards AFB began in the late 1980s (Buescher et al. 1995). Fifty Long term monitoring sites were established in 2003. Prior to 2009, Mohave ground squirrels were observed or captured at 15 of these locations (Donn et al. 2010). The data indicated that abundances were greatest on the eastern side of Rogers Dry Lake but that Mohave ground squirrel also were present to the south and just west of Rogers Dry Lake, and they also occurred in low numbers to the north and east of Rosamond Dry Lake (Donn et al. 2010). After 2009, a new Mohave ground squirrel survey protocol was established to determine Mohave ground squirrel occupancy and density across all sites, the new protocol entailed two different sampling techniques (trapping and visual methods) (Donn et al. 2010). Surveys were conducted using both trapping and visual methods in 2010 (Clark et al. 2010) and again in 2011 (Perez et al. 2011).

In 2018, a camera trapping protocol was executed on 25 previously established monitoring sites. In total, 1,770,636 images were recorded over the course of the project yielding Mohave ground squirrel observations at 21 of the 25 study plots. The results of this study show that Mohave ground squirrels continue to be present in most historical locations and suggests that Mohave ground squirrels may no longer inhabit most of the western portions of Edwards AFB (Lopez and Tautfest 2019).

Mohave ground squirrels mate soon after they emerge from their burrows (between mid-February and mid-March). Reproduction success is more favorable in the year following sufficient rainfall (approximately 30 millimeters) by January of the prior year and when there is a standing crop of about 1 gram per square foot of annual forage material than when prior year rainfall conditions are below average (Harris and Leitner 2004, Donn et al. 2010).

Mohave Shoulderband Snail (Petitioned but Not Listed)

The USFWS was petitioned in January 2014 to list Mohave shoulderband snail (*Helminthoglypta greggii*) as threatened or endangered. In April 2014, the 90-day finding indicated that action may be warranted (USFWS 2015), resulting in a 12-month status review. On 05 December 2017, the USFWS determined the Mohave shoulderband snail did not need protection under the Endangered Species Act (USFWS 2017).

The Mohave shoulderband snail was first described as a rather small, thin-shelled, land snail (Willett 1931). To date, very little is known about this species other than its morphological characteristics and minimum microhabitat preferences. It has been found at only three sites in the world, all of which are in Kern County, California: Soledad Mountain, Standard Hill, and Middle Butte (Curry 2014a). The habitat where they have been found consists of rock outcrops and talus slopes in the Rosamond Hills area of the western Mojave Desert. Survey data provided to the USFWS in 2014 reported 15 point locations where the Mohave shoulderband snail had been observed at Soledad Mountain (Curry 2014b, pers. comm.).

The USFWS developed a Draft Species Status Assessment, survey protocol, and initiated additional field snail surveys in January 2017. Based on the draft assessment information, a GIS-based analysis of Edwards AFB identified 11.5 acres of potential Mohave shoulderband habitat on a butte in the northwest corner of the base. Environmental Management funded a survey of this location that took place on 24 February 2017, during which no live snails or shells were detected. The soil appears to be more granitic than that of Soledad Mountain (Cerasale 2017). Edwards AFB GIS analysis identified some areas on the southeast corner of Edwards AFB that could also be surveyed (Appendix B, Figure 16).

California Listings

Flora Listed by the California Native Plant Society's Rare Plant Program

The California Native Plant Society (CNPS) list uses four categories to rank plant species according to their status in California and elsewhere. List 1 ranks species as extinct, extirpated, endangered, threatened, or rare in both California and elsewhere. List 2 ranks species as extinct, extirpated, endangered, threatened, or rare in California but extant or more common elsewhere. List 3 includes species about which more information is needed, and list 4 lists species that are watch-listed because they are rare and/or have a very limited distribution. The plant species from Lists 1, 2, and 4 that are found on Edwards AFB are listed in Appendix C, Table 4.

Edwards AFB has conducted surveys to locate and map the distribution of plants species ranked by the CNPS in List 1 as 1B: rare, threatened, or endangered in California and elsewhere. Natural resource personnel also record and map species from Lists 2–4 when they are observed. In particular, extensive surveys and studies have been conducted for four CNPS 1B species that occur on base: the Barstow woolly sunflower, alkali mariposa lily, desert cymopterus (*Cymopterus deserticola*), and Rosamond eriastrum (*Eriastrum rosamondense*). Figure 17 in Appendix B maps the known locations of species from CNPS List 1B and Lists 2–4, as given in CDFW's California Natural Diversity Database (CNDDB). These plant populations vary from a few to thousands of individuals within a concentrated area. During dry years, however, seed germination may be suppressed, resulting in variability in plant numbers.

Joshua tree (Petitioned for listing as State Threatened)

The Joshua tree was petitioned for listing as threatened in October 2019. The CDFW initiated a review of the petition in November 2019. A department petition evaluation was due on 1 March 2020. In late December 2019, Edwards AFB provided the same two Joshua tree analyses (412 CEG/CEVA 2017a, 2017b) to CDFW for consideration in its petition evaluation.

Alkali Mariposa Lily

The alkali mariposa lily, which produces a pink blossom, inhabits the drainage areas around the dry lakebeds on base. Surveys for this species were conducted along with other sensitive plant studies. The plants are large and are relatively widespread, as germination and flowering are dependent on rainfall (Greene and Sanders 2006). Alkali mariposa lilies were found in abundance along vegetation transects (estimated 4,800 plants) on the west side of Rosamond Dry Lake (Huddleston and Bratton 2016). About 162,000 plants on 63,780 acres have been documented on Edwards AFB (Appendix B, Figure 17). Populations vary from solitary individuals to large numbers spread out over more than 500 acres.

Desert Cymopterus

Desert cymopterus populations occur in areas where ground disturbance occurs, primarily from occasional foot traffic during wildlife and plant inventories and inspection of groundwater-monitoring wells. Edwards AFB has about 54 documented populations of desert cymopterus, most of which are scattered over 3,384 acres primarily on the PIRA (Appendix B, Figure 17). Small numbers of individuals also are found around the Main Base away from the developed areas.

In 2003, Edwards AFB developed a habitat model for desert cymopterus. The model was updated in 2004. The model used the habitat attributes of the known occurrences of this species. The purpose of the model was to use attribute data to identify other potential sites where this species might occur. Edwards AFB conducted field surveys to validate the model in 2004. Using the model and ground-truth field surveys, six new small populations of desert cymopterus were found on Edwards AFB and slightly north of the base. These new populations increased the known distribution and abundance of this species within the Rogers Dry Lake basin (Huddleston and Bratton 2016).

Lancaster Milkvetch

Lancaster milkvetch (*Astragalus preussii* var. *laxiforus*) is a perennial herb native to California, Arizona, Utah, and Nevada. It occurs in alkaline flats around 700 meters in elevation and flowers between March and May (Wojciechowski and Spellenberg 2014). Lancaster milkvetch is only documented in five locations in California, all of which are on Edwards AFB. Of the five locations reported on Edwards AFB, two are likely duplicate reports. On June 18, 2014, University of California Riverside staff collected and verified that one population of approximately 37 individuals is still extant on Edwards AFB Schmoker and Sanders 2014). A sixth occurrence of this species reported from Coachella Valley listed in the CNDD, is a misidentification (personal communication, Andy Sanders 2014).

Mojave Spineflower

During a 2015 baseline survey in the southwestern region of the base, Mojave spineflower (*Chorizathe spinosa*) s found (Huddleston and Bratton 2016). See 7.4.1.6 for details on vegetation type and soils where this species was found. Despite the relatively low amount of precipitation received at Edwards AFB, Mojave spineflower was abundant between the western edge of Rosamond Dry Lake and the installation boundary.

Barstow Woolly Sunflower

Barstow woolly sunflower populations are located in areas where ground disturbance occurs primarily by occasional foot traffic to conduct wildlife and plant inventories and inspection of groundwater monitoring wells. Barstow woolly sunflower is typically found in loamy to gravelly soils in saltbush and creosote bush scrub habitats. In 1995, the base documented 98,760 Barstow woolly sunflower plants on base. These

populations were scattered over 37 acres mostly within halophytic phase saltbush scrub habitat (Huddleston and Bratton 2016).

In 1995, surveys for the Barstow woolly sunflower were conducted on Edwards AFB at the locations of 3 previously known populations and in 47 areas of potential habitat. Surveys detected 98,760 Barstow woolly sunflowers covering 37 acres; however, the area covered by many populations was less than 0.06 acre. Ninety-five percent of the populations were found in halophytic-phase saltbush scrub, with one population in Joshua tree woodland habitat with a halophytic-phase saltbush scrub understory. In 85 percent of the survey areas where Barstow woolly sunflower was found, the azonal habitat was claypan, and 75 percent of the populations were found in association with alluvial plain geomorphology. Overall, clay and silt soil components were dominant elements in the soil textures (Huddleston and Bratton 2016).

Rosamond Eriastrum

Rosamond eriastrum, an annual herb in the Polemoniaceae family, is endemic to a very small area between Rosamond and Lancaster in Los Angeles County. It was recently described by Gowen (2013). At Edwards AFB, the species is found near the southwestern boundary, both on and off base. The plants grow on low hummocks in alkali flats and scalds throughout chenopod scrub adjacent to claypans, often on sandy and silty loam soil. Based on the limited information available, Rosamond eriastrum was recommended for the CNPS rank of 1B.1 (based on its rarity) and for the ranks of G1?/S1? (i.e., thought to be critically imperiled globally and in California) by NatureServe (2020) and the CNDDB (2020).

Edwards AFB conducted a baseline survey in the southwestern region of the base focusing on Rosamond erastrium, but several other sensitive species were found (as described below in 7.4.1.7–7.4.1.9) (Huddleston and Bratton 2016). Historically, Rosamond eriastrum was classified as Hoover's eriastrum (*Eriastrum hooveri*), but it was reclassified in 2013 as its own species based on flower color and length of stamens (Gowen 2013). The survey area vegetation is primarily composed of shadscale scrub and spinescale scrub vegetation on soil types of mainly Leuhman, Challenger, and Cahon. Despite the relatively low amount of precipitation received at Edwards AFB, an estimated 14,000 Rosamond erastrium were observed. These observations occurred in all soil types in the survey area.

Spreading Pygmyleaf

During a 2015 baseline survey in the southwestern region of the base, spreading pygmyleaf (*Loeflingia squarrosa* var. *artemisiarum*) was found (Huddleston and Bratton 2016). Despite the relatively low amount of precipitation received at Edwards AFB, several thousand spreading pygmyleaf plants were found on sandy soils and disturbed areas along the southeast side of Piute Ponds.

Yellow Spinescape

During a 2015 baseline survey in the southwestern region of the base, yellow spinescape (*Goodmonia luteola*) also was detected (Huddleston and Bratton 2016). Despite the relatively low amount of precipitation received at Edwards AFB, yellow spinescape was generally widespread and abundant with several thousand plants found near Rosamond erastrium populations.

Fauna

State endangered and threatened fauna are highlighted here. The bald eagle (*Haliaeetus leucocephalus*), California least tern, and least Bell's vireo, all recorded as vagrants at Edwards AFB, and willow flycatcher, recorded as a migrant on base, are state endangered. The desert tortoise, a resident species at Edwards AFB; bank swallow (*Riparia riparia*), an observed migrant; and Swainson's hawk (*Buteo swainsonii*), both observed vagrants on base; and Mohave ground squirrel, a resident on base, are all state listed as threatened. The burrowing owl (*Athene cunicularia*), a wintering and year-round resident, is listed as a species of special

concern. Additionally, 31 special-status species of birds, 1 reptile, and 4 mammals also have been observed on Edwards AFB.

California Least Tern (State Endangered)

The California least tern was state listed as an endangered species in 1971 (Frost 2017).

Least Bell's Vireo (State Endangered)

The least Bell's vireo was state listed as an endangered state species in 1980.

Willow Flycatcher (State Endangered)

The willow flycatcher was state listed as endangered in 1991 and includes three subspecies including the southwestern willow flycatcher. In the last five or six decades, the breeding populations have disappeared from most of the lower-elevation riparian areas in the state (Gaines 1974, Serena 1982), which has resulted in a decrease in population size by as much as 46% (Rosenberg et al. 2016).

Bank Swallow (State Threatened)

The bank swallow was state listed as threatened in 1989.

Swainson's Hawk (State Threatened)

The Swainson's hawk was state listed as threatened in 1983. The most recent Five Year Status Review was completed by CDFW in 2016 and it was recommended that this species continue to be listed as threatened.

Mohave Ground Squirrel (State Threatened)

The Mohave ground squirrel was state listed as threatened in 1971. Kern County filed a petition to delist the species in 1991 based on insufficient available information in 1971. It was determined that delisting was not warranted, however. In 2005, a petition was submitted to the USFWS to list the Mohave ground squirrel as federally endangered. Following the 12-month status review in 2011, the USFWS determined that listing of the species was not warranted.

Burrowing Owl (State Species of Special Concern – Wintering and Year-round Resident)

Burrowing owls have been observed in colonies in a number of places, including the Main Base near the curation facility and museum, at the landfill borrow pit, along the main runway, and in the NASA area. Colonies also have been found in more remote areas, such as North Gate, Piute Ponds, and the PIRA, where there are burrows, mining pits, or open pipes. In 2006, the largest and densest population inhabited an area between Rosamond and Lancaster Boulevards, adjacent to the Curation Facility (Building 5296) and the golf course. Environmental Management fenced this area and installed signs to delineate a *Burrowing Owl Conservation Area* of approximately 184 acres (Appendix B, Figure 18). Removal of a trailer park adjacent to the conservation area in 2005 /2006 and reduction in the number of readily available rodents, the numbers of burrowing owls using the conservation area are minimal. Threats to the species are those associated with the desert-urban interface (i.e., stray dogs and human disturbance), and reduced forage due to drought.

Greater Western Mastiff Bat (State Species of Special Concern)

The greater western mastiff bat (*Eumops perotis californicus*) was detected but was not manually verified during an echolocation survey using Kaleidoscope Pro conducted in 2017 (Schwab 2018). CEMML was contracted again in 2019 to verify whether the acoustic pattern indeed represented the greater western mastiff bat.

Pallid Bat (State Species of Special Concern)

The pallid bat was observed on base during a major bat survey conducted on base between 1994 and 1996 (Brown-Berry 1998). Seven large areas on base were surveyed using techniques including (1) diurnal visual inspections for bats or guano that would indicate potential roosts, (2) acoustic monitoring for echolocation signals, (3) nocturnal visual inspections (using night-vision equipment) for roosting and foraging areas, and (4) mist-netting at water sources and potential roost entrances. A 2017 echolocation survey (Schwab 2018) also confirmed the presence of pallid bat.

Townsend's Big-eared Bat (State Species of Special Concern)

To date, Townsend's big-eared bat has not been documented on base. In 2014, none were detected during survey of abandoned buildings via acoustic surveys and scanning for sign (guano or moth wings) (Wilson 2014). A subsequent echolocation survey using Kaleidoscope Pro was conducted in 2017, during which an acoustic pattern like that of Townsend's big-eared bat was detected but was not manually verified (Schwab 2018). CEMML was contracted again in 2019 to verify whether the acoustic pattern indeed represented Townsend's big-eared bat.

Western Red Bat (State Species of Special Concern)

The western red bat (*Lasiurus blossevillii*) was documented with acoustic equipment at the Golf Course Pond during a 2014 survey (Wilson 2014). A subsequent echolocation survey using Kaleidoscope Pro was conducted in 2017, during which an acoustic pattern like that of the western red bat was detected but was not manually verified (Schwab 2018). CEMML was contracted again in 2019 to verify whether the acoustic pattern indeed represented the western red bat.

2.3.5 Wetlands and Floodplains

Wetlands, as defined by EO 11990 Protection of Wetlands, are areas "inundated by surface or ground water with a frequency sufficient to support and, under normal circumstances, do or would support a prevalence of vegetative or aquatic life that requires saturated or seasonally saturated soil conditions for growth and reproduction." Aquatic habitats on Edwards AFB consist of natural and manmade ponds and their associated wetland areas. These habitats meet the definition above. In turn, they support numerous bird species and invertebrates such as freshwater shrimp (Eubranchiopod). Examples of aquatic habitats on Edwards AFB are the Piute Ponds Complex and Branch Memorial Park Pond.

Ephemeral systems (natural and modified), including clay pans, playas (lakebeds), stormwater and evaporation ponds, washes, and seeps, are wet only intermittently after rainfall, which is infrequent and minimal in the Mojave Desert. The ephemeral systems found on Edwards AFB do not support hydrophytic plant species, nor are hydric soil types dominant in these systems (Cowardin et al. 1979; NRCS 1996, 1997; USACE 2008, 2015); thus, they are not protected under the new 2019 Navigable Waters Protection Rule of the Clean Water Act (DoD, USACE, and U.S Environmental Protection Agency [USEPA] 2019) that repealed and replaced the 2015 Clean Water Rule (DoD, USACE, and USEPA 2015) that had extended protection to ephemeral systems.

Piute Ponds Complex

The Piute Ponds Complex (Photograph A) and the connecting washes/creeks are major hydrological features of Edwards AFB. The complex is located in the southwestern corner of Edwards AFB and is bounded on the west by base's western boundary, Avenue E to the south, and 50th Street East to the east (Appendix B, Figure 9). It is part of the Rosamond watershed (French et al. 2004) and consists of lower Amargosa Creek, ponds, marshes, wetland meadows, low sand dunes, small clay pans, and Rosamond

Dry Lake. It includes the largest body of perennial surface water on Edwards AFB and it is the largest freshwater marsh in Los Angeles County. Portions of the complex are designated as floodplain.

The wetlands (excluding Rosamond Dry Lake) and associated uplands comprise approximately 9,089 acres (Appendix B, Figure 10). About 15 percent (1,364 acres) of the area, including ponds, wetlands, wet meadows, and clay pans, are situated in the Water Management Area in which the flow and levels of water can be managed (Appendix B, Figure 10). Around the Water Management Area there are other seasonally flooded wetlands fed by ephemeral surface/stormwater as it flows to the lakebed. The Rosamond Dry Lake portion of the Piute Ponds Complex is approximately 13,800 acres. There is upland grassland habitat in unflooded areas within and surrounding the ponds, and non-native tamarisk is abundant along the dikes. Many cultural resource sites have been identified within the complex.

Photograph A. Piute Ponds Complex, October 2013.

Major vegetative components in the Piute Ponds complex are listed below.

- Floating and emergent aquatic vegetation—Found in and along the edges of ponds, marshes, and pans; includes cattails and common tules. Cattails and common tules are the dominant emergent plants within the ponds containing water.
- Undesirable vegetation—Grows along dike edges, beach/island areas within the ponds, and interspersed in meadow areas.
- Wetland meadow—Found next to ponds, marshes, and pans.
- Alkali sink—Located around the wetland areas extending towards Rosamond Dry Lake.
- Desert scrub with multiple distinct associations—Found around the alkali sink and in drier desert/uplands.
- Riparian—Grows along Clod Creek, Goose Sluice, Avenue C, and dikes; consists of Fremont cottonwood (*Populus fremonti*), tamarisk (*Tamarix* spp.), and willows (*Salix* spp.).

- Sensitive plant species—Alkali mariposa lily, Rosamond eriastrum, and Mojave spineflower are found.in and around the complex.

Animals found within the complex include avian species, raccoons (*Procyon lotor*), muskrats (*Ondatra zibethicus*), and the non-native African clawed frogs (*Xenopus laevis*).

Historically, the complex was supported entirely by surface water flow and artesian springs; now, however, the primary, annual flow is from D14, which is supplemented periodically by rainfall and surface water flow from Amargosa Creek, Little Rock Creek, and the Cottonwood Creek system (NSR 2012). Surface water begins to flow after about 0.60 inches of rain has fallen and, when this occurs, a major amount of surface flow from the watershed enters the Piute Complex (NSR 2012). This amount of surface water flow over four days can dwarf the amount of recycled water supplied to the area for the same time period and cover much of the Rosamond Dry Lake lakebed with water. Much of the natural storm flow, however, has been diverted by the surrounding cities. It is currently unknown how much flooding Rosamond Dry Lake requires for maintaining a healthy and stable pond and wetland environment. Because the Piute Ponds Complex is such an important complex of habitats, there is a separate management plan for it (15.0 Associated Plans, Tab 15.5, *Piute Ponds Complex Management Plan*) (412 CEG/CEVA 2014).

Branch Memorial Park Pond

Branch Memorial Park Pond (Photograph B) is a manmade, six-acre pond. It was established in 1961 to honor Major General Irving Branch after his untimely death in a fighter plane crash while he was Commander of Edwards AFB (Air Force Flight Test Center History Office 2001). The primary purpose of the pond is to provide a major quality of life aspect for base residents and personnel.

Well C-1 provides water for the pond, which is maintained year-round at water levels that vary from 2 to 12 feet to support nesting habitat for birds in spring and stocked fish. The well serves not only the pond but the South Gate access point, restrooms (inoperable since 2013), and a hydrant located adjacent to the Road. The pond also can be filled from the aboveground red and white water tank on south base; however, the tank is currently inoperable.

The pond embankment consists of open space, trees (Fremont cottonwood, mesquite, sandbar willow [*Salix sessilifolia*], mule-fat [*Baccharis salicifolia*]), and native shrubs (saltbush). Emergent vegetation in the pond is primarily cattail with some common tule. Resident, migratory, and breeding wildlife species use the vegetation in and around the pond for foraging, roosting, nesting, and cover. The pond is managed as a fish pond and supports populations of stocked fish, including largemouth bass, channel catfish, and bluegill. Rainbow trout (*Oncorhynchus mykiss*) may be stocked in the pond during colder winter months. Tricolored blackbirds have been observed nesting at the pond, and statewide surveys to track their populations, including the one at Branch Memorial Park Pond, are conducted regularly by volunteers with the Tricolored Blackbird Working Group. Northern harriers (*Circus hudsonius*) also have been observed nesting at the pond, and more than 50 other bird species have been observed using the pond, including various duck species, pied-billed grebe (*Podilymbus podiceps*), great egret, great blue heron (*Ardea herodias*), California quail (*Callipepla californica*), osprey (*Pandion haliaetus*), Cooper's hawk (*Accipiter cooperii*), red-breasted sapsucker (*Sphyrapicus ruber*) and several other woodpecker species, American kestrel (*Falco sparverius*), various swallow species, and savannah sparrow (*Passerculus sandwichensis*).

Photograph B. Branch Memorial Park Pond, August 2012.

Ephemeral Wash Systems

The Delineation and Characterization of "Waters of the United States" (Lichvar and Sprecher 1996), is the most comprehensive study accomplished to date on the aquatic landscape at Edwards AFB. This report mapped 351 separate dry washes totaling 487 miles. Ephemeral washes like the one pictured here in a mesquite bosque are normally dry but may become inundated after adequate rainfall (Photograph C).

Photograph C. Mesquite Bosque with Great Basin Sage.

Modified Wash Systems

Many of the wash systems within the developed areas of the base are modified and associated surface flow of rainwater is diverted. Likewise, many off-base wash systems have been modified to divert them away from urban and rural development.

Clay Pans, Playas, Lakebeds

These areas represent most of the flood-prone areas on the base. This clay pan and dune system (including the lakebeds) is a notable resource. Nowhere else in the Mojave Desert is there an ecosystem with the unusual combination of geomorphic and biological conditions that exist in this system (Brostoff and Rundel 2005) (Photographs D, E). Perhaps the most related biological conditions are those that exist in the Kalahari Desert of South Africa and Botswana (Brostoff and Rundel 2005).

Photograph D. Example of clay pan/low sand dune area, November 2013.

Photograph E. Example of clay pan/low sand dune area, April 2014.

Evaporation Pond and Storm Water Ponds

The South Base Evaporation Ponds are located on the southwest portion and western edges of Rogers Dry Lake and consist of five adjacent ponds, approximately 50 acres each, for a total of 250 acres (Photograph F). These ponds once supported wetland vegetation and were used heavily by waterfowl, shorebirds, and land birds, including migratory and resident species, throughout the year, which made them a popular birding area. The ponds had been fed by secondary treated effluent from the Waste Water Treatment Plant. But in the mid-1990s, the new tertiary treatment plant was constructed and began diverting most of the 400,000 gallon per day of tertiary treated effluent from the ponds to irrigate the golf course. Now the ponds typically receive tertiary treated effluent from the plant only November through January when water requirements at the golf course are low. Generally, only one or two of the evaporation ponds are used for overflow during this time.

There are an additional 105 acres of relict sewage ponds to the south of the South Base Evaporation Ponds that are no longer used. These old ponds were used during the early years of Edwards AFB before effluent was treated. They were used for hunting at one time and remnants of old blinds still may be detected.

Photograph F. Old and current South Base Waste Water Treatment Plant evaporation ponds.

The AFRL Waste Water Treatment Plant Evaporation Ponds are currently located west of Downfall Road and consist of four ponds, approximately two acres each (Photograph G). The AFRL treatment plant was constructed in the mid-1990s and supplies secondary treated effluent to the ponds. Approximately one acre of ponding occurs within one of the ponds at a time. The previous evaporation ponds consisted of six ponds ranging in size from 0.50 to 0.90 acres and located within a wash (the ponds aligned linearly in Photograph

G) approximately 500 feet to the northwest of the current ponds. The old ponds were frequently full and abundant with wetland vegetation and used heavily by various birds, both resident and migratory species.

Photograph G. Old and current Waste Water Treatment Plant evaporations ponds at the Air Force Research Laboratory.

Various stormwater ponds have been in use throughout the base, such as those on the flightline and AFRL. The number of stormwater ponds is unknown.

Seeps from Unknown Sources

Several seeps have been reported at Edwards AFB. Based on the vegetation there, a known seep is located near the west boundary, one mile north of Rosamond Boulevard, west of the "Division" pole line. There may be other seeps throughout the base, including on the AFRL and in the housing area, but they have not been verified or delineated.

Floodplains

AFMAN 32-7003 and EO 11988 Floodplain Management direct the USAF to provide leadership in dealing appropriately with floodplains to preserve the natural and beneficial values of floodplains. EO 11988 further states that, "Each agency shall provide leadership and shall take action to reduce the risk of flood loss, to minimize the impact of floods on human safety, health and welfare, and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for (1) acquiring, managing, and disposing of federal lands, and facilities; (2) providing federally undertaken, financed, or assisted construction and improvement; and (3) conducting federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities."

Floodplains, as defined by Executive Order 11988, are lowland and relatively flat areas adjoining inland and coastal waters that are subject to a one percent or greater chance of flooding in any given year. The 100-year floodplains (one percent or greater chance of flooding) for Rogers Dry Lake, Rosamond Dry Lake, Mojave Creek, and AFRL have been delineated (Appendix B, Figure 19; French et al. 2003, 2004: Miller and French 2004; French and Miller 2009). The Mojave Creek delineation (Appendix B, Figure 20) was updated in 2020 (Heintz and Miller 2020).

Flood-prone areas (Appendix B, Figure 19) also have been identified on Edwards AFB (Bowers and Meyer. 2002). The flood prone areas include washes and clay pans adjacent to and connecting the lakebeds, such as those between Rosamond Dry Lake and Buckhorn Dry Lake and the areas between Buckhorn Dry Lake and Rogers Dry Lake. These are areas that have not been included in the 100-year floodplain delineations, but flood events that move across these landscape features fill the defined channels, the clay pans and merge into "channels" thousands of feet to miles wide. This type of flow is common during major storm events.

Rosamond Dry Lake and Rogers Dry Lake are inundated with natural storm flow during wet winters (about every five years). The Rogers Dry Lake drains towards the southern end of the lake. Portions of the lakebed can remain inundated until late summer due to the low permeability of the lakebed soils and slow evaporation rate if sufficient surface flow is received. Water on the lakebed contains suspended sediment scoured from beds and banks of channels and tributaries to Rogers Dry Lake and from erosion of the lakebed surface (Blodgett and Williams 1992). For both lakebeds, erosion of the lakebeds when the wind causes small waves also generates suspended sediment. Inundation combined with wind action moves sediments across the playa, filling surface cracks, fissures, and other surface irregularities, when the suspended material is deposited on the lakebed as the water evaporates. A study of the geomorphology of the dry lakebeds concluded that periodic flooding of the playas was critical for maintaining a smooth, hard, compact pavement or lakebed surface (Motts 1970).

Mojave Creek is a relatively well-defined drainage course that connects the roughly 200-square mile Mojave-Soledad Mountain Drainage Area to Edwards AFB. The lower portion of Mojave Creek drains into Rogers Dry Lake, but it is not hydrologically connected to the upper portion of Mojave Creek (Sullivan et al. 2017, Heintz and Miller 2020). The drainage channel extends through residential areas and parallels Lancaster Boulevard south of the intersection with Rosamond Boulevard. The flow fans out near Rogers Dry Lake, creating flood-prone areas between Lancaster Boulevard and the lakebed. (Figure 19).

2.3.6 Other Natural Resource Information

Edwards AFB is looking for opportunities to improve energy efficiencies. Renewable energy comes in many forms, the most common of which are wind and solar. On USAF installations, wind power has taken a back seat to solar energy based on the need to maintain lower vertical profiles for flight-based missions. Edwards AFB is no exception to this; however, in the region surrounding Edwards AFB, developers strive to tap into both the abundant wind and solar generation potentials. Although favoring solar energy development helps to avoid the dangers presented by wind towers in the vicinity of flight operations, there are potential impacts to wildlife and conflicts with the military mission.

Grazing has not been allowed on Edwards AFB for over 50 years, although unauthorized sheep grazing took place occasionally before and after the base boundary was completely fenced in the late 1990s. Portions of Edwards AFB are still recovering from past overgrazing practices. In terms of biodiversity and impacts to native plants, grazing in the Mojave Desert has shifted the vegetation from native annual wildflowers to nonnative exotic weeds and reduced diversity (less palatable) of native annuals. In general, grazing in the desert results in a nearly permanent shift from a high biodiversity of native annuals to a high biomass of primarily three species of introduced weedy annuals: redstem filaree (*Erodium cicutarium*), cheat grass

(*Bromus tectorum*), and red brome (*Bromus rubens*), plus the native fiddleneck (*Amsinkia tesselata*). When grazing is combined with ORV use, it increases loss of diversity among native annuals and reduces shrub cover. Although annual vegetation on Edwards AFB has not recovered from the past unauthorized grazing disturbance, it has not degraded further, whereas much of the adjacent western Mojave Desert continues to be degraded.

2.4 Mission and Natural Resources

2.4.1 Natural Resource Constraints to Mission and Mission Planning

Natural Resources are not considered to be a major constraint to the mission at Edwards AFB, and are incorporated with mission capabilities. When Rosamond Dry Lake, Buckhorn Dry Lake, and Rogers Dry Lake flood, some mission operations may be delayed until the lakebed surface dries out. Flooding, however, is essential to the long-term sustainability of the lakebed, as it is the only process that can keep the lakebed surfaces smooth and available for aircraft operational mission uses.

Migratory birds flying through the base, especially along the flightline, have the potential to delay aircraft takeoffs and landings. The base incorporates the use of a BASH Plan and modifies its flights as necessary.

Since the desert tortoise was federally listed nearly 30 years ago, not one project on Edwards AFB has been stopped or halted because of tortoise concerns. In 2014, Edwards AFB incorporated training and protection measures from 23 USFWS biological opinions that protected both the species and the mission into one basewide biological opinion, titled *Biological Opinion for Operations and Activities at Edwards Air Force Base, California* (USFWS 2014a).

The soils at Edwards AFB are highly erodible, which could be perceived as a constraint but, if kept healthy, these soils do not impact the mission. In fact, Edwards AFB takes operational advantage of its resources to pursue testing and evaluation of important operational missions. Not all of Edwards AFB is available to every possible type of mission, but all of it is available for missions appropriate to a particular area. There are open areas, ridge lines, lakebed surfaces, shrubs, trees, and water, all of which can be used and incorporated into a component of an operational mission.

The climate at Edwards AFB is expected to become warmer with climate change, which could have secondary effects on the base's mission. Examples include shifts in vegetation type and cover, and in species' migration patterns. Additional effects of climate change could include

- increases in temperature and wind velocity that lead to unsafe conditions for launching existing and planned weapons and equipment, which, in turn, could diminish launch capacity;
- increased wind velocities and airborne dust that damage vital mission infrastructure, leading to increased maintenance requirements and/or the need to purchase new equipment;
- potential loss of future training areas; and
- disruption to the acquisition and transportation of materials required for the maintenance, construction, and storage of the equipment required to support the mission.

2.4.2 Land Use

Edwards FB lands can be classified using three land categories: improved, semi-improved, and unimproved (Appendix B, Figure 21). Of the total area encompassed by the base, improved lands account for about 3.0 percent (9,225 acres), semi-improved lands account for about 4.5 percent (13,838 acres), and 284,452 acres (92.5 percent) is unimproved lands. Natural resources issues related to land management on Edwards AFB include maintaining compatible land uses and reducing ground disturbance and erosion to combat problems related to fugitive dust and loss of habitat.

Improved Lands

This classification includes lands occupied by buildings and other permanent structures, as well as lawns and landscape plantings for which personnel annually plan and conduct intensive maintenance activities. Improved lands include the cantonment area, athletic areas, golf course, and housing areas. Grass in these areas is typically maintained at a height of two to four inches during the growing season. Vegetation on improved lands requires maintenance to ensure survival in the local arid climate.

Semi-Improved Lands

This classification includes lands where periodic maintenance is conducted primarily for operations such as erosion and dust control, bird control, and visual clear zones. Semi-improved lands include areas adjacent to taxiways and aprons, runway clear zones, lateral safety zones, rifle and pistol ranges, weapons firing and bombing ranges (targets and target areas), picnic areas, ammunition storage areas, antennae facilities, and golf course roughs. Semi-improved areas are mowed less often than the maintained turf grass on improved lands.

Unimproved lands

Unimproved lands are areas not classified as improved or semi-improved lands. The majority of lands at Edwards AFB are unimproved. These lands are not scheduled for mowing, irrigation, pruning, or insect control. Unimproved lands on base include ponds and any areas where natural vegetation is allowed to grow unimpeded by maintenance activities.

2.4.3 Current Major Mission Impacts on Natural Resources

Mission test and training activities at Edwards AFB have the potential to impact natural resources. Most of the aircraft testing takes place at high altitudes, in designated spin zone test areas, and in low-level and supersonic test corridors, which case few on-the-ground impacts on natural resources. Mission test activities associated with impacts to natural resources include aircraft test flights that use the runways on the dry lakebeds, inert bomb scoring, releases of flares from aircraft, laser testing, live-fire from aircraft, cargo drops, static testing of rocket motors/engines at AFRL, ground-support activities that assist with the flying mission of the USAF, training operations, grading existing and new targets and roads, building demolition and construction, installation of utility lines and corridors, landscape maintenance activities, aircraft crashes and clean-up, fires, and ORV travel. Importantly, large areas of the base remain relatively undisturbed, undeveloped, and relatively untouched by the current mission, allowing for conservation of natural resources.

The condition of the lakebeds at Edwards AFB, particularly that of Rogers Dry Lake, has been a subject of continued research and concern (Motts 1970; DMA Consulting Engineers 1988; USGS 1998; Orme 2002). Some of the research has entailed taking borings of the lakebed surfaces and sub-surfaces. These measurements may be repeatable and could provide insights as to the trajectory of lakebed health.

In the early 1990s, the USGS was contracted to study groundwater levels and land subsidence when a large fissure opened up on the southern portion of the lakebed. Much attention was focused on this issue and measurements on the southern end of the lakebed indicated that there had been a three-foot subsidence in that area (USGS 1998). Polygonal surface cracks were noted during this study however the focus was on subsidence fissuring. Both Motts (1970) and the USGS (1998) were contracted to respond to concerns about cracking and dust issues on the lakebeds. Once the studies were completed, there were no long-term conclusions as to future lakebed stability, mission impacts to the natural resource, or recommended actions to correct issues.

More recently, the Desert Research Institute conducted a lakebed health and feasibility of use study (Miller et al. 2020). In general, the bearing capacities of the lakebed at the soil-sampling locations were consistently over 10,000 kilopascals. The high bearing-capacity values explain the generally high structural integrity and resistance to disturbance of the lakebed soil and account for why the lakebed surface is suitable for airfield operations and vehicle traffic when it is dry. Aggregate stability tests of the surface crust, on the other hand, produced rather low values, indicating an increased risk for soil erosion by water, but aggregate disintegration provides an opportunity for soil structure regeneration and reaggregation during inundation events, thus allowing the lakebed to "heal" from minor disturbances due to airfield operations, vehicle traffic, or naturally occurring microscale cracks between aggregates. It is important to note, however, that fissures and macropolygons are less likely to recover within a single inundation event timeframe and may take years or decades to naturally heal.

Microbial communities found at Rogers Dry Lake were fairly similar to those of other dry lakebeds in the Mojave Desert. Additionally, the microbial community in surficial soils across the lakebed had a high degree of similarity except at the disturbed runway sampling location. The dynamic and versatile microbial community on the Rogers Dry Lake lakebed persists during long dry periods, and it rapidly activates and adapts following ephemeral wetting events.

Encroachment and Mission Impacts

In the face of increasing encroachment on installation boundaries, the DoD developed the Readiness and Environmental Protection Integration (REPI) program. Launched in 2004, REPI is part of the DoD Sustainable Ranges Initiative, a multi-level effort designed to ensure the future use of military training lands by addressing issues of potential encroachment on military testing and training. Critical support is needed for the REPI program at Edwards AFB. There are six REPI target areas for REPI acquisition areas associated with the joint Air Force/Navy Program and the Air Force Only Program; they include the High Altitude Supersonic Corridor, Black Mountain Supersonic Corridor, Rough One, Cords Road, North Spin Area, and the PIRA (Appendix B, Figure 22). The purchase of lands and/or easements under the REPI Program establishes conservation, preserves habitat, and provides additional protection for listed and sensitive species. This effort is expected to maintain key wildlife corridors for species' movements and maintaining species' heterogeneity. Overall, REPI emphasizes the need for installations to look outside their boundaries to work constructively and creatively with communities and other stakeholders. The program aims to

- preserve test and training spaces,
- limit incompatible development that threatens to jeopardize military readiness,
- foster partnerships with other federal and state government entities and nongovernment organizations,
- provide funding,
- acquire conservation easements from willing sellers, and
- preserve high-value habitat for listed and sensitive species.

Encroachment and Impacts on Wildlife Habitats

Urban and commercial development and associated activities reduce the biodiversity of existing plant and wildlife communities, directly impact sensitive plant populations, and threaten survivorship of the desert tortoise.

Urban encroachment indirectly impacts the mission by degrading habitat adjacent to the base boundary, loss of which could effectively increase the relative value of base lands to conservation, biodiversity, and species of special concern. When this occurs, sensitive, threatened, or endangered species may use the base

as a refuge or travel corridor and establish residency in suitable habitat. In turn, the mission could be impacted by increasingly restrictive requirements to protect sensitive species and their currently occupied habitat. The USAF strives to avoid disturbing species and their habitats in and around operating areas, including but not limited to, test/training weapons ranges, airlift drop zones, and spin zones.

Encroachment and Renewable Energy Development

The drive to reduce potential environmental impacts and the effects of climate change, along with the rising costs of power and reduced budgets, have forced the DoD leadership to consider alternative sources of energy. In 2010, the DoD and the U.S. Department of Energy signed a memorandum of understanding (MOU) to cooperate in the development of renewable energy technologies. Subsequently, the USAF developed the 2010 Air Force Energy Plan, which states, "*Where possible, the AF* [Air Force] *will develop and utilize renewable and alternative energy to reduce greenhouse gas emissions*." As a result, installations are increasingly looking for opportunities and searching for the right technologies to use renewable and alternative forms of energy and improve energy efficiencies while minimizing mission impacts.

Renewable energy comes in many forms, the most common of which are wind and photovoltaic solar power plants. On USAF installations, wind power has taken a back seat to solar energy because solar panels don't present the types of dangers presented by wind towers in the vicinity of flight operations; however, loss of wildlife habitat and cultural resources can occur when areas are graded before the installation of solar photovoltaic panels. Many facilities are now mowing instead of grading to allow vegetation rehabilitation.

Both wind and solar facilities near the base boundary can impact the radar test mission at Edwards AFB. Solar power would seem to represent a minimal impact to the mission and, on an installation conducting operational flights, it would be true in most cases. Solar power plants can present some issues at an installation that operates aircraft/aircraft systems that are in various stages of development. Reflectivity has been minimized through technological innovation. Communication systems incorporated into these developments that move the panels and transmit data wirelessly can have an impact on test capabilities, depending on the type of technology, frequencies used, and proximity to the test environment.

When performing developmental tests on aircraft radar systems, the intent is to validate the parameters of these systems to ensure they meet required design specifications. In this scenario, the area where the flight test is being conducted is effectively a laboratory where the environment should be as sterile and devoid of ground clutter as possible. Though this type of aircraft radar testing is routinely done off-base in areas such as the Cords Road radar flight test path, these systems are also tested over multiple locations across the installation.

Studies have quantified the impacts on radar systems qualification testing from wind turbines operating within a designated test area. The 412 TW tests the ground-mapping performance of Synthetic Aperture Radar on aircraft such as the B-1, B-2, F-16, F-22, F-35, and Global Hawk using reflectors and targets that are located both on and off-base. On the base, reflector arrays are located on Rosamond Dry Lake, the Farm Drop Zone, and the east range. In addition, the base uses the AFTC museum aircraft and the reflectors near them.

The development of renewable energy and other commercial sites have the potential to further constrain the test mission. For example, the PIRA at the southern and eastern boundaries of the base is Edwards primary weapons test area with targets that support both live and inert munitions. In 2005, a critical target area was expanded for use by fully armed, live weapons with warheads in the 500- to 1,000-pound class. Such weapons require larger safety zones. Further, newer air-to-ground munitions (missiles, guided munitions, glide-bombs) now have extended ranges that expand the calculated safety zone for test

execution. Renewable energy development along the base boundary has the potential to compromise those established and extended safety zones and limit the capabilities of the mission. In addition to the weapons and munitions aspect, aircraft operations on the PIRA include high-speed, low-altitude flights that would be incompatible with the vertical structures required for concentrating solar plants and the tall towers typically associated with wind energy development. Another area located along Edwards AFB's southern boundary is the Farm Drop Zone, which is used for testing and training air drops of equipment, pallets, and personnel; these air drops can stray significantly off target and may result in significant damage to solar panels and wind towers if they are located near the lakebed drop zones.

2.4.4 Potential Future Mission Impacts on Natural Resources

The EIAP ensures proper coordination and planning of on-base projects. As required by AFI 32-1015, the preparation and submission of a work request Form 332, Dig Permit, or AF Form 813 triggers the EIAP process. The 412 CEG/CEV staff review Work Request and Dig Permit for each proposed project to determine what level of environmental analysis and documentation are required. Project plans and EIAP documentation are reviewed to ensure compliance with the Endangered Species Act and other natural resources regulations. Member organizations of the Environment Safety and Occupational Health Council review all projects on Edwards AFB to ensure that all environmental impacts are identified and considered early in the project planning process and that appropriate mitigations are developed.

Management of the Environmental Restoration Program (ERP) at Edwards AFB is the responsibility of Air Force Civil Engineer Center (AFCEC) Installation Support Service. The DOD established the ERP in 1975 to provide guidance and funding for investigating and remediating hazardous waste sites generated by historical disposal activities at military installations. The fundamental goal of the restoration program is to protect human health and the environment. The primary federal laws addressing ERP activities are the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) (42 U.S.C. 9601, et seq.) and the Superfund Amendments and Reauthorization Act (Public Law 99-499, 42 U.S.C. 11001, et seq.). CERCLA requires the cleanup, or remediation, of hazardous waste sites created by historical disposal practices. The responsibility for cleanup of military installations and lands was given to the DoD. The USEPA and the various states participate in that cleanup effort by identifying the applicable or relevant and appropriate cleanup standards and procedures. Edwards AFB, the USEPA, the California Environmental Protection Agency (CalEPA) Department of Toxic Substances Control, and the CalEPA Regional Water Quality Control Board Lahontan Region entered into a Federal Facility Agreement on 24 September 1990 that specifies the time schedule, manner of remedy selection, and informal and formal dispute processes that are to be used when remediation agreements cannot be reached between the parties.

The ERP areas have been consolidated into ten operable units (OUs), based on location and/or type of facility or contamination (Appendix B, Figure 23). Several of the OUs have been combined, and OU 3, Basewide Water Wells, has been closed. OUs 1, 2, 4/9, 5/10, 6, 7, and 8 each have an independent Federal Facility Agreement schedule, detailing when primary documents will be issued for regulatory review. As such, each OU has a different schedule for submission of the draft Record of Decision (ROD) to the EPA, CalEPA Department of Toxic Substances Control, and CalEPA Regional Water Quality Control Board for review and approval. Each ROD will present a discussion of the cleanup alternative(s) selected for the sites contained in each OU. After the RODs are signed, the base will complete the design and construction of all the specific cleanup technologies selected.

Groundwater contamination is present at all open ERP sites. Interim (i.e., pre-ROD) treatment systems have been installed at sites associated with OUs 1, 4/9, and 5/10 and have been operating to remove groundwater

and soil contamination. Final (i.e., post-ROD) treatment systems have been installed at sites associated with OUs 2 and 6 and have been operating to remove groundwater contamination.

Impacts to natural resources may result from the release of hazardous substances, pollutants, and contaminants into the environment or from CERCLA response actions to clean up those releases. AFCEC, through the ERP process, is responsible for identifying such CERCLA releases, considering ecological risks and natural resource injury issues, and assessing impacts to the environment. The ERP process addresses impacts to threatened and endangered species, migratory birds, and biotic communities, it develops and selects response actions when it is likely that a release could result in an unacceptable risk to ecological receptors. Ecological risk assessments have been completed for all of the OUs.

The ERP decision-making process involves communication on natural resource issues, reviews and comments on remedial actions, and ecological risk assessments to ensure that response actions, to the extent practicable, are undertaken in a manner consistent with goals and objectives set forth in the INRMP. Edwards AFB coordinates with Federal and California State regulatory and resource agencies to evaluate and resolve potential natural resource injury issues.

The following are estimates of ground disturbances (acres) anticipated over the next five years.

- OU 1 Main Base: Well Installations, 1.25 acres
- OU 2 South Base: Well Installations, 10 acres
- OU 4/9 AFRL: Well Installations, 7.5 acres; Well Abandonments, 7 acres
- OU 5/10 North Base: No Ground Disturbance
- OU 6 NASA/OU 8 Site 25: Well Installations, 7 acres
- OU 7 Basewide Miscellaneous: No Ground Disturbance
- OU 7 Chemical Warfare Materiel: No Ground Disturbance
- OU 7 Site 3 Main Base Inactive Landfill: Cover, Stormwater Controls, Fencing, 64 acres
- OU 8 Northwest Main Base: No Ground Disturbance
- Compliance Restoration Program: Treatability Studies at Gas Stations, 0.75 acre
- Military Munitions Response Program: No Ground Disturbance

Over time, land-use choices made for the sake of supporting renewable energy initiatives and providing the base with alternative sources of power, could result in loss of substantial amounts of habitat. This in turn could result in mission options becoming limited. Future mission site options would be reduced as a result of solar developments on base. For example, in preparation for construction of a proposed, enhanced-use lease solar site at Edwards AFB, a list of potential alternate sites was developed and coordinated across base functional areas to support development of a required Environmental Impact Statement.

3.0 ENVIRONMENTAL MANAGEMENT SYSTEM

The USAF environmental program adheres to the Environmental Management System (EMS) framework and its "Plan, Do, Check, Act" cycle for ensuring mission success. EO 13834, *Efficient Federal Operations*; DoDI 4715.17, *Environmental Management Systems*; AFI 32-7001, *Environmental Management*; and the International Organization for Standardization 14001 (2015), *Environmental Management Systems—Requirements with Guidance for Use*, provide guidance on how environmental programs are established, implemented, and maintained to operate under the EMS framework.

The natural resources program employs EMS-based processes to achieve compliance with all legal obligations and current policy drivers, effectively manage associated risks, and instill a culture of continual improvement. The INRMP serves as an administrative operational control that defines compliance-related activities and processes.

4.0 GENERAL ROLES AND RESPONSIBILITIES

General roles and responsibilities that are necessary to implement and support the natural resources program are listed in the table below. Specific natural resources management-related roles and responsibilities are described in appropriate sections of this plan.

Office/Organization/Job Title (Listing is not in order of hierarchical responsibility)	Installation Role/Responsibility Description
Installation Commander	• 412th Test Wing Installation Commander. • Approve the INRMP by signature on all revised INRMPs. The Installation Commander may re-delegate signature authority to a lower level provided that the signatory has control over all aspects and management objectives addressed within the subject INRMP. • Certify annual review of the INRMP as valid and current; or delegates the certification of the annual INRMP review authority to no lower than the Civil Engineer Squadron Commander. • Provide appropriate staffing to ensure implementation of the INRMP. • Control access to and use of installation natural resources. • Sign Findings of No Practicable Alternative for actions within a floodplain or wetland. • Sign cooperative agreements entered into pursuant to the Sikes Act, 16 U.S.C. § 670c-1, so long as the individual exercising the authority is a General Officer or a member of the Senior Executive Service. • Approve and sign the installation WFMP. The Installation Commander may re-delegate signature authority to a lower level provided that the signatory has control over all aspects of WFMP implementation.
AFCEC Natural Resources Media Manager/Subject Matter Expert/Subject Matter Specialist	• Serves as the natural resources program manager and provides technical assistance and guidance to USAF on natural resources issues. • Advocates for resources required to implement approved installation INRMPs.
Bureau of Land Management	• Reviews draft INRMP before public review during National Environmental Policy Act (NEPA) process.
California Department of Fish and Wildlife	• Reviews INRMP.
Installation Natural Resources Manager	• 412 CEG/CEVA Manages all base natural resources.
Installation Security Forces	• 412th Security Forces Squadron protects human safety.

Office/Organization/Job Title **(Listing is not in order of hierarchical responsibility)**	**Installation Role/Responsibility Description**
Installation Unit Environmental Coordinators; see AFI 32-7001 for role description	• Conducts Installation Unit Environmental Coordinator duties as required.
Installation Wildland Fire Program	• 412 CEG/CEVA coordinates installation wildland fire management activities • Natural Resource Manager is Wildland Fire Program Coordinator.
Installation Pest Management Coordinator	• 412th Civil Engineer Squadron, Service Contracts manages installation pest management program.
Range Operations	• 412th Range Squadron, Engineering Range Operations manages the Precision Impact Range Area (PIRA). Natural resources issues on the PIRA are managed by 412 CEG/CEVA.
Conservation Law Enforcement	• 412 CEG/CEVA oversees conservation law enforcement activities through AFCEC with on-base USFWS Federal Wildlife Officer (FWO). • 412 CEG/CEVA coordinates with CDFW Game Wardens on an as needed basis.
NEPA/Environmental Impact Analysis Process (EIAP)	• 412 CEG/CEVA NEPA/EIAP personnel conduct NEPA/EIAP for all Installation projects in coordination with the Natural Resources Manager.
National Oceanic and Atmospheric Administration (NOAA)/ National Marine Fisheries Service	• NA
U.S. Forest Service	• NA
U.S. Fish and Wildlife Service	• Reviews INRMP. • Conducts section 7 consultations, including providing biological opinions as required. • Coordinates Recovery and Sustainment Partnership Initiative

5.0 TRAINING

The USAF installation Natural Resource Managers (NRMs)/Points of Contact and other natural resources support personnel require specific education, training, and work experience to adequately perform their jobs. Section 107 of the Sikes Act requires that professionally trained personnel perform the tasks necessary to update and carry out certain actions required within this INRMP. Specific training and certification may be necessary to maintain a level of competence in relevant areas as installation needs change, or to fulfill a permitting requirement.

Installation Supplement—Training

Natural resources management training is provided to ensure that installation personnel, contractors, and visitors are aware of their roles in the program and the importance of their participation to its success. Training records are maintained IAW the Recordkeeping and Reporting section of this plan. Below are key natural resources management-related training requirements and programs.

NRMs at Category I installations must take the DoD Natural Resources Compliance course, endorsed by the DoD Interservice Environmental Education Review Board and offered for all DoD Components by the Naval Civil Engineer Corps Officers School (CECOS). Other applicable environmental management courses are offered by the Air Force Institute of Technology, the National Conservation Training Center managed by the USFWS, and the Bureau of Land Management Training Center.

- Natural resource management personnel shall be encouraged to attain professional registration, certification, or licensing for their related fields, and may be allowed to attend appropriate national, regional, and state conferences and training courses.
- All individuals who will be enforcing fish, wildlife, and natural resources laws on USAF lands must receive specialized, professional training on the enforcement of fish, wildlife, and natural resources in compliance with the Sikes Act. This training may be obtained by successfully completing the Land Management Police Training course at the Federal Law Enforcement Training Center.
- Individuals participating in the capture and handling of sick, injured, or nuisance wildlife should receive appropriate training, including mandatory training for attaining any required permits
- Personnel supporting the BASH program should receive flight line drivers training, training in the identification of bird species occurring on airfields, and specialized training in the use of firearms and pyrotechnics, as appropriate for their expected level of involvement.
- The DoD-supported publication, Conserving Biodiversity on Military Lands—A Handbook for Natural Resources Managers, provides guidance, case studies, and other information regarding the management of natural resources on DoD installations.
- Individuals who monitor and evaluate pest management contract services on DoD installations should complete the Air Force Pest Management Quality Assurance Evaluator Course.

6.0 RECORDKEEPING AND REPORTING

6.1 Recordkeeping

Numerous types of records must be maintained to support implementation of the natural resources program. The installation maintains the required records IAW AFMAN 33-363, *Management of Records*, and disposes of records IAW the Air Force Records Management System records disposition schedule. Specific records are identified in applicable sections of this plan, in the Natural Resources Playbook, and in referenced documents.

Installation Supplement—Recordkeeping

Recordkeeping duties are supported by Natural Resources staff.

6.2 Reporting

The installation NRM is responsible for responding to natural resources-related data calls and reporting requirements. The NRM and supporting AFCEC Natural Resources Media Manager and Subject Matter Specialist should refer to the Environmental Reporting Playbook for guidance on execution of data gathering, quality control/quality assurance, and report development.

Installation Supplement—Reporting

Reporting requirements are supported by Natural Resources staff.

7.0 NATURAL RESOURCES PROGRAM MANAGEMENT

This section describes the current status of the installation's natural resources management program and program areas of interest. Current management practices, including common day-to-day management practices and ongoing special initiatives, are described for each applicable program area used to manage existing resources. Program elements for natural resources that do not exist on the installation are identified as not applicable and include a justification, as necessary.

Installation Supplement—Natural Resources Program Management

Natural resources management is accomplished by base civil service staff. The government staff ensures compliance with base policies and regulations and manages the natural resource program. An on-site natural resource contractor provides natural resource technical support specific to complying with the basewide biological opinion regarding the desert tortoise. The contractor's responsibilities include endangered species awareness education, pre-activity surveys, habitat protection delineation, project activity monitoring and reporting, habitat disturbance determinations, and desert tortoise fence repair, among other tasks. Off-base contractors conduct the majority of the natural resource field studies, inventories, surveys, and preparation of biological reports. Off-base contractors also implement natural resource management projects, including invasive species control, habitat restoration, cleanup of illegal dump sites, wetlands dredging, nuisance animal control, sign installation, and prescribed burning.

Edwards AFB maintains certain state and federal permits to help manage natural resource programs. They include a state Aquaculture Permit for managing a warm-water fishery at Branch Memorial Park Pond and a USFWS migratory bird depredation permit related to airport operation activities conducted on the flightline to minimize BASH concerns. The base requires that partner federal agencies, universities, and contractors to maintain state and federal permits, as needed, to perform their work or studies. For instance, USGS maintains a USFWS desert tortoise recovery permit for the Desert Tortoise Head Start Program at Edwards AFB.

Edwards AFB also maintains MOUs, memoranda of agreement (MOA), and interagency agreements with a variety of partners to help manage the base's natural resource programs. They include an MOU with CDFW regarding the collection of dead specimens of desert tortoises for educational purposes; an MOU with CDFW to acquire periodic assistance from CDFW state game wardens to enforce state game laws and Sikes Act regulations on Edwards AFB; an MOU with the DOI to provide a full-time Fish and Wildlife Officer to enforce federal natural and cultural laws and regulations; an MOU with the County Sanitation District No. 14 of Los Angeles County concerning water management and maintenance at the Piute Ponds Complex; an Interagency Agreement with USGS provides support for multi-year studies and research pertaining to the Desert Tortoise Head Start Program at Edwards AFB; and an MOU with San Diego Zoo Global and the USGS in support of an additional Desert Tortoise Head Start Program at Edwards AFB.

To address threats of encroachment to Edwards AFB's missions, the Installation Mission Sustainability Team (IMST) was established. This team is made up of subject matter experts from across the installation, including representatives from Airfield Management, Airspace Management, Civil Engineering, Environmental Management, Community Planning/Air Installation Compatible Use Zone Management, Real Property, Legal, Base Bioenvironmental Engineer, Public Affairs, Military Range Management, Mission Safety, Spectrum Management, Security Forces, Test and Evaluation, and Installation Tenants. These representatives provide the subject matter expertise necessary to enable the IMST to identify encroachment and sustainment challenges and elevate the issues to base leadership. The IMST performs Encroachment Assessments. These assessments address a given installation encroachment condition in terms of four evaluation factors: (a) mission impacts; (b) community impacts; (c) internal management of

encroachment and sustainment challenges; and (d) external stakeholder considerations, including community support or opposition, quality of relationships, regulatory protections, and information sharing.

Military installations and ranges have experienced increased encroachment hazards due to urban and commercial development. REPI is part of the DoD's overall Sustainment Initiative designed to ensure the future use of military operations by addressing issues of potential encroachment on military testing and training. This effort emphasizes the need for installations to look outside their boundaries and work constructively and creatively with communities and other stakeholders.

Currently, there are six target REPI acquisition areas associated with the joint USAF/Navy Program: the High Altitude Supersonic Corridor, Black Mountain Supersonic Corridor, West Spin Area, Cords Road, and the PIRA (Appendix B, Figure 22). Although it is not the sole purpose of REPI, the purchase of lands and/or easements the REPI can establish conservation habitat and ensure protection for listed and sensitive species, and it can maintain key habitat corridors for wildlife movements and species diversity.

7.1 Fish and Wildlife Management

Applicability Statement

This section applies to all USAF installations that maintain an INRMP. This section **IS** applicable to Edwards AFB.

Program Overview/Current Management Practices

Fish and wildlife program management focuses on conserving desert habitat on Edwards AFB. Native wildlife includes a wide variety of invertebrates, reptiles, birds, and mammals adapted to various desert habitats on base. Natural resource management is critical to the maintenance of biodiversity, which provides critical support to the military mission by

- providing natural landscapes for realistic training and testing conditions and greater flexibility of military operations,
- providing natural resource-based outdoor recreation opportunities, and
- maintaining compliance with the ESA, AFIs, and other USAF directives and environmental laws.

The goal is to fully support the USAF mission by establishing conditions that encourage self- sustaining, healthy ecosystems to function naturally with a minimal amount of human interference. Ongoing and future studies of plants, animals, birds, habitat, and vegetation communities provides critical information that is incorporated into the installation's GIS database for current and future reference and analysis. Over the long term, efforts will focus on assessing and monitoring the health of the base's ecosystem to ensure continuation of the various base missions while maintaining the diversity of natural resources. Wildlife conservation activity is implemented through the INRMP to maintain biodiversity passively whenever possible.

7.1.1 Fish and Wildlife Program Management

Long-term monitoring is a fundamental aspect of adaptive management and efforts are underway at Edwards AFB to evaluate and determine the appropriate indicators that will determine the overall health of the ecosystem and allow for a focused and cost-effective monitoring program. An initial habitat quality analysis (HQA) study conducted on the base in 1992 and 1993 established 60 long-term monitoring plots (Mitchell et al. 1993). These plots provided the baseline and benchmarks against which to measure and evaluate biological resource changes over time (Appendix B, Figure 24). Since 2004, the base has been monitoring some of these plots on an annual basis; the number of plots monitored each year is based on

available funding. Initially, these HQA study plots were used for monitoring both flora and fauna but the plots were found to be unsuitable for monitoring fauna; thus, in 2017, it was decided that the HQA study plots would be used to monitor only long-term habitat quality. Now separate monitoring protocols are being developed and implemented for fauna monitoring. The new HQA study design for monitoring habitat quality (vegetation) increased the number of plots to 70, with some being in the same location as they were previously and others in a new location. This was done to capture a more accurate and representative sample of the vegetation communities on base. The first round of data collection occurred in 2019 and additional surveys will occur at planned regular intervals in the future.

Insects and Arthropods

Several surveys for aquatic invertebrates have documented the presence of fairy shrimp, tadpole shrimp, and common clam shrimp. In the resulting reports, some concerns were highlighted and recommendations made to improve management of the sensitive ecosystem occupied by these invertebrate species. Base activities that may be harmful to these species include vehicle traffic on lakebeds and clay pan areas, which crush eggs and break down soil structure; the biodegradable petroleum product used to mark runways; and the inflow of gravel and other elements from areas of concentrated base activities along the flight line, which may perturb water chemistry and change soil structure (Branchiopod Research Group 1993). As further studies are conducted, these issues should be monitored and documented to determine the extent of impacts on the overall populations of freshwater shrimp within a given hydrological unit.

The construction of roads and buildings on the base also could affect aquatic habitats, with potential effects ranging from fragmentation of natural temporal pools (i.e., playas) and populations to disturbances of sites by vehicular traffic, changes in water chemistry (from influxes of pollutants), and transport of animals to other areas of the base. In the event that branchiopods are transported to new areas, they may have negative impacts on the indigenous animals in those areas. This is a concern, particularly for locally rare species on Edwards AFB, such as Colorado fairy shrimp. Therefore, preserving these habitats in their natural conditions is important and the following are recommendations for monitoring of these habitats (Perez and Donn 2009).

- Conduct branchiopod crustacean sampling during the dry-season. Dry season sampling in 31 of the 55 sites sampled during the wet season detected brachiopods that were not detected during the wet-season. Sampling of sites and culturing of eggs should be conducted during the dry season to determine the presence of rare species.
- Conduct wet-season sampling of sites in which branchiopods were detected only during the dry-season sampling to identify the conditions associated with the hatching of eggs.
- Conduct further surveys in the northwest area of the base and the PIRA. The 2009 survey was the first survey for branchiopod crustaceans in the northwest area and the PIRA. Statistically significant differences in site chemistry were detected among areas, and Colorado fairy shrimp were found only in the northwest area of the base.

Fish

Fish do not require any special management considerations because all fish in Edwards AFB wetlands are stocked. It is recommended that no invasive fish species be stocked.

Amphibians and Reptiles

Management actions recommended by AMEC Earth and Environmental (2008) to benefit native amphibians and reptiles include

- periodic monitoring of sensitive and rare native amphibian and reptilian populations;

- maintaining or restoring natural hydrological processes by maintaining and preserving natural hydrological regimes of water tables and stream flows, such as inundation and desiccation cycles;
- protecting natural drainages from degradation caused by clearing and trampling of vegetation and erosion;
- restoring and revegetating disturbed and degraded habitats;
- enhancing and restoring habitat and microhabitat heterogeneity in aquatic systems by maintaining waters of varying depths and permanence, setting aside certain areas for establishing native aquatic vegetation and other areas for open water;
- as appropriate, determining the need to control non-native amphibian and reptile populations and implementing pest management plans;
- considering and evaluating the potential introduction of native amphibian species in areas from which non-native amphibians are removed;
- avoiding or minimizing impacts to Haystack Butte to prevent impacts to known populations of the common chuckwalla (*Sauromalus ater*);
- reducing impacts associated with roads and trails by closing non-essential roads and enforcing speed limits;
- managing projects to maintain habitat continuity and encourage movements among amphibians and reptile populations (e.g., providing safe crossings on roadway projects); and
- monitoring for snake fungal disease (caused by the *Ophidiomyces ophiodiicola* fungus).

Birds

Consistent with military mission requirements, Edwards AFB encourages incorporation of comprehensive migratory bird management objectives into relevant planning documents, including the INRMP, Integrated Pest Management Plan (IPMP), Installation Master Plans, National Environmental Policy Act (NEPA) analyses, and other relevant documents (DoD 2014). Consistent with current and emerging mission requirements, Edwards AFB will manage base lands in a manner that supports migratory bird conservation, habitat protection, restoration, and enhancement. Edwards AFB will inventory and monitor bird populations on base lands to the extent feasible to facilitate conservation decisions and efforts. Edwards AFB will refer to comprehensive planning efforts for migratory birds, including Partners in Flight Bird Conservation Plans, the North American Waterfowl Management Plan, U.S. Shorebird Conservation Plan, North American Waterbird Conservation Plan, Sonoran Joint Venture and other associated regional plans.

Mammals

Bats have been receiving more attention and management since the 2006 discovery of the fatal disease, white-nose syndrome, among bats in New York. This rapidly spreading disease, caused by the *Pseudogymnoascus destructans* fungus, infects overwintering cave-roosting bats. In 2018, the disease was discovered in California. Other threats include loss of roosting and foraging habitat, the primary potential threat to bats at Edwards AFB. Currently, foraging, watering, and natural roosting habitats at Edwards are stable, as wetlands and ponds are maintained to support human use and the military mission (Piute Ponds Complex, Branch Memorial Park Pond, AFRL Fire Station 3, and the Golf Course Pond). Edwards AFB continues to identify and demolish many abandoned and energy-inefficient structures. These structures often serve as primary roosting habitats for many cave-roosting bat species. To minimize negative effects on bats, a survey for bats will be conducted before the start of any demolition activity. If bats are detected, efforts will be made to passively exclude them prior to demolition and to avoid demolition during the breeding season. Not all abandoned buildings are being used or are considered suitable as day, night, maternity, or winter roost sites for bats but, during a bat survey conducted at Edwards AFB (Brown-Berry 1998), bats were detected in several buildings that have already been demolished, including one with a documented maternity roost. Management activities include surveys to look for bats species and humane

exclusion of them prior to building demolition. Construction of suitable alternative roosting habitat is not a viable mitigation measure. Some mines and pitfalls on base provide suitable roosting habitat for bats. When closing mines and pitfalls for human and wildlife safety, efforts are made to determine bat presence and provide bat access when bats are present.

Rabbit Hemorrhagic Disease virus type 2 (RHDV2) was confirmed in wild rabbits in California in May 2020 and has since spread to 5 counties, including Los Angeles and San Bernardino counties. There is concern that high mortality in local rabbit populations due to the disease will affect populations of other species that rely on rabbits as prey, and that as RHDV2 spreads through the state it could significantly impact populations at risk, such as the endangered riparian brush rabbit. It may be necessary to develop protocols specific to sick or dead rabbits due to this disease for carcass reporting/collection and disinfection of potentially contaminated clothing/shoes/equipment.

7.1.2 Enforcement of Fish and Wildlife Laws

Enforcement of fish and wildlife laws is executed by the on-base USFWS Federal Wildlife Officer (FWO).

7.1.3 Demand for Hunting, Fishing, and Non-consumptive Uses of Resources

Demand for upland game hunting is relatively low at Edwards AFB. There is a relatively high demand, however, for waterfowl hunting. Likewise, there is a high demand for fishing at the Piute Ponds Complex and Branch Memorial Park, and birdwatching is popular at the Piute Ponds Complex.

7.1.4 Wildlife Education and Interpretive Programs

Wildlife education is provided, as requested, for on-base residents, school groups, and during newcomer briefings. Live snakes, animal mounts, and pelts are provided. Brochures and pamphlets are provided at newcomers briefings and are available at the Housing Office. Written material is either purchased from the State of California or reproduced on base by Public Affairs through their media contractor. An effort is now underway to produce brief natural resource videos specific to Edwards AFB.

7.1.5 Nuisance Wildlife Problems and Wildlife Control Techniques

Nuisance animals usually pose a public safety hazard. Nuisance wildlife species at Edwards AFB include coyotes, bobcats, California ground squirrels, venomous snakes, and ravens, some of which are attracted to the base because of illegal trash dumps. Water, food, and vegetative/manmade shelter in the cantonment area also attract coyotes, bobcats, ravens, and California ground squirrels. In wildlife-urban interface of Edwards AFB, the main nuisance animal deterrent is education, including brochures, videos, and talks addressing issues about proper trash disposal and living in the wildland-urban interface. Cleanup of illegal trash dumps and precluding illegal access to base in the Piute Ponds Complex area is an ongoing effort.

Control of hazardous, sickly, and injured wildlife is handled by Environmental Management staff, the USFWS FWO, the U.S. Department of Agriculture Animal and Plant Health Inspection Service's Wildlife Services (APHIS-WS), CDFW, and Security Forces. An Edwards AFB Wildlife Incident Procedures outlines the processes to follow when encountering such wildlife (412 CEG/CEVA 2019b). Some details are listed below.

- Coyotes—Current CDFW policy is that there are no concerns with coyote control on Edwards AFB
- CDFW has no issues with live trapping bobcats and releasing them, as long as the release site is appropriate habitat on Edwards AFB (must have access to water). Trapped animals cannot be released off base. Planned, lethal control of bobcats not related to an immediate threat to human health requires a permit from the State.

- Other species—There is the potential for issues with other species that may be non-resident on Edwards AFB (e.g., black bear, mountain lion, raccoon, skunk, wild turkey). Although trapping and releasing them on Edwards AFB is an option, it may be inappropriate due to animal size and/or lack of habitat. These issues will be addressed on a case-by-case basis.
- Live trapping and translocation/release will be conducted by 412 CEG/CEVA (government or contractor) biologists. Prior to implementing trapping, a plan of approach must be developed and approved by the Environmental Management Chief and Natural Resource Manager
- If an animal that is trapped shows signs of having young, an effort is required to locate the young. If an animal that has been trapped requires euthanasia, the Edwards AFB veterinarian will administer the euthanasia. Euthanasia can also be administered by the APHIS-WS biologist.
- Generally, lethal control will be conducted by APHIS-WS.
- Following lethal control, the animal will be disposed of properly (e.g., burial or bagged and placed in the trash). If the animal was acting strangely (e.g., disoriented, aggressive) and/or is diseased, the CDFW or APHIS should be asked whether they want to conduct a necropsy. The Edwards AFB USFWS FWO also can arrange for a necropsy.
- After the control action is completed, there should be appropriate follow-up, including basewide emails through Public Affairs as needed. Ideally, a final report should be prepared and filed on the shared drive to detail the incident in chronological order, including who was involved, actions taken, and which worked versus any that did not, relevant map(s), and recommendations.

Veterinary services are occasionally available on base, but they are not funded to attend to hazardous, sickly, or injured animals. Providing veterinary services to treat and/or euthanize injured wildlife and nuisance animals is ongoing.

7.1.6 Policies, Programs, and Methods Used to Control Feral Animals

Feral animals are not very prevalent at Edwards AFB but do include packs of feral dogs and feral cats. Occasionally, goats, sheep, and horses enter the base from adjacent properties or from if released by on-base residents. Policies and procedures for removing feral animals are handled by contacting APHIS-WS.

7.1.7 Measures to Protect Significant Fossil Resources

Significant paleontological resources are generally vertebrate fossils of any age, or especially rich, diverse, detailed, or otherwise important deposits of invertebrate or plant fossils. None have been identified on Edwards AFB.

7.2 Outdoor Recreation and Public Access to Natural Resources

Applicability Statement

This section applies to all USAF installations that maintain an INRMP. This section **IS** applicable to Edwards AFB.

Program Overview/Current Management Practices

There are 14 on base areas suitable for outdoor recreation (Appendix B, Figure 25). These areas include two upland game hunting areas, the Piute Ponds Complex, Branch Memorial Park, three ORV-use areas, an area for flying model airplanes, a Rod and Gun Club, an equestrian facility, an 18-hole golf course, the FamCamp, park and athletic complexes, and the AFRL track. The Installation Commander, in consultation with Environmental Management, Security Forces, Safety Office, Service Division, and Judge Advocate, determines the extent of access on all areas designated as suitable for outdoor recreation and described in this INRMP. Use of outdoor recreation areas by the general public is allowed when such use is deemed by the Commander to be compatible with the military mission. Demand for upland game hunting is relatively

low, whereas the demand for waterfowl hunting at the Piute Ponds Complex and fishing at Branch Memorial Park is relatively high. Demand for use of ORV areas is seasonal and minimal. Birdwatching is popular at the Piute Ponds Complex.

Areas listed below are designated as suitable and open for outdoor recreation on Edwards AFB. However, use of a particular outdoor recreation area may only be available to certain authorized individuals.

- Bissel Hills Hunting Area 1—Available to permitted hunters.
- Mesquite Woodlands Hunting Area 2—Available to permitted hunters.
- Piute Ponds Complex Hunting Area 3—Available to permitted hunters and authorized public.
- Branch Memorial Park Fishing Area 4—Available to permitted anglers and authorized on-base users.
- ORV Area 1—Available to lessee club members.
- ORV Area 2—Available to authorized on-base users.
- ORV Area 3—Available to authorized on-base users.
- Model Airplane Flight Area—Available to lessee club members.
- Rod and Gun Club—Available to authorized users.
- Equestrian Facilities—Available to authorized on-base users.
- Golf Course—Available to anyone with authorized base access.
- FamCamp—Available to anyone with authorized base access.
- Park and Athletic Complexes (hiking/jogging trails, par course fitness trails, swimming pools, skateboard park, and ball fields)—Available to authorized on-base users.
- AFRL Track: Available to authorized on-base users with AFRL access.

7.2.1 Outdoor Recreation Management

AFI 34-110, *Air Force Outdoor Recreation Programs*, provides guidance for initiating and maintaining outdoor recreation programs at USAF installations. The AFI outlines roles and responsibilities, safety considerations, program goals, and funding categories. A number of DoD, federal, and state guidelines and restrictions provide policy guidance for managing specific recreational programs.

The Installation Commander is responsible for outdoor recreation management on Edwards AFB. The Services Division, Environmental Management, Civil Engineering, and Security Forces cooperate to execute the outdoor recreation program. Environmental Management manages the natural resources on Edwards AFB and outdoor recreation activities at Branch Memorial Park, the Piute Ponds Complex, the Upland Game Hunting areas, and the ORV Areas. The remaining recreational areas are overseen by the Services Division.

Management of natural resources provides opportunities for outdoor activities on USAF lands, as described in AFMAN 32-7003. This INRMP presents procedures to integrate Outdoor Recreation Management information into the overall base mission and into natural resources planning and management. Providing quality outdoor recreation experiences contributes to an enhanced quality of life for base personnel and contributes to multiple uses of natural resources.

Hunting, Fishing, Trapping Program—Organization and Management

The CDFW hunting and fishing rules and regulations are applied on base, but they may be further limited by the Edwards AFB Instruction (EAFBI) 32-7064, *Management of Hunting and Fishing Program* (EAFBI 2020), which governs hunting and fishing on Edwards AFB. For example, trapping is not permitted on Edwards AFB and the fishing catch limit is different. The State of California's rules and regulations applicable to hunting and fishing, including state wildlife policies, agency responsibilities, hunting and fishing provisions, trapping provisions, licensing and permit requirements, take restrictions, and penalties

for code violations, are spelled out in the Fish and Game Regulations of the California Code of Regulations (CCR), Title 14, Division 1. Information on hunting and fishing at Edwards AFB is periodically announced in public affairs announcements and provided on the Edwards AFB iSportsman website.

Environmental Management is responsible for conferring with USFWS and CDFW to ensure compliance with appropriate federal and state laws. Environmental Management staff, CDFW Game Wardens, and USFWS FWOs check to be sure that hunters hold current hunting licenses and comply with waterfowl bag limits. CDFW game wardens enforce state hunting and fishing regulations, whereas USFWS FWOs enforce federal, state, and Edwards AFB regulations. Persons authorized to hunt on base include active duty and retired members of the military and their dependents, DoD employees, tenant organizations, contractors assigned to Edwards AFB and their dependents, sponsored guests, and the public. In general, public access to Edwards AFB is restricted in that each person is required to obtain a pass or permit or be escorted to enter the installation. Environmental Management collects Hunting and Fishing Program permit fees electronically through iSportsman, whereby the funds are deposited into the Fish and Wildlife Conservation Account (57X5095). The funds generated are available only to Environmental Management for fish and wildlife management activities at Edwards AFB.

Flight Scheduling is responsible for providing information to Environmental Management about when low-altitude aircraft missions will take place to help prevent conflicts between the military mission and hunting activities.

Hunting

There are three designated hunting areas on Edwards AFB. Upland game hunting (dove, quail, chukar [*Alectoris chukar*], and rabbit) is permitted in the Bissel Hills Hunting Area 1 and the Mesquite Woodlands Hunting Area 2. Waterfowl hunting is permitted at the Piute Ponds Complex Hunting Area 3.

Upland Game Hunting

The Bissel Hills Hunting Area 1 encompasses approximately 16,140 acres. The Mesquite Woodlands Hunting Area 2 encompasses approximately 3,400 acres. Dove, quail, chukar, and rabbit hunting is permitted IAW state CCRs. These areas are accessed via unimproved roads and trails. The management strategy for upland game hunting in these areas is to conserve the existing natural habitat. No game stocking is proposed. Previously installed water guzzlers are not maintained and will be removed.

Waterfowl Hunting

The Piute Ponds Complex provides wetlands habitat for hunting of migratory waterfowl. The water management area has 13 ponds containing up to 2,000 acre feet of water. District 14 provides tertiary treated water to the complex, which is then distributed via channels and adjustments to both wood weir and screw-gate weirs. The dykes created over the years to contain the water also serve as unimproved roads. The inflow from District 14 drops just three feet through the complex before flowing onto the lakebed of Rosamond Dry Lake. There are approximately 40–50 locations designated for hunting blinds, which are subject to change in number and location from year to year; there are designated blind location(s) for mobility-impaired hunters as well. Blind construction is the responsibility of anyone permitted to use one of the blind locations. Use of non-motorized watercraft is allowed only during waterfowl hunting season to access duck blinds and retrieve harvested ducks or geese or through written permission from the 412th Civil Engineer Group, Environmental Management Division (412 CEG/CEV). The only amenities are two portable toilets and a small observation shelter.

The Piute Ponds Complex Management Plan (412 CEG/CEVA 2014) is a component plan of this INRMP and describes in detail the management goals, objectives, and implementation strategies. Regular maintenance of the area requires weekly weir monitoring and occasional adjustments to manage proper water flow. Natural pond succession requires the removal of excess cattails, common tules, and sediment from within the ponds (every year, rotating among ponds) to maintain wildlife habitat and hydrological processes. Control of invasive plant species and restoration of native wetlands habitat is ongoing. Prescribed fire is one tool used to remove excess biomass, control invasive plants, reduce piled vegetation, and improve wildlife habitat. Mechanical removal of cattails/common tules is used to improve hydrological flow and improve wildlife habitat. Dredging is most effective when removing vegetation/roots and sediment separately. Excavated vegetation and sediment is placed in a designated spoils area within the complex. Fence repair and installation of regulation signage is necessary to enforce hunting regulations described in EAFBI 32-7064. Nuisance animals, such as packs of dogs, and trash dumping pose public safety and environmental hazards. Civil Engineering manages a basewide portable toilet contract that includes two toilets at the Piute Ponds Complex which are cleaned weekly and paid for by Environmental Management (57X5095) funds.

Birdwatching

The Piute Ponds Complex is a well-documented birdwatching site for individual birders and birding groups and for various seasonal bird surveys. It is considered a "Birding Hotspot" on eBird, and school classes visit the site to enhance their understanding of biology and use the area as an outdoor laboratory to enhance their understanding of biological sciences. Access to the area, regardless of the user's existing approval status for base access, requires processing through Environmental Management. This is to ensure that visitors understand the guidelines for visiting the area (such as exclusion times) and allows Environmental Management to remain cognizant of usage pressure on the area. Branch Memorial Park Pond is accessible for birding by those with approved base access.

Fishing

Fishing is permitted only at Branch Memorial Park Pond. This six-acre pond is supplied with water from well C-4, which also supplies South Gate. Water use is about 270 acre feet per year. A dirt access road forms the perimeter of the pond. Fish structures in the form of 55-gallon barrels and rock piles have been placed within the pond. An aerator system that was installed in the pond is not functional. There are no improvements dedicated to access for mobility-impaired anglers.

Branch Memorial Park Pond is stocked using 57X5095 account funds and is managed primarily to support fishing; however, fish suppliers willing to deliver to Edwards AFB are very limited due to the base's remote location. A state fishing license and a base fishing permit are required for fishing at Branch Memorial Park Pond, and public access is restricted to those with DoD-approved access passes. Fishing is allowed all year IAW EAFBI 32-7064. Floating waders are allowed, but only two non-motorized boats may be on the water at any given time. Swimming is not allowed in the pond

Natural pond succession requires the removal of excess cattails, common tules, and sediment from within the pond every 3–5 years. Mechanical removal is most effective when removing vegetation/roots and sediment separately. Excavated vegetation and sediment are to be placed in a designated area adjacent to the pond. Prescribed burning can be used to reduce some of the piled vegetation. Some vegetation is left remaining in the pond to provide oxygen and cover for fish and bird nesting habitat. Some vegetation control may be required around the pond edges and around the boat ramps as well.

Environmental Management is responsible for managing Branch Memorial Park Pond, and equipment and supplies are purchased when needed. Civil Engineering is responsible for maintaining the restrooms, infrastructure, and the water-delivery system at the park, and it also clears vegetation and sediment from the pond. An Aquaculture Permit from the State is renewed each year to allow fish stocking.

Off-Road Vehicle Program—Organization and Management

EAFBI 31-280, *Motor Vehicle Traffic Supervision*, serves as the regulation for the three ORV-use areas, and the Services Division is the Office of Primary Responsibility for overseeing ORV use on base. ORVs authorized for use on base are limited to those covered by Specialty Vehicle Institute of America training, and include off-highway motorcycles (dirt bikes), dual sport bikes (off-highway motorcycles that are street legal), and all-terrain vehicles (three- or four-wheel). All ORVs must be registered with the state and operated only within designated areas and trails of the ORV areas.

Edwards AFB requires all riders of motorized ORVs to carry proof of ORV safety training and the basewide biological opinion regarding the desert tortoise requires riders to undergo desert tortoise awareness training prior to using ORVs in the ORV areas. The awareness training is provided by Environmental Management, to which riders are referred by the Services Division. Security Forces and the USFWS Federal Wildlife Officer regularly patrol the areas to ensure that riders remain within the boundaries and use existing trails.

Besides desert tortoise awareness training, compliance with the basewide biological opinion requires regulatory signage in the ORV areas to preclude additional habitat destruction. Signs are placed at least every half mile along the boundary to delineate the ORV area boundaries. Interpretive signs providing rules, maps, and safety information are placed in at least two main access points to each ORV Area. Law enforcement personnel patrol the areas to ensure riders remain on designated trails. Habitat disturbance is monitored.

Off-Road Vehicle Areas

ORV Area 1 (approximately 100 acres), located between the housing and cantonment areas, is operated under a special-use lease and is for use only by members of the lessee club. It has groomed jumps, track, fences, storage containers, and bleachers. Access is limited by an entrance gate and partial fence. As of 2018, the lessee had abandoned the lease and the area is closed, although a new lessee is being considered.

ORV Area 2 (approximately 15,040 acres), located west of the housing area, is jointly used for motorized ORV use, non-motorized mountain biking, equestrian use, hiking, and jogging.

ORV Area 3 (approximately 4,328 acres with 32 miles of trails), located just north and northwest of NASA/Armstrong and primarily west of Rosamond Boulevard, is used only for non-motorized mountain biking and jogging. No motorized ORVs are permitted in ORV Area 3.

Natural resource management of these ORV areas is focused on containing habitat destruction to designated trails or, in the case of ORV Area 1, to the permit area.

The lease abandonment of ORV Area 1 has led to illegal use of the area and abandonment of built structures. If a new lessee is not found, restoration of this area would be required, although financial responsibility of restoration is undetermined. Because access to the site is easy, a volunteer restoration project could prove effective and the recovery could be monitored scientifically.

Regular law enforcement patrols are most effective in preventing use of undesignated trails; however, they are time consuming and costly. Preventing undesignated trail use is first addressed with signage, then with barricades, and finally with vertical mulching.

There are maps of designated trails for each ORV area, but the extent of undesignated trails is not well documented. Regular monitoring of the ORV areas to assess signage condition and needs, the spread of undesignated trails, and widening or erosion of designated trails is required annually. A habitat-monitoring protocol (412 CEG/CEVA 2019a) was established for ORV Area 2. The protocol allows for annual monitoring of sample trails and habitat on a rotating basis, minimizing the time requirements for monitoring and making it possible to use volunteer monitors. No monitoring protocol has been developed for ORV Area 3.

Model Airplane Flight Area

The Model Airplane Flight Area is leased by the Muroc Model Masters. It is located on the lakebed of Rosamond Dry Lake north of Rosamond Avenue. The lease prohibits use of the area when the lakebed is wet or inundated with water.

Rod and Gun Club

The Rod and Gun Club is administered by the Services Division IAW AFI 34-110, *Air Force Outdoor Recreation Programs and Procedures*. Facilities consist of a club house building and various ranges, including some for archery, trap, and skeet shooting.

Equestrian Facilities

Equestrian facilities in base include 50 stables (capacity for 100 horses), an exercise and training area, and a large, open riding area. The facilities are provided for authorized users IAW AFI 34-110, *Air Force Outdoor Recreation Programs and Procedures*. All horses in the facilities must be inoculated against local diseases, and a veterinarian must declare them free of infectious diseases. Equestrians can use the trails within ORV Area 2, which is located adjacent to the stables.

Golf Course

AFI 34-116, *Air Force Golf Course Program*, provides guidance and procedures for USAF golf programs to enhance the mental and physical well-being of USAF members and their families. The program's goal is to facilitate the creation of an environmentally friendly golf course facility while also supporting the installation mission. As indicated by AFMAN 32-7003, golf course maintenance is one of the land management programs of the USAF; the Services Division is responsible for preparing and administering the base's *Golf Course Management Plan*.

Camping

FamCamp, an authorized camping location operated by the Services Division, is located next to the bowling alley and Hap Arnold Park. It provides full hookups.

Branch Memorial Park is a designated primitive campground, also administered by the Services Division. Camping is limited to the landscaped portion of Branch Memorial Park. Ten 10- x 10-foot campsites are available. BBQ grills, covered picnic tables, and portable toilets are provided, but no open fires are permitted.

The Piute Ponds Complex has a camping area available for use by waterfowl hunters on the night before a legal hunt day. Camping at Piute Ponds also may be authorized for special events at other times of the year. The only amenity provided is a portable toilet. No open fires are permitted except while camping, and then only the use of gas or charcoal grills is permitted. Environmental Management administers use of the

camping area and covers the costs of providing and maintaining the portable toilet with 57X5095 funds as part of a basewide portable toilet contract managed by Civil Engineering.

Parks and Athletic Complexes

Several parks are located within the cantonment area and are managed by the Services Division. The parks include hiking/jogging trails, par course fitness trails, Frisbee golf, a paintball course, swimming pools, a skateboard park, and ball fields. These forms of recreation are largely independent of any natural resources. Branch Memorial Park, although open for use by all, can be reserved exclusively for large events.

Air Force Research Laboratory Track

The AFRL track is available to those with restricted AFRL access.

7.3 Conservation Law Enforcement

Applicability Statement

This section applies to all USAF installations that maintain an INRMP, as all installations are required to provide a method for enforcing conservation laws. This section **IS** applicable to Edwards AFB.

Program Overview/Current Management Practices

7.3.1 Source of Authority for Natural Resources Law Enforcement

The primary sources of authority include the federal ESA, MBTA, Sikes Act, associated permits and the basewide biological opinion, USFWS and CDFW hunting and fishing regulations, and other laws and regulations discussed in more detail throughout various sections of this document.

7.3.2 Organization and History of Installation Conservation Law Enforcement

The 412th Security Forces Squadron is the primary law enforcement agency for Edwards AFB. In the performance of its mission, it this squadron enforces state and federal laws and base-level regulations.

Edwards AFB has an on-base USFWS FWO funded through an MOA between the USAF and the USFWS. The *Conservation Law Enforcement Program Operations Plan (CLEP-OP) for Federal Wildlife Officers Assigned to Edwards AFB* guides the base's USFWS FWO and describes the conservation law enforcement procedures, mutually agreed to by the signatories, that the USFWS FWO will follow at the installation (412 TW 2019). The CLEP-OP is a component plan of the Edwards AFB INRMP.

7.3.3 Jurisdiction (Exclusive, Concurrent, Proprietary) of Installation Lands

The Edwards AFB Magistrate Court Program has jurisdiction for all misdemeanor violations of federal law committed by civilians on Edwards AFB property, and the Installation Commander has administrative jurisdiction for all violations of USAF and base regulations committed by civilians on Edwards AFB property. The 412th Test Wing Military Justice Program has jurisdiction for all violations of federal and military law and base regulations committed by military service members on Edwards AFB property. The USFWS Refuge of Law Enforcement has the authority to enforce the MBTA, ESA, Lacey Act, and Archaeological Resources Protection Act on federal property. The CDFW has the authority within its jurisdiction to enforce state fish and game codes and federal laws on Edwards AFB.

7.3.4 Current Enforcement Activities and Program Emphasis

Enforcement of natural and cultural resource laws on base is focused primarily on hunting regulations, ORV use, poaching incidents, and trespassing. Enforcement is the responsibility of the USFWS FWO,

CDFW Wildlife Officer, and/or any other certified law enforcement officer in compliance with the Sikes Act. Attention is also given to illegal collections of desert tortoise and other wild animals.

7.3.5 Training and Certification Requirement for Conservation Law Enforcement Personnel

All individuals enforcing fish, wildlife, and natural resources laws and regulations on USAF lands require specialized, professional training for fish, wildlife, and natural resource law enforcement, IAW the Sikes Act (AFMAN 32-7003). This training may be obtained by acquiring certification as a state fish and wildlife conservation law enforcement officer or by successfully completing the Land Management Police Training course at the Federal Law Enforcement Training Center. Correspondence courses and standard Security Forces training do not meet the requirements of the Sikes Act.

7.4 Management of Threatened and Endangered Species, Species of Concern, and Habitats

Applicability Statement

This section applies to USAF installations inhabited by threatened and endangered species on USAF property. This section **IS** applicable to Edwards AFB.

Program Overview/Current Management Practices

In general, management approaches for sensitive species are the same as they are for all flora and fauna. The goal is to fully support the USAF mission by establishing conditions that encourage a self-sustaining, healthy ecosystem to function naturally with a minimal amount of human interference. Likewise, wildlife conservation through INRMP implementation is conducted to maintain biodiversity passively whenever possible. Ongoing and future studies of plants, animals, birds, habitats, and vegetation communities provides crucial information that is incorporated into the base's GIS database for current and future reference and analysis. Over the long term, efforts will focus on assessing and monitoring the health of the base's ecosystem to ensure continuation of the various base missions while maintaining the diversity of natural resources.

Threatened and endangered species and habitats are managed at the landscape scale or ecosystem level, with consideration for short- and long-term goals shared by federal and state resource agencies. Adoption and implementation of shared federal and state goals are expected to assist with meeting the INRMP goals and objectives and lead to a healthy desert ecosystem, minimize impacts to species and their habitats, and be consistent with the military mission. Moreover, managing at the ecosystem level is expected to conserve not only listed and sensitive species but also common species of the desert environment.

Additional management strategies will be developed on the basis of future inventory, monitoring, and research results. Locations and numbers of sensitive plants are entered into the base's GIS database, delineated, and used to site any future project and develop the associated EIAP to protect and preclude impacts to populations of rare or sensitive plants located in close proximity to the project. When appropriate, briefings given to project personnel will include topics on rare plants.

A Species of Interest list for flora and fauna specific to Edwards AFB is updated annually (Appendix C, Table 4). The list identifies species of special status and concern to the USFWS and the state of California found on or in nearby habitat that is similar to habitat found on Edwards AFB. This list guides management decisions regarding requirements for species (1) inventory and monitoring, (2) data analysis, (3) habitat management concerns, and (4) resource programming. Each year, the Species of Interest list is reviewed at the annual INRMP review meeting with CDFW and USFWS partners.

7.4.1 Status of Threatened and Endangered Species Inventories

Edwards AFB has a robust GIS database that includes report data from most past studies and surveys. A list of species observed is kept in both the Edwards AFB GIS database and in Appendix B. Some of the Species of Interest inventoried over the years are described below.

The HQA protocol provides for recurring monitoring of vegetation habitat quality which helps inform plant inventory needs. Specific inventories of species of interest are programmed based on listing status.

Alkali Mariposa Lily

In 2016, alkali mariposa lily was inventoried (Huddleston and Bratton 2016).

Desert Cymopterus

In 2014, desert cymopterus was inventoried (Huddleston and Bratton 2016).

Joshua Tree

In 2017, Edwards AFB conducted a GIS-based analysis to assess Joshua tree population trends on Edwards AFB from 1992 to 2015 (412 CEG/CEVA 2017a).

.Lancaster Milkvetch

In 2014, Lancaster milkvetch was inventoried (Schmoker and Sanders 2014). Recommend addition surveys.

Mojave Spineflower

In 2015, Mojave spineflower was inventoried in conjunction with a baseline survey in the southwestern region of the base (Huddleston and Bratton 2016).

Barstow Woolly Sunflower

In 1995, Barstow woolly sunflower was inventoried basewide (Huddleston and Bratton 2016).

Rosamond Eriastrum

In 2015, Rosamond Eriastrum was inventoried in conjunction with a baseline survey in the southwestern region of the base (Huddleston and Bratton 2016).

Spreading Pygmyleaf

In 2015, spreading pygmyleaf was inventoried in conjunction with a baseline survey in the southwestern region of the base (Huddleston and Bratton 2016).

Yellow Spinescape

In 2015, yellow spinescape was inventoried in conjunction with a baseline survey in the southwestern region of the base (Huddleston and Bratton 2016).

Desert Tortoise

In 2017, the desert tortoise was inventoried basewide (Steele et al. 2019).

Western Pond Turtle

In 2019 and 2020, the western pond turtle was inventoried (Gomez 2020a, 2020b).

Bank Swallow (State Threatened)

In 2015 thru 2017, the bank swallow was inventoried as part of a nine site wetland/riparian survey for other targeted species (Feestra 2018).

Burrowing Owl

In 2015 thru 2017, the burrowing owl was inventoried as part of a nine site wetland/riparian survey for other targeted species (Feestra 2018).

California Least Tern

In 2015 thru 2017, the least tern was inventoried as part of a nine site wetland/riparian survey for other targeted species. The California least tern was not differentiated (Feestra 2018).

Least Bell's Vireo

In 2015 thru 2017, the Bell's vireo was inventoried as part of a nine site wetland/riparian survey as a targeted species. The least Bell's vireo was not differentiated (Feestra 2018).

Southwestern Willow Flycatcher

In 2015 thru 2017, the willow flycatcher was inventoried as part of a nine-site wetland/riparian survey as a targeted species. The southwestern willow flycatcher was not differentiated (Feestra 2018).

Tricolored Blackbird

In 2019–2020, the tricolored blackbird was inventoried for breeding activity on base (Causey and Feenstra 2019).

Western Snowy Plover

In 2015 thru 2017, the snowy plover was inventoried as part of a nine site wetland/riparian survey as a targeted species. The western snowy plover was not differentiated (Feenstra 2018).

Western Yellow-Billed Cuckoo

In 2015 thru 2017, the western yellow-billed cuckoo was inventoried as part of a nine site wetland/riparian survey for other targeted species (Feestra 2018).

California Mastiff Bat

In 2017, the California mastiff bat was inventoried as part of a basewide echolocation survey. (Schwab 2018).

Mohave Ground Squirrel

In 2019, the Mohave ground squirrel was inventoried for absence/presence at previously established monitoring plots (Lopez and Tautfest 2019).

Pallid Bat

In 2017, the pallid bat was inventoried as part of a basewide echolocation survey. (Schwab 2018).

Townsend's Big-eared Bat

In 2017, the Townsend's big-eared bat was inventoried as part of a basewide echolocation survey. (Schwab 2018).

Western Red Bat

In 2017, the western red bat was inventoried as part of a basewide echolocation survey. (Schwab 2018).

Mohave Shoulderband Snail

In 2017, the Mohave shoulderband Snail was inventoried in modeled habitat. No live snails or snails shells were detected (Cerasale 2017).

Monarch Butterfly

In 1998 and 1999 the monarch butterfly was inventoried as part of a larger survey (Pratt 2000).

7.4.2 Ongoing Threatened and Endangered Species Monitoring Programs

Desert Tortoise

Natural resource agencies have had difficulties estimating population densities of desert tortoise throughout its range (USFWS 2010). Moreover, protection and restoration efforts for this species often do not have immediate, observable results, especially in the desert, and they require a long-term monitoring program for detecting effects. Based on 25-year criteria for the species' recovery outlined in the 1994 Recovery Plan (USFWS 1994a), a long-term monitoring program for the desert tortoise was implemented in 2001. Density estimates of adult tortoises have varied among recovery units and years. In the first six years of range-wide monitoring (2001–2005 and 2007), relative density estimates in the Western Mojave Recovery Unit (the unit that includes Edwards AFB) ranged from 3.8–6.1 tortoises/kilometer (USFWS 2014a).

From 2004 – 2012 and 2014, relative density estimates of adult desert tortoises in the Western Mojave Recovery Unit ranged from 0.5 – 8.4 tortoises/kilometer. From 2004 – 2012, densities of adult desert tortoises in the Western Mojave Recovery Unit declined on average -7.1% per year. Despite the increasing population trend of adults in the Northeastern Mojave Recovery Unit, its small area and low starting density resulted in a relatively small overall increase in the number of adult tortoises by 2014. In contrast, the much larger areas of the Eastern and Western Mojave and Colorado Desert Recovery Units, plus the higher estimated initial densities in these areas, explain much of the estimated total loss of adults since 2004. It is estimated there were 124,050 fewer adult tortoises range-wide in 2014 compared to the 336,393 tortoises present in 2004 (Allison and McLuckie 2018).

Declining adult densities through 2014 have left the Western Mojave adult numbers at 49% of their 2004 levels. Such steep declines in the density of adults are only sustainable if there are suitably large improvements in reproduction and juvenile growth and survival. However, the proportion of juveniles has not increased anywhere since 2007, and the proportion of juveniles in 2014 has declined to 91% of their representation in 2004 (Allison and McLuckie 2018).

A 2009 analysis indicated that 25 percent of tortoise habitat in the Western Mojave area has been converted to impervious surfaces (paved or developed areas) (USFWS 2014a). Moreover, invasive weed species have been found to have adverse effects on the physiological health of desert tortoises (compromised nutritional status), which likely reduces the long-term reproductive potential of young tortoises. These findings, along with several other factors, have caused the USFWS to conclude that species' recovery is a substantial challenge (USFWS 2014a).

To gain a better understanding of the status and trends of desert tortoise populations at Edwards AFB and to help the base meet initial INRMP goals and objectives for the desert tortoise, surveys were conducted to estimate relative tortoise densities on base. From 1991 to 1994, 347 square-mile sections were surveyed,

and then in 2006 and 2007, 338 square-mile sections were surveyed. Both surveys were completed using BLM's standardized strip transect methods for estimating relative densities, which included recording tortoise sign as well as live tortoises. Today, however, those methods are no longer recommended because they were believed to inflate density estimates (see discussion two paragraphs down). Therefore, a new methodology was needed for subsequent surveys. The new protocol was a modified version of the 2010 USFWS Pre-Project Field Survey Protocol for Potential Desert Tortoise Habitats. It entails recording only live tortoises and requires surveying a minimum linear distance of 431 kilometers, which allows for calculating estimates over large, relatively contiguous areas. Using the new protocol in a 2017 survey, 341 square-mile sections were sampled.

Relative densities of desert tortoises on Edwards AFB (using the BLM methodology) ranged from 3 to 69 individuals per square mile (per 2.6 square kilometers) in 1991–1994, with a mean of 15.9 per square mile (standard deviation=11.8), and from 0 to 58 individuals per square mile in 2006–2007, with a mean of 7.8 per square mile (standard deviation=7.8) (Appendix B, Figure 26). The 2017 survey, however, resulted in an estimated mean of 2.6 tortoises per square mile. Table 5 and Table 6 in Appendix C show the 2017 estimates of desert tortoise abundance and relative density, by area and habitat type, respectively, on Edwards AFB. The 2017 results indicate that density was greater on the east side of the base than on the west side, with the greatest density being in the northeast quadrant.

A comparison of the three sets of survey results indicates that there has been a substantial decline since the early 1990s. Although it is reasonable to assume that the 2017 results were lower due, in part, to the new survey protocols, the recorded decline was comparable to numbers found in the rest of the Fremont-Kramer Critical Habitat Unit which includes and surrounds the eastern portion of Edwards AFB. These techniques provide indices of relative density only, and should not be interpreted as absolute density. Sources of inherent error include low sampling intensity (sampled 2.7 percent of each square-mile section), accuracy of the trend plot data obtained from USGS, and observer bias. In addition, sign (scat and tracks) can be missed easily or go undetected, depending on the vegetation cover and angle of the sun, tortoise burrows may have been disregarded if it appeared that they were modified and/or used or modified by other animals, and other animal burrows may have been recorded as tortoise burrows. These factors likely influenced the density estimates.

On the basis of requirements outlined in the basewide biological opinion and the presence of suitable habitat, desert tortoise monitoring is ongoing at Edwards AFB and conducted in association with many projects and USAF activities and operations. This includes the Edwards AFB's Desert Tortoise Head Start Program, which is part of the San Diego Zoo's Global Desert Tortoise Head Start Program and is described in detail below. Edwards AFB also supports USFWS sponsored long term line distance surveys in the Fremont-Kramer Critical Habitat Unit lying within Edwards AFB by providing base access. Overall, the program at Edwards AFB has included long-term monitoring of desert tortoise, conducting baseline inventories of and monitoring changes in diversity among the desert flora and fauna; refining existing vegetation maps; habitat restoration; predator studies; closing unused roads to conserve habitat; repairing and replacing exclusion fences established to keep tortoises from crossing roads; closing pitfalls in areas deemed hazardous to desert tortoises; monitoring ecological trends in the HQA study plots; and long-term monitoring of other sensitive species. Edwards AFB coordinates with the USFWS and CDFW to ensure that long-term monitoring methods used are standardized among the agencies.

Desert Tortoise Head Start Program

The Edwards AFB Desert Tortoise Head Start Program was established in 2002 IAW a USFWS Section 10(a)(1)(A) permit of the Endangered Species Act. Among other things, the program entailed capturing

wild, adult, gravid tortoises and placing them into predator-proof pens until they laid their eggs. Following egg laying, the female tortoises were released in the same location where they were captured. Once the tortoises had hatched, they were kept in the pens until released into the wild according to set protocols and attributions. Prior to release, each tortoise was fitted with an approved radio transmitter so it could be tracked and monitored, and then it was released at a predetermined location.

Since 2011, the USGS has been assisting Edwards AFB to improve the success of its Desert Tortoise Head Start Program. In 2013 a closure plan for the animal husbandry portion of the Head Start Program was submitted to the USFWS and approved. Release of 119 juveniles from the Head Start pens was accomplished in 2013 and 2014 in three separate releases.

1) In fall 2013, 35 juveniles were released at Leuhman Ridge (2003–2007 cohorts). As of May 2019, 16 of the 35 were known to be alive, 12 were known to be dead, and 7 were missing.
2) In spring 2014, 36 juveniles were released at Baker-Nunn (2008 and 2009 cohorts). As of May 2019, 3 were known to be alive; 9 were known to be dead; and 24 were missing.
3) In fall 2014, 48 juveniles were released at Leuhman Ridge (2005–2010 cohorts). As of May 2019, 13 were known to be alive; 18 were known to be dead; and 17 were missing.

As of May 2019 the combined survival rate for these three releases was between 27% and 67%, depending on whether the missing tortoises are counted as dead or alive, respectively.

In September 2018, a juvenile tortoise (#584) was discovered alive inside one of the Head Start pens. This tortoise was from the 2009 cohort and was last seen in September 2014, prior to the final juvenile tortoise release. The USFWS was consulted and subsequently the tortoise was provided with supplemental water and food until it was released at the Baker-Nunn site with a transmitter in October 2018. As of May 2019, this animal, juvenile #584, was still alive.

In 2017, San Diego Zoo Global was awarded a $500,000 grant from the California Energy Commission to conduct desert tortoise Head Start and translocation research in the East and West Mojave Desert. San Diego Zoo Global and the USGS approached Edwards AFB requesting use of the base's desert tortoise Head Start pens for their study. The study design included using gravid female tortoises from the base from which to collect eggs in 2018 and 2019. The juveniles were provided with supplemental water and food while in the Head Start pens and then all were planned for release in fall of 2020. Following release, the juveniles will be tracked through spring 2022. One of the main goals of this project is to study the effects of different microhabitat variables, such as substrates and presence of rodent burrows, on the success of tortoise releases/translocations. In 2018, 15 females laid a total of 73 eggs, 65 of which hatched successfully. In 2019, 13 females laid a total of 72 eggs, 63 of which hatched successfully. As of July 2020, 59 of the 2018 cohort and 57 of the 2019 cohort were still alive.

Desert Tortoise Exclusion Fencing

Galvanized metal exclusion fences have been installed to minimize desert tortoise road crossings in critical habitat and other areas deemed hazardous to desert tortoises. Such areas include the AFRL rocket engine/motor test areas and facilities, paved roads that desert tortoises have been observed crossing, and secondary access roads to bombing targets on the PIRA. In addition, exclusion fencing has been used throughout the base to keep desert tortoises from falling into open mines, prospect pits with steep banks, and other pitfalls or potential hazards. The integrity of exclusion fences is monitored and repaired or replaced when necessary, based on funding availability. For instance, a basewide project to maintain and repair 37 kilometers of existing desert tortoise exclusion fencing and two kilometers of base perimeter

fencing was completed in 2017. This effort also included inspecting and documenting the status of 321 known tortoise pitfalls and 19 tortoise protection signs.

Base Boundary Fence

Installing and maintaining a base boundary fence has served to limit most trespassing on Edwards AFB lands by the general public. Impacts associated with trespassing and human disturbance, such as trash dumping and ORV use, are deterred when the fence is intact. This benefits the desert tortoise, other sensitive species, and more common species; thus, continued maintenance of the base boundary fence is a high priority.

7.4.3 Current Biological Opinions for Threatened and Endangered Species

Since 1991, Edwards AFB has consulted with the USFWS under Section 7 of the ESA on USAF project actions and operations where there was a potential to affect the desert tortoise and its habitat. The USFWS consultations originally resulted in 50 biological opinions. The 2014 basewide biological opinion consolidated all previous biological opinions and covers all anticipated USAF activities and operations that have potential to impact the tortoise and its on-base habitat in the foreseeable future (USFWS 2014a). On 21 February 2020, the USFWS amended the basewide biological opinion to clarify translocation plans, transmitter-based monitoring and monitoring requirements, and health assessments related to the Solar Enhanced Use Lease and ongoing operations and activities at Edwards AFB (USFWS 2020).

All USAF projects or actions that could affect the desert tortoise and its habitat are reviewed and evaluated via the EIAP, the USAF's NEPA review process. IAW the basewide biological opinion requirements, surveys, monitoring, and/or environmental protection measures are incorporated into the project prior to, during, and following mission support activities and operations. Adherence to the terms and conditions of the basewide biological opinion minimizes impacts to desert tortoises and their habitat. For all projects, appropriate mitigation/minimization measures must be undertaken to comply with the terms and conditions of the basewide biological opinion. These measures include restoration and enhancement of disturbed habitat.

To ensure successful restoration and revegetation, Environmental Management prepared an *Edwards Air Force Base Revegetation Plan* (Air Force Flight Test Center 1994a). The plan recommends procedures for restoring topography, soils, and native vegetation to pre-disturbance conditions. A perimeter fence has been installed around the base to help protect tortoise habitat, particularly designated critical habitat for the desert tortoise, and the USAF is responsible for regularly patrolling and repairing damaged sections of the perimeter fence. The base installed exclusion fences in areas that pose potential hazards to tortoises, and some active bombing targets and approximately 150 pitfalls (mines and prospect pits) have been closed to preclude tortoises from becoming trapped in them (Earth Tech 2000). Unused roads in areas with high tortoise densities are recommended for closure.

Edwards AFB manages a desert tortoise adoption program in the housing area to track captive non-wild desert tortoises. As military families leave, captive non-wild desert tortoises are adopted out to new families. The purpose of this program is to educate base residents about desert tortoises, prevent the collection of wild desert tortoises for pets, and to prevent the release of captive non-wild desert tortoises.

Project planning at Edwards AFB emphasizes maximum reuse of facilities and siting of new facilities within previously disturbed areas to minimize loss of desert tortoise habitat. Projects are screened to determine the management practices necessary to ensure the protection of desert tortoises and critical habitat.

In 2018, an MOU between the DoD and the DOI established a Recovery and Sustainment Partnership initiative (DoD and DOI 2018). The purpose of the MOU is to develop and promote effective ecosystem and species conservation and initiatives to reduce or eliminate the need for Federal protection and regulation under the ESA and provide for increased flexibility for military mission activities. The desert tortoise is one of the targeted species. Edwards AFB is engaged in the initiative through the USAF but does not currently require any additional regulatory relief to accomplish mission objectives. Following the terms and conditions of the basewide biological opinion are not currently burdensome.

7.4.4 Current Consultations

Currently, there are no formal consultations in progress with the USFWS.

7.4.5 Other Ongoing Programs to Manage T&E species

The USFWS and other agencies of the Desert Managers Group in California are implementing a plan to remove common ravens that prey on desert tortoises and implement other actions that would reduce "subsidies" (i.e., food and water; nesting, roosting, and perching sites) that promote increases in raven abundance in the California Desert (USFWS 2008b). Edwards AFB manages various Small Business Innovation Research projects geared towards protecting desert tortoises, reducing raven populations, and reducing invasive species.

7.4.6 Relationship of On-Base Habitats of Concern to Similar Local and Regional Critical Habitats

Desert Tortoise Critical Habitat

Portions of the desert tortoise Fremont-Kramer Critical Habitat Unit includes and surrounds the eastern portion of Edwards AFB. The Fremont-Kramer Critical Habitat Unit was established prior to development of the Edwards AFB INRMP. The Fremont-Kramer Critical Habitat Unit is located within portions of the AFRL and PIRA and is largely closed to human use due to safety concerns in the weapons testing area. Those mission activities have some effect on habitat, although the locations of those activities are relatively static and limited, with little expansion expected. Fire and its associated impacts, including invasion and range expansion of invasive species, may be the largest risk to habitats in this area of the base. From 2010 – 2020, wildfires impacted approximately 125 acres of the Fremont-Kramer Critical Habitat Unit located on Edwards AFB.

The region east of the Edwards AFB boundary is a designated Desert Wildlife Management Area and considered the best habitat in the west Mojave for managing desert tortoise populations. Some lands to the north and substantial lands to the east are managed by the BLM, and nearly all land west of the base's western boundary is private.

The optimal reserve size recommended for protecting viable desert tortoise populations is 1000 square miles or 640,000 acres (USFWS 1994a); however, only 4 of the 12 critical habitat units meet this threshold. The Fremont-Kramer Critical Habitat Unit covers 518,000 acres. Population viability models indicate that reserves should support 10,000–20,000 adult desert tortoises to maximize estimated time to extinction (i.e., approximately 390 years, depending on rates of population change; USFWS 1994a). The Fremont-Kramer and Superior-Cronese Critical Habitat Units share boundaries and form contiguous blocks estimated to contain more than 10,000 adult desert tortoises (USFWS 2014a). The entirety of Edwards AFB is also managed for the conservation of desert tortoise, and because the base overlaps the Fremont-Kramer Critical Habitat Unit, it effectively expands the contiguous open space available for viable tortoise populations.

Mesquite Bosque

Mesquite trees on Edwards AFB represent a rare habitat (mesquite bosque) in Los Angeles County and the county's SEA Task Advisory Council has included them in SEA 47. Los Angeles County proposes to increase the size of SEA 47 to encompass the entire ecosystem, from the foothills of the mountains to the lakebeds on Edwards AFB. The proposed Los Angeles County General Plan (Meffe et al. 1997) is being updated and, if this plan is accepted, the entire Little Rock Creek watershed, including scattered mesquite trees from the boundary of U.S. Forest Service lands to the base boundary, will be protected. Regional watershed management includes limiting the density of development allowed within the SEA boundaries (Los Angeles County 2019).

7.5 Water Resource Protection

Applicability Statement

This section applies to USAF installations that have water resources. This section **IS** applicable to Edwards AFB.

Program Overview/Current Management Practices

7.5.1 Regional Watershed Issues

Water harvesting and diversion is a significant issue affecting Edwards AFB. Historically, large dams were constructed in the region surrounding the Antelope Valley to divert water from developing communities before the importance of water flow to the lakebeds was recognized. Currently, a large amount of water is held behind these dams. Along with the dams, communities in the region have developed numerous points of water diversion and water-harvesting (rainwater collection) areas—with plans to construct more water-harvesting areas in the near future, further diverting water flow away from the downstream resources. Water decisions made by surrounding communities do not take into account the need for water in the Antelope Valley lakebeds.

Due to concerns about water shortages in the Antelope Valley, there is an increased interest in the tertiary water supplied by D14. This interest has fueled conversations about how to use that water that range from using all of it for drinking water to actively trying to develop industry and commercial interest in the recycled water. This may eventually lead to water shortages for the Piute Ponds Complex (412 CEG/CEVA 2014).

7.5.2 Waste Water Management Issues

The Main Base tertiary treatment plant was designed for a larger base population than currently exists and does not receive enough effluent to adequately sustain the system. Most of the tertiary treated effluent from the Main Base tertiary treatment plant is used to irrigate the Muroc Golf Course. At the golf course the tertiary effluent is mixed with well water and used to irrigate the golf course, typically from March thru October. Golf Course Management has indicated that the water seems to be high in salts, which could be affecting the greens.

7.5.3 Storm Water Management Issues

Stormwater ponds adjacent to the active runways in the northern portion of Rogers Dry Lake create habitat that attracts and increases the number of waterbirds; however this creates potential for BASH incidents. There are at least three areas of concern near the airfield that retain water. Projects being constructed in the Rogers Dry Lake drainage system must not build stormwater diversions or detention

basins; thus, there are drainage ditches on the airfield that require regular maintenance to allow stormwater to flow to the Rogers Dry Lake.

7.5.4 Health of Existing On-Installation Habitats of Concern

Desert Tortoise Habitat

In general, desert tortoise critical habitat and other habitat that supports desert tortoises on Edwards AFB are considered healthy and able to fully support a recovered tortoise population when the physical and biological features of critical habitat are present. These elements include sufficient open space to allow for tortoise movements, dispersal, and gene flow; sufficient quality and quantity of forage species and proper soil conditions; suitable substrates for burrowing, nesting, and overwintering; burrow and shelter sites, including sufficient vegetation for shelter from temperature extremes and predators; and habitat protected from disturbance. Overall, however, the general health of desert tortoise habitat in the western Mojave Desert is poor.

Range-wide, the major threats to desert tortoise critical and occupied habitat are the same as those on Edwards AFB: invasive species, anthropogenic disturbance, predation by common raven, respiratory disease, habitat loss, and habitat fragmentation. Urban and agricultural development, concentrated ORV use, and other recreation activities can completely destroy habitat. Surface disturbance leads to increased rates of erosion and generation of dust. The unchecked stormwater that runs off disturbed ground and increases rates of erosion also affects habitat beyond the directly affected areas by altering substrates, removing shrubs, and possibly destroying burrows and other shelter sites. Increased levels of dust can hinder photosynthesis in the plants that provide tortoise cover and forage. Additionally, major roads like Highway 58 likely disrupt the movement, dispersal, and gene flow of desert tortoises. Grazing, effects of historical burns, invasive plants, altered hydrology, drought, wildfire potential, fugitive dust, and climate change/temperature extremes contribute to the stresses affecting desert tortoise populations, by reducing the suitability of burrowing substrates and vegetative cover. Finally, disturbed substrates and increased atmospheric nitrogen enhance the likelihood that invasive species will become established and out-compete native species, the proliferation of which increases the risk of large-scale fires, which further diminish the habitat conditions favorable for desert tortoises (USFWS 2014a).

Over the long term, management efforts will focus on assessing and monitoring the base's ecosystem health to ensure the various base missions can continue while maintaining the diversity of natural resources. Promoting ecosystem health is a primary management strategy for long-term wildlife population stability in the face of climate change. Healthy ecosystems and stable populations will enhance tortoise resilience and adaptability with regard to habitat changes and possible shifts in range.

In the basewide tortoise population survey, the highest relative densities were found in creosote bush scrub and xeric saltbush scrub habitats. During 2006–2007, substantially less disturbed area (i.e., paved roads, dirt roads, dirt tracks, garbage, firearm shells, shooting sites, ordnance, denuded areas, partially denuded areas, buildings) was observed across the study area than that observed during 1991–1994. The only areas of disturbance that increased were paved roads (+2.5 percent change), ordnance (+8.6 percent), and denuded areas (+3 percent). Blandford et al. (2010) indicated that the Edwards AFB's ORV program with designated trails, formally started in the mid-1990s, is likely the reason for the 65 percent decrease in ORV tracks.

Woodlands

At Edwards AFB, natural woodlands include Joshua tree and mesquite trees within desert scrub habitats. These woodlands are important and rare features of the western Mojave Desert. They add to habitat diversity by providing a canopy cover that allow for mesic microclimates that support the growth of many

annual plants. They also provide nesting habitat for birds. Dead trees (snags) provide perches for foraging and resting raptors and nesting sites for cavity-nesting birds, while fallen trees provide shelter and food for a diverse assemblage of insects, reptiles, and small mammals.

Joshua trees are the most prominent and widespread naturally-occurring treelike species on base. They occur in creosote and saltbush scrub habitats throughout Edwards AFB but typically not in dense stands. Mesquite trees are components of specific natural habitats on base and, thus, have a more limited distribution, primarily in a small area southwest of the southern end of Rogers Dry Lake and along Lancaster Boulevard. Mesquite trees are found in close association with saltbush plants where relatively deep groundwater is available.

Overall, the primary management goals for desert woodlands are to conserve these limited natural resources for threatened and endangered species and other wildlife and to maintain the integrity of the desert ecosystem. Main approaches to conservation are to avoid impacts through appropriate project siting and planning, discouraging unauthorized harvesting of mesquite trees for firewood, removing exotic tree species such as tamarisk (*Tamaris*k sp.) and non-native mesquite trees, and maintaining natural the system's natural hydrology. Managing woodlands helps to maintain wildlife habitat diversity for migratory birds and other native, nongame species; conserve watersheds; and sustain/enhance biodiversity.

For Joshua trees specifically, Environmental Management encourages conserving them wherever feasible. Moreover, the *Edwards Air Force Base Revegetation Plan* (Air Force Flight Test Center 1994a) recommends planting Joshua trees to maintain the diversity of natural habitats on base. Joshua tree restoration efforts will follow the recommendations in the *Edwards Air Force Base Revegetation Plan*.

Mesquite species are phreatophytic—deep-rooted plants that depend on accessing groundwater for their water needs). Indeed, in the south-central portion of Edwards AFB, mesquite plants come up naturally along roadsides and in ditches and in disturbed, ponded areas along roads and at the southern end of Rogers Dry Lake in halophytic saltbush scrub. These trees' affinity for mesic sites make them difficult and costly to replace and efforts to restore mesquite bosque habitats have a poor success rate. To the maximum extent possible, projects located in areas where mesquite bosque occurs will be sited in a way that avoids adversely impacting the drainages upon which they depend. Unauthorized mesquite harvesting is managed by limiting access to the installation.

The biggest challenge to woodland management in the Mojave Desert is reduced soil moisture resulting from past groundwater pumping, watershed degradation, alteration of natural water flows, and years of drought in the Mojave Desert. The increased drought stress is affecting both Joshua and mesquite trees. Previous studies showed that the levels of disturbance within the mesquite bosque have been high as well, as indicated by the percent cover of exotic weedy plants that are present today and evidence of past wood cutting.

7.5.5 Regional Programs

The intent of the Integrated Regional Water Management Plan (IRWMP) is to provide a means for interested parties in the Antelope Valley to apply for grant money to manage groundwater and surface water. Many of the regions proposed water-harvesting projects have applied for funding. This IRWMP is intended to enable region-level integrated planning and prioritization associated with water issues. Edwards AFB has been invited to join this team to assist with guiding water management.

7.5.6 Water-Quality Monitoring

The base's drinking water system includes seven water wells that are sampled quarterly by the Bioenvironmental Engineering Office. They also sample one off-line well that currently is not part of the drinking water system. There is also one well that supplies non-potable water to South Gate and Branch Memorial Park Pond, and there are two wells that supplies non-potable water to the waste water treatment plant for supplementing the tertiary water used to irrigate the golf course.

Water in the Piute Ponds Complex is monitored by D14 according to their waste discharge requirements (WDRs), issued by Lahontan Regional Water Quality Control Board. There are currently three sampling points within the ponds and 12 groundwater monitoring wells that D14 monitors under these WDRs. These reports need to be reviewed regularly to stay cognizant of the water-quality results, changes that may occur with the water chemistry, water flows, and issues that may affect water flow at the Piute Ponds Complex (412 CEG/CEVA 2014).

7.5.7 Cooperative Programs

Antelope Valley Integrated Regional Water Management Group is responsible for writing and overseeing the implementation of the IRWMP. Edwards AFB is not a member of this group, but base personnel attend meetings to educate community stakeholders on the importance of issues regarding surface water flow to the base, particularly the lakebeds. This would be an important group in which to have membership and to support with funding, as needed, to ensure that Edwards AFB interests are considered seriously.

7.6 Wetland Protection

Applicability Statement

This section applies to USAF installations that have existing wetlands on USAF property. This section **IS** applicable to Edwards AFB.

Program Overview/Current Management Practices

No wetlands on Edwards AFB meet the criteria of jurisdictional wetlands regulated under the 404 Clean Water Act (CWA). There are, however, wetlands (Piute Ponds) that are managed as stated in AFMAN 32-7003, Chapter 3, Section 3.1, which states, "In compliance with EO 11990, Protection of Wetlands, the Air Force will seek to preserve the natural values of wetlands while carrying out its mission on both Air Force lands and non-Air Force lands. To the maximum extent practicable, the USAF will avoid actions that would either destroy or adversely modify wetlands."

7.6.1 Health of Existing Wetlands

Piute Ponds Complex

The three main indicators currently used to assess the health of the Piute Ponds Complex are (1) use by avian species, (2) vegetative response/structure, and (3) water quality. A summary is provided here; a more in-depth discussion is available in the Piute Ponds Complex Management Plan (15.5 Piute Ponds Complex Management Plan) (412 CEG/CEVA 2014).

Avian Use

The high number of avian species (225 documented in GIS) that use the Piute Ponds Complex is an indication of the area's high levels of biodiversity, biological importance, and productivity (Los Angeles County Sanitation District 2004). Most of the birders who visit the complex have documented their

observations of 298 avian species in the popular eBird.com database, which spans the years from 1980 to the present. Harvest data from the hunting season is gathered on a regular basis and can indicate waterfowl use of the complex. Opening day of waterfowl hunting season is thought to provide the best information on use of the complex by resident waterfowl, although changes in migratory patterns due to climate change may be impacting the accuracy of this indicator over time. The full-season data are useful for understanding use of the complex by migrating waterfowl.

Vegetation

The most common plant species in the marsh/pond complex are common tule, willow weed (*Persicaria lapathifolia*), swamp prickle grass (*Crypsis schoenoides*), cattails, and five-hook bassia (*Bassia hyssopifolia*). Common tule provides good cover and nesting sites. Smartweed and swamp timothy are considered some of the best forage for waterfowl and are abundant in the marsh and ponds. Common tule, however, has become old and overgrown and is taking up a significant portion of the available marsh and pond areas. While this is good habitat for some species, such as marsh wrens and rails, it appears that there is an overabundance of this habitat type, which is preventing fresh common tule growth and healthy marsh habitat for most avian species. A balance of old, decadent common tule and new common tule growth must be maintained. Prescribed fire is used to create mixed-aged stands.

Water Quality

The quality or water flowing into the Complex is measured by D14 at sampling site RS2, RS3, and RS4. The monthly, quarterly, and annual D14 reports provide results of more than 100 water-quality parameters, including those pertaining to acute toxicity. Reports are filed with Lahontan Water Quality Control Board in compliance with WDRs and provided to Environmental Management. The WDRs, as they relate to the Complex, are listed below.

- R6V-2002-0053, Waste discharge and water reclamation requirements for Lancaster Water Reclamation Plant, 11 September 2002.
- R6V-2002-053A1, amended WDRs, including interim effluent ammonia limits, 13 Jul 2005.
- R6V-2002-0053, revised monitoring and reporting requirements, 14 Mar 2007.
- R6V-2002-053-A02, corrected references to specific requirements in previous orders, 12 Jan 2011.
- D14 water that flows into the Complex changed from secondary effluent to tertiary, June 2012.

The intentions of the restoration work at Piute Ponds (see Waterfowl Hunting on page 63; restoration described in detail in the *Piute Ponds Complex Management Plan* (412 CEG/CEVA 2014)) are to increase the capacity of water from D14, provide the base more opportunities for moving or holding water from the lakebed when necessary for operational missions, and to enhance ecosystem health and function. Overall, the restoration work helps Edwards AFB to meet the goals identified in the Piute Ponds Complex Management Plan.

The Piute Ponds Complex is in a period of transition. A major Ducks Unlimited project accomplished in 2012 increased the number of water-control structures from 9 to 25 and added or improved dikes for three additional ponds and the lakebed channels. This improved the ability to manage the water levels and water flows throughout the complex. A follow-on Ducks Unlimited project in 2014 removed overgrowth of vegetation in Little Piute, recut swales, and cleared ponds to provide better water flow, encouraged growth of new vegetation, and reclaimed some capacity for more water.

In 2019, numerous areas of the complex were dredged around weirs and along clogged channels to improve water flows. Prescribed burning also took place to clear out areas with loads of decadent vegetation, such

as around the southern and western edges of Big Piute, Shuttle Pond, and in North Ducks Unlimited Pond. The need for additional dredging and prescription burning activities is projected for future years.

The overall health of the Piute Ponds Complex is considered good, although efforts to improve water flow and vegetation growth will continue. Further information on the health and management of the Piute Ponds Complex is available in the *Piute Ponds Complex Management Plan* (412 CEG/CEVA 2014).

Branch Memorial Park Pond

The four main indicators currently used to assess the health of the Branch Memorial Park Pond are (1) observations of live fish, (2) vegetation, (3) visitors, and (4) water availability. The pond is managed primarily to provide fishing opportunities to individuals who work and live on base and others who have access to the base. Branch Memorial Park Pond also provides nesting habitat for tricolor blackbirds. New management recommendations for enhancing habitat quality for avian and fish species, as well as for recreational use, are under development and should be available in 2021.

Fish

Fish within the ponds have spawned repeatedly and offspring appear to survive. No fish die-offs have occurred within the pond. Most of this information is obtained from discussions with various fishermen using the pond on a regular basis.

Vegetation

Vegetative condition and bird use of the vegetation is recorded during periodic visual surveys of Branch Memorial Park Pond by Natural Resource personnel. They note the health of the vegetation, where and what type of vegetation is growing or not growing, and whether vegetation includes undesirable species or species that provides cover or nesting sites. In 1999, tamarisk was removed from around the pond and the pond has remained tamarisk free. Although there is a tamarisk seed bank within 600 feet of the pond, only a few small tamarisk have had to be removed since the original conversion from tamarisk-dominated vegetative community to one of Fremont's cottonwood, willows, mesquite, and mule-fat. Vegetation within and around the pond appears healthy and provides appropriate structure for this pond, including nesting habitat for tricolored blackbirds, which have nested in the common tules, cattails, and mule-fat. The blackbirds also use the trees, particularly honey mesquite around the pond, from which to scan for food and where fledgling find cover. They also feed in the honey mesquite bosque area and saltbush scrub habitat in the vicinity of the pond.

Visitors

Visitor use is obtained during periodic surveys at Branch Memorial Park Pond. These visitor checks provide information on how much use the pond receives and observations of fish availability, spawning, and survivorship. Based on occasional interviews, visitor satisfaction with the pond appears to be high.

Water Levels

Water levels are maintained and checked often by the Civil Engineering Water Shop and Natural Resource biologists. The well water that supplies the pond is turned on and off frequently during nesting season to ensure that the pond is at the proper water level to protect nesting habitat and adjusted when fish stocking occurs.

Golf Course Pond

Currently, health of the Golf Course Pond is not being evaluated, but there have been two fish die-offs at the pond. The cause of the die-offs has not been determined. In 2014, an acoustic bat survey conducted at the Golf Course Pond indicated a healthy level of bat activity (109 bat passes/night), including significant activity of the western red bat, a CDFW species of special concern. Bats may be feeding on insects and/or drinking at this location. Bat abundance is correlated with insect abundance and indicates a functional ecosystem (Fenton et al. 1992, Wickramasinghe et al. 2004, Jones et al. 2009, Wilson 2014).

Rogers Dry Lake

Lakebeds are complicated landscape features influenced by soils, hydrology, biology, and other factors. The three main indicators currently used to assess the health of these features are (1) soil stability, (2) surface features, and (3) flooding.

Soil Stability

As indicated in sections 2.1.2 and 2.1.4, a number of factors have led to instability of the lakebeds. The soil surface on Rogers Dry Lake in particular is subject to significant wind erosion. This impacts air quality and deposits windblown soils onto surrounding habitats. Photograph H and Photograph I below depict dust blowing from the surface of Rogers Dry Lake. On the day the photos were taken, steady winds reportedly reached an average of 20 knots and peaked at 40 knots. This was not an atypical event for wind and soil erosion.

Photograph H. Dust blowing off southern portion of Rogers Dry Lake, May 2014.

Photograph I. Dust blowing across Mercury Boulevard, May 2014.

Surface Features

The fissures and macropolygon fields on Rogers Dry Lake and Rosamond Dry Lake are long-lived features that have periodically formed in approximately the same locations through time as lakebed the groundwater table drops, which leads to desiccation and shrinkage of the fine-grained lakebed sediments, regardless of whether subsidence occurs. If fissures formed strictly from deep-seated land subsidence, then the rate and areal extent of formation ought to have been decreasing because the rate of subsidence has been decreasing through time. Similarly, one would expect the spatial distribution to become more concentrated in the southern part of Rogers Dry Lake than in the north because subsidence is greater at the southern end of the lakebed. That is not the case, as there are macropolygon fields distributed in many areas across the lakebed. In addition, new fissures may reappear in the exact same locations as "healed" fissures upon further shrinkage of the sediment volume because fissures represent existing zones of weakness.

Flooding

Analysis of 1984 to 2017 aerial photography and Landsat imagery indicated that Rogers Dry Lake and Rosamond Dry Lake lakebeds were at least partially inundated approximately 15 times, or an average of approximately once every few years. At Rogers Dry Lake, differences in microtopography cause water to pond in certain areas, covering up to about 62 percent of the lakebed during the larger inundation events. The locations of these ponds are not static but are moved around by the wind, causing hydroplanation and smoothing of the lakebed surface, the fundamental physical processes that lead to a healthier lakebed.

The only delineated Federal Emergency Management Agency (FEMA) flood zones on base are site specific and address Rogers Dry Lake, Rosamond Dry Lake, Rich Dry Lake, AFRL, and the Mojave Creek watershed south of Forbes Avenue (Appendix B, Figure 19 and Figure 20). The lack of FEMA flood zone delineation anywhere else on base does not imply that a FEMA flood zone does not exist, but rather that the area has not been subject to a FEMA flood zone analysis.

Rosamond Dry Lake

Rosamond Dry Lake receives supplemental flooding from D14 via Piute Ponds. It seems that this has helped to stabilize the surface soils even though the flooding is currently only enough to cover about five percent

of the surface. Because the flooding is annual, however, it helps to keep the subsurface moist enough as surface flow drops below the surface laterally or via piping to other areas on the lakebed. Surface features on the lakebed, including a minimal amount of polygonal cracking and crack healing, appear to be more natural.

Buckhorn Dry Lake

Buckhorn Dry Lake is not currently impacted by mission operations. It is impacted, however, by the same surface water diversion as Rosamond Dry Lake and Rogers Dry Lake and have moderately unstable soils. There is no supplemental flooding of Buckhorn Dry Lake.

Rich Dry Lake

Rich Dry Lake has been mined for clay to repair Rogers Dry Lake repairs; thus, it is considered to be the second most impacted lakebed on Edwards AFB. Rich Dry Lake is also the most remote and least studied lakebed and to date there is no information on its condition is currently known.

Clay Pans

The clay pans in the northwest corner of the base could be impacted by development of a solar facility of approximately 4,000 acres. These clay pans are the only on-base places where Colorado fairy shrimp are known to occur, and although it is not designated as sensitive, threatened, or endangered, it is currently considered locally rare. There has been no real concern with regard to development near or damage to the remaining clay pans. The extent of historical impact to clay pans on base is unknown, without ongoing impacts, the clay pans are very resilient and heal readily.

Ephemeral Wash Systems

Several large ephemeral wash systems were severely impacted, both on and off base, by water diversion and/or maintenance activities, including Mojave Creek, the Buckhorn Dry Lake-to-Rogers Dry Lake wash system, and Cottonwood and Oak Creeks. For example, to reduce a potential fire hazard in proximity to Main Base houses and other developments, there is ongoing clearing of vegetation along Mojave Creek. Lancaster Boulevard splits Buckhorn Dry Lake and Rogers Dry Lake and culverts have been added to keep the flow of surface water off Lancaster Boulevard. There is no information about the health of other ephemeral washes on the base or future impacts to them.

Mesquite Bosque

The mesquite bosque encompassed by SEA 47 (276 acres) and located on base at the southern boundary) is a rare riparian habitat, both on base and in Los Angeles County. The overall health of this riparian habitat likely has been impacted by surface water diversion, groundwater subsidence, homesteading, construction of the historical sled track, and construction of and modifications to the South Gate entrance and the main roads into South Gate. Negative effects of invasive annual and perennial grasses and forbs on the bosque, such as Russian knapweed (*Rhaponticum repens*), cheat grass, and tamarisk, have not been quantified, but there is the potential for negative effects of competition from invasive species and hybridization with non-native mesquite species escaping landscaped areas and traveling along roadside ditches.

The health of the mesquite bosque was evaluated during a 2017 study that looked at both the health of the habitat as well as the trees themselves (ManTech 2018a). Long-term study plots and protocols for monitoring were established and surveys were conducted in the spring of 2017, which was a “superbloom” year. Overall, results indicated that the percentage of native cover was slightly greater than that of nonnative cover and bare ground. Of the 92 plant species detected, 87 percent were native. Point-center quarter plots

were used to capture size and density data for the mesquite trees. The canopy volume data varied considerably from 0.03 square meters to 1,675 square meters, with the majority of trees (34 percent) being on the small end (0.03–76 square meters). All trees encountered were estimated to be 10 years or older due to their size and bark characteristics. Tree density varied across the plots, ranging from less than one tree up to 17 trees per acre.

While performing base-wide aerial surveys for invasive plants in July and August 2017, overflights of the mesquite groves revealed patterns of low and high vigor areas (ManTech 2018b). "Vigor" was inferred from the observation that fewer branches had leafed out, making certain trees and groups of trees appear less green (grayish). In some cases, these grayer areas were near roads, although trees along the immediate verges of roads displayed high vigor. Low vigor areas were particularly apparent near the sled track and established roads, indicating that these features may be diverting the surface flow of water away from the trees. There should be a study to look at the possibility of reconnecting those hydrological systems and developing a full understanding of the microtopography and underlying hydrological systems to ensure that there are no negative impacts to the mesquite bosque.

Surveys in the fall/winter of 2017 were conducted to determine the extent of non-native mesquite species that had "escaped" from landscape plantings (ManTech 2018b). A total of 307 infestations and 2.56 net acres of non-native mesquite trees were mapped, most of which were near the cantonment area; however, some had become established farther away in the ditch along Lancaster Boulevard that leads to the native mesquite bosque. In the summer and fall of 2018, cut-stump treatments were conducted on more than 1.43 acres (net) to eradicate non-native mesquite (ManTech 2019a). Trees that were found during the 2017 survey in maintained landscaped areas were not treated. Follow-up monitoring and treatments will need to continue until landscaped trees can be removed and replaced.

Evaporation Ponds/Storm Water Ponds

No evaluations of evaporation or storm water ponds are currently being conducted.

Seeps

No evaluations of seeps are currently being conducted.

7.6.2 Status of Wetland Inventories and Delineations

In 1997, the Los Angeles County District of the USACE delineated jurisdictional wetlands on Edwards AFB, whereby the lakebeds, most of the clay pans, and drainages leading to the lakebeds were identified as jurisdictional "Waters of the United States" under Section 404 of the Clean Water Act, thus protecting them from dredging and filling without a permit. Over the next two decades, there was ongoing debate and subsequent rulings that resulted in expanding and contracting the definitions of jurisdictional "Waters of the United States" and which wetland types, therefore, were protected or excluded by the Clean Water Act. As of 2015, after yet another ruling known as the Clean Water Rule, none of the wetlands on Edwards AFB were considered jurisdictional "Waters of the U.S." (USACE and USEPA 2015).

7.6.3 Long-Term Monitoring of Wetlands

The Audubon Christmas Bird Count is an annual bird survey effort that has taken place since 1900, and today this effort takes places at hundreds of places across the Americas. The results of these efforts is a long-term database that allows for analyses of trends in avian abundances and distributions. One of the Christmas Bird Count areas covers the Piute Ponds Complex and is used to monitor birds there. More recently, an electronic database known as eBird.com, to which birdwatchers and ornithologists alike can

upload their bird sightings. Many of the birders that visit the Piute Ponds Complex upload their bird observations to this database, and base personnel can access the database to analyze avian trends at the Piute Ponds Complex. Hunter bag checks conducted during the hunting season are also used to monitor changes in avian trends. Lastly, water quality at Piute Ponds is measured regularly and tracked by Los Angeles County Sanitation District 14, as required by their water discharge permits.

7.6.4 Pending Section 404 and 401 Permits

There are no pending Section 404 or 401 permits, as there are no "Waters of the U.S." at Edwards AFB under the 2015 Clean Water Rule pf the CWA (USACE and USEPA 2015).

7.6.5 Wetland Restoration and Enhancement

The Wildland Support Module (WSM), plus various contracted entities and D14, help to control vegetative growth, improve/repair infrastructure, and various other enhancement and restoration actions associated with wetlands. The *Piute Ponds Complex Management Plan* (412 CEG/CEVA 2014) further discusses the program and plans for restoration and enhancement.

7.6.6 Wetlands Banking

Edwards AFB is not involved with any local or regional wetlands banking.

7.6.7 Current Management Practices Used to Manage Wetland Resources

Piute Ponds Complex management practices are expanded upon within the *Piute Ponds Complex Management Plan* (412 CEG/CEVA 2014) and only briefly described here. While meeting the mission needs of Edwards AFB and D14, the complex will be managed to develop and maintain a healthy mosaic of habitats for many different wetland species. An effort will be made to make the area suitable for species of interest, but the priority will always be to maintain the overall biodiversity of the site.

Edwards AFB will continue to partner with the D14 on a regular basis regarding water flow, D14 needs, operational mission needs, lakebed, and wildlife needs. Close coordination and ties must be maintained with both D14 and Airfield Management to ensure a successful outcome for all the partners. Water flow into the complex is monitored by Environmental Management staff throughout the year through on-site inspections, adjustments, review of D14 water data, and input and observations from users and volunteers.

Day-to-day maintenance on water-control structures, dikes, and roads is accomplished by D14, but major maintenance due to catastrophic failure within the Piute Ponds Complex, whether from storm-related or unknown causes, will be a joint effort between D14 and Edwards AFB. An MOU between Edwards AFB and D14 describing each party's responsibilities was updated in 2017 and supersedes a 1991 MOA and a 1981 Letter of Understanding.

Wildlife at the Piute Ponds Complex will be monitored to ensure that the area continues to protect the wetland species that use the area. This will be accomplished by evaluating the observations submitted by birdwatchers, reviewing www.ebird.com, contracted and volunteer studies, and monitoring the harvest data obtained during hunter bag checks. Environmental Management staff will solicit and review information provided by volunteers, visitors, educators, and researchers on the status of the area. It is important to maintain an ongoing dialogue with the users, as they can be the best early source of trend information at the complex. In addition, the complex will be inspected on a regular basis by Environmental Management staff to monitor water levels, wildlife presence, vegetation and wildlife response to the water levels, and invasive species status/extent. Although valuable information is obtained from users, volunteers, and contractors, it cannot replace the on-site involvement by base natural resource personnel, who ensure that

the area operates as intended for all parties and the management goals for the area are met. Environmental Management staff will evaluate the management of the Piute Ponds Complex and develop projects to address any issues found or enhancements needed, as warranted. Partnerships with other entities, such as that with Ducks Unlimited, may be expanded to fully use available resources and expertise.

Other measures of management success at Piute Ponds Complex will include responses to prescribed fire, invasive species treatments, and habitat restoration. Prescribed burns in the area will be monitored via photo points to record how the vegetation responds and to determine the burn rotation that may be necessary. Invasive species monitoring will be conducted using the invasive species grid system, set up to determine the use of herbicide over time, as a proxy for determining management goals for containment, reduction, or eradication of a species. In addition, restoration success will be evaluated through the long-term survivorship of plantings, their ability to self-sustain, and the creation of the intended habitat features for wildlife enhancement.

7.6.8 Special Initiatives to Address Resource Problem Areas: Vegetation Control

Piute Ponds

Several methods of vegetation control, such as mechanical manipulation, prescribed burns, and manual removal, will be used. Principle concerns include the expansion of common tules and cattails, sharp increases in tamarisk, planting of desirable tree species, and presence of non-native perennial pepperweed (*Lepidium latifolium*).

Branch Memorial Park Pond

Several methods of vegetation control, such as mechanical manipulation, prescribed burns, manual removal, and herbicides, will be used. The principle concern at this time is balancing removal of common tules and cattails to keep them from overtaking the pond and impacting the fishing opportunities, while also leaving enough common tules to provide suitable habitat for nesting tricolored blackbirds. Continuous inspections will be accomplished to ensure that tamarisk is quickly removed if more germinate around the pond.

7.6.9 Significant Management Issues Related to the Mission

There are concerns associated with the diversion of natural storm flow away from the lakebeds. This concern has been elevated to USAF management and leadership. Environmental Management and Airfield Management have an ongoing partnership for addressing water management on Rosamond Dry Lake. Participation in the Antelope Valley Integrated Water Management Group is ongoing, but membership in this group could enhance the base's ability to address its water needs.

7.6.10 Future Concerns

The tertiary treated effluent used to create and maintain wetlands in the Piute Ponds Complex which flows into Rosamond Dry Lake may be jeopardized as demand for recycled water increases and is considered a viable option for the future development of Antelope Valley. The requirement for Edwards AFB to maintain the natural surface flow onto Rosamond Dry Lake through the watersheds creates challenges for surrounding communities as they strive to increase the amount of groundwater available for development through water recycling and improved local flood control. The Piute Ponds Complex has broad support from community users, who likely would oppose any decision to reduce or eliminate the flow of water to the ponds (412 CEG/CEVA 2014).

7.7 Grounds Maintenance

Applicability Statement

This section applies to USAF installations that conduct ground-maintenance activities that could impact natural resources. This section **IS** applicable to Edwards AFB.

Program Overview/Current Management Practices

7.7.1 General Maintenance Issues

Base landscaping would benefit from both a coordinated effort and a comprehensive landscape management plan. A *Landscape Development and Management Plan, Technical Information Report* was produced in 2018 (TetraTech 2018) and a subsequent review of the plan was completed (ManTech 2018c). The purpose of these reports was to provide information and recommendations to help guide future landscaping decisions. They focus on using native and non-invasive xerophytic plants that provide the necessary structure and aesthetics for the base's populace while reducing water use and dust generation. The goal is to eventually incorporate recommendations into the base development and planning guides for plants to use and plants to avoid because of their potential to cause ecological harm to the surrounding native habitats.

Currently, the base does not spray trees in landscapes to prevent insect or disease outbreaks. Some pesticide applications are conducted to control weeds in areas landscaped with rock, as well as along roadsides.

7.7.2 Nonpoint Source Pollution Associated with Pesticide and Fertilizer Use in Landscaped Areas

Potential concerns associated with nonpoint source pollution are damage to native vegetation and degradation of potable groundwater, health hazards in recreational areas, and harm to fish and wildlife. One objective of the base's *Spill Prevention Control and Countermeasure Plan* (USAF 2018) and its *Hazardous Substance Incident and Emergency Spill Response Plan* (USAF 2020) is to protect the environment, preserve natural drainage patterns, manage runoff, and minimize erosion.

Edwards AFB landscaping does not require excessive use of pesticides or fertilizers, however, some stormwater runoff could mobilize minimal amounts of pesticides or fertilizers. Stormwater runoff is not connected to any ocean or other body of water; however, major storms do transport stormwater runoff to the lakebeds via many desert washes and Mojave Creek. During storms, water can flow from streets and streams onto the lakebeds.

7.7.3 Green Waste Disposal

Green waste is composted and reused on base. The green waste composting facility and grinder operation are located on a four-acre parcel of land within the boundaries of the Main Base Landfill. The composting facility accepts leaves, grass clippings, tree trimmings, and other green waste, as well as untreated wood, plywood, pallets, and any wood suitable for grinding.

7.7.4 Urban Forest Management

The program for urban forest management on base is the responsibility of Civil Engineering (CE) in coordination with Environmental Management staff. Since there are no forests on base, urban forest management primarily consists of managing the use and care of landscape trees in the housing areas and other developed areas of the base. Trees in developed areas include, but are not limited to mesquite, pine (*Pinus* spp.), cottonwood, palm, ash, elm, and mulberry.

Because the region suffers from water shortages and continuous drawdown of the aquifers, recent landscaping efforts have focused on xeriscaping (i.e., planting species that are native to the desert, thereby requiring less water to maintain).

Environmental Management will continue to recommend best management strategies, including where urban landscape trees are planted in developed portions of the base. Tree planting locations are important to consider in terms of to managing and controlling wildlife. For example, BASH risks would increase if trees were planted near the runways and taxiway, and trees planted in developed areas create habitat that attracts mesopredators to populated areas.

Conversion of Old Area C housing to a natural landscape is resulting in mortality of the remaining mature trees due to the lack of irrigation. As these trees die, they are being cut, piled, and burned by the Wildland Support Module.

7.7.5 Lists of Recommended and Prohibited Landscaping Plants

Recommended and prohibited landscaping plants are provided in two separate reports: ManTech (2018c) and Tetra Tech (2018).

7.7.6 Grounds Maintenance Contract

Lawns in ball fields, parks, and small landscaped areas are mowed to maintain healthy turf; however, most decorative turf areas will be converted to rock or natural habitat. The golf course turf is maintained by the 412th Force Support Squadron personnel. Trees and bushes within landscaped areas are maintained by CE personnel or by contractors. Landscaped common areas and parks within base housing are maintained by the privatized housing contractor.

Road shoulders and associated drainages are mowed or graded on an annual basis by CE personnel. Excess vegetation is removed from drainages within base housing to allow unimpeded water flow.

7.8 Forest Management

Applicability Statement

This section applies to USAF installations that maintain forested land on USAF property. This section **IS NOT** applicable to Edwards AFB.

Program Overview/Current Management Practices

There are no managed forested lands on Edwards AFB; however, there are areas on base where older base housing has been removed, utilities have been shut off, and the mature, 60-foot-high cottonwoods and pines there are slowly dying from lack of water. They are becoming a safety hazard and are cut and burned by the Wildland Support Module yearly.

7.9 Wildland Fire Management

Applicability Statement

This section applies to USAF installations with unimproved lands that present a wildfire hazard and/or installations that use prescribed burns as a land management tool. This section **IS** applicable to Edwards AFB.

Program Overview/Current Management Practices

The *Wildland Fire Management Plan* (412 CEG/CEVA 2020) is a component of this INRMP.

7.9.1 Wildfire History and Frequency

Based on available GIS data from 1998 to 2019, approximately 985 acres on Edwards AFB have been impacted by fires (Appendix B, Figure 27).

7.9.2 Threat of Wildland Fire to Mission and Natural Resources

Lightning is the primary cause of wildland fires on base. Lightning occurs with cyclonic summer storms that can occur from June through October. Primarily, storms with gusty, swirling winds come from the east and south. The base also has high winds from fall to spring without the presence of precipitation. There is a potential for wildfires to spread more rapidly and increase in size during periods of high winds. Fires also increase the potential for soil erosion by destroying biological soil crusts, leaving soils exposed to wind and water erosion, which, in turn, leads to degraded air and water quality.

The second leading cause of fires on base is the release of flares from flying aircraft that land in native habitat just outside of bladed target areas. The PIRA contains about 60,800 acres of designated desert tortoise critical habitat and, based on the available 1998–2019 GIS fire data, approximately 232 acres of critical habitat were impacted by fires. If the frequency of fires increases in tortoise habitat due to mission related activities and fires become larger, a decision to blade a larger buffer area associated with a specific PIRA target may need to be considered. The primary concern with increasing the size of target areas is increased fugitive dust and decreased visibility. It also removes desert tortoise habitat on the PIRA. Mission-related activities usually occur when wind conditions are relatively calm, thus not conducive to the spread of fires over the landscape. Additionally, such mishaps are restricted to small areas. Any loss of designated critical desert tortoise habitat within the PIRA would be accounted for in the basewide biological opinion. If a fire starts on the PIRA, the mission stops until the fire is extinguished. To reduce fire occurrence, the PIRA has changed the chemicals used in spotting charges; phosphorus is not used in ordnance during summer months. PB-13 is the only target approved for live ordnance, defined by the PIRA as explosive munitions.

Another cause of fire on base is from off-base human-initiated fires. These fires occur from nearby roads, homes, and camps. Trespass onto base has also resulted in fires on base.

Although Edwards AFB has over 200,000 acres of vegetated terrain, the base has not experienced a history of severe wildfires (Appendix B, Figure 27). Wildfires have not caused any physical damage to real property buildings and facilities.

7.9.3 Organizational Structure for Wildland Protection and Response Protocols

Edwards AFB Fire and Emergency Services has seven functional elements: Management, Administration, Operations, Fire Prevention, Fire Protection Training, Communications, and Logistics. The WFMP lists the organizational structure and personnel responsible for wildland fire activities (412 CEG/CEVA 2020). The WFMP also shows the locations of the five fire stations on base, each with its own defined district boundaries (District 1 through District 5) (Appendix B, Figure 28).

Currently, Edwards AFB has trained about 50 percent of its Fire and Emergency Services staff to fight wildland fires; however, training is ongoing as required for new hires. The WFMP discusses certification, training, fitness standards, safety, emergency plans, and standard operating guidelines for wildland fire management personnel. The WFMP assists with determining suppression resources needed to respond to installation wildfire hazards. Firefighters maintain a state of readiness for any minor or moderate fire, including maintaining firefighting equipment on a daily basis.

To fight or contain a minor, moderate, or major wildland fire within any of the five districts, Fire and Emergency Services personnel rely on the *Installation Emergency Management Plan* (USAF 2019), where specific preparedness actions or tasks are listed along with the responsible person or organization to carry out such actions or tasks involving a wildland fire that appears to be out of control. Fire and Emergency Services personnel also rely on the *Standard Operating Guide* to ensure that all necessary trained personnel, equipment, and associated facilities are prepared to respond to and suppress a wildland fire. Additionally, a "Step-up" plan incorporates Air Force Wildland Fire Branch personnel from the Wildland Support Module as part of the response guide, staffing guide and administrative actions for wildfire preparedness and response. The *Installation Emergency Management Plan*, *Standard Operating Guide*, and Step-up plan are found in the Appendices of the WFMP.

All public relations and media notification affairs pertaining to fire are handled by Public Affairs. Any communications provided by Fire and Emergency Services personnel is coordinated through the Security Forces Operations Officer and provided to Public Affairs personnel. All communications are reviewed and approved by base leadership prior to release.

7.9.4 Prescribed Fire

Prescribed fire is used on Edwards AFB as a natural resource management tool to clear natural debris, protect man-made structures, minimize fire fuel intensity, reduce non-native and invasive species, minimize soil erosion, and improve natural ecological processes. Prescribed fire burning methods include pile burning, targeted area burning, and broadcast burning. Controlled burns are used at the Piute Ponds Complex, Branch Memorial Park Pond, Old Area C, Golf Course, Fireworks Display Area, PIRA, and Combat Arms Training and Maintenance (CATM) locations. Environmental Management coordinates all proponent requests for use of prescribed fire.

Use of prescribed fire requires a project-specific Prescribed Fire Plan or "burn plan." Air Force Wildland Fire Branch subject matter experts prepare the Prescribed Fire Plan. This plan includes guidelines for the burn to help-ensure control of the fire, minimize potential adverse environmental impacts, and achieve burn objectives. The burn plan includes notifications of key leadership; cooperating offices such as Fire and Emergency Services, the Emergency Communications Center, Airfield Management, local Air Pollution Control Districts; and persons living and working on base.

7.10 Agricultural Outleasing

Applicability Statement

This section applies to USAF installations that lease eligible USAF land for agricultural purposes. This section **IS NOT** applicable to Edwards AFB.

Program Overview/Current Management Practices

The NRCS prepared a *Grazing and Cropland Management Plan* in conjunction with a soil survey for Edwards AFB (NRCS 1996, 1997). The plan included recommendations for grazing and agricultural outleases on portions of the base, based on the presence of suitable soils and vegetation and compatibility with mission use areas. Because of mission safety and environmental and concerns, however, grazing and agriculture are not allowed on Edwards AFB. The presence of unexploded ordnance in the open desert from past mission operations present a safety hazard for personnel and grazing animals, and environmental impacts associated with farming would include groundwater pumping to water crops, major surface disturbance, impacts to sensitive plant communities and animal populations, increased habitat fragmentation, soil erosion, and pollution of stormwater runoff from pesticides and fertilizers.

7.11 Integrated Pest Management Program

Applicability Statement

This section applies to USAF installations that perform pest management activities in support of natural resources management (e.g., invasive species, forest pests, etc.). This section **IS** applicable to Edwards AFB.

Program Overview/Current Management Practices

7.11.1 Natural Resources Program Support of Integrated Pest Management

Through coordination with CE and the pest control contractor, natural resources management supports the IPM Program by

- controlling invasive species that degrade natural resources in desert habitat not maintained by CE;
- actively reviewing updates to the IPMP;
- providing information on the biology of plants, animals, and protected species;
- recommending control options;
- evaluating effectiveness, costs, and benefits of proposed control actions;
- assessing potential environmental impacts of using chemical pesticides;
- consulting with regulatory agencies to obtain necessary permits for controlling pests; and
- managing revegetation projects.

7.11.2 Household Pests

This group of pests includes cockroaches, flies, ants, crickets, spiders, and other similar organisms. These are usually nuisance pests affecting personnel morale; however, some also may become health risks. To control these pests, an integrated approach of sanitation, inspection, exclusion (eliminating entries and refuge areas), and chemical control is used, with sanitation measures being emphasized and chemicals used only as a last resort. Cockroaches are the primary concern; thus, inspection of food-handling establishments is conducted monthly and chemical treatment is conducted, as needed, after sanitation and exclusion control measures have been implemented. The 412th Medical Group's Public Health Office is notified prior to pesticide application in food-handling facilities or the clinic.

7.11.3 Structural Pests

Termites are the primary pests of structures pests at Edwards AFB. Termites can severely damage a facility and necessitate extensive repairs. Chemical treatment is the primary method used for controlling termites.

7.11.4 Stored-Product Pests

Pests of stored products include invertebrates that infest boxed cereals and other foods. They usually become a problem when food is stored too long; thus, these pests are not a major concern at Edwards AFB. The 412th Medical Group personnel train managers of food facilities on how to inspect all incoming shipments of produce and meat products to ensure that the food is not contaminated.

7.11.5 Health-Related Pests

Pests that can affect human health typically includes bees, wasps, black-widow spiders (*Latrodectus* spp.), fleas, mosquitoes, and similar organisms. At Edwards AFB, health-related pests also include California ground squirrels and other rodents that potentially carry plague (*Yersinia pestis*), hantavirus (*Hantavirus* spp.), West Nile virus (*Flavivirus* spp.), and other diseases that can be transmitted to humans and affect the

health of base personnel. Measures used to control health-related pests include habitat modifications, mechanical traps, exclusion, and chemical controls.

7.11.6 Pest Management

The *Federal Insecticide, Fungicide, and Rodenticide Act of 1996* (7 U.S.C. 136, et seq., as amended) regulates the manufacture, use, storage, and disposal of chemicals used as pesticides, as described in 40 CFR, Parts 150–180. An *Integrated Pest Management Plan* is required for Edwards AFB IAW DoDI 4150.7, the *DoD Pest Management Program*. DoDI 4150.7 states that it is DoD policy to establish and maintain safe, effective, and environmentally sound IPM programs to prevent or control pests and disease vectors that may adversely impact the readiness of military operations by affecting personnel health or damaging structures, material, or property.

The DoD has established three Measures of Merit for pest management at its installations (Office of the Under Secretary of the Defense 1994). Measure of Merit 1 required all DoD installations to have a Pest Management Plan prepared, reviewed, and updated annually by the end of FY 1997. Measure of Merit 2 set a goal to reduce the amount of pesticides used at DoD installations by 50 percent (as compared to a baseline use in FY 1993) by FY 2000. Pesticide reduction was implemented as part of the overall pollution prevention program at Edwards AFB. Measure of Merit 3 set a goal of having all DoD installation pesticide applicators properly certified by the end of FY 1998.

DoDI 4150.7 requires that on-site reviews be conducted using the guidance provided in DoDI 4150.7, and the *Installation Pest Management Program Guide, Armed Forces Pest Management Board Technical Guide No. 18*. Technical Guide 18 (Office of the Under Secretary of Defense 2013) provides information and requirements for installation pest management programs and guidance for evaluation of these programs. The Pest Management Plan follows the USAF guidance found in AFMAN 32-1053, *Integrated Pest Management Program*, and describes pest management program operations, management procedures, pest management facilities, health and safety issues regarding application of pesticides and herbicides, and regulatory compliance issues. AFMAN 32-1053 discusses specific procedures and identifies responsibilities for pest management programs at USAF installations. Overall, AFMAN 32-1053 guidance emphasizes avoiding impacts to the environment.

CE is the office of primary responsibility for pest management on Edwards AFB and implements the *Edwards Air Force Base Integrated Pest Management Plan* in coordination with Environmental Management, Public Health, Bioenvironmental Engineering, Safety Office, and Security Forces. Pest control that is part of any construction project or contract must be coordinated with CE for scheduling and monitoring of the pest management work. The contractors are required to submit pesticide reports via the web-based Integrated Pest Management Information System and forward a copy of the report to the Installation Pest Management Coordinator as detailed in the IPMP.

IPM is a DoD-mandated approach to pest control that uses routine monitoring to determine whether pest control measures are necessary. IPM employs mechanical, physical, cultural, biological, and educational methods to control pests at population levels low enough to prevent undesirable damage or annoyance. Pest-control measures are implemented only when monitoring determines that a pest will cause unacceptable economic, medical, or aesthetic damage if not treated, and chemicals (the least-toxic possible) are used only as a last resort. Treatments are chosen and scheduled to be the most effective and least disruptive to the natural environment.

Wildlife pests or nuisance animals are any wild or domestic animals that cause annoyance, health and safety hazards, landscape or property damage, or compromise mission objectives. These pests primarily include

ants, mosquitoes, mice, California ground squirrels, snakes, bobcats, and coyotes. Written permission to relocate wildlife species must be received from the Natural Resource Manager prior to trapping activities.

The pest management contractors overseen by CE are responsible for controlling pests (e.g., weeds, insects, mice, gophers, rabbits, and California ground squirrels) everywhere except housing, where pest control has been privatized. The use of kill-traps is the preferred method for most rodent control. Carbon monoxide poisoning and pesticides are also used in areas containing major infestations of rodents, such as California ground squirrels. California ground squirrels are nuisance pests in the Military Family Housing area and other developed and landscaped areas of Main Base and South Base, including the golf course.

CE develops projects to control pests and manages contracted activities for pest management. Tenant organizations provide funding for pesticide applications from their own budgets. All pest-control work on Edwards AFB is conducted by contractors overseen and monitored by the Installation Pest Management Coordinators. The Installation Pest Management Coordinators also maintain a file of all applicable state, federal, and DoD regulations that pertain to pesticides. Regulations concerning the sale, application, and distribution of pesticides in California are reviewed periodically for relevancy to base operations.

The Edwards AFB self-serve store does not currently stock pesticides for household use, but base customers can make recommendations for store purchase of pesticides.

7.11.7 Pest Species that Potentially Affect Natural Resource Management

California ground squirrels have spread to all landscape areas within Main Base, the housing area, and South Base. In some cases, they have entered occupied houses on base and have to be removed by the pest contractor. Their foraging and burrowing damage lawns and landscaped areas containing grass, shrubs, and trees. If left unchecked, California ground squirrels may invade interfaces between native desert and populated areas, thus impacting white-tailed antelope and Mohave ground squirrels.

The CDFW classifies California ground squirrels as nongame mammals. Nongame mammals found destroying landscapes or other property may be controlled at any time, in any manner that is legal and humane, by the owner or tenant of the property. They may be controlled by federal, state, or county officers or employees while acting in their official capacity.

An IPM strategy for controlling California ground squirrels consists of several components that maximize the beneficial effects while minimizing environmental effects and risks to human safety. Benefits are greatest when several strategies are integrated on a continuous basis. The IPM strategy is designed to produce long-term, sustainable management of damage from California ground squirrels and may require a variety of data collection and strategies to control the population, such as

- identification of occupied areas,
- testing and applying control techniques,
- monitoring effectiveness of control techniques,
- monitoring changes in population distribution,
- determining acceptable population thresholds, or
- determining whether California ground squirrels are expanding into native desert areas.

7.11.8 Control of Predators

The primary objective of bobcat and coyote management is to protect base personnel. Goals include educating base personnel about bobcats and coyotes, maintaining coyote health and natural behavior, and being prepared to respond to problem animals. Environmental Management conducts surveys as needed to monitor and assess potential problems with bobcats and coyotes in the base housing and cantonment areas,

and keeps a database of sightings and incidents to detect any patterns in animal behavior and/or occurrence. The primary method of maintaining bobcat and coyote health and natural behavior is to prevent people from feeding these animals, first through education of base personnel. Environmental Management personnel also train base personnel to harass bobcats and coyotes and coordinate with the USFWS FWO to implement aversion and harassment measures as needed. If harassment and aversion do not work, animals will be removed by USDA Wildlife Services or the USFWS FWO. Written permission to relocate wildlife species must be received from the Natural Resource Manager prior to trapping activities. If further assistance is required, the base contacts USDA Wildlife Service for support. Security Forces personnel only assist when human safety is an immediate issue.

7.11.9 Invasive Species Management

Invasive species management priorities and protocols on Edwards AFB are specified in the 2018 Edwards Air Force Base *Invasive Species Management Plan* (ManTech 2018d), which is a component part of this INRMP.

Executive Order 13112, *Invasive Species*, was signed on 3 February 1999. The spread of exotic species has the potential to replace healthy, diverse ecosystems with biologically impoverished, homogeneous populations. As such, the purpose of EO 13112 is to prevent the introduction of invasive species, provide for their control, and minimize the economic, ecological, and human health impacts attributed to invasive species.

Although invasive weed species are not numerous, they are increasing and can attain nearly 100 percent of their annual biomass in early rainfall years, easily out-competing the native annuals. Weedy annuals of disturbed areas, such as redstem filaree, tumble mustard (*Sisymbrium altissimum*), Russia thistle (*Salsola tragus*), red brome, cheat grass, western tansymustard (*Descurainia pinnata ssp. glabra*), and Mediterranean grass (*Schismus barbatus*) are common in disturbed portions of natural habitats throughout the base. African rue (*Peganum harmala*), to which the California Food and Agriculture Department gives an A rating (meaning it is a known economic or environmental detriment but is not yet known to be established in California or it is present but the distribution is limited enough to allow for possible eradication and/or successful containment), had been recorded along Jones Road, but Kern County Agriculture Department has been conducting surveys and applying herbicides to eliminate this species on Edwards AFB. After multiple years without detection, it is assumed it has been eradicated from the base.

Edwards AFB has conducted surveys to identify invasive species and their distribution through various plant inventory projects. A concentrated effort was conducted in 2016 and 2017 with helicopter surveys in areas of the base that were most vulnerable to invasions of non-native species: roadsides and target areas, seasonally flooded areas, and Piute Ponds. During these surveys, invasive species and their extent within the various areas were mapped to help identify problematic areas and come up with solutions. The *Invasive Species Management Plan* (ManTech 2018d) was then developed with specific work plans for areas of concern (ManTech 2018e, ManTech 2019c and d), labeled Priority Management Areas (PMAs). The PMAs (Appendix B, Figure 29) were designed to address specific problem areas and the best methods and timing for invasive species control, given the environment and disturbance regime. In addition, an on-the-ground survey for invasives species within the developed areas of the base was conducted in 2019 to catalog invasive species that have the potential to escape landscaped areas and invade the surrounding natural habitats (Redhorse Corporation 2019).

Invasive species treatments in natural areas began in 2016 in and around the Piute Ponds Complex and extended into other PMAs in subsequent years, following the work plans developed for each area. Successes

in treated areas are being recorded using a grid system developed for the entire base. During each treatment, species, percent cover, and amount of herbicide used for each grid cell is recorded. Using the amount of herbicide used in a given cell serves as a proxy for the extent of invasive species in that cell and can help to reveal trends over multiple years. Infested grid cells are revisited every year and buffer cells around each infestation are also monitored to see whether the infestations have spread, are being contained, or have been removed from each cell. Recurring monitoring and treatments are required because there are pervasive off-base seed sources causing new invasive species infestations on base. Persistent management should keep existing and new infestations contained and manageable. During helicopter surveys in 2017 and subsequent treatment of the invasive Sahara mustard (*Brassica tournefortii*) along roadsides, it was noted that this species was beginning to invade adjacent, intact desert habitat, including designated desert tortoise critical habitat. A new project was initiated in 2019 to map the extent of Sahara mustard and begin treating this species to stop the spread and ultimately reduce the extent of invasion into natural habitat (Gulf South Research Corporation [GSRC] 2020). In 2015–2016, removal of the habitat-modifying, invasive tamarisk trees in and around the Air Field began. Removing tamarisk also reduces potential BASH concerns, as the trees provide both shelter and perching habitat for multiple problematic species (ManTech 2017). This project was extended in 2019 to catalog all tamarisk trees near the flightline and within the main flight paths for subsequent treatment and removal, slated to begin in 2020 (GSRC 2020).

In addition to invasive species treatments in heavily infested areas of the Piute Ponds Complex, habitat restoration work is also being completed. Post-treatment restoration work is important for heavily infested areas so that there is something to take the place of the invasive species and create a resilient habitat that can outcompete new invaders. In the Piute Ponds Complex, various willow species, cottonwood, and desert olive (*Forestiera pubescens*) have been planted in hopes that, once they reach maturity, they can provide replacement habitat where tamarisk was removed. Survivorship of these plantings have varied quite a bit over space and time as planting techniques were refined. Overall, the willow and cottonwood survivorship averages about 29 percent, varying from 0 to 96 percent across locations. Olive trees were planted in the spring of 2019, and as of August 2019 their survivorship was 51 percent. On-going monitoring will continue and restoration protocols adjusted based on success and failures throughout the system (ManTech 2019b).

A 2019 Cantonment Area survey identified 39 invasive species (Redhorse Corporation 2019). Of those, 10 were high-priority species and six were identified as new occurrences on EAFB. Detailed species profiles were created for each of the 10 high-priority invasive plant species encountered and include detailed distribution maps with coverage estimates by location and field observations. Additionally, treatment recommendations were included for all high-priority species, with considerations for the feasibility of cantonment-level control, chemical treatment options, treatment timing, and level of effort required. A treatment-priority analysis provided a way of ranking the need for control measures for each invasive species observed. This treatment priority analysis assigned five plant species a "High" level of treatment priority: Giant reed (*Arundo donax*), ripgut brome (*Bromus diandrus*), Maltese star-thistle (*Centaurea melitensis*), Russian knapweed, and tamarisk.

7.12 Bird/Wildlife Aircraft Strike Hazard

Applicability Statement

This section applies to USAF installations that maintain a BASH program to prevent and reduce wildlife-related hazards to aircraft operations. This section **IS** applicable to Edwards AFB.

Program Overview/Current Management Practices

The *Bird/Wildlife Aircraft Strike Hazard (BASH) Plan, Volume 1—Edwards Air Force Base, 412 TW BASH Plan 91-212, Vol. 1*; *AFI 91-204*, *Safety Investigations and Reports*; and *USAF Pamphlet 91-212*, *Bird/Wildlife Aircraft Strike Hazard (BASH) Management Techniques*, provide guidance for the BASH Reduction Program. Air Force Pamphlet 91-212, which provides guidance for implementing an effective bird/wildlife aircraft strike hazard reduction program, applies to all USAF personnel who plan, support, or are engaged in flying operations. The Flight Safety Office manages the BASH Reduction Program on Edwards AFB.

The Edwards AFB Bird Hazard Working Group consists of representatives from Flight Safety, Airfield Management, Air Traffic Control, flying units, tenant organizations, CE, Environmental Management, and Aircraft Maintenance. These USAF personnel work together to assist the Safety Office with drafting and implementing the BASH Reduction Plan to prevent or reduce the potential for BASH.

Edwards AFB is situated within the boundary of the Pacific Flyway, which is a major migratory route for many bird species, including waterfowl. Seasonal migration and daily flight patterns of birds create an increased risk to flight operations. The control tower monitors the movements of birds in the airfield environment and alerts aircraft when there are large numbers of birds near the runway or in flight corridors. Flight Safety maintains records of the types and numbers of birds harassed, depredated, and struck by aircraft.

BASH risks may be controlled and reduced through a variety of methods. The primary method is managing habitats to discourage birds from using the runway and flightline environment. Other methods include

- revegetating disturbed areas near the runways using native plants that discourage bird populations;
- preventing accumulations of standing water near the runway;
- using lighting that does not attract insects and insectivorous birds;
- continuing use of the bird avoidance model to predict times of day, year, and locations when birds are more likely to be active;
- mechanically securing buildings to deny access to nuisance bird populations;
- using harassment techniques, such as pyrotechnics and acoustics to move birds away from active flight operational areas;
- limiting sunrise and sunset takeoffs and landings during severe or moderate bird activity, or delaying or cancelling flights, depending on the severity of the bird activity and during the presence of large flocks of birds on the flightline; and
- using lethal removal of birds IAW the Migratory Bird Depredation Permits issued by the USFWS.

The Flight Safety Office and Airfield Management, in coordination with the Environmental Management natural resource manager or wildlife biologist, are responsible for assisting with the elimination of bird hazards along the flightline, including the hangars. Dispersal methods are implemented for birds posing a hazard to aircraft. One method of dispersing birds is firing a shotgun using pyrotechnic shells, producing a startle effect. Elimination of birds in hangars is also accomplished with exclusion measures, such as keeping hangar doors closed. Additionally, Environmental Management has used a trained falcon to discourage birds around the runway. If nonlethal dispersal methods are not successful or the birds become acclimated to applied dispersal methods, lethal methods are used to remove birds. Annual Migratory Bird Depredation Permit reports are completed and submitted to the USFWS by the Flight Safety Office.

7.12.1 Existing and Potential Hazards to Aircraft Posed by Wildlife

There is a low to moderate bird hazard at Edwards AFB. Although Rogers Dry Lake, Rosamond Dry Lake, and Buckhorn Dry Lake may become inundated with water during the winter and spring months, resulting in the presence of aquatic arthropods (shrimp) that are a food source for migratory birds, the BASH risk is minimized by reporting sightings to Airfield Management and implementation of the BASH Plan, as appropriate. The BASH risks on base are minimized by the selection and planting of landscape plants that do not attract nesting birds in areas that have had BASH problems in the past, and through building design by limiting the number of sites on the outside of buildings that would be attractive to nesting birds. Environmental Management wildlife biologists and USDA Wildlife Services biologists work together to remove birds and other wildlife from hangars and other buildings on base if they pose a BASH risk.

7.12.2 BASH Focal Species and Natural Resource Hazards

The primary bird species occurring adjacent to the flightline include Bell's sparrow (*Artemisiospiza belli*), burrowing owl, mourning dove, and California horned lark (*Eremophila alpestris actia*). Horned larks are the primary problem species associated with hazards to aircraft. They are grassland birds that do well in the desert, especially in areas that contain standing water or areas of sparse vegetation (e.g., flightlines and taxiways). Large flocks of horned larks congregate in close vicinity to the Main Base flightline or adjacent to the runways, especially in areas that are disturbed through mowing or grading.

In 2014, the USAF conducted a golden eagle data review and analysis for all of Edwards AFB and within a 10 mile radius. This analysis was conducted to assess the necessity of obtaining a federal permit IAW 50 CFR 22.27 (Removal of Eagle Nests). Data were gathered from multiple sources including the Edwards AFB BASH database, Edwards AFB GIS database, basewide surveys, the BLM, the Audubon Society Christmas Bird Count, and eBird. This study showed that sighting clusters appeared to be associated with habitats such as wetlands and clay pans within scrublands on base (The Sanberg Group 2014). Eighty-six percent of the reported sightings in this analysis were at Piute Ponds.

Although there have been no reported BASH incidents involving golden eagles on Edwards AFB, the probability of this happening is heightened in areas such as Piute Ponds and in areas like the PIRA, where low-altitude flights are more frequent (The Sanberg Group 2014). It was concluded that, based on the lack of any golden eagle BASH incidents on and around Edwards AFB, for now there is no need to obtain a permit pertaining to 50 CFR 22.27.

The number of rock pigeons (*Columba livia*) has been increasing in the housing and flightline areas, where the hangars provide roosting and nesting habitat. This species is expected to pose an increased BASH risk in the future. Control actions should be taken as soon as possible while population numbers are still relatively low. The addition in 2019 by 412 TW/Safety Flight of an APHIS-WS biologist to depredate migratory birds has aided in removal also or rock pigeons and their nests from hangers.

7.12.3 Federal or State Permits

A USFWS MBTA Depredation Permit for Airfield Operations is issued to Edwards AFB. The permit allows activities for removing, harassing, or depredating migratory birds that pose a risk to airport safety. The Flight Safety Office holds the permit and is responsible for its annual renewal.

7.12.4 How the Natural Resources Program Supports BASH Plan Objectives

Environmental Management conducts inventories and behavioral studies of the birds on base to develop habitat management measures to discourage or reduce the number of birds using the areas around the runways and taxiways. Environmental Management natural resources staff collects information on bird

population densities and movements and provides information to Airfield Management and Flight Safety about bird migrations. A 2019 airfield habitat study provided wildlife and habitat recommendations to reduce potential BASH concerns (Clifford 2019), and a tamarisk removal project targeting the airfields at North Base, Main Base, and South Base was initiated in 2018 and scheduled for completion in 2022 (GSRC 2019).

7.13 Coastal Zone and Marine Resources Management

Applicability Statement

This section applies to USAF installations that are located along coasts and/or within coastal management zones. This section **IS NOT** applicable to Edwards AFB.

Program Overview/Current Management Practices

There are no coastal zones or marine resources at Edwards AFB.

7.14 Cultural Resources Protection

Applicability Statement

This section applies to USAF installations that have cultural resources that may be impacted by natural resource management activities. This section **IS** applicable to Edwards AFB.

Program Overview/Current Management Practices

There are no substantial or significant fossil resources known to exist on Edwards AFB. In the event of a paleontological discovery, the natural and cultural resource sections will work together on protection and management of the resources.

Evidence suggests that the area now known as Edwards AFB has been continuously occupied by people for thousands of years and base operations are only the most recent contributor to that long history. The vast accumulation of cultural materials (known also as cultural resources) that result from human activity hold great significance for our collective heritage as a region and a nation. As such, the *National Historic Preservation Act*, as amended, directs Edwards AFB to establish policies that conserve, protect, and preserve these cultural resources, whether or not they result from the current military mission.

The Edwards AFB ICRMP presents strategies that ensure compliance with federal, state, and local regulations, and it ensures that Edwards AFB protects resources for the good of the public. In general, the strategies consist of the categories that follow.

Identification and Evaluation—Identification of buildings, landscapes, and artifacts that were (and in some cases still are) used by people throughout time. The data will be analyzed and evaluated, and sites are classified based on where they are located and how they were used.

Determination and Nomination—Based on the classification of cultural resources, specialists determine their relative importance by comparing them to other resources found on base, in the region, and around the country. Cultural resource specialists weigh the importance of the resources against predetermined criteria and the exemplary ones are nominated for inclusion on the National Register of Historic Places (NRHP). The NRHP is the official list of the Nation's historic places that are worthy of preservation.

Preservation, Protection and Education—NRHP sites undergo additional study and examination; associated artifacts are removed and preserved in a special on-base curation facility. Aspects of the site that cannot be removed are stabilized and protected against natural and human disturbance. Because Edwards AFB is a

steward of resources that ultimately belong to the public, it educates the public when possible about resources that help define the historical development of the area.

It should be noted that the ICRMP is only one aspect of the overall management of the environment. The ICRMP and the INRMP work in tandem to address larger environmental concerns, and cooperation between the goals of the ICRMP and INRMP are coordinated for this purpose. For provisions that address the protection and management of cultural resources on Edwards AFB, please refer to the ICRMP (412 TW 2017b).

7.14.1 Natural Resource Management Activities Affecting Cultural Resources

The Piute Ponds Complex is actively managed for habitat maintenance and restoration, water flow, and recreation. There are numerous identified, yet unevaluated, cultural sites scattered throughout the complex. Current management activities are accomplished by avoiding these sites, and a project is in place to evaluate these sites and determine what management activities can take place there. This may require a multi-year resource effort, which will inform the *Piute Ponds Complex Management Plan* (412 CEG/CEVA 2014).

7.15 Public Outreach

Natural Resources personnel participate in a variety of on-base and off-base public outreach events and venues. Education on various natural resources topics, such as the desert tortoise and other sensitive resources, wildlife safety, natural resources laws and regulations, hunting, and outdoor recreational use, is delivered through presentations, posters, handouts, information booths, briefings, and daily interactions with base personnel. The base maintains a recreation webpage where information about hunting, fishing, ORV use, hiking, and other outdoor recreational opportunities is provided, along with options to purchase permits online. Natural Resources personnel maintain a Facebook page for Environmental Management to disseminate educational information and monitor wildlife issues in base housing. Resources personnel also lead fieldtrips and provide educational outreach for local schools, clubs, and base organizations.

7.15.1 Natural Resources Awareness Program

Natural Resources personnel provide natural resources training to base newcomers, ORV users, building managers, and temporary and permanent workers. This highly successful program is a USFWS requirement in the basewide biological opinion and, since 1991, it has reached thousands of individuals.

Natural Resources personnel have been actively involved in educating the public at outreach events for any years. At these events, they have live animals (which may include live desert tortoises and/or snakes), taxidermy specimens, GIS data-collection activities, and information on sensitive plants and animals of the Mojave Desert. These outreach programs are conducted during Earth Day, in local elementary classrooms and on high school career days, various on-base gatherings and events, and some off-base local community events.

7.15.2 Wildlife Education and Interpretation

The Natural Resources Education Program focuses on desert tortoise and ESA education. As such, all persons working on Edwards AFB are required to attend a desert tortoise awareness briefing, and a general awareness briefing is given to personnel that work indoors or within developed areas of the base. Project-specific briefings are provided to personnel working outdoors in areas where desert tortoises are known to occur, and tailgate briefings are given to personnel that have received a project-specific briefing, but may be working in different areas of the base or under varying conditions, such as season, weather, or areas of high desert tortoise density. A briefing is also provided for personnel and projects that have the potential to

impact birds protected under the MBTA. Three types of briefing videos have been produced to target children, contractors, and government personnel.

Environmental Management provides several types of additional briefings aimed at everyone working and living on base, including school children. A primary topic is safety and desert wildlife. Topics include the potential dangers of rattlesnakes, coyotes, and scorpions; and the importance of not collecting or feeding wildlife. Various presentations are provided for general audiences to promote wildlife and nature appreciation. A slide presentation that includes a discussion on desert safety is given to base newcomers and building managers. In addition a briefing on the desert tortoise, newcomers also attend briefings on natural resources and safety. Many of these presentations are also enhanced with brochures, flyers, fact sheets, live animal demonstrations, and a display of taxidermy specimens. Discussions about the desert tortoise and sensitive plants are also provided on a project-specific basis.

Environmental Management also provides an education program on natural resources during special events such as Earth Day and visits to Piute Ponds. This can involve government personnel, contractors, and volunteers who discuss the desert environment and the natural resources that occur on base. The program can include poster boards, live animals, wildlife taxidermy, nature walks; GIS demonstrations, and brochures.

7.15.3 Natural Resources Education Materials

Numerous natural resources stories are published each year in the base newspaper.

Edwards AFB Produced Videos

- Desert Tortoise 1993 https://www.youtube.com/watch?v=vaiE-ixl5BY
- Desert Tortoise Awareness for Newcomers 2020
- Desert Tortoise Awareness for Contractors 2020
- MBTA https://www.youtube.com/user/EdwardsAFBEM/videos

Edwards AFB-Produced Brochures, Flyers, and Fact Sheets

- The Birds of Edwards AFB California (birder's checklist)
- ORVs on Edwards AFB (brochure)
- Wildflower Tour Guide (brochure)
- The Desert Tortoise at Edwards Air Force Base (brochure)
- Predators (flyer)
- Living with Desert Wildlife (brochure)
- Lakebeds are Alive (flyer)
- Desert Tortoise Alert Card (wallet card)
- Desert Tortoise Awareness Decal
- Do Not Feed Wildlife (poster)
- Time to Talk Trash (bumper stickers and buttons)
- Wild Animals Can Be Aggressive (poster)
- Living with Birds at Edwards AFB (brochure)
- Burrowing Owl (flyer)
- Common Barn Owl (fact sheet)
- Bobcat (fact sheet)
- Burrowing Owl (fact sheet)
- Red Coachwhip Racer (fact sheet)
- Common Kingsnake (fact sheet)

- Coyote (fact sheet)
- Desert Blonde Tarantula (fact sheet)
- Desert Tortoise (fact sheet)
- Desert Kit Fox (fact sheet)
- Desert Kangaroo Rat (fact sheet)
- Desert Iguana (fact sheet)
- Gopher Snake (fact sheet)
- Great Horned Owl (fact sheet)
- Greater Roadrunner (fact sheet)
- Mojave "Green" Rattlesnake (fact sheet)
- Red-Tailed Hawk (fact sheet)
- Sidewinder (fact sheet)
- White-Tailed Antelope Ground Squirrel (fact sheet)
- Mohave ground squirrel (fact sheet)

Updates and new product requirements include the following videos.

- Wildland Fire Management on Edwards AFB (video)
- Living with Wildlife Predators on Edwards AFB (video)
- Wildlife Subsidy Reduction on Edwards AFB (video)

7.16 Climate Change Vulnerabilities

Applicability Statement

This section applies to USAF installations that have identified climate change risks, vulnerabilities, and adaptation strategies using authoritative, region-specific climate science, climate projections, and existing tools. This section **IS** applicable to Edwards AFB.

Program Overview/Current Management Practices

In 2019, Colorado State University assessed and generated downscaled temperature and precipitation data to develop climate projections for two future carbon-emission scenarios (a moderate-emission scenario and a high-emission scenario, for two different decal periods (i.e., a total of four emission-timeframe scenarios) and used tools and models to assess impacts of future climate on natural resources at Edwards AFB (CEMML 2019a). This section is based mostly on those modelling results.

7.16.1 Climate Models Developed for Edwards AFB

Historical daily climate data recorded over a 30-year period (1980–2009) were used to represent average historical (baseline) conditions and generate climate projections. These data represent the 30-year historical reference point used by the Intergovernmental Panel on Climate Change (IPCC) to define climate change scenarios. Future climate conditions for Edwards AFB, assessed under both a moderate-emission scenario (Representative Concentration Pathway [RCP] 4.5) and a high-emission scenario (RCP 8.5), were projected to produce two decadal time series of daily climate values: one for 2026–2035 and 2046–2055, represented hereafter as 2030 and 2050, respectively.

Model inputs included the historical baseline data to develop a time series of daily data for 2030 and 2050. Historical baseline data gathered for the installation included average daily temperature, maximum and minimum daily temperatures, and daily precipitation. Climate data were converted from their original metric units to English units for analysis. For each of these variables, a daily anomaly was computed for each emission scenario (RCP 4.5 and RCP 8.5) for each time period (2030 and 2050). Daily data were then

averaged over each 10-year period for each variable and scenario to produce annual average temperature, average annual maximum and minimum temperatures, and average annual precipitation (CEMML 2019a).

The Colorado State University assessment was based primarily on publicly available plus authorized (for use) AFCEC data (CEMML 2019a). The climate projections developed by CEMML (2019a) were based on recent global climate model simulations developed for the IPCC (IPCC-AR5), Coupled Model Intercomparison Project Phase 5, U.S. National Center for Atmospheric Research, and Community Climate System Model (Hibbard et al. 2007; Moss et al. 2008, 2010; Gent and Danabasoglu 2011; Hurrell et al. 2013).

7.16.2 Projected Climate Impact at Edwards AFB—Results of the Models

Climate projections for Edwards AFB (CEMML 2019a) indicate that minimum and maximum temperatures will increase over time under both the moderate and high carbon emission scenarios (RCP 4.5 and RCP 8.5, respectively) for the two future decades: 2030 and 2050. Average temperature and precipitation also tend to increase but not uniformly throughout the year under any of the four RCP-decade scenario, nor do they follow an intuitive pattern between scenarios. Although the increases are generally greater for the 2050 timeframe, temperature in February, June, and December projected under the RCP 4.5-2030 scenario is greater than that projected for the same months under the RCP 4.5-2050 scenario. In general, precipitation at the installation is projected to increase under all scenarios, with the largest increases occurring from January through March and in November (CEMML 2019a).

Where Edwards AFB is located, the climate is characterized by hot, dry summers and cool to cold winters. This pattern is projected to continue, but with warmer winters and summers. Ultimately, the increasing trend in average annual temperature and precipitation will result in fewer freeze-thaw days, more growing degree-days, and more hot days. The system-wide impacts of these changes will be highly dependent on the ability of the flora and fauna to adapt to changing seasons, temperature extremes, and more rapid fluxes in temperature.

7.16.3 Hydrological Vulnerability to Climate Change

Stream channel overflow models were developed to better understand potential effects of climate change on inundation levels at Edwards AFB (CEMML 2019a). The base's complex surface hydrology is influenced by an extensive network of ephemeral channels, large evaporative losses, and permeable soils; thus, the available data available for most of the drainages were insufficient for modeling these factors. Inundation models developed for the Mojave Creek watershed used data from up to 2017 (i.e., within the data-acquisition timeframe of the USAF Climate Change Project; CEMML 2019a). The models assumed that the upper and lower portions of Mojave Creek are linked, but they are not linked, as shown in Figure 19 (Appendix B) (Sullivan et al. 2017, Heintz and Miller 2020). Therefore, the reliability of the overflow model's results is uncertain. Understanding the effects of future inundation potential in this drainage is important because it includes residential areas, the airfield, and other impervious areas at Edwards AFB that contribute to increased potential storm runoff. Changes in projected inundation can be used to assess implications for infrastructure, vegetation, fish and wildlife species, and mission constraints.

Developing the Inundation Models

Model inputs for simulating inundation along Mojave Creek and into Rogers Dry Lake following projected storm events included physical characteristics of the watershed (soil type, water table depth, land cover, channel characteristics, topography, and elevation) and "design storm" data. Design storms, which are hypothetical storms used to help planners design infrastructure, evaluate flood hazards, and/or inform land-

use planning and resource management, were developed to estimate baseline conditions and inundation potential under the four RCP-decade scenarios (CEMML 2019a).

Three-day storm events were used as the basis for design storms because rainfall occurring over consecutive days can cause soil saturation, overland flow, and compounding of runoff that may lead to flooding. The National Oceanic and Atmospheric Administration (NOAA) Atlas 14 was used to develop a synthetic rainfall distribution (hyetograph of rainfall intensity over time) for modeling each design storm. Design storms were based on the largest rainfall event of each year from 1996 to 2005 and then averaged over the 10 years; therefore, they do not represent extreme weather events (e.g., hurricanes, extraordinary storm fronts) and inundation levels of design storms are expected to be lower than those of a current 100-year storm. Data up to 2017 were used for analysis and development of the inundation models, sourced from the AFCEC Environmental GIS project, within the framework and time frame of the USAF Climate Change Project (CEMML 2019a).

Results of Inundation Models

The baseline design storm for Edwards AFB was estimated to produce 2.84 inches of precipitation over a three-day period. Overall, projected inundation correlated with changes in total design storm precipitation. Although average annual precipitation is projected to increase under all four RCP-decade scenarios, the design storms are estimated to decrease under three of the scenarios, which indicates that smaller rainfall events may occur more frequently. Under all four scenarios, inundation levels in developed areas along the Mojave Creek drainage at Edwards AFB are projected to be within inundation levels of the current 100-year floodplain

More specifically, total design storm precipitation for the RCP 4.5 emission scenario is projected to decrease by 7 percent and 16 percent by 2030 and 2050, respectively. Projected inundation associated with smaller storms also is projected to decrease. Inundated area is estimated to decrease 10 percent and 18 percent by 2030 and 2050, respectively. Under the RCP 8.5 emission scenario, inundation resulting from design storms is projected to remain similar to that of the baseline storms. Overall, inundation under this scenario is projected to decrease 9 percent and 11 percent by 2030 and 2050, respectively. This trend, however, differed from that of the 4.5 emission scenarios in that total precipitation is projected to decrease 5 percent by 2030 but then increase by 60 percent of the baseline by 2050.

Variability in projected inundation affects the extent to which estimated runoff would drain into Rogers Dry Lake. For the three climate scenarios under which total projected inundation decreases, the extent of inundation into Rogers Dry Lake is lower than baseline inundation. Variability in projected inundation was influenced by total precipitation of design storms, daily distribution of precipitation over the three-day period of design storms, and climate-driven changes in land cover. Land cover also covaried with soils and depth to water table (both held constant between scenarios), adding further variability to the results.

The Desert Research Institute estimated future changes in lakebed inundation frequency by identifying precipitation thresholds that result in standing water on the lakebed and using downscaled general circulation model precipitation projections to identify the change in frequency of causative precipitation events. At Edwards AFB, the number of precipitation events resulting in inundation is likely to decrease by one or two events per decade; however, the percentage of years with at least one inundation event is unlikely to change significantly, so the frequency of future inundation events that help to heal lakebed surfaces is unlikely to change. The frequency of multiple inundation events in the winter is projected to decrease slightly, so there may be a corresponding slight decrease in the periods when the lakebed airfield is unusable because of inundation (Miller et al. 2020).

7.16.4 Vegetation Cover Vulnerability to Climate Change

Although predictions of monsoon activity in North America are highly uncertain (Bukovsky et al. 2013), more frequent and/or more intense tropical storms could alter desert vegetation communities, particularly those in washes or floodplains.

Desert ecosystems are expected to shift westward and upward in elevation over the coming century (Barrows 2011, Barrows and Murphy-Mariscal 2012), and in some areas they may replace upslope vegetation that is less suited to increasingly hot, dry conditions (Lenihan et al. 2008, Friggens et al. 2013). In turn, this could result in higher rates of evapotranspiration that could lead to an earlier, more rapid seasonal drying-down of open water/wetland vegetation communities; increased water stress in nearby basin-floor communities; and later, less frequent, and briefer wetting of nearby playas. Consequently, the combination of shrinking perennial flows and open waters coupled with higher water temperatures at locations/times when water temperatures are not influenced by groundwater discharges or snowmelt, persistence of these hydrologic conditions later into the fall or early winter, and reduced groundwater recharge would affect current vegetation cover at Edwards AFB (Comer et al. 2012).

Creosote bush scrub communities might be the most vulnerable to climate change effects, mainly because they depend more heavily on seasonal rainfall for successful germination than other desert communities and because it remains uncertain how climate change may affect pollinators. Land-use changes in response to climate change will increase vulnerability as well (CEMML 2019a). Climate change may stress Joshua trees, inhibiting their ability to survive wildfires, and it may reduce the area of suitable ecosystem so that any fire will impact a larger proportion of the remaining Joshua tree population. The interaction between increasing frequencies and sizes of wildfires facilitated by invasions of exotic grasses and a climate change-related increase in severe wildfire conditions could pose a great threat the survivorship of Joshua trees, even within their refugia. Because of this added exposure, management of this species may need to focus on weed control and restoration efforts within identified climate refugia, minimizing stressors that could reduce Joshua tree survivorship (Barrows and Murphy-Mariscal 2012). With changing climate conditions, alien annual grasses can potentially outcompete native annual plants and alien forbs in the Mojave Desert by significantly affecting native annual seedling density and biomass (Brooks 2000).

7.16.5 Fish and Wildlife Vulnerabilities to Climate Change

Climate change is likely to favor newly arriving, non-native species that have the ability to outcompete native species that are already experiencing reduced fitness due to deteriorating environmental conditions (Hellmann et al. 2008). Although this trend is global, it is expected to be far more pronounced in the southwestern U.S. (Archer et al. 2008).

Scarcity of water is already an issue for wildlife populations at Edwards AFB and will continue to be, despite projections of increased precipitation, because much of the precipitation will fall in winter (CEMML 2019a). Higher frequency and intensity of fires can lead to greater rates of run-off and erosion, resulting in habitat disturbances that would compound water-scarcity issues for wildlife at Edwards AFB. Higher rates of run-off, and evapotranspiration associated with increasing temperatures, may have particularly negative effects on aquatic organisms, including fairy shrimp, backswimmers, amphipods, and dragonfly nymphs (Archer et al. 2008). Although wildlife communities at Edwards AFB are composed of organisms highly adapted to hot, arid environments, some may not be able to withstand the projected increases in temperature. Generalist species are likely to better cope with rising temperatures through behavioral adaptations, such as becoming nocturnal on hot days (Stahlschmidt et al. 2011).

Higher air temperatures projected by the models (CEMML 2019a) also may affect water quality negatively, particularly in lentic systems, such as lakes and ponds. As water temperatures rise in lentic systems, dissolved oxygen content decreases, altering water quality, particularly for larval amphibians and aquatic macroinvertebrates. Increasing water temperature also can increase the chances of algal blooms occurring, which further deplete dissolved oxygen content and degrade habitat quality (Paerl et al. 2011).

Changing vegetation communities can have negative impacts on specialist wildlife species that historically depended on specific native plant species for their survival (Dukes and Mooney 1999). Consequently, this too could alter wildlife communities on Edwards AFB. For example, a widely distributed species such as common chuckwalla is predicted to lose 92 percent of its suitable habitat in parts of the southwestern U.S. (Barrows 2011).

7.16.6 Threatened and Endangered Species Vulnerabilities and Adaptation to Climate Change

Changing climate conditions further complicate population-status projections for species that are already of conservation concern. Few populations have been sufficiently studied to make reliable estimates of species' responses to changes in temperature, precipitation, and seasonality. Historical patterns used to guide management decisions are likely to be insufficient for future management challenges (Bierbaum et al. 2013). Although numerous species have already begun to demonstrate phenotypic plasticity (behavioral, morphological, and physiological) and evolutionary responses to climate change, the speed and magnitude of climate change could overwhelm species' abilities to cope with a new climate.

Using single-species management approaches for adaptation to climate change runs the risk of disrupting ecosystem function and further imperiling other species. DoDI 4715.03 requires that installations employ adaptive and ecosystem-based management; therefore, many current management activities for threatened and endangered species are appropriate for enhancing their resilience or facilitating their adaptation to climate change. An ecosystem approach that prioritizes functional diversity, maintains habitat, habitat variability, and habitat connectivity can help to support species' genetic and functional diversity that may be important for adapting to climate change and/or facilitating species' migrations to more favorable habitats. When approaching the uncertainty inherent with managing species under changing environmental conditions, additional analysis and planning are required.

Effective approaches for adapting to climate change require site-specific climate projections as well as local knowledge of species and their habitats. Adaptation actions can focus on addressing changes as they occur (reactive strategies) or avoiding impacts of changes (proactive strategies). In the context of threatened and endangered species with limited habitats, it may be prudent to focus on anticipatory actions to avoid losses that may hinder species' recoveries; however, if changes are already affecting priority species, a reactive approach may be needed for their long-term survival.

Actions, both proactive and reactive, can be further refined by which management strategies are selected. Resistance strategies seek to maintain the status quo and prevent species from being affected negatively; resilience strategies are those that support ecosystem function without fundamental shifts; and realignment strategies focus on transitioning to a new ecosystem state (Holling 1973, Millar et al. 2007). Proactive approaches that anticipate change can help to extend the period over which species may have to adapt to changing climate and avoid catastrophic declines associated with stochastic events that affect an already stressed ecosystem. A comprehensive guide to assist installations with planning for adapting to climate change has been developed (Stein et al 2019) and may be used to identify and address climate-related threats to species of concern and their habitats.

7.16.7 Wild Fire Management Considerations under Projected Climate Change

In the Desert Southwest during average precipitation years, there is typically insufficient vegetation to support the spread of fire across large areas; fire frequency and size are correspondingly constrained. This may remain the case even under the climate scenarios addressed in this study. Years of substantially above-average winter rainfall, however, can escalate fire frequency and size during the following fire season, sometimes dramatically, due to increased vegetation continuity (Crimmins and Comrie 2004).

The projected climate for the next two decades may lead to increased likelihood of winter rains sufficient to support additional grass and herbaceous annual growth, potentially resulting in greater fire frequency and greater potential for fire to spread. Combined with warmer summer temperatures, fires also are likely to burn more intensely, hampering control efforts and exacerbating negative effects of fire (CEMML 2019a).

Across all four climate scenarios projected by CEMML (2019a), precipitation is likely to increase markedly in February and, to a lesser degree, in March. With the exception of the RCP 4.5-2050 scenario, substantial precipitation increases are evident in November as well. Precipitation during January and December is expected to remain similar to that of the current day, with only minor exceptions; thus, the general trend across climate scenarios indicates an overall increase in moisture during the winter months. The average increase in precipitation from November through March is 35 percent, but under the RCP 4.5-2030 and RCP 8.5-2050 scenarios, precipitation in November is expected to increase by 200 and 168 percent, respectively. Conversely, precipitation from May through October is projected to remain largely unchanged relative to current day amounts, with very dry summers in the desert ecosystem despite small increases in precipitation (CEMML 2019a).

The projected increase in winter rainfall across RCP-decade scenarios would result in commensurate flushes of growth that cure by summer, providing a more continuous fuel bed through which fires may propagate during the summer fire season. Increased temperature also may result in fuels curing earlier in the year, leading to greater springtime fire activity and expansions of the fire season. Projected monthly rainfall for April and May under future climate scenarios is less than 0.5 inches. This makes it unlikely that increased rainfall during these months would mitigate the effects of temperature increases and their associated impacts on the growth and curing of grasses and annual herbaceous plants that can promote the spread of fire (CEMML 2019a).

7.17 Geographic Information Systems

Applicability Statement

This section applies to all USAF installations that maintain an INRMP, since all geospatial information must be maintained within the USAF GeoBase system. This section **IS** applicable to Edwards AFB.

Program Overview/Current Management Practices

AFI 32-10112, *Installation Geospatial Information and Services*, provides the policy and guidance for GIS management on all USAF installations, including Edwards AFB. GIS is a management tool that consists of computer hardware, software, geographic and non-geographic data, and personnel whose responsibilities are to accurately and efficiently capture, store, maintain, analyze, and display geographically referenced information. The 412th Communications Squadron manages the overall GIS hardware infrastructure, whereas the 412th Civil Engineer Group (412 CEG) manages the functional environmental GIS work, including table design and creation, data storage methodologies, data maintenance, analysis, and the development of custom end products.

The Edwards AFB GIS is a major proponent of GIS integration in the AFMC and USAF as a whole. Edwards AFB is leading the way in implementing the GeoBase vision of enabling decision-makers with an enterprise capability for installation mapping and the visualization of fused, analyzed, and multi-functional data. Edwards AFB provides Geobase services through a single GIS database, centrally located servers, and a web-based, interactive map site. Edwards AFB GIS currently uses software from a wide variety of vendors, as appropriate, including Environmental Systems Research Institute, Autodesk, Intergraph, Google, and EXELIS. The Edwards AFB GIS is also on the cutting edge with the implementation of an Oracle spatial database to leverage the existing GIS software while supporting platform independence. In addition, 412 CEG adheres to the Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) required by the DoD. The SDSFIE standard provides GIS standardization for table structure, metadata, and data storage among all DoD installations.

The 412 CEG Geographic Information System Working Group (GISWG) is a key part of managing the Edwards AFB enterprise GIS. The Edwards AFB GIS uses state of the art equipment, software, and custom configurations to support the mission through efficient and effective management of spatial data and the ability to analyze the data in support of specific program and project requirements. The GISWG oversees strategic initiatives related to exploiting GIS as a tool for planning and execution throughout the base. Environmental Management is a key member of the GISWG and uses GIS extensively in all aspects of its environmental programs.

The Edwards AFB GIS program provides a variety of applications and products for a wide-range of end user needs. Many requirements for custom maps and analyses are currently being met by the Edwards AFB web-based GIS Map Viewer. The GIS Map Viewer provides thousands of maps to hundreds of end-users every month, allowing GIS contractor and government personnel to spend additional time on other productive activities. The GIS capabilities are divided into the following categories and used in adaptive management of natural resources.

- Data collection
- Data maintenance
- Data analysis
- Data summarization

Based on these capabilities, the Environmental Management staff relies heavily on the use of GIS in its daily operations. The GIS supports Natural Resources, Cultural Resources, ERP, Environmental Quality, and the EIAP. The types of support provided include, but are not limited to

- providing custom mapping products;
- locating regional and local government boundaries;
- locating base infrastructure;
- locating USAF flight activity boundaries;
- delineating wildlife habitats and corridors;
- monitoring and tracking sensitive species;
- monitoring and managing habitat disturbance and restoration efforts;
- modeling habitat suitability;
- delineating floodplains;
- characterizing stormwater flow patterns;
- analyzing projects for NEPA and EIAP compliance;
- storing data for regulatory reporting;
- delineating land-use controls; and
- providing an interactive GIS map viewer.

Environmental Management uses various data-collection methodologies to ensure that a focused and cost-effective long-term monitoring program is achieved. One goal of this monitoring program is to determine how plant communities change spatially over time as a result of ground-disturbance activities. To accomplish this goal, Environmental Management has acquired remote sensing imagery and LIDAR elevation data and plans to periodically reacquire updated imagery and LIDAR data. Environmental Management acquired multispectral imagery from a satellite platform in 2003 and hyperspectral imagery from an aerial platform in 2008 and 2019. LIDAR elevation data were collected from an aerial platform in 2006 and 2015. Environmental Management also has access to high-resolution (3- to 12-inch) aerial photography acquired periodically by 412 CEG. In addition, publically available satellite-based imagery is acquired and used when appropriate.

The LIDAR data have been used to develop accurate and precise digital elevation models and generate slope and aspect maps. LIDAR data also have been used to (1) determine spatial distribution of vegetation canopy heights and (2) building heights, (3) define surface water flow patterns, and (4) improve the accuracy of 100-year floodplain maps. Imagery and LIDAR-derived data have been used to develop high-quality maps of the spatial distribution within vegetation communities to identify areas of past disturbance and to model potential distributions of sensitive species habitat. For instance, habitat modeling based on multispectral imagery directly supported the USFWS decision not to list the desert cymopterus. Similarly, LIDAR-derived data directly supported the USFWS decision not to list the Joshua tree.

The GIS data and maps will be used in future surveys and modeling efforts to identify species habitat, evaluate recovery of various habitats from mission-related projects, activities, and operations, as well as support the implementation of environmental projects to benefit the desert ecosystem. This information also will be used to evaluate habitat stability and will support the regional recovery effort, taking into consideration the goals and objectives of the *Desert Tortoise Recovery Plan* and this INRMP. Some data gathered from this effort may be shared with federal and state agencies to aid in the regional effort of assessing the stability of endangered and sensitive species and potential recovery of desert tortoise throughout its range in the Mojave Desert.

7.18 Lakebed

Lakebed inundation events play a key role in restoring the resilience of the lakebed surface; however, for lakebed surface areas where aggregate stability is particularly low or during periods when inundation is infrequent, artificially irrigating areas with high levels of vehicular traffic and airfield operation areas (such as runways) may be appropriate and could be accomplished using standard construction equipment. Limiting lakebed vehicle traffic and aircraft taxiing to specific routes would reduce the footprint requiring mitigation. In combination with limiting future disturbance of both lakebed margins and the surrounding shoreline, reducing the disturbance footprint will help to minimize dust emissions.

Based on the unique composition and limited strength of the subsurface soils found at the Desert Research Institute sampling location, continued use of the lakebed runway at the north end of Rogers Dry Lake should be reconsidered or heavy aircraft activities should be limited. Because fissures and macropolygons repeatedly form in the same locations over time, it is recommended that this issue continue to be treated as a geotechnical problem. This would entail backfilling new fissures with compacted fill that shares the same particle size, composition, and shrink-swell properties as the lakebed material specific to the fissure location. It is also recommended that periodic surveys be conducted of the runways and other areas on the lakebeds used for military activities. This could be done by making on-the-ground observations, but it may be more efficient and thorough to use unmanned aerial vehicles with optical or LIDAR sensors (Miller et al. 2020.)

8.0 MANAGEMENT GOALS AND OBJECTIVES

Edwards AFB establishes long term, expansive goals and supporting objectives to manage and protect natural resources while supporting the military mission. Goals express a vision for a desired condition for the installation's natural resources and are the primary focal points for INRMP implementation. Objectives indicate a management initiative or strategy for specific long- or medium-range outcomes and are supported by projects. Projects are specific actions that can be accomplished within a single year. Also, in cases where off-installation land uses may jeopardize USAF missions, this section may list specific goals and objectives aimed at eliminating, reducing, or mitigating the effects of encroachment on military missions. These natural resource management goals for the future have been formulated by the preparers of the INRMP from an assessment of the natural resources, current condition of those resources, mission requirements, and management issues previously identified. Below are the integrated goals for the entire natural resources program.

The installation goals and objectives are displayed in the 'Installation Supplement' section below in a format that facilitates an integrated approach to natural resource management. By using this approach, measurable objectives can be used to assess the attainment of goals. Individual work tasks support INRMP objectives. The projects are key elements of the annual work plans and are programmed into the conservation budget, as applicable.

Installation Supplement—Management Goals and Objectives

Goals are broad guiding principles for the program; thus, they may or may not change over the life of the INRMP. Objectives may be difficult to achieve in a given year; sometimes it takes multiple years. In years when rainfall is below average, which may occur in consecutive years, very little progress can be made with respect to spring surveys, restoration efforts, and even baseline surveys. During these years, listed wildlife and other sensitive species are difficult to find because they occur in low or dispersed populations, or are relatively small, cryptic, rarely active, nocturnal, or distributed over a wider range than in years with normal or above normal rainfall. In other words, wildlife population levels and activity periods in the desert vary widely, depending on the amount and timing of precipitation. Comparisons from one year to the next can be difficult because climatic conditions change year to year. Determining trends may take up to ten or more years of sampling in order before analysis results can provide meaningful status parameters of a particular species or its habitat and overall ecosystem health.

Projects are performed by either governmental staff or contractors. The numbers of governmental staff are determined and funded based on an algorithm performed by AFCEC for each USAF installation. Each project listing describes an implementation method and time frame. The 412 CEG/CEVA staff implementation is either annual (execution once a year) or ongoing (as needed over the course of the year). Contractor implementation is either recurring (execution every year) or by FY (indicating the proposed year of specific project funding obligation). Specific project implementation typically takes place 1 -2 years after the funding obligation.

8.1 Natural Resource Program Management

GOAL 1 **MAINTAIN PROFESSIONALLY TRAINED GOVERNMENT NATURAL RESOURCE MANAGEMENT STAFF.**

Objective 1.1 Ensure natural resource management personnel complete the DoD Natural Resource Compliance Course offered by the Naval CECOS, as required by AFMAN 32-7003 (2020) and attend other appropriate national, regional, and state conferences and training courses.

GOAL 2 MAINTAIN CURRENT INRMP COMPONENT PLANS.

Objective 2.1 Update component plans as required.

Project 2.1.1 Update Piute Ponds Complex Management Plan—FY18.
Project 2.1.2 Update Wildland Fire Management Plan—Annually.
Project 2.1.3 Update Invasive Species Management Plan—Annually.
Project 2.1.4 Update Habitat Restoration Plan—FY20.
Project 2.1.5 Complete Branch Memorial Park Pond Vegetation Management Plan—FY18.

GOAL 3 INTEGRATE MANAGEMENT OF EDWARDS AFB NATURAL RESOURCES WITH COOPERATING AGENCIES.

Objective 3.1 Prepare INRMP in cooperation with the USFWS and the CDFW.

Project 3.1.1 Solicit input and reviews of INRMP annual updates and revisions with cooperating agencies—Annually.
Project 3.1.2 Conduct INRMP annual review meetings with cooperating agencies—Annually.
Project 3.1.3 INRMP Revision for Operation and Effect—FY24.

8.2 Fish and Wildlife Management

GOAL 4 MAINTAIN AND ENHANCE QUALITY AND QUANTITY OF HABITAT.

Objective 4.1 Limit habitat disturbance of unimproved lands.

Project 4.1.1 Track and report habitat disturbance—Annually.
Project 4.1.2 Identify and restore disturbed habitat using updated site-specific restoration plans; monitor success for adaptive management.
Project 4.1.3 Incorporate HQA data into GIS, review and analyze to determine biodiversity trends—Ongoing.
Project 4.1.4 Monitor all 70 HQA study plots every 4–6 years—Recurring.
Project 4.1.5 Remove Just Add Water equipment from native habitat—FY20.

Objective 4.2 Limit creation of new roads

Project 4.2.1 Develop in calendar year (CY) 23 a current map of existing road/trail locations—Annually.
Project 4.2.2 Update Road Closure Plan—FY25.

Objective 4.3 Minimize dust build up on desert vegetation.

Project 4.3.1 Evaluate mowing road shoulders vs. grading.
Project 4.3.2 Evaluate using prescribed burns on targets vs. discing.

Objective 4.4 Control nuisance wildlife.

Project 4.4.1 Identify and remove illegal trash dumps—Recurring.
Project 4.4.2 Identify and repair boundary fence breaks—Recurring.
Project 4.4.3 Remove stray animals from Edwards AFB—Recurring.
Project 4.4.4 Remove hazardous, sickly, injured wildlife from Edwards AFB—Recurring.
Project 4.4.5 Provide for veterinary services to treat and/or euthanize injured wildlife and nuisance animals—Recurring.
Project 4.4.6 Create educational materials/campaign to limit nuisance animal attractants in and around populated areas—Recurring.

GOAL 5 PROVIDE A SUSTAINABLE ECOSYSTEM BY MAINTAINING BIODIVERSITY.

Objective 5.1 Maintain current inventories of basewide fauna species (not species of interest).

Project 5.1.1 Develop survey protocols and implement surveys for bats—FY19.
Project 5.1.2 Develop survey protocols and implement surveys for large mammals—FY20.
Project 5.1.3 Develop survey protocols and implement surveys for nesting birds—FY24.
Project 5.1.4 Develop survey protocols and implement surveys for migratory non-nesting birds—FY25.
Project 5.1.5 Develop survey protocols and implement surveys for reptiles—FY21.
Project 5.1.6 Develop survey protocols and implement surveys for small mammals—FY22.
Project 5.1.7 Develop survey protocols and implement surveys for amphibians—FY23.
Project 5.1.8 Update inventory for aquatic invertebrates—FY26.
Project 5.1.9 Update inventory for terrestrial invertebrates—FY27.

Objective 5.2 Implement faunal species-protection measures.

Project 5.2.1 Perform bat roost surveys in pitfalls, mines, buildings and other suitable structures via exit counts—FY19.

Objective 5.3 Manage for migratory birds and their habitats, including "Birds of Conservation Concern."

GOAL 6 IMPROVE AIR QUALITY.

Objective 6.1 Reduce fugitive dust.

Project 6.1.1 Investigate new methods for clearing targets on the PIRA and Farm Drop Zone to ensure soil stabilization—Ongoing.
Project 6.1.2 Investigate best management practices for road shoulder maintenance—Ongoing.
Project 6.1.3 Stabilize soils on Rogers Dry Lake—Ongoing.

8.3 Outdoor Recreation and Public Access to Natural Resources

GOAL 7 PROVIDE NATURAL RESOURCE-BASED OUTDOOR RECREATIONAL OPPORTUNITIES.

Objective 7.1 Identify suitable natural areas for outdoor recreation.

Project 7.1.1 Evaluate identified outdoor recreation areas for suitability—Annually.

Objective 7.2 Maintain current and effective EAFBI 32-7064 Management of Hunting, and Fishing Program.

Project 7.2.1 Review and update EAFBI 32-7064 Annually.
Project 7.2.2 Maintain *Sikes Act* online permit reservation system—Recurring.
Project 7.2.3 Review, update, and implement visitor-access controls—Annually.

Objective 7.3 Maintain upland game hunting opportunities.

Project 7.3.1 Remove non-functioning wildlife guzzlers—FY20.
Project 7.3.2 Install Recreational Use Requirements signage, Upland Game—FY20.

Objective 7.4 Maintain waterfowl hunting opportunities at Piute Ponds Complex.

Project 7.4.1 Implement Piute Ponds Complex Management Plan—Recurring.
Project 7.4.2 Install Recreational Use Requirements signage, Piute Ponds—FY20.

Objective 7.5 Maintain fishing opportunities at Branch Memorial Park Pond.

Project 7.5.1 Stock fish in winter and spring—Recurring.
Project 7.5.2 Test for water quality—Ongoing.
Project 7.5.3 Install Recreational Use Requirements signage, Branch Memorial Park Pond—FY20.

Objective 7.6 Provide opportunities for off-road vehicle use.

Project 7.6.1 Determine status of permittee and suitability of ORV Area 1—Annually.

Project 7.6.2 Monitor habitat disturbance of ORV Areas 2 and 3, per existing protocol—Recurring.

Project 7.6.3 Purchase and install Recreational Use Requirements signage ORV Areas 1, 2, and 3—FY20.

Objective 7.7 Provide birdwatching opportunities at Piute Ponds Complex and Branch Memorial Park.

Project 7.7.1 Develop interpretive and guidance *Signage Plan* and install signs at Piute Ponds Complex and Branch Memorial Park—FY20.

Objective 7.8 Provide other recreational opportunities in coordination in coordination with Outdoor Recreation.

Objective 7.9 Coordinate with Outdoor Recreation to insure conservation of natural resources is considered when they manage outdoor recreation facilities—Annually.

8.4 Conservation Law Enforcement

GOAL 8 MAINTAIN AN ACTIVE CONSERVATION LAW ENFORCEMENT PROGRAM.

Objective 8.1 Maintain professionally trained conservation law enforcement officers.

Project 8.1.1 Implement MOA providing for a full-time USFWS FWO at Edwards AFB—Recurring.

Project 8.1.2 Provide general oversight to USFWS FWO assigned to Edwards AFB—Ongoing.

Project 8.1.3 Coordinate conservation law enforcement support with cooperating agencies—Annually.

8.5 Management of Threatened and Endangered Species and Habitats

GOAL 9 SUSTAIN POPULATIONS OF FEDERALLY LISTED SPECIES IN SUPPORT OF ESA RECOVERY PROGRAMS.

Objective 9.1 Manage Head Start Program.

Project 9.1.1 Maintain Interagency Agreement with USGS in coordination with USFWS Recovery Office through to the program's conclusion—Annually.

Project 9.1.2 Release and track survivorship of juvenile tortoises IAW USFWS Recovery Permit through CY24—Recurring.

Project 9.1.3 Decommission head start pens in CY21 and explore options for reuse by other groups—Ongoing.

Objective 9.2 Maintain desert tortoise protection measures described in basewide Biological Opinion for Operations and Activities at Edwards Air Force Base, California (8-8-14-F-14).

Project 9.2.1 Apply minimization measures to proposed projects on Edwards AFB, as required by the Biological Opinion (BO)—Recurring.

Project 9.2.2 Survey and repair the desert tortoise exclusion fencing and secure pitfalls—Recurring.

Project 9.2.3 Maintain integrity of perimeter fence by repairing fence damage expeditiously to protect habitat—Recurring.

Project 9.2.4 Conduct regular patrols of the base boundary fence by law enforcement personnel—Recurring.

Project 9.2.5 Install tortoise protection signs—Recurring.

Project 9.2.6 Perform pre-activity surveys and monitoring on construction project sites—Recurring.
Project 9.2.7 Evaluate and report habitat disturbance from construction projects—Recurring.
Project 9.2.8 Provide desert tortoise awareness training—Recurring.
Project 9.2.9 Create updated Desert Tortoise Awareness Video—FY19.
Project 9.2.10 Acquire signage to encourage closure of dumpster lids—Annually.
Project 9.2.11 Install signage to encourage dumpster lid closure—Ongoing.
Project 9.2.12 Conduct annual review with USFWS of previous year's activities and document—Annually.

Objective 9.3 Maintain current basewide inventories for desert tortoises.

Project 9.3.1 Conduct desert tortoise relative density study and compare to previous studies—FY22.
Project 9.3.2 Participate in USFWS range-wide population surveys and other tortoise-related surveys or studies—Annually.

GOAL 10 SUSTAIN POPULATIONS OF AT-RISK SPECIES.

Objective 10.1 Maintain current Species of Interest inventories for state and federally listed species or considered-for-listing species.

Project 10.1.1 Develop survey protocols and implement surveys for western pond turtle at Piute Ponds Complex and develop a population viability analysis study report—FY18.
Project 10.1.2 Conduct surveys for tri-colored blackbirds at Branch Memorial Park Pond and develop a population viability analysis study report—FY18.
Project 10.1.3 Conduct surveys for Mohave shoulderband snail, as protocols permit—Annually.
Project 10.1.4 Evaluate threat of round-tailed ground squirrels to Mohave ground squirrels—FY18.
Project 10.1.5 Conduct surveys for Species of Interest receiving increased regulatory attention or for which little is known about on-base populations, such as Lancaster milkvetch; Rosamond eriastrum; and popcorn flower species, including *Plagiobothrys leptocladus*, *P. canescens* var. *catalinensis* (rare), and *P. bracteatus*, red rock poppy (*Eschscholzia minutiflora* t*wisselmannii*); and spreading pygmy leaf poppy—Recurring.

Objective 10.2 Conserve and maintain habitat occupied by Species of Interest.

Project 10.2.1 Create/maintain a successional cattail/common tule marsh at Branch Memorial Park Pond—Recurring.
Project 10.2.2 Evaluate efficacy of maintaining the Burrowing Owl Conservation Area—FY22.

8.6 Water Resource Protection

GOAL 11 SUSTAIN HYDROLOGICAL FUNCTION OF SURFACE WATER FLOW WITHIN WATERSHEDS.

Objective 11.1 Sustain natural surface water sheet flow reaching the lakebeds.

Project 11.1.1 Determine surface flow onto lakebeds.
Project 11.1.2 Evaluate consequences of continued diversion of water from lakebeds.

Objective 11.2 Establish watershed ecosystem health monitoring protocols.

Project 11.2.1 Use aquatic invertebrate population data as one indicator of ecosystem health.

Project 11.2.2 Conduct population viability analysis of aquatic invertebrates from inventory Project 5.1.8 data and compare to prior studies—FY26.

Objective 11.3 Reduce wind-induced soil erosion from Rogers Dry Lakebed surface.

Project 11.3.1 Establish baseline soil erosion data and implement monitoring procedures.

Objective 11.4 Collaborate with adjacent communities to address and solve water diversion concerns.

Project 11.4.1 Participate in Integrated Regional Water Management Team's ongoing planning efforts.

8.7 Wetland Protection

GOAL 12 DEVELOP AND MAINTAIN ACCURATE FLOODPLAIN INFORMATION.

Objective 12.1 Update floodplain delineations.

Project 12.1.1 Complete 100-year and 500-year floodplain delineation for the southwestern portion of Edwards AFB—FY20.

GOAL 13 CONSERVE AND MAINTAIN THE PIUTE PONDS COMPLEX TO ACCOMMODATE REQUIREMENTS OF THE EDWARDS AFB'S OPERATIONAL MISSION AND LOS ANGELES COUNTY SANITATION DISTRICT 14 WASTE WATER DISCHARGE.

Objective 13.1 Develop holistic approach to conserving and maintaining the Piute Ponds Complex.

Project 13.1.1 Complete an Environmental Assessment to support management actions at the Piute Ponds Complex—FY20.

Project 13.1.2 Complete a comprehensive Piute Ponds Complex Management Plan—FY19.

Objective 13.2 Implement management activities described in the *Piute Ponds Complex Management Plan*.

Project 13.2.1 Review and maintain MOU between Edwards AFB and District 14—Annually.

Project 13.2.2 Perform recurring routine maintenance on water control infrastructure—Recurring.

Project 13.2.3 Maintain restoration plantings—Recurring.

Project 13.2.4 Provide and maintain two portable restrooms—Recurring.

Project 13.2.5 Perform vegetation management activities—Recurring.

GOAL 14 CONSERVE AND MAINTAIN BRANCH MEMORIAL PARK POND TO ACCOMMODATE REQUIREMENTS OF EDWARDS AFB OPERATIONAL MISSION.

Objective 14.1 Develop holistic approach to conserving and maintaining the Branch Memorial Park Pond.

Project 14.1.1 Develop a comprehensive Branch Memorial Park Pond Management Plan—FY23.

Objective 14.2 Implement management activities described in the *Branch Memorial Park Pond Management Plan*.

Project 14.2.1 Conduct yearly routine vegetation management to pond area—Recurring.

GOAL 15 SUSTAIN ECOLOGICAL INTEGRITY OF THE MESQUITE BOSQUE HABITAT.

Objective 15.1 Determine long-term viability of mesquite bosque.

Project 15.1.1 Collect and evaluate tree data (age and size class).

Project 15.1.2 Evaluate impact of non-native mesquite trees on native mesquite trees.

Project 15.1.3 Conduct periodic surveys at about 40 relevés to assess and monitor the

health and integrity of mesquite bosque woodland habitat—FY23

Objective 15.2 Maintain hydrological continuity of mesquite bosque habitat.

Project 15.2.1 Install culverts on roads bisecting mesquite bosque habitat—FY22

8.8 Grounds Maintenance

GOAL 16 PROMOTE A COHESIVE CONSERVATION APPROACH FOR MAINTAINING DEVELOPED LANDSCAPES.

Objective 16.1 Improve landscape and land management processes and coordination.

Project 16.1.1 Review Installation Landscape Management Plan—Annually.

Project 16.1.2 Provide natural resource awareness training to Corvias Housing program managers and contractors—Annually.

Objective 16.2 Enhance native wildlife habitat values of landscaping.

Project 16.2.1 Update list in CY21 of local native plant species in *Installation Landscape Management Plan*—Annually.

Project 16.2.2 Provide educational materials promoting planting of native species in developed areas—Annually.

Objective 16.3 Restore decommissioned cantonment lands to natural landscapes.

Project 16.3.1 Remove dead and dying trees in old housing area (Area C)—Recurring.

Objective 16.4 Protect desert tortoises included in the adoption program.

Project 16.4.1 Provide desert tortoise awareness training to Corvias Housing program managers and contractors—Recurring.

Project 16.4.2 Update protocols in CY20 for adopted tortoise transfer, "parent" responsibilities, Corvias grounds maintenance activities, and health assessments—Recurring.

Objective 16.5 Prevent invasion of landscape elements into native habitat (e.g., non-native mesquite).

Project 16.5.1 Prevent new plantings of non-native invasive species within developed landscapes, as described in *Invasive Species Management Plan*—Recurring.

Project 16.5.2 Remove existing non-native invasive species in developed landscapes, as described in *Invasive Species Management Plan*—Recurring.

8.9 Wildland Fire Management

GOAL 17 MINIMIZE NEGATIVE IMPACTS TO NATURAL RESOURCES FROM WILDLAND FIRE.

Objective 17.1 Implement *Wildland Fire Management Plan* to reduce wildfire.

Project 17.1.1 Map all fires to maintain fire history—Annually.

Project 17.1.2 Document fire impacts to natural resources; implement Burned Area Emergency Response (BAER) Team for large fires—Recurring.

Project 17.1.3 Implement and monitor appropriate restoration measures, per the BAER report—Recurring.

Project 17.1.4 Provide National Wildfire Coordinating Group wildland fire training opportunities to Fire and Emergency Services (FES) via WSM—Recurring.

Objective 17.2 Determine areas on Edwards AFB where habitat modification could reduce risk to as-built infrastructure.

Project 17.2.1 Coordinate survey in CY21 of high-risk areas by WSM and FES—Recurring.

Objective 17.3 Eliminate causes of anthropogenic fire.

Project 17.3.1 Continue to encourage restrictive use of phosphorus flares and spotting charges during high fire-danger conditions—Ongoing.

GOAL 18 MAINTAIN, RESTORE, AND IMPROVE NATIVE HABITAT CONDITIONS WITH PRESCRIBED FIRE.

Objective 18.1 Implement *Wildland Fire Management Plan* to manage vegetation with prescribed fire.

Project 18.1.1 Update areas where prescribed burn can be used, per EIAP requirements—Annually.

Project 18.1.2 Use prescribed fire to conduct routine yearly vegetation management at Piute Ponds Complex—Recurring.

Project 18.1.3 Use prescribed fire to conduct routine yearly vegetation management at Branch Memorial Park Pond—Recurring.

Project 18.1.4 Use prescribed fire to conduct routine yearly vegetation management at Old Area C—Recurring.

Project 18.1.5 Use prescribed fire to conduct routine yearly vegetation management at Fireworks Display Area—Recurring.

Project 18.1.6 Use prescribed fire to conduct routine yearly vegetation management at Golf Course—Recurring.

Objective 18.2 Determine areas of Edwards AFB where use of prescribed fire would be a cost-effective tool to accomplish mission operational requirements and conserve natural resources.

Project 18.2.1 In CY20, evaluate potential for using prescribed fire on PIRA target PB-8 and CATM—Recurring.

Project 18.2.2 In CY20, evaluate potential of using prescribed fire on Old Waste Water Treatment Plant Retention Ponds.

Project 18.2.3 In CY24, evaluate potential of using prescribed fire on PIRA target Barbell—Recurring.

8.10 Installation Pest Management Program

GOAL 19 SUPPORT THE INSTALLATION PEST MANAGEMENT PROGRAM.

Objective 19.1 Assist Installation Pest Manager with implementing installation *Integrated Pest Management Plan.*

Project 19.1.1 Provide natural resource expertise in review of installation *Integrated Pest Management Plan*—Annually.

Project 19.1.2 Include natural resource minimization measures regarding invasive species and biosecurity requirements during the EIAP—Ongoing.

Project 19.1.3 Provide natural resource expertise on pest-management projects—Ongoing.

Project 19.1.4 Comply with herbicide-reporting requirements on natural resource projects—Recurring.

GOAL 20 ENSURE PUBLIC SAFETY FROM PREDATORY WILDLIFE.

Objective 20.1 Determine risk to public safety by predatory wildlife.

Project 20.1.1 Develop a study and management plan for evaluating public safety due to predatory wildlife, specifically bobcats and coyotes, located in or influenced by the housing areas, commercial areas, school areas, and play areas within a portion of the cantonment area on Edwards AFB and develop mitigation measures—FY20.

Objective 20.2 Implement predatory wildlife management measures.

Project 20.2.1 Provide wildland urban interface education to base population at newcomer's briefing, commander's call, and outreach events—Annually.

Project 20.2.2 Provide wildland urban interface education to Security Forces—Annually.

Project 20.2.3 Establish protocols in CY21 for response by Security Forces, USFWS FWO, FES, Environmental Management, or APHIS-WS to emergency calls about predatory wildlife emergency calls—Annually.

8.11 Invasive Species Management Program

GOAL 21 PREVENT THE INTRODUCTION OF NOXIOUS AND INVASIVE PLANT SPECIES AND CONTROL THEIR SPREAD.

Objective 21.1 Implement the Edwards AFB Invasive Species Management Plan.

Project 21.1.1 Review and update the *Invasive Species Management Plan*—Annually.

Project 21.1.2 Include biosecurity measures for ground disturbing projects on base during the EIAP—Ongoing.

Project 21.1.3 Treat targeted high-priority invasive species in Priority Management Areas—Recurring.

Project 21.1.4 Treat up to 1,000 acres and monitor 3,000 acres of Sahara mustard through FY23 in off-roadside native habitat per year—Recurring.

Project 21.1.5 Treat tamarisk in designated airfield management areas through FY23—Recurring.

Project 21.1.6 Update basewide survey of invasive species every 10 years—FY27.

Project 21.1.7 Plant more desirable native trees within the Piute Ponds Complex to replace tamarisk—Recurring.

Project 21.1.8 Coordinate roadside grading- and herbicide-treatment schedules to maximize treatment effectiveness—Annually.

Project 21.1.9 Purchase and install track out grates on major access roads to Piute Ponds Complex—FY20.

8.12 Bird Wildlife Aircraft Strike Hazard

GOAL 22 MINIMIZE BIRD STRIKES.

Objective 22.1 Maintain Migratory Bird Depredation Permit for Airfield Operations.

Project 22.1.1 Assist Safety Office as required to prepare and submit MBTA Depredation Permit Annual Report—Annually.

Project 22.1.2 Assist Safety Office as required to request MBTA Depredation Permit renewal—Annually.

Objective 22.2 Support BASH Program.

Project 22.2.1 Provide natural resource subject matter expertise to Safety Office and USDA APHIS Wildlife Services biologist—Ongoing.

Project 22.2.2 Attend semi-annual BASH Working Group meetings—Ongoing.

Project 22.2.3 Participate in quarterly Airfield Inspections—Ongoing.

Project 22.2.4 Provide bird migration updates to airfield manager—Ongoing.

Project 22.2.5 Include minimization measures regarding anti-perching devices and *Migratory Bird Treaty Act* requirements during the EIAP on projects posing possible BASH concerns—Ongoing.

8.13 Cultural Resources Protection

GOAL 23 PROTECT CULTURAL RESOURCES

Objective 23.1 Comply with cultural resource legal requirements when implementing natural resource projects.

- Project 23.1.1 Coordinate all activities listed in INRMP IAW Edwards AFB ICRMP—Recurring.
- Project 23.1.2 Conduct field evaluations of cultural sites at the Piute Ponds Complex and make recommendations about site significance for State Historic Preservation Officer (SHPO) concurrence to allow various management activities—Recurring.
- Project 23.1.3 Complete desktop survey of cultural resource sites identified at the Piute Ponds Complex to determine possible submission to SHPO as Historic District—FY19.

8.14 Public Outreach

GOAL 24 FOSTER NATURAL RESOURCE AWARENESS AND EDUCATION.

Objective 24.1 Provide natural resource training to decrease impacts to protected and at-risk species and habitats.

- Project 24.1.1 Review and update training plans for newcomer's briefing, commander's call, and contractor training—Annually.
- Project 24.1.2 Provide natural resource education to base population at newcomer's briefing, commander's call, and outreach events—Ongoing.
- Project 24.1.3 Provide desert tortoise awareness training, as required by BO, to base population and contractors—Recurring.
- Project 24.1.4 Provide training on living with predators, birds, snakes, and other fauna on base—Ongoing.
- Project 24.1.5 Purchase reptile display cases, animal pelts, mounts, and other educational materials—FY21.

Objective 24.2 Provide natural resource information and educational materials to base population.

- Project 24.2.1 Review, update, and acquire existing brochures—Recurring.
- Project 24.2.2 Identify gaps in natural resource information materials and program for their development—Annually.
- Project 24.2.3 Develop Desert Tortoise Awareness video for base population—FY19.
- Project 24.2.4 Develop Wildland Urban Interface video for base population—FY22.
- Project 24.2.5 Develop Wildfire Management video for base population—FY19.
- Project 24.2.6 Develop Reducing Trash Subsidies video for base population—FY19.
- Project 24.2.7 Provide natural resources, tours, presentations, demonstrations, and training—Ongoing.

Objective 24.3 Encourage education and research pursuits.

- Project 24.3.1 Track number of educational use activities and research projects.
- Project 24.3.2 Partner with regional and local universities—Ongoing.
- Project 24.3.3 Encourage birding activity at Piute Ponds Complex and encourage data submission via eBird.com—Ongoing.

8.15 Climate Change Vulnerabilities

GOAL 25 INTEGRATE CLIMATE CHANGE CONSIDERATIONS INTO NATURAL RESOURCES MANAGEMENT.

Objective 25.1 Include climate change recommendations in project reports.

Project 25.1.1 Request relevant study reports beginning in FY21, include statement of effects of currently modelled temperature and rainfall estimates for Edwards AFB—Ongoing.

8.16 Geographic Information Systems

GOAL 26 INTEGRATE GIS INTO NATURAL RESOURCES MANAGEMENT.

Objective 26.1 Collect and maintain accurate data in GIS database.

Project 26.1.1 Review and update Edwards AFB GIS Standards—Annually.
Project 26.1.2 Ensure compliance to Edwards AFB GIS Standards by contractors—Ongoing.
Project 26.1.3 Update hyperspectral imagery and other remote sensing data—FY24.
Project 26.1.4 Purchase one GPS unit—FY22.
Project 26.1.5 In CY21, design and implement attribution standards for features stored in GIS—Annually.

Objective 26.2 Increase accessibility of natural resource GIS data to natural resource managers; providing reporting, evaluation, and analysis capabilities.

Project 26.2.1 Incorporate natural resources data into GIS map viewer—Ongoing.
Project 26.2.2 Provide training on use of a GIS map viewer—Ongoing.
Project 26.2.3 In CY22, make all natural resource data available on the desktop for natural resource managers to develop and use for evaluation and analysis—Annually.

Objective 26.3 Increase usability and functionality of GIS data.

Project 26.3.1 Create, populate, and maintain metadata for all GIS datasets—Ongoing.
Project 26.3.2 Implement a bi-weekly Natural Resource GIS Users Group to focus on GIS methods and work flows used to accomplish data-related duties—Ongoing.
Project 26.3.3 Complete major table maintenance required by SDSFIE updates—Ongoing.

Objective 26.4 Increase effectiveness of natural resources GIS capabilities.

Project 26.4.1 Design and create automated scripts to assist natural resource data users in repetitive analyses—Ongoing.

Objective 26.5 Conduct analyses and develop models using GIS and remote sensing data.

9.0 INRMP IMPLEMENTATION, UPDATE, AND REVISION PROCESS

9.1 Natural Resources Management Staffing and Implementation

9.1.1 Natural Resources Management Staffing

The Installation Commander is responsible for management and conservation of natural resources on Edwards AFB. The Environmental Management Office on Edwards AFB is responsible for implementing the natural resource management program as well as conducting the annual INRMP review.

Internal USAF organizations responsible for support and coordination of the natural resource management program include the Legal Office, Public Affairs, various CE functions, Security Forces, Fire Department, Outdoor Recreation, Safety Office, and test mission organizations.

External Air Force organizations responsible for support and coordination of the natural resource management program include the AFCEC Environmental Directorate Technical Support Branch (AFCEC/CZTQ), AFCEC Environmental Directorate, Installation Support Section, and the Wildland Fire Branch (AFCEC/CZOF).

The primary external cooperating agencies are the USFWS and CDFW. Other stakeholders include other government agencies, nongovernmental organizations, and the general public. Environmental Management natural resource staffing requirements include those listed below.

- Chief, Resources and Planning: 1
- Natural Resource Manager: 1
- Lead Wildlife Biologist: 1
- Desert Tortoise Biologist (contractor): 1
- EIAP Support Team: 4
- GIS Support Team: 2
- GIS Support (Contractor): 1

There are currently no staffing deficiencies or training requirements that may hinder INRMP implementation.

9.1.2 Implementation

Implementation of projects is mostly through cooperative agreements administered by a USACE Grants Officer. Funding is received under the National MOA, where all AFCEC funds are accepted in Omaha and then a Military Interdepartmental Purchase Request is sent to the appropriate Corps Districts. Typically, the Omaha or the Alaska Districts processes the projects as the Grants Officer administrators. These projects are offered mostly to universities participating in the Cooperative Ecosystem Studies Units Network, a national consortium of federal agencies, tribes, academic institutions, and state and local governments.

Project implementations also are contracted via AFCEC/CZTQ Blanket Purchase Agreements, which are administered by the General Services Administration and AFCEC/CZTQ. Some projects also are contracted and administered through the Naval Facilities Engineering Command using an Indefinite Delivery Indefinite Quantity Contract Providing Range Sustainability Services for Military Training and Testing Range Complexes and Assets at Various Locations Worldwide. Some services and supplies are purchased through Edwards AFB contracting services or via a Government Purchase Card.

9.2 Monitoring INRMP Implementation

An Annual Report prepared by the NRM summarizes the effectiveness of prior year INRMP implementation. The Annual Report is used by the USAF and cooperating agencies to monitor INRMP implementation progress. The Annual Report outlines project progress, project accomplishments, an analysis of important results, and relevant adaptive management strategies that are feasible for implementation.

9.3 Annual INRMP Review and Update Requirements

9.3.1 Annual INRMP Review

AFMAN 32-7003 establishes a process by which the annual INRMP review and coordination should occur. The Edwards AFB NRM coordinates with cooperating agency (USFWS and CDFW) personnel throughout the year to resolve any INRMP-related issues. In preparation for the annual INRMP review, the NRM prepares an Annual Report summarizing the effectiveness of prior year INRMP implementation. The prior year is one year from the date of the final cooperating agency signature on the most recent INRMP revision. The Annual Report documents the implementation status of the INRMP in the areas listed below.

- Sufficiency of Natural Resource Staff
- Partner Coordination
- Sufficiency of Programming and Budgeting
- Progress of Annual Work Plan Implementation
- Overall Implementation Rating
- Currency as to Operation and Effect

The annual INRMP review may be via an on-site review, or by conference or video call. An on-site review provides an opportunity to visit project locations and discuss project implementation. The annual INRMP review includes a review of the Annual Report, the current Species of Interest List, and the current Annual Work Plan. Findings from the annual INRMP review are documented in a memorandum of the meeting minutes. A request is made of the USFWS and CDFW representatives for them to respond about whether either cooperating agency is interested in performing any of the Annual Work Plan projects. The Installation Commander or appropriate designee certifies the annual review as valid and current, per AFMAN 32-7003. Currently the NRM certifies the annual review meeting minutes.

9.3.2 INRMP Update and Revision Process

The *Sikes Act* requires that a formal review be completed no less than every five years, including coordination with the collaborating agencies and applicable stakeholders. AFMAN 32-7003 and DoDI 4714.03 state that the INRMP should be reviewed annually. Annual reviews are the process by which INRMP updates are maintained, eliminating the need for five-year signatures if annual concurrence is achieved. AFMAN 32-7003 states that, "An INRMP update consists of minor edits within the existing INRMP that provide current information, or adjusts implementation timelines that would not result in changes to management goals and objectives that are substantively different than those previously agreed to by the cooperating agencies, and would not result in environmental consequences different from those in the existing INRMP. Minor update requirements are identified during the INRMP annual review and coordination (see paragraph 3.8). An INRMP update documents minor changes agreed to by the cooperating agencies on how the INRMP is implemented, and does not represent a change in the scope of the INRMP that would require renewed signatures by the authorized representative from each agency. An INRMP update does not require public review and comment on the decision to continue implementing the INRMP as updated."

Annual cooperating agency concurrence signatures for an INRMP Update are not readily secured. Therefore, the Installation Commander or his designee certifies the Annual Report and the Annual Report is inserted into the updated INRMP document in Section 16.0.

For five-year reviews and any future significant revisions that require signature, Environmental Management coordinates with the applicable internal USAF organizations, before sending the revised INRMP to the USFWS, CDFW, and, if necessary, the general public for review and comments. For major changes to the INRMP, Environmental Management is responsible for providing a 30-day public review and comment period on the INRMP and EIAP documentation prior to approval by the resource agencies and installation commander's signature.

AFMAN 32-7003 states that an INRMP revision occurs when, ". . . changes in the installation mission or land use would alter the biogeophysical environment such that significant edits need to be made to ensure that the INRMP reflects the current natural resources management requirements. Changes to the INRMP goals and objectives constitute an INRMP revision. Revise an INRMP if a change in land use or condition would result in environmental impacts not anticipated by the parties to the INRMP when the INRMP was last reviewed as to operation and effect. The need for an INRMP revision is determined during the INRMP annual review (see paragraph 3.8). Provide an opportunity for the public to review and comment on a draft INRMP revision (see paragraph 3.5.5). For new and revised INRMPs, mutual agreement by a cooperating agency is documented by the signature of an authorized representative from each agency on the signature page for the INRMP, or by written correspondence (see paragraph 3.6)."

10.0 ANNUAL WORK PLANS

This section provides the INRMP Annual Work Plans that require funding separate from governmental staff funding. Annual Work Plans include the current year and at least four succeeding years. The projects are listed by Project, Project Title, Funding Source, and Priority. Each Project is described by either an Objective (includes numerous consolidated projects) or Project number tied to the Goals listed in Section 8.0. Each Project is described as either Recurring (funding required every year) or by FY (indicating the proposed year of specific project funding obligation). Project Title and Funding Source reflect the Resource Allocation Model funding designations and year(s) of funding. The Work Plans provide all the necessary information for building a budget within the USAF framework. Priorities are defined as follows.

- High Priority—The INRMP signatories assert that (1) if the project is not funded, the INRMP is not being implemented and the USAF is non-**compliant** with the *Sikes Act*; or (2) the project is specifically tied to an INRMP goal and objective and is part of a "Benefit of the Species" determination necessary for ESA Sec 4(a)(3)(B)(i) critical habitat exemption.
- Medium Priority—The project supports a specific INRMP goal and objective and is deemed by INRMP signatories to be important for preventing non-compliance with a specific requirement within a natural resources law or by EO 13112, *Exotic and Invasive Species*; however, the INRMP signatories would not contend that the INRMP is not being implemented if not accomplished within the programmed year due to other priorities.
- Low Priority—Project supports a specific INRMP goal and objective, enhances conservation resources or the integrity of the installation mission, and/or supports long-term compliance with specific requirements within natural resources law, but it is not directly tied to specific compliance within the proposed year of execution.

ANNUAL Work Plans FY20–FY24					
Project Number	**Project**	**Occurrence**	**Project Title**	**Funding Source**	**Priority**
1.1	Objective Project: Ensure natural resource management personnel complete the DoD Natural Resource Compliance Course offered by the Naval Civil Engineer Corps Officers School (CECOS), as required by AFMAN 32-7003, and attend other appropriate national, regional, and state conferences and training courses.	Ongoing	TRAINING, ENV FUNCTION, CN	AFCEC	High
2.1.4	Update Habitat Restoration Plan	FY20	MGT, HABITAT—INRMP	FSPMA53206119	Medium
4.1.4	Monitor all 70 HQA study plots every 4 to 6 years	Recurring	MGT, HABITAT—INRMP	FSPMA53226119 FSPMA53236119 FSPMA53246119	Medium
4.1.5	Remove Just Add Water equipment from native habitat	FY20	MGT, HABITAT—INRMP	FSPMA53206119	Medium
4.2.2	Update Road Closure Plan	FY25	MGT, HABITAT—INRMP	FSPMA53256119	Medium
4.4	Objective Project: Control Nuisance Wildlife	Recurring	MGT, SPECIES—INRMP	FSPMA53206120 FSPMA53216120 FSPMA53226120 FSPMA53236120 FSPMA53246120	Medium
5.1.2	Develop survey protocols and implement surveys for large mammals	FY20	MGT, SPECIES—INRMP	FSPMA53206120	Medium
5.1.3	Develop survey protocols and implement surveys for nesting birds	FY24	MGT, SPECIES—INRMP	FSPMA53216120	Medium
5.1.4	Develop survey protocols and implement surveys for migratory non-nesting birds	FY25	MGT, SPECIES—INRMP	FSPMA53226120	Medium

5.1.5	Develop survey protocols and implement surveys for reptiles	FY21	MGT, SPECIES—INRMP	FSPMA53236120	Medium
5.1.6	Develop survey protocols and implement surveys for small mammals	FY22	MGT, SPECIES—INRMP	FSPMA53246120	Medium
5.1.7	Develop survey protocols and implement surveys for amphibians	FY23	MGT, SPECIES—INRMP	FSPMA53256120	Medium
5.1.8	Update inventory for aquatic invertebrates	FY26	MGT, SPECIES—INRMP	FSPMA53266120	Medium
5.1.9	Update inventory for terrestrial invertebrates	FY27	MGT, SPECIES—INRMP	FSPMA53276120	Medium
7.2.2	Maintain Sikes Act online permit reservation system	Recurring	FISH & WILDLIFE	AFCEC/CZTQ	Medium
7.3.1	Remove non-functioning wildlife guzzlers	FY20	MGT, SPECIES—INRMP	FSPMA53206120	Medium
7.3.2	Install Recreational Use Requirements signage, Upland Game	FY20	MGT, HABITAT—INRMP	FSPMA53206119	Medium
7.4.1	Implement Piute Ponds Complex Management Plan	Recurring	MGT, WETLANDS / FLOODPLAINS—INRMP	FSPMA5320915 FSPMA5321915 FSPMA5322915 FSPMA5323915 FSPMA5324915	Medium
7.4.2	Install Recreational Use Requirements signage, Piute Ponds	FY20	MGT, WETLANDS / FLOODPLAINS—INRMP	FSPMA5320915	Medium
7.5.1	Stock fish in winter and spring	Recurring	FISH & WILDLIFE	575095 18JB 667100	Medium
7.5.3	Install Recreational Use Requirements signage, Branch Memorial Park Pond	FY20	MGT, WETLANDS / FLOODPLAINS—INRMP	FSPMA5320915	Medium
7.6.2	Monitor habitat disturbance of ORV Areas 2 and 3, per existing protocol	Recurring	MGT, SPECIES—T&E	FSPMA53207119 FSPMA53217119 FSPMA53227119 FSPMA53237119 FSPMA53247119	High

7.6.3	Purchase and install Recreational Use Requirements signage—ORV Areas 1, 2, and 3	FY20	MGT, HABITAT—INRMP	FSPMA53206119	Medium
7.7.1	Develop interpretive and guidance Signage Plan and install signs at Piute Ponds Complex and Branch Memorial Park	FY20	MGT, WETLANDS / FLOODPLAINS—INRMP	FSPMA5320915	Medium
8.1.1	Implement MOA providing for a full-time USFWS FWO at Edwards AFB	Recurring	USFWS/USAF	AFCEC/CZTQ	High
9.1.2	Release and track survivability of juvenile tortoises IAW USFWS Recovery Permit thru CY24	Recurring	MGT, SPECIES—T&E	FSPMA53207119 FSPMA53217119 FSPMA53227119 FSPMA53237119 FSPMA53247119	High
9.2	Objective Project: Maintain desert tortoise protection measures described in basewide Biological Opinion for Operations and Activities at Edwards Air Force Base, California (8-8-14-F-14)	Recurring	MGT, HABITAT—T&E	FSPMA53207118 FSPMA53217118 FSPMA53227118 FSPMA53237118 FSPMA53247118	High
9.2	Objective Project: Maintain desert tortoise protection measures described in basewide Biological Opinion for Operations and Activities at Edwards Air Force Base, California (8-8-14-F-14)	Recurring	MGT, SPECIES—T&E	FSPMA53207119 FSPMA53217119 FSPMA53227119 FSPMA53237119 FSPMA53247119	High
9.3.1	Conduct relative density study and compare to previous studies	FY22	MGT, SPECIES—T&E	FSPMA53227119	High
10.1.5	Conduct surveys for Species of Interest receiving increased regulatory attention or for which little is known about on-base populations	Recurring	MGT, SPECIES—T&E	FSPMA53217119 FSPMA53227119 FSPMA53237119 FSPMA53247119 FSPMA53257119	High
10.2.2	Evaluate efficacy of maintaining the Burrowing Owl Conservation Area	FY22	MGT, SPECIES – T&E	FSPMA53227119	High

11.2.2	Perform population viability analysis of aquatic invertebrates from inventory project data (5.1.8) compared to prior studies	FY26	MGT, SPECIES—INRMP	FSPMA53266120	Medium
12.1.1	Complete 100-year and 500-year floodplain delineation for the southwestern portion of Edwards AFB	FY20	MGT, WETLANDS / FLOODPLAINS—INRMP	FSPMA5320915	Medium
13.1.1	Complete an Environmental Assessment to support management actions at the Piute Ponds Complex	FY20	MGT, WETLANDS / FLOODPLAINS—INRMP	FSPMA5320915	Medium
13.2	Objective Project: Implement management activities described in the Piute Ponds Complex Management Plan	Recurring	MGT, WETLANDS / FLOODPLAINS—INRMP	FSPMA5320915 FSPMA5321915 FSPMA5322915 FSPMA5323915 FSPMA5324915	Medium
13.2.4	Provide and maintain 2 portable restrooms	Recurring	FISH & WILDLIFE	575095 18JB 667100	Medium
14.1.1	Develop a comprehensive Branch Memorial Park Pond Management Plan	FY23	MGT, WETLANDS / FLOODPLAINS—INRMP	FSPMA5323915	Medium
14.2.1	Perform yearly routine vegetation management to Branch pond area	Recurring	MGT, WETLANDS / FLOODPLAINS—INRMP	FSPMA5320915 FSPMA5321915 FSPMA5322915 FSPMA5323915 FSPMA5324915	Medium
15.1.3	Perform periodic surveys at some 40 relevés to assess and monitor the health and integrity of mesquite bosque woodland habitat	FY23	MGT, WETLANDS / FLOODPLAINS—INRMP	FSPMA5323915	Medium
15.2.1	Install culverts on roads bisecting mesquite bosque habitat	FY22	MGT, WETLANDS / FLOODPLAINS—INRMP	FSPMA5322915	Medium
16.3.1	Remove dead and dying trees in old housing area (Area C)	Recurring	WILDLAND FIRE	AFCEC/CZOF	Medium

17.1	Objective Project: Implement Wildland Fire Management Plan to reduce wildfire	Recurring	WILDLAND FIRE	AFCEC/CZOF	Medium
18.1	Objective Project: Implement Wildland Fire Management Plan to manage vegetation with prescribed fires	Recurring	WILDLAND FIRE	AFCEC/CZOF	Medium
20.1.1	Develop a study and management plan for evaluating public safety due to predatory wildlife, specifically bobcats and coyotes, located in or influenced by the housing areas, commercial areas, school areas and play areas within a portion of the cantonment area on Edwards AFB and develop mitigation measures	FY20	MGT, SPECIES—INRMP	FSPMA53206120	High
21.1.3	Treat targeted High Priority Invasive Species in Priority Management Areas	Recurring	MGT, INVASIVE SPECIES—INRMP	FSPMA53206121 FSPMA53216121 FSPMA53226121 FSPMA53236121 FSPMA53246121	High
21.1.4	Treat up to 1,000 acres and monitor 3,000 acres of Sahara mustard through FY23 in off-roadside native habitat per year	Recurring	MGT, INVASIVE SPECIES—INRMP	FSPMA53206121 FSPMA53216121 FSPMA53226121 FSPMA53236121	High
21.1.5	Treat Tamarisk in designated airfield management areas through FY23	Recurring	MGT, INVASIVE SPECIES—INRMP	FSPMA53206121 FSPMA53216121 FSPMA53226121 FSPMA53236121	High
21.1.6	Update basewide survey of invasive species every 10 years	FY27	MGT, INVASIVE SPECIES—INRMP	FSPMA53276121	High
21.1.7	Plant more desirable native trees within the Piute Ponds Complex to replace tamarisk	Recurring	MGT, INVASIVE SPECIES—INRMP	FSPMA53206121 FSPMA53216121 FSPMA53226121 FSPMA53236121 FSPMA53246121	High

21.1.9	Purchase and install track out grates on major access roads to Piute Ponds Complex	FY20	MGT, WETLANDS / FLOODPLAINS—INRMP	FSPMA5320915	Medium
23.1.2	Conduct field cultural site evaluations at the Piute Ponds Complex and make recommendations of site significance for SHPO concurrence to allow various management activities	Recurring	MGT, WETLANDS / FLOODPLAINS—INRMP	FSPMA5320915 FSPMA5321915 FSPMA5322915 FSPMA5323915 FSPMA5324915	Medium
24.1.3	Provide desert tortoise awareness training as required by biological opinion to base population and contractors	Recurring	MGT, SPECIES—T&E	FSPMA53207119 FSPMA53217119 FSPMA53227119 FSPMA53237119 FSPMA53247119	High
24.1.5	Purchase reptile display cases, animal pelts, mounts, and other educational materials	FY21	EQUIPMENT PURCHASE MAINTAIN CN—INRMP	FSPMA53216111	Medium
24.2.4	Develop Wildland Urban Interface video for base population	FY22	MGT, SPECIES—INRMP	FSPMA53226120	Medium
26.1.3	Update hyperspectral imagery and other remote sensing data	FY24	MGT, HABITAT—INRMP	FSPMA53246119	Medium
26.1.4	Purchase one GPS unit	FY22	EQUIPMENT PURCHASE MAINTAIN CN—INRMP	FSPMA53226111	Medium

[1] AFCEC/CZOF=Air Force Engineer Center Environmental Directorate, Wildland Fire Branch.

11.0 REFERENCES

11.1 Standard References (Applicable to all USAF installations)

- AFMAN 32-7003, Environmental Conservation
- eDASH Natural Resources Program Page
- Natural Resources Playbook
- DoDI 4715.03, Natural Resources Conservation Program

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12.0 ACRONYMS AND ABBREVIATIONS

12.1 Standard Acronyms and Abbreviations (Applicable to all USAF Installations)

- eDASH Acronym Library
- Natural Resources Playbook—Acronym Section
- USEPA Terms & Acronyms, http://ofmpub.epa.gov/sor_internet/registry/termreg/searchandretrieve/termsandacronyms/search.do

12.2 Installation Acronyms

412 CEG	412th Civil Engineer Group
412 CEG/CEV	412th Civil Engineer Group, Environmental Management Division
412 CEG/CEVA	412th Civil Engineer Group, Assets Branch
412 TW	412th Test Wing
ACEC	Area of Critical Environmental Concern
AF	Air Force (also USAF)
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AFCEC/CZOF	Air Force Civil Engineer Center, Environmental Directorate, Wildland Fire Branch
AFCEC/CZTQ	Air Force Civil Engineer Center, Environmental Directorate, Technical Support Branch
AFI	Air Force Instruction
AFMAN	Air Force Manual
AFMC	Air Force Materiel Command
AFPD	Air Force Policy Directive
AFRL	Air Force Research Laboratory
AFY	Acre Feet per Year
APHIS-WS	Animal and Plant Health Inspection Service's Wildlife Services
AVEK	Antelope Valley East Kern
AVIRWMP	Antelope Valley Integrated Regional Water Management Plan
BAER	Burned Area Emergency Response
BASH	Bird/Wildlife Aircraft Strike Hazard
BLM	Bureau of Land Management
BO	Biological Opinion
CalEPA	California Environmental Protection Agency
CATM	Combat Arms Training and Maintenance
CCR	California Code of Regulations
CDFW	California Department of Fish and Wildlife
CDWR	California Department of Water Resources
CE	Civil Engineering
CECOS	Civil Engineer Corps Officers School (Naval)

CEMML	Center for Environmental Management of Military Lands
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CI	Confidence Interval
CLEP-OP	Conservation Law Enforcement Program-Operations Plan
CNDDB	California Natural Diversity Database
CNPS	California Native Plant Society
CRPR	California Rare Plant Ranking
CWA	Clean Water Act
CY	Calendar Year
D14	Los Angeles County Sanitation District 14
DoD	Department of Defense
DoDI	Department of Defense Instruction
DOI	Department of the Interior
DT	Desert Tortoise
EAFBI	Edwards Air Force Base Instruction
EIAP	Environmental Impact Analysis Process
EMP	Environmental Management Plan
EMS	Environmental Management System
EO	Executive Order
ERP	Environmental Restoration Program
ESA	Endangered Species Act
FEMA	Federal Emergency Management Agency
FES	Fire and Emergency Services
FWO	Federal Wildlife Officer
FY	Fiscal Year
GIS	Geographic Information System
GISWG	Geographic Information System Working Group
GSRC	Gulf South Research Corporation
HQA	Habitat Quality Analysis
IAW	In Accordance With
ICRMP	Integrated Cultural Resources Management Plan
IMST	Installation Mission Sustainability Team
INRMP	Integrated Natural Resources Management
IPCC	Intergovernmental Panel on Climate Change
IPM	Integrated Pest Management
IPMP	Integrated Pest Management Plan
IRWMP	Integrated Regional Water Management Plan
LIDAR	Light Detection and Ranging

MBTA	Migratory Bird Treaty Act
MOA	Memorandum of Agreement
MOU	Memorandum of Understanding
MSL	Mean Sea Level
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
NRHP	National Register of Historic Places
NRM	Natural Resource Manager
NSR	North State Resources
ORV	Off-Road Vehicle
OU	Operable Unit
PIF	Partners in Flight
PIRA	Precision Impact Range Area
P.L.	Public Law
PMA	Priority Management Area
POC	Point of Contact
RCP	Representative Concentration Pathway
REPI	Readiness and Environmental Protection Initiative
RHDV2	Rabbit Hemorrhagic Disease Virus Type 2
ROD	Record of Decision
SDSFIE	Spatial Data Standards for Facilities, Infrastructure, and Environment
SEA	Significant Ecological Area
SHPO	State Historic Preservation Officer
SWP	State Water Project (of California)
U.S.	United States
U.S.C.	United States Code
USACE	United States Army Corps of Engineers
USAF	United States Air Force (also AF)
USEPA	United States Environmental Protection Agency
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WDR	Waste Discharge Requirement
WFMP	Wildland Fire Management Plan
WSM	Wildland Support Module

13.0 DEFINITIONS

13.1 Standard Definitions (Applicable to all USAF installations)

- *Natural Resources Playbook—Definitions Section*

13.2 Installation Definitions

N/A

14.0 APPENDICES

14.1 Standard Appendices

14.1.1 Appendix A

Appendix A. Annotated summary of key legislation related to design and implementation of the INRMP.

Federal Public Laws and Executive Orders	
National Defense Authorization Act of 1989, Public Law (P.L.) 101–189; Volunteer Partnership Cost-Share Program	Amends two Acts and establishes volunteer and partnership programs for natural and cultural resources management on DoD lands.
Defense Appropriations Act of 1991, P.L. 101–511; Legacy Resource Management Program	Establishes the "Legacy Resource Management Program" for natural and cultural resources. Program emphasis is on inventory and stewardship responsibilities of biological, geophysical, cultural, and historic resources on DoD lands, including restoration of degraded or altered habitats.
EO 11514, Protection and Enhancement of Environmental Quality	Federal agencies shall initiate measures needed to direct their policies, plans, and programs to meet national environmental goals. They shall monitor, evaluate, and control agency activities to protect and enhance the quality of the environment.
EO 11593, Protection and Enhancement of the Cultural Environment	All Federal agencies are required to locate, identify, and record all cultural resources. Cultural resources include sites of archaeological, historical, or architectural significance.
EO 11987, Exotic Organisms	Agencies shall restrict the introduction of exotic species into the natural ecosystems on lands and waters which they administer.
EO 11988, Floodplain Management	Provides direction regarding actions of federal agencies in floodplains, and requires permits from state, territory, and federal review agencies for any construction within a 100-year floodplain and to restore and preserve the natural and beneficial values served by floodplains in carrying out its responsibilities for acquiring, managing and disposing of Federal lands and facilities.
EO 11989, Off-Road vehicles on Public Lands	Installations permitting off-road vehicles to designate and mark specific areas/trails to minimize damage and conflicts, publish information including maps, and monitor the effects of their use. Installations may close areas if adverse effects on natural, cultural, or historic resources are observed.

Appendix A. Annotated summary of key legislation related to design and implementation of the INRMP.

EO 11990, Protection of Wetlands	Requires Federal agencies to avoid undertaking or providing assistance for new construction in wetlands unless there is no practicable alternative, and all practicable measures to minimize harm to wetlands have been implemented and to preserve and enhance the natural and beneficial values of wetlands in carrying out the agency's responsibilities for (1) acquiring, managing, and disposing of Federal lands and facilities; and (2) providing Federally undertaken, financed, or assisted construction and improvements; and (3) conducting Federal activities and programs affecting land use, including but not limited to water and related land resources planning, regulating, and licensing activities.
EO 12088, Federal Compliance with Pollution Control Standards	This EO delegates responsibility to the head of each executive agency for ensuring all necessary actions are taken for the prevention, control, and abatement of environmental pollution. This order gives the United States Environmental Protection Agency (USEPA) authority to conduct reviews and inspections to monitor federal facility compliance with pollution control standards.
EO 12898, Environmental Justice	This EO requires certain federal agencies, including the DoD, to the greatest extent practicable permitted by law, to make environmental justice part of their missions by identifying and addressing disproportionately high and adverse health or environmental effects on minority and low-income populations.
EO 13112, Exotic and Invasive Species	To prevent the introduction of invasive species and provide for their control and to minimize the economic, ecological, and human health impacts that invasive species cause.
EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds	The USFWS has the responsibility to administer, oversee, and enforce the conservation provisions of the *Migratory Bird Treaty Act*, which includes responsibility for population management (e.g., monitoring), habitat protection (e.g., acquisition, enhancement, and modification), international coordination, and regulations development and enforcement.
United States Code	
Airborne Hunting Act (16 U.S.C. 742j-l)	Prohibits and levies imprisonment and/or a fine for shooting or attempting to shoot for the purpose of capturing or killing any bird, fish, or other animal from an aircraft; for using an aircraft to harass any bird, fish, or other animal; or knowingly participating in using an aircraft for any of these purposes *unless* such person is employed by, an authorized agent of, or operating under a license or permit of, any State or the U.S. to administer, protect, or aid in the administration or protecting land, water, wildlife, livestock, domesticated animals, human life, or crops; and each such person operating under a license or permit shall report to the applicable issuing authority each calendar quarter the number and type of animals so taken.

Appendix A. Annotated summary of key legislation related to design and implementation of the INRMP.

Animal Damage Control Act (7 U.S.C. § 426-426b, 47 Stat. 1468)	Provides authority to the Secretary of Agriculture for investigation and control of mammalian predators, rodents, and birds. DoD installations may enter into cooperative agreements to conduct animal control projects.
Archaeological Resource Protection Act of 1979, as amended (16 U.S.C. 460aa-460mm)	Prohibits anyone from excavating/removing archaeological resources from federal or Indian lands without a permit from a land managing agency; prohibits any sales, purchase, exchange, transport, or receipt of archaeological resources. Violations can result in substantial fines and imprisonment and confiscation of relevant archaeological resources.
Assault Act (18 U.S.C. 111)	Punishes anyone who forcibly assaults, resists, opposes, impedes, intimidates or interferes with any person designated in 18 U.S.C. § 1114 (i.e., any officer, employee, or member of the uniformed services in any branch of the U.S. Government) while engaged in or on account of the performance of his/her official duties.
Assimilative Crimes Act 18 U.S.C. § 13	The *Assimilative Crimes Act*, 18 U.S.C. § 13, makes state law applicable to conduct occurring on lands reserved or acquired by the Federal government as provided in 18 U.S.C. § 7(3), when the act or omission is not made punishable by an enactment of Congress. Prosecutions instituted under this statute are not to enforce the laws of the state, but to enforce Federal law, the details of which, instead of being recited, are adopted by reference. In addition to minor violations, the statute has been invoked to cover a number of serious criminal offenses defined by state law such as burglary and embezzlement. However, the *Assimilative Crimes Act* cannot be used to override other Federal policies as expressed by acts of Congress or by valid administrative orders.
Bald and Golden Eagle Protection Act of 1940, as amended (16 U.S.C. 668-668d)	This law provides for the protection of the bald eagle (the national emblem) and the golden eagle by prohibiting, except under certain specified conditions, the taking, possession, and commerce of such birds. The 1972 amendments increased penalties for violating provisions of the Act or regulations issued pursuant thereto and strengthened other enforcement measures. Rewards are provided for information leading to arrest and conviction for violation of the Act.
Clean Air Act, (42 U.S.C. § 7401– 7671q, July 14, 1955, as amended)	The amendments made in 1970 established the core of the clean air program. The primary objective is to establish Federal standards for air pollutants. It is designed to improve air quality in areas of the country which do not meet federal standards and to prevent significant deterioration in areas where air quality exceeds those standards.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 (Superfund) (26 U.S.C. § 4611–4682, P.L. 96-510, 94 Stat. 2797), as amended	Authorizes and administers a program to assess damage, respond to releases of hazardous substances, fund cleanup, establish clean-up standards, assign liability, and other efforts to address environmental contaminants. Installation Restoration Program guides cleanups at DoD installations.

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Endangered Species Act (ESA) of 1973, as amended (P.L. 93-205, 16 U.S.C. § 1531 et seq.)	Protects threatened, endangered, and candidate species of fish, wildlife, and plants and their designated critical habitats. Under this law, no federal action is allowed to jeopardize the continued existence of an endangered or threatened species. The ESA requires consultation with the USFWS and the NOAA Fisheries (National Marine Fisheries Service) and the preparation of a biological evaluation or a biological assessment may be required when such species are present in an area affected by government activities.
Federal Aid in Wildlife Restoration Act of 1937 (Pittman-Robertson Act; 16 U.S.C. § 669–669i; 50 Stat. 917)	Provides federal aid to states and territories for management and restoration of wildlife. Fund derives from sports tax on arms and ammunition. Projects include acquisition of wildlife habitat, wildlife research surveys, development of access facilities, and hunter education.
Federal Environmental Pesticide Act of 1972	Requires installations to ensure pesticides are used only IAW their label registrations and restricted-use pesticides are applied only by certified applicators.
Federal Land Use Policy and Management Act (43 U.S.C. § 1701–1782)	Requires management of public lands to protect the quality of scientific, scenic, historical, ecological, environmental, and archaeological resources and values; as well as to preserve and protect certain lands in their natural condition for fish and wildlife habitat. This Act also requires consideration of commodity production such as timbering.
Federal Water Pollution Control Act (Clean Water Act [CWA], 33 U.S.C. §1251–1387)	The CWA is a comprehensive statute aimed at restoring and maintaining the chemical, physical, and biological integrity of the nation's waters. Primary authority for the implementation and enforcement rests with the USEPA.
Fish and Wildlife Conservation Act (16 U.S.C. § 2901–2911; 94 Stat. 1322, PL 96-366)	Installations encouraged to use their authority to conserve and promote conservation of nongame fish and wildlife in their habitats.
Fish and Wildlife Coordination Act (16 U.S.C. § 661 et seq.)	Directs installations to consult with the USFWS, or state or territorial agencies to ascertain means to protect fish and wildlife resources related to actions resulting in the control or structural modification of any natural stream or body of water. Includes provisions for mitigation and reporting.
Fish and Wildlife Recreation Act of 1962, as amended (Refuge Recreation Act; 16 U.S.C. 460k–460k-4)	Authorizes the Secretary of the Interior to administer refuges, hatcheries, and other conservation areas for recreational use, when such uses do not interfere with the area's primary purposes. Includes providing for public-use fees/permits and penalties for violation of regulations; authorizes acquisitions and donations of lands and interests suitable for fish-/wildlife-oriented recreation, protection of natural resources, and conservation of endangered or threatened species.

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Lacey Act of 1900 (16 U.S.C. §§ 3371–3378, 701, 702, 32 Stat. 187, 32 Stat. 285; 18 U.S.C. §§ 42–43)	Prohibits the importation of wild animals or birds or parts thereof, taken, possessed, or exported in violation of the laws of the country or territory of origin. Provides enforcement and penalties for violation of wildlife related Acts or regulations.
Leases: Non-excess Property of Military Departments, 10 U.S.C. § 2667, as amended	Authorizes DoD to lease to commercial enterprises Federal land not currently needed for public use. Covers agricultural outleasing program.
Marine Mammal Protection Act of 1972, as amended (16 U.S.C. 13611407)	The act prohibits "take" of marine mammals and implements a moratorium on importing/exporting and sale of any marine mammal and/or marine mammal part or product in the U.S.
Migratory Bird Treaty Act (16 U.S.C. § 703–712)	The Act implements various treaties for the protection of migratory birds. Under the Act, taking, killing, or possessing migratory birds is unlawful without a valid permit.
Migratory Bird Hunting Stamp Act of 1934 (16 U.S.C. 718a–718k)	This act requires any waterfowl hunter of 16 or more years of to purchase a valid Federal hunting stamp and have it on his/her person when hunting; receipts from permit fees are used to cover USFWS expenses for administering the migratory bird permitting programs.
National Environmental Policy Act of 1969 (NEPA), as amended; P.L. 91-190, 42 U.S.C. § 4321 et seq.	Requires federal agencies to utilize a systematic approach when assessing environmental impacts of government activities. Establishes the use of environmental impact statements. NEPA proposes an interdisciplinary approach in a decision-making process designed to identify unacceptable or unnecessary impacts on the environment. The Council of Environmental Quality created Regulations for Implementing the National Environmental Policy Act (40 CFR] Parts 1500–1508), which provide regulations applicable to and binding on all Federal agencies for implementing the procedural provisions of NEPA, as amended.
National Historic Preservation Act, 16 U.S.C. § 470 et seq.	Requires federal agencies to take account of the effect of any federally assisted undertaking or licensing on any district, site, building, structure, or object included in or eligible for inclusion in the National Register of Historic Places (NRHP). Provides for the nomination, identification (through listing on the NRHP), and protection of historical and cultural properties of significance.
National Trails Systems Act (16 U.S.C. § 1241–1249)	Provides for the establishment of recreation and scenic trails.
National Wildlife Refuge Acts	Provides for establishment of National Wildlife Refuges through purchase, land transfer, donation, cooperative agreements, and other means.
National Wildlife Refuge System Administration Act of 1966 (16 U.S.C. § 668dd–668ee)	Provides guidelines and instructions for the administration of Wildlife Refuges and other conservation areas.

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Native American Graves Protection and Repatriation Act of 1990 (25 U.S.C. § 3001–13; 104 Stat. 3042), as amended	Established requirements for the treatment of Native American human remains and sacred or cultural objects found on Federal lands. Includes requirements on inventory, and notification.
Plant Protection Act of 2000 (7 U.S.C. §7701 et seq.)	Consolidates responsibilities originally promulgated under and now supersedes the *Federal Noxious Weed Act of 1974*, the *Federal Plant Pest Act of 1957*, and the *Plant Quarantine Act of 1912*. Pertains to plant pests and noxious weeds. Authorizes the Department of Agriculture Secretary to issue regulations for preventing introductions of plant pests into or disseminating them within the U.S. This includes regulations and petitions regarding noxious weeds, genetically engineered plants, and plant pests ranging from invertebrates and fungi to infectious agents.
Rivers and Harbors Act of 1899 (33 U.S.C. § 401 et seq.)	Makes it unlawful for the USAF to conduct any work or activity in navigable waters of the United States without a federal permit. Installations should coordinate with the U.S. Army Corps of Engineers (USACE) to obtain permits for the discharge of refuse affecting navigable waters under National Pollutant Discharge Elimination System and should coordinate with the USFWS to review effects on fish and wildlife of work and activities to be undertaken as permitted by the USACE.
Sale of certain interests in land, 10 U.S.C. § 2665	Authorizes sale of forest products and reimbursement of the costs of management of forest resources.
Soil and Water Conservation Act (16 U.S.C. § 2001, P.L. 95-193)	Installations shall coordinate with the Secretary of Agriculture to appraise, on a continual basis, soil/water-related resources. Installations will develop and update a program for furthering the conservation, protection, and enhancement of these resources consistent with other federal and local programs.

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Sikes Act (16 U.S.C. § 670a–670l, 74 Stat. 1052), as amended	Provides for the cooperation of DoD, the Departments of the Interior (USFWS), and the State Fish and Game Department in planning, developing, and maintaining fish and wildlife resources on a military installation. Requires development of an INRMP and public access to natural resources and allows collection of nominal hunting and fishing fees. NOTE: AFMAN 32-7003 sec. 1.14.9. Staffing. As defined in DoDI 4715.03, use professionally trained natural resources management personnel with a degree in the natural sciences to develop and implement the installation INRMP. (T-0). 3.9.1. Outsourcing Natural Resources Management. As stipulated in the *Sikes Act*, 16 U.S.C. § 670 et. seq., the Office of Management and Budget Circular No. A-76, Performance of Commercial Activities, August 4, 1983 (Revised 29 May 2003) does not apply to the development, implementation, and enforcement of INRMPs. Activities that require the exercise of discretion in making decisions regarding the management and disposition of government owned natural resources are inherently governmental. When it is not practicable to utilize DoD personnel to perform inherently governmental natural resources management duties, obtain these services from federal agencies having responsibilities for the conservation and management of natural resources.
DoD Policy, Directives, and Instructions	
DoD Instruction 4150.07 DoD Pest Management Program dated 29 May 2008	Implements policy, assigns responsibilities, and prescribes procedures for the DoD Integrated Pest Management Program.
DoD Instruction 4715.1, Environmental Security	Establishes policy for protecting, preserving, and (when required) restoring and enhancing the quality of the environment. This instruction also ensures environmental factors are integrated into DoD decision-making processes that could impact the environment, and are given appropriate consideration along with other relevant factors.
DoD Instruction (DoDI) 4715.03, Natural Resources Conservation Program	Implements policy, assigns responsibility, and prescribes procedures under DoDI 4715.1 for the integrated management of natural and cultural resources on property under DoD control.

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OSD Policy Memorandum—17 May 2005— Implementation of Sikes Act Improvement Amendments: Supplemental Guidance Concerning Leased Lands	Provides supplemental guidance for implementing the requirements of the *Sikes Act* in a consistent manner throughout DoD. The guidance covers lands occupied by tenants or lessees or being used by others pursuant to a permit, license, right of way, or any other form of permission. INRMPs must address the resource management on all lands for which the subject installation has real property accountability, including leased lands. Installation commanders may require tenants to accept responsibility for performing appropriate natural resource management actions as a condition of their occupancy or use, but this does not preclude the requirement to address the natural resource management needs of these lands in the installation INRMP.
OSD Policy Memorandum (1 November 2004), Implementation of Sikes Act Improvement Act Amendments: Supplemental Guidance Concerning INRMP Reviews	Emphasizes implementing and improving the overall INRMP coordination process. Provides policy on scope of INRMP review, and public comment on INRMP review.
OSD Policy Memorandum (10 October 200), Implementation of Sikes Act Improvement Act: Updated Guidance	Provides guidance for implementing the requirements of the *Sikes Act* in a consistent manner throughout DoD and replaces the 21 September 1998 guidance Implementation of the *Sikes Act Improvement Act* amendments. Emphasizes implementing and improving the overall INRMP coordination process and focuses on coordinating with stakeholders, reporting requirements and metrics, budgeting for INRMP projects, using the INRMP as a substitute for critical habitat designation, supporting military training and testing needs, and facilitating the INRMP review process.
USAF Instructions, Directives, and Other Relevant Guidance	
32 CFR Part 989, as amended, and AFI 32-1015, Integrated Installation Planning	Provides guidance and responsibilities in the EIAP for implementing INRMPs. Implementation of an INRMP constitutes a major federal action and therefore is subject to evaluation through an Environmental Assessment or an Environmental Impact Statement.
AFI 32-7062, Air Force Comprehensive Planning	Provides guidance and responsibilities related to the USAF comprehensive planning process on all USAF-controlled lands.
AFMAN 32-7003, Environmental (supersedes AFI 32-7065, Cultural Resources Management)	This instruction implements AFPD 32-70 and DoDI 4710.1, Archaeological and Historic Resources Management. It explains how to manage cultural resources on USAF property in compliance with Federal, state, territorial, and local standards.
AFMAN 32-7003, Environmental Conservation (supersedes AFI 32-7064, Integrated Natural Resources Management)	Implements AFPD 32-70, Environmental Quality; DoDI 4715.03, Natural Resources Conservation Program; and DoDI 7310.5, Accounting for Sale of Forest Products. It explains how to manage natural resources on USAF property in compliance with Federal, state, territorial, and local standards.

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Conservation Law Enforcement Program, Operations Plan (CLEP-OP)	Outlines the standard operating procedure to guide the USFWS FWO stationed at Edwards AFB, and describes the conservation law enforcement procedures mutually agreed to by the signatories, that will be followed by a FWO stationed at the installation.
AFPD 32-70, Environmental Quality	Outlines the USAF mission to achieve and maintain environmental quality on all USAF lands by cleaning up environmental damage resulting from past activities, meeting all environmental standards applicable to present operations, planning its future activities to minimize environmental impacts, managing responsibly the irreplaceable natural and cultural resources it holds in public trust and eliminating pollution from its activities wherever possible. AFPD 32-70 also establishes policies to carry out these objectives.
Edwards Air Force Base Instruction 32-7064, Management of Hunting and Fishing Program	Implements AFMAN 32-7003, *Environmental Conservation* (supersedes AFI 32-7064, *Integrated Natural Resources Management*) and the Edwards AFB INRMP; provides informational guidance on all permitted hunting and fishing activities conducted on Edwards AFB beyond restrictions outlined in California State Regulations; applies to all persons who hunt and fish on Edwards AFB
Policy Memo for Implementation of Sikes Act Improvement Amendments, HQ USAF Environmental Office (29 January 1999)	Outlines the USAF interpretation and explanation of the *Sikes Act* and *Sikes Act Improvement Act of 1997.*

14.2 Installation Appendices

14.2.1 Appendix B. Figures.

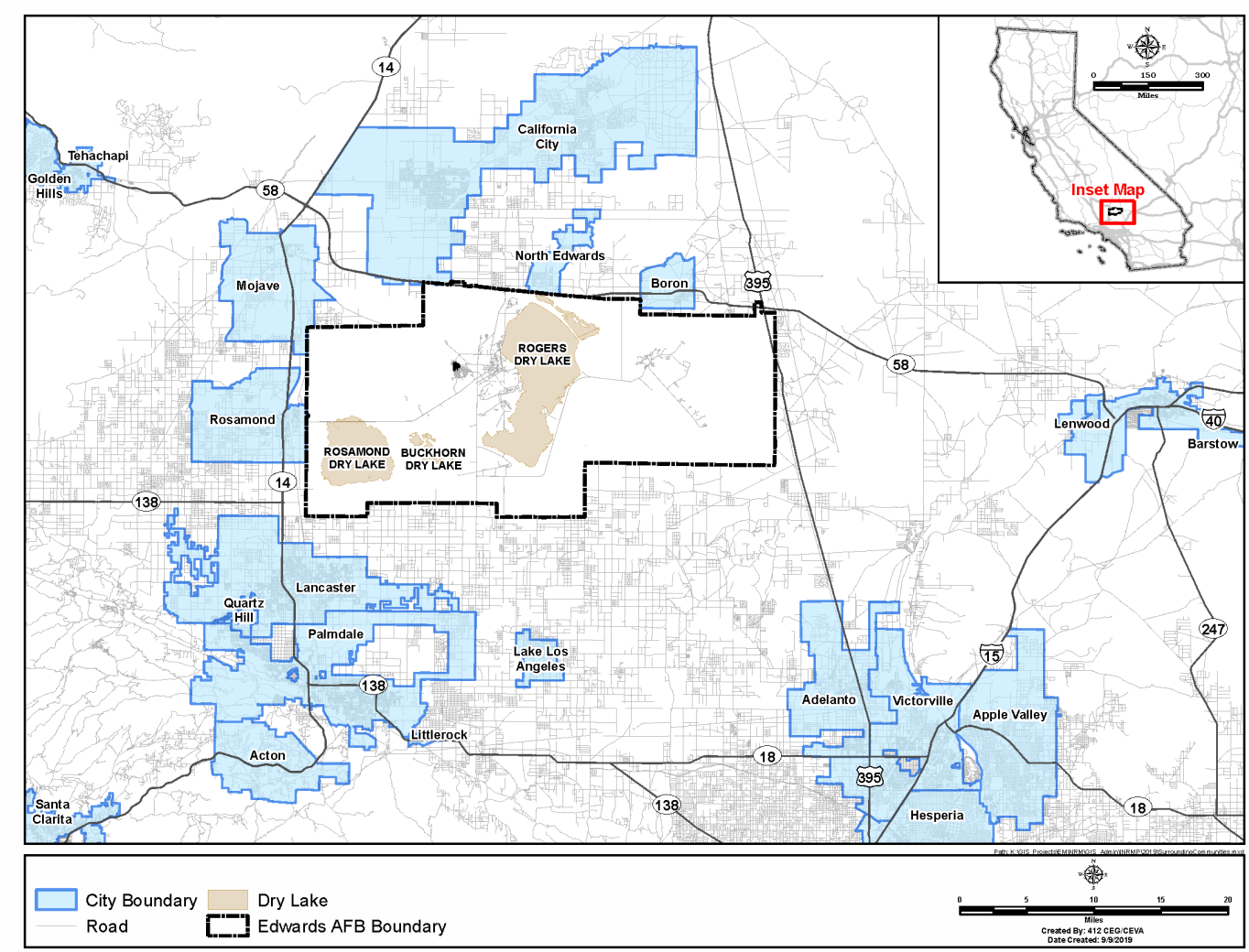

Figure 1. Surrounding communities.

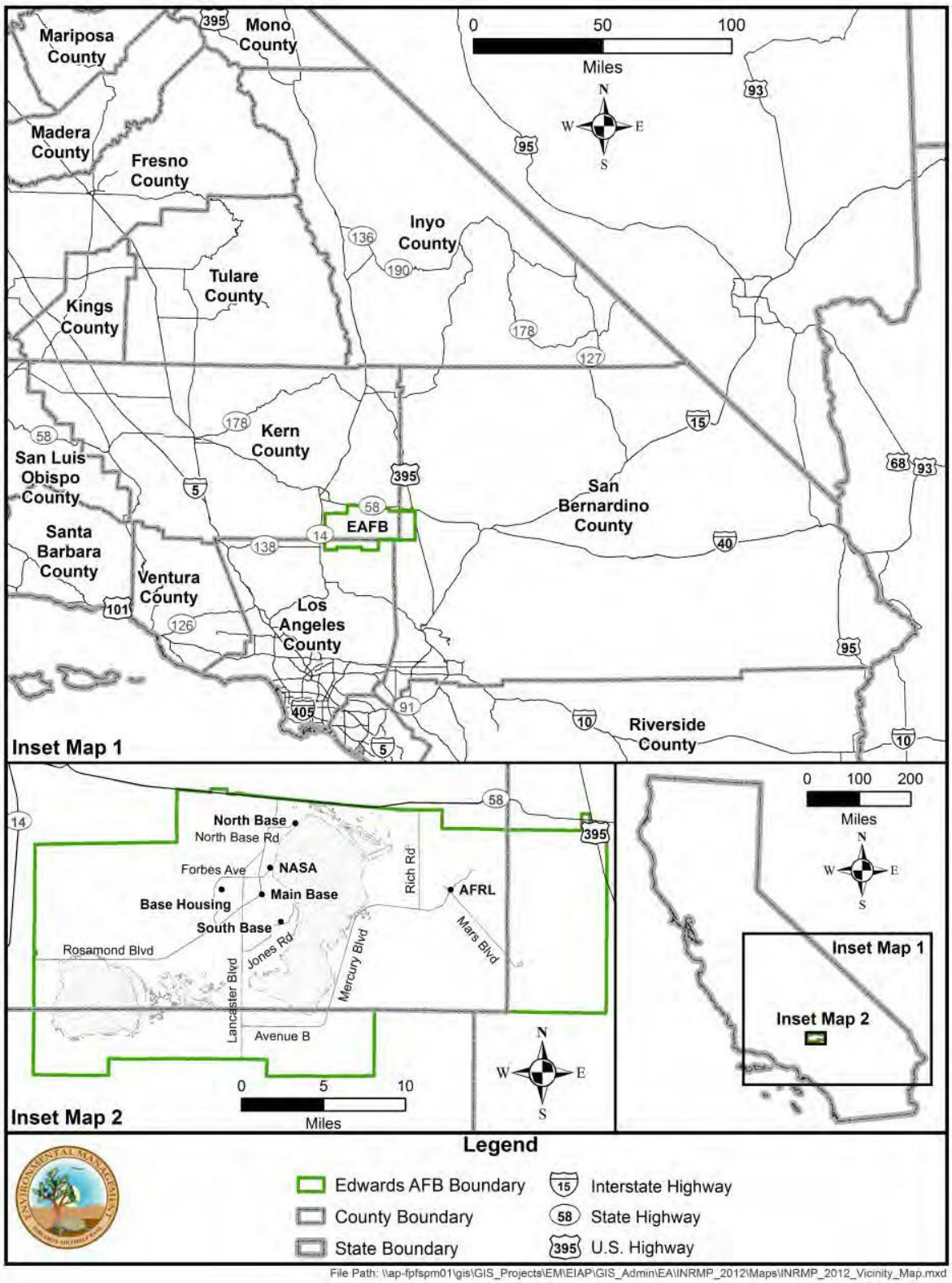

Figure 2. Vicinity and highways.

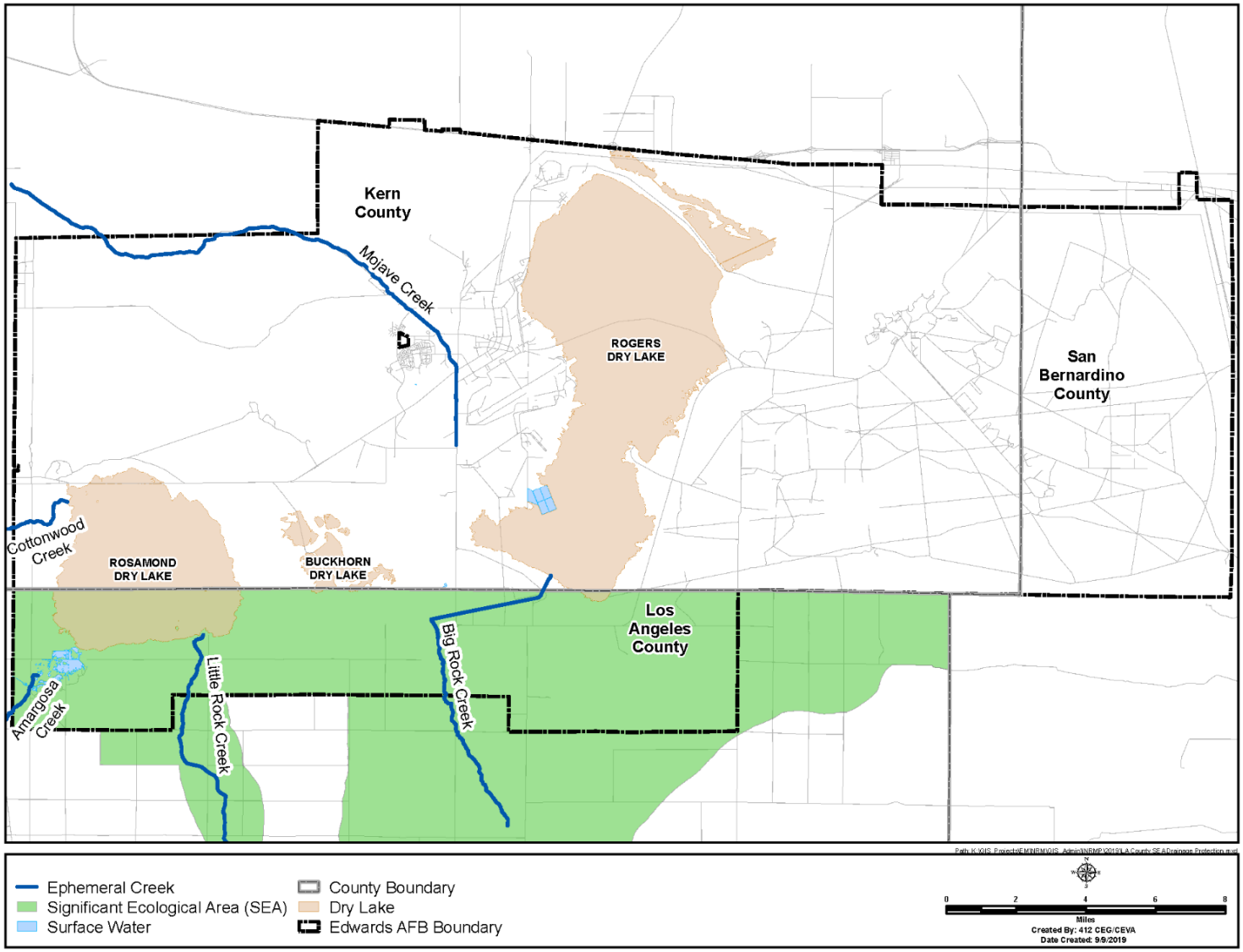

Figure 3. Los Angeles County Significant Ecological Area drainage protection

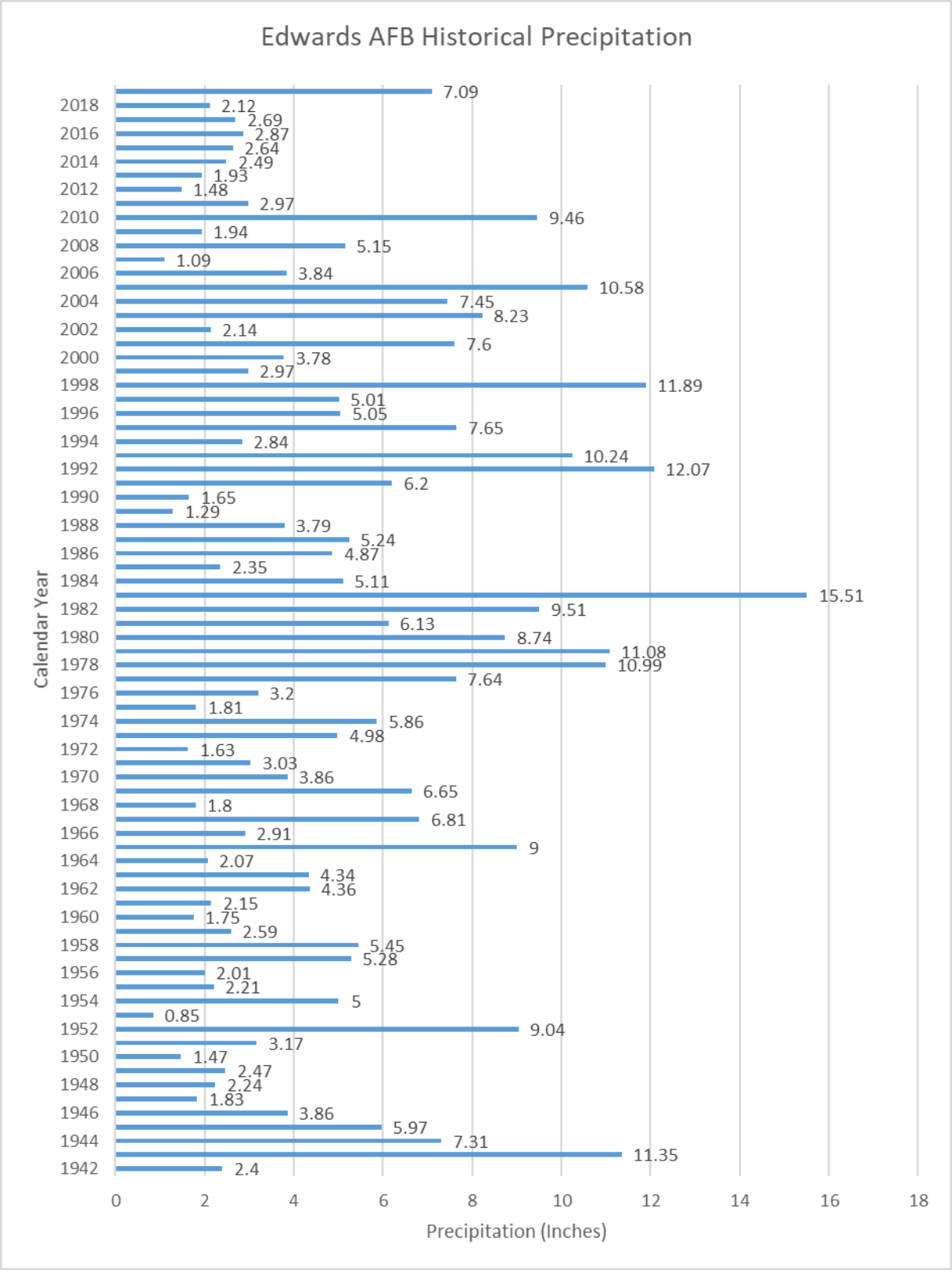

Figure 4. Edwards AFB rainfall data.

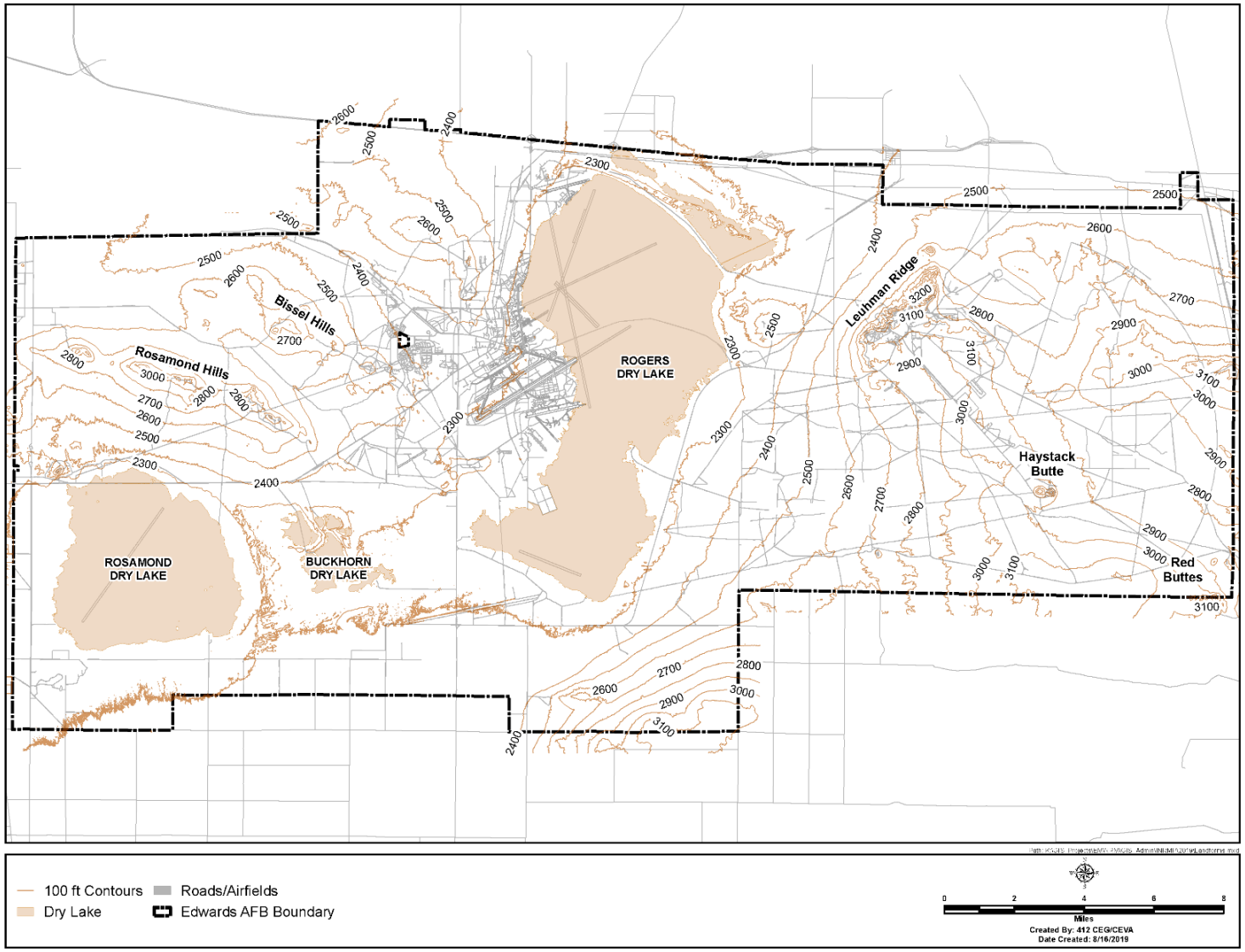

Figure 5. Landforms with 100-foot contours

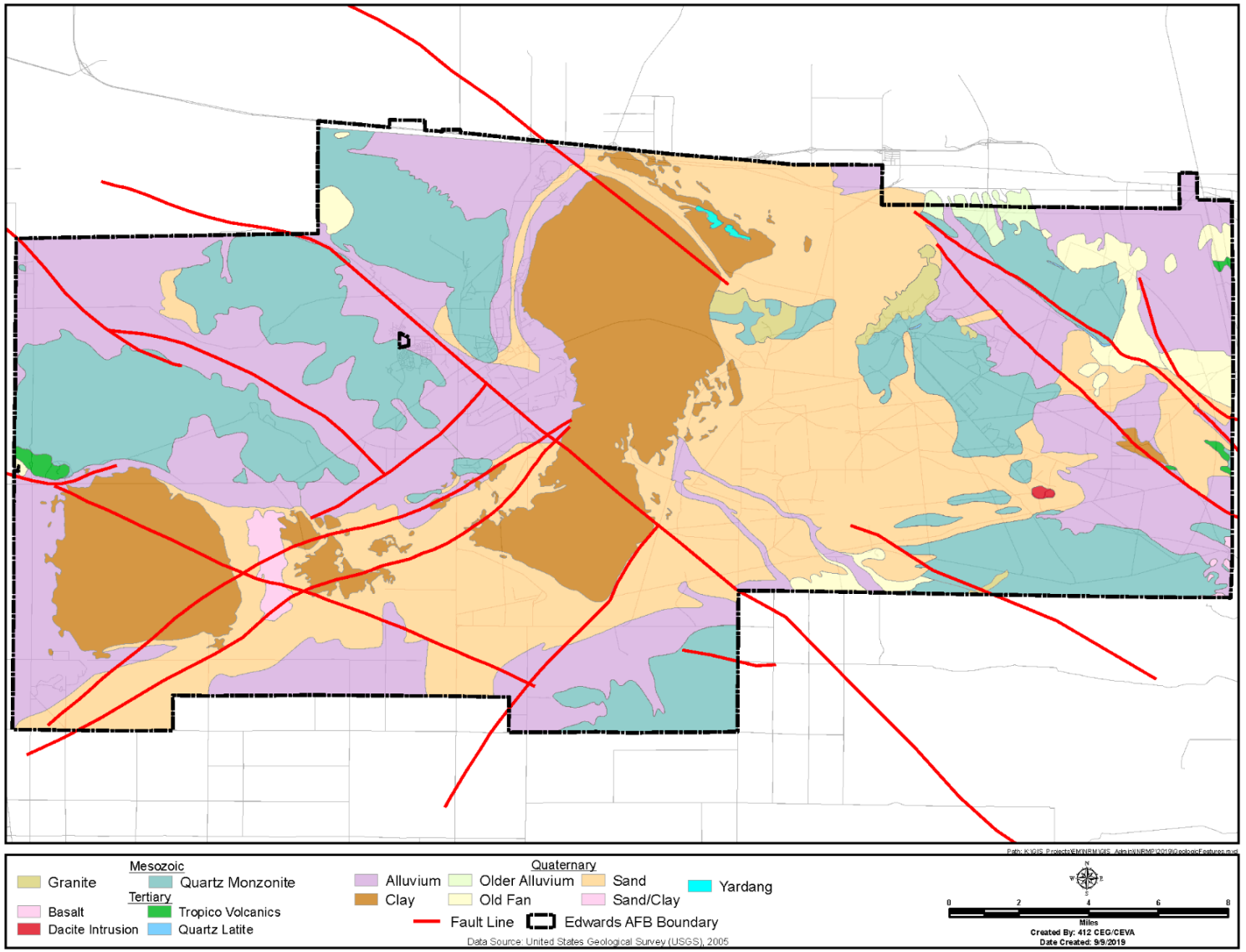

Figure 6. Geological features on Edwards AFB.

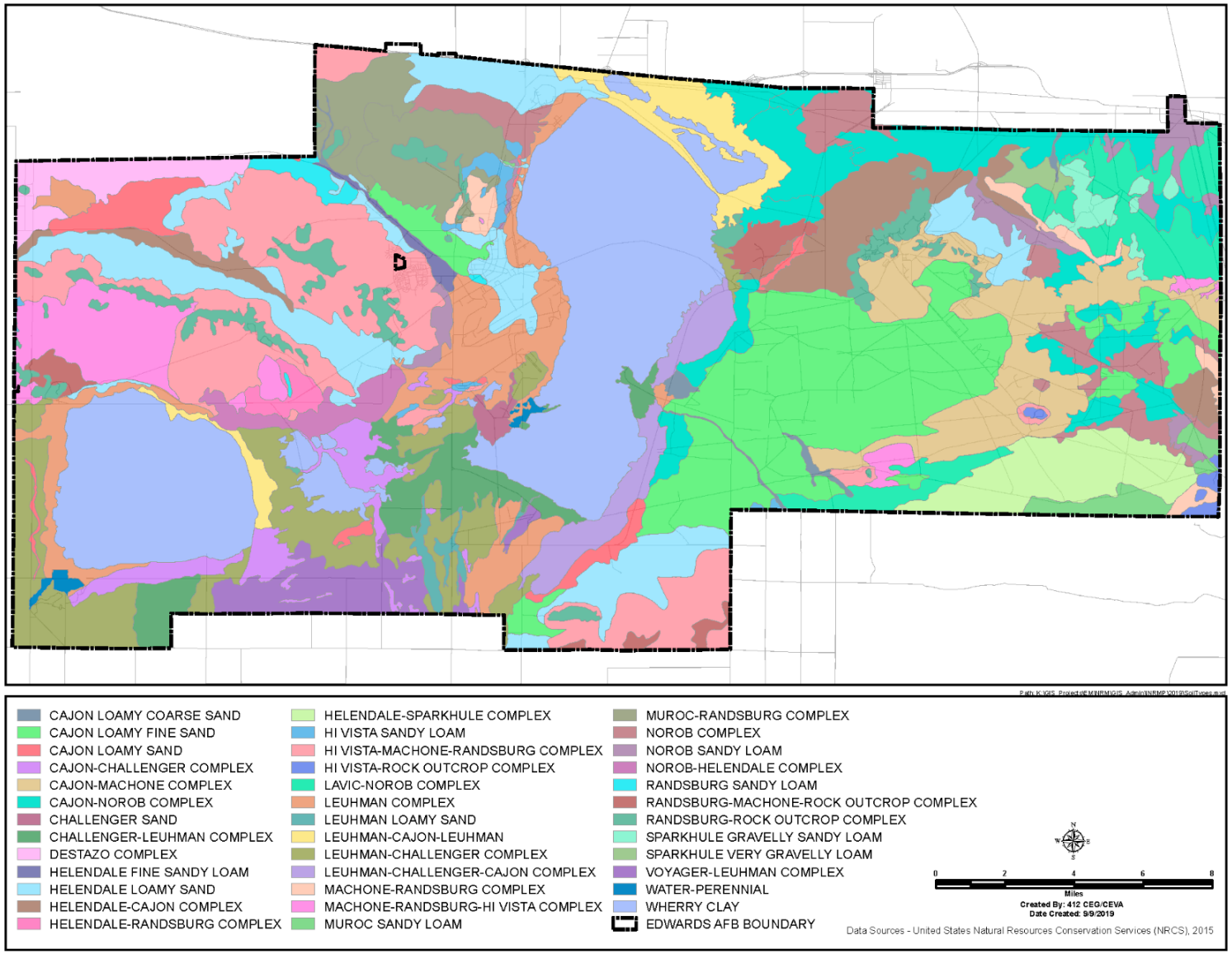

Figure 7. Soil types at Edwards AFB.

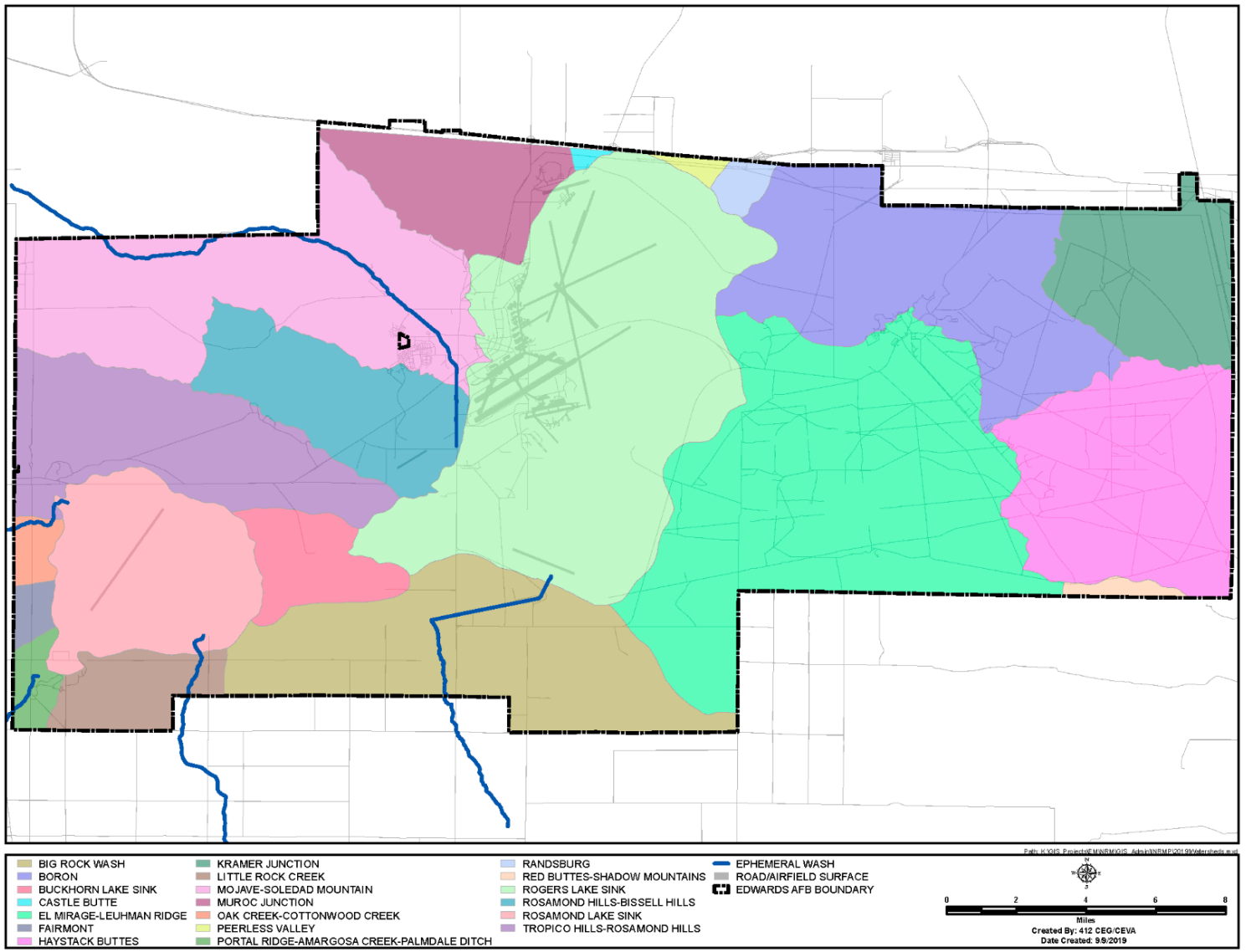

Figure 8. Watersheds on Edwards AFB.

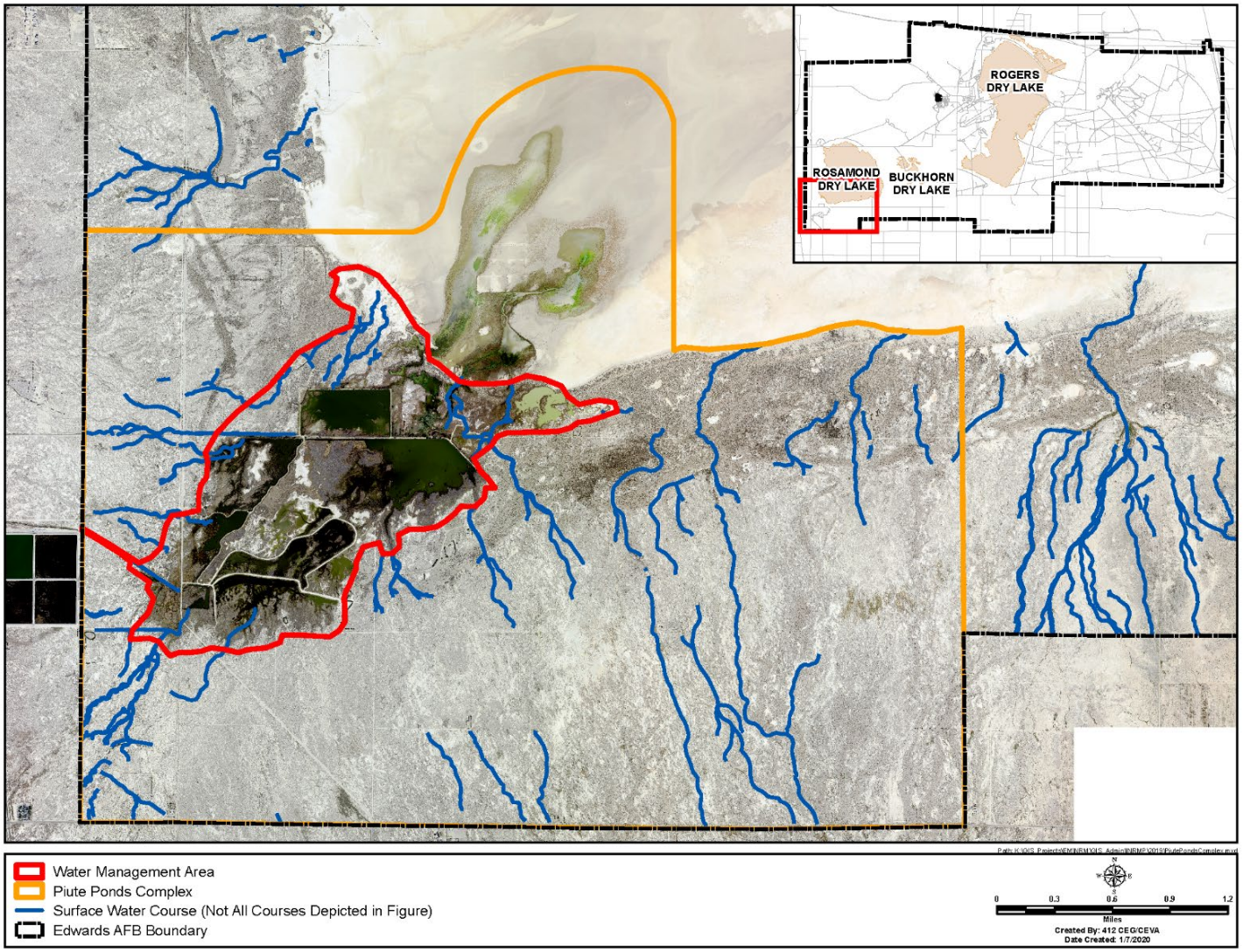

Figure 9. Piute Ponds Complex.

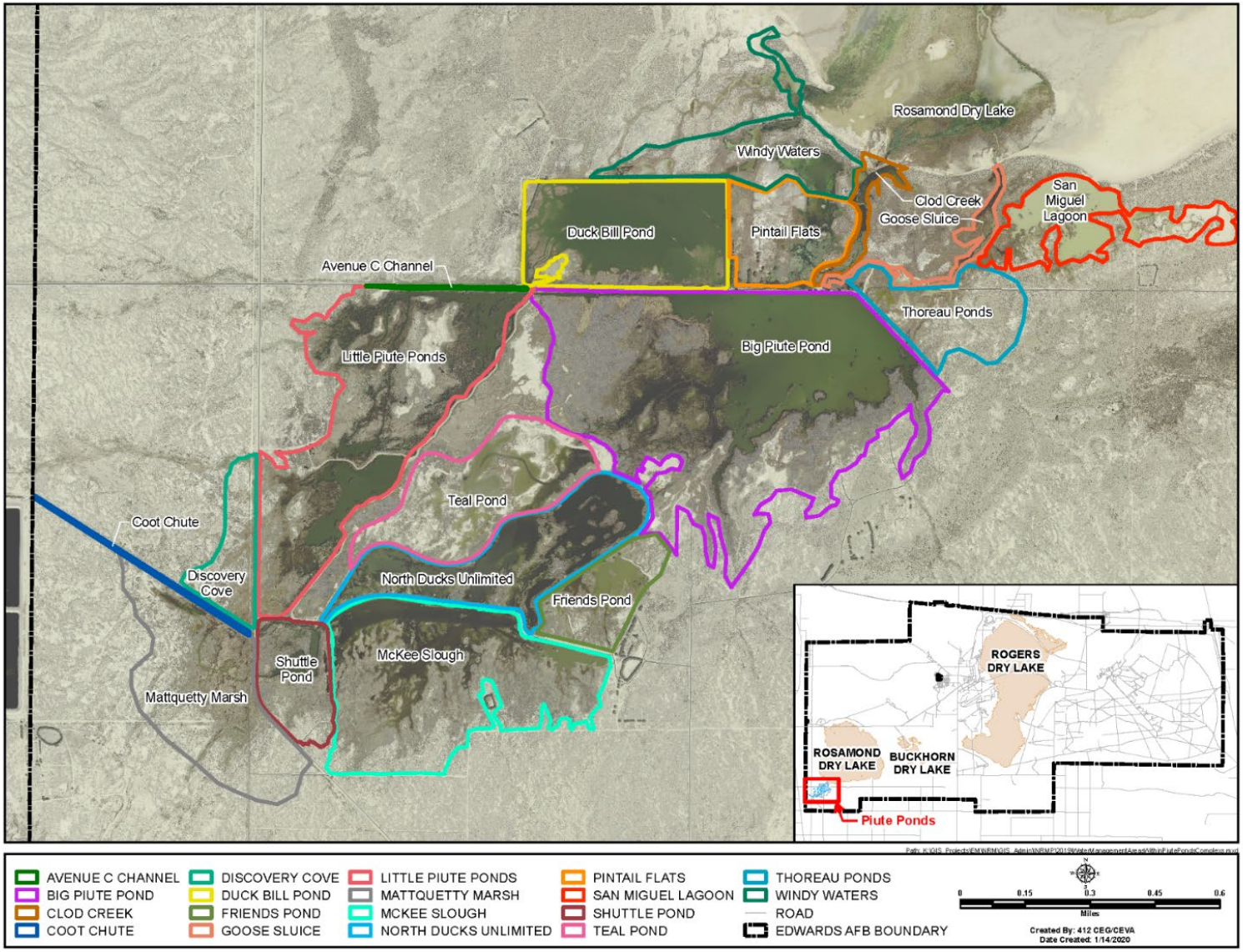

Figure 10. Water Management Areas within Piute Ponds Complex.

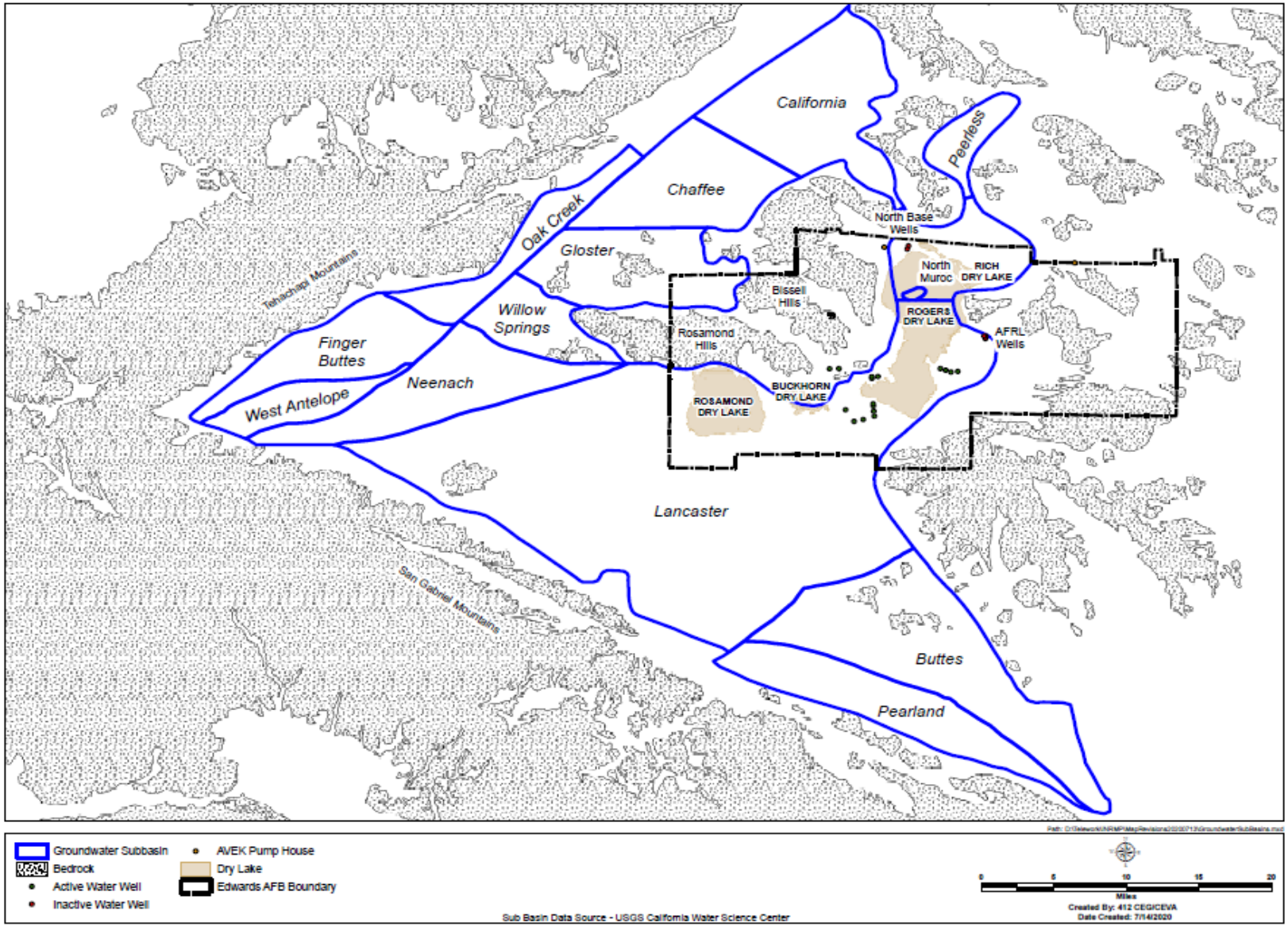

Figure 11. Groundwater subbasins.

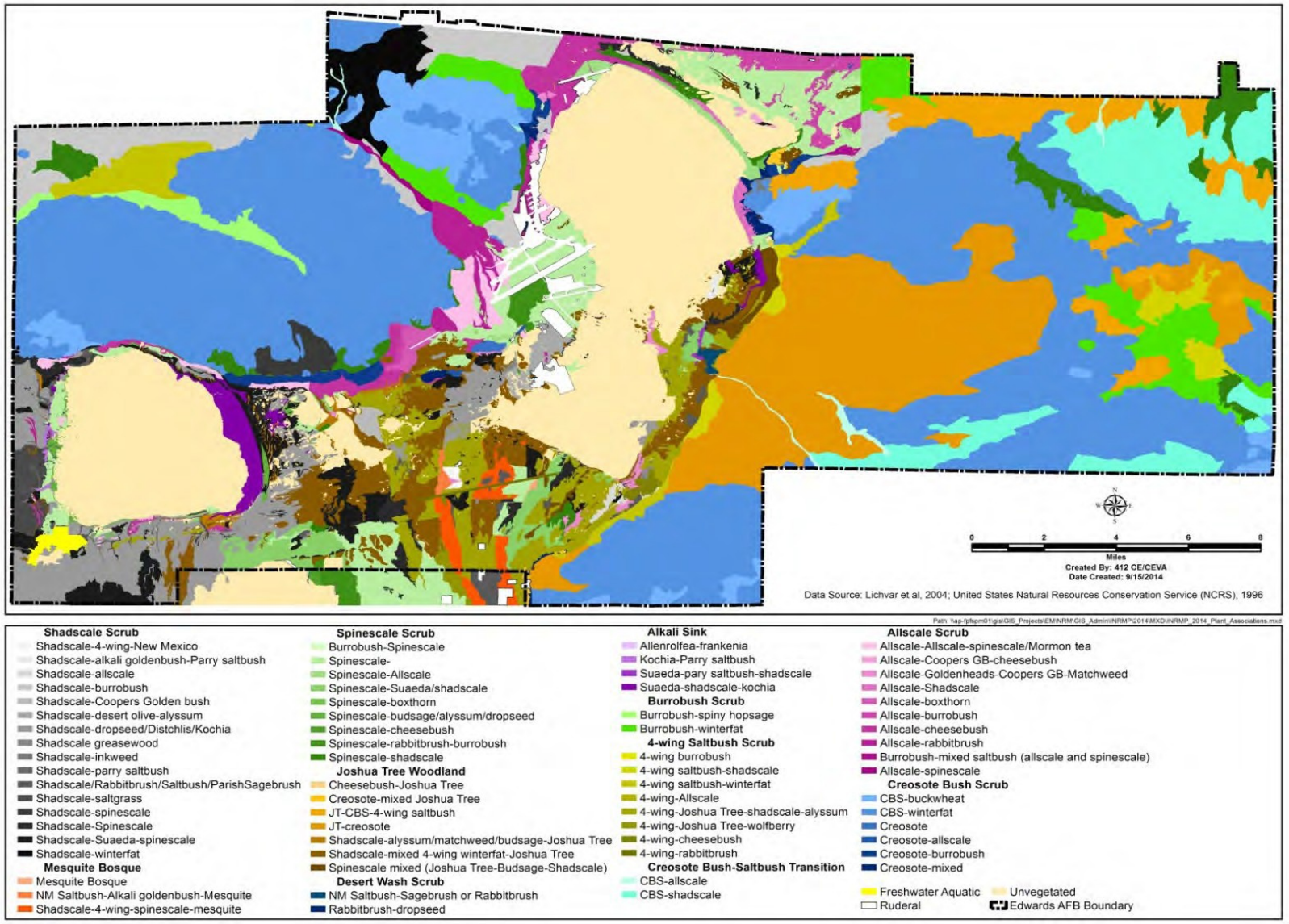

Figure 12. Plant associations.

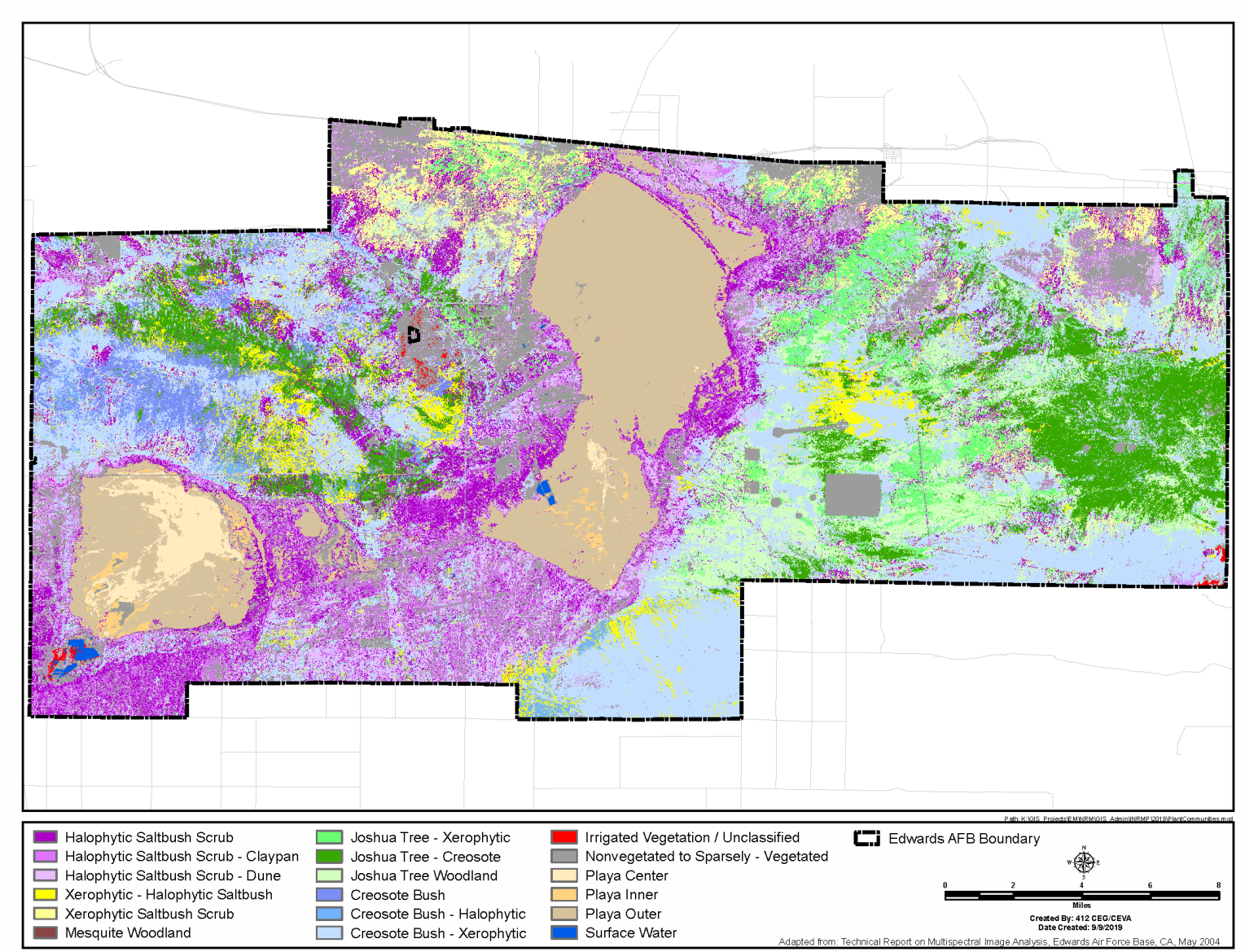

Figure 13. Plant communities on Edwards AFB.

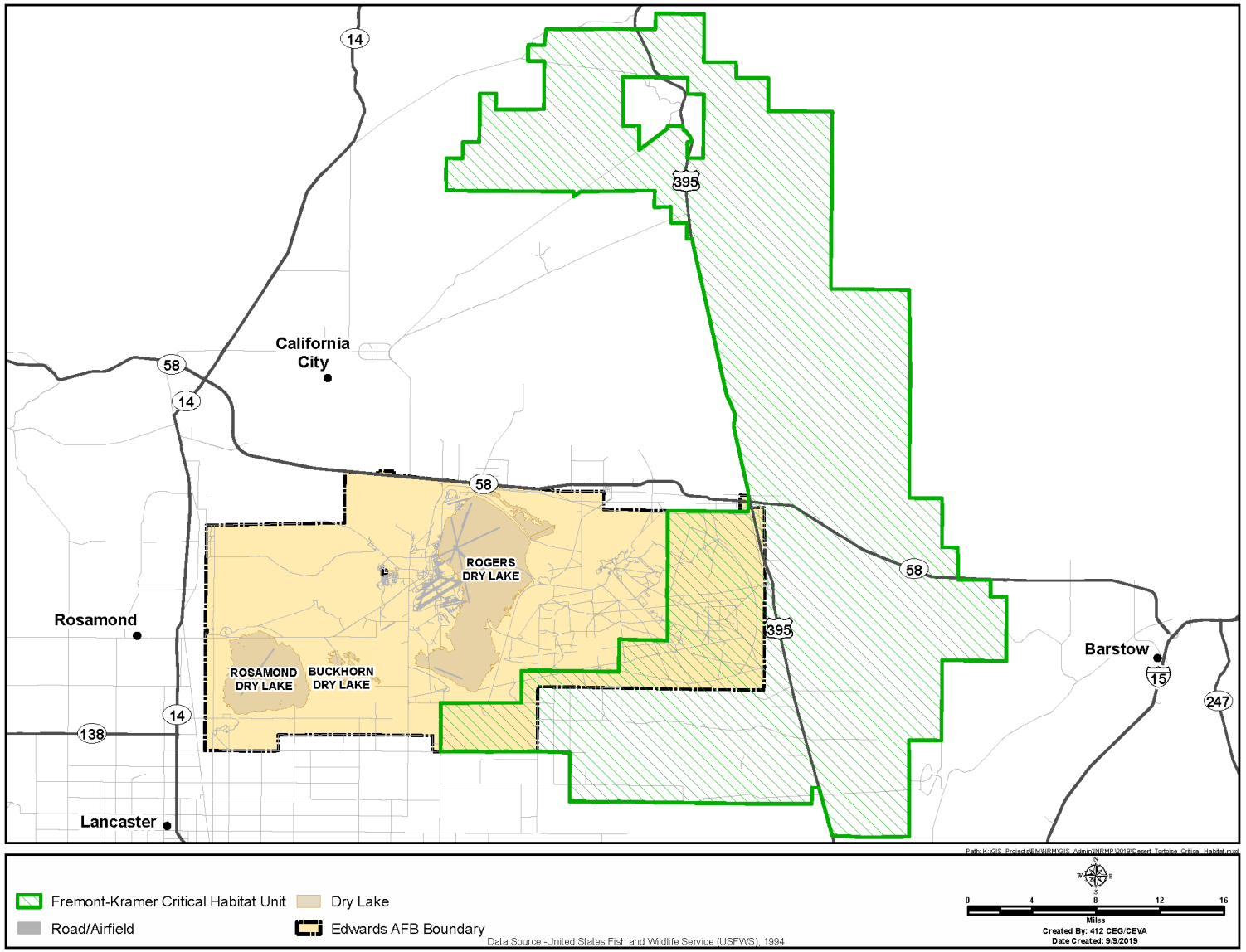

Figure 14. Desert tortoise critical habitat on Edwards AFB.

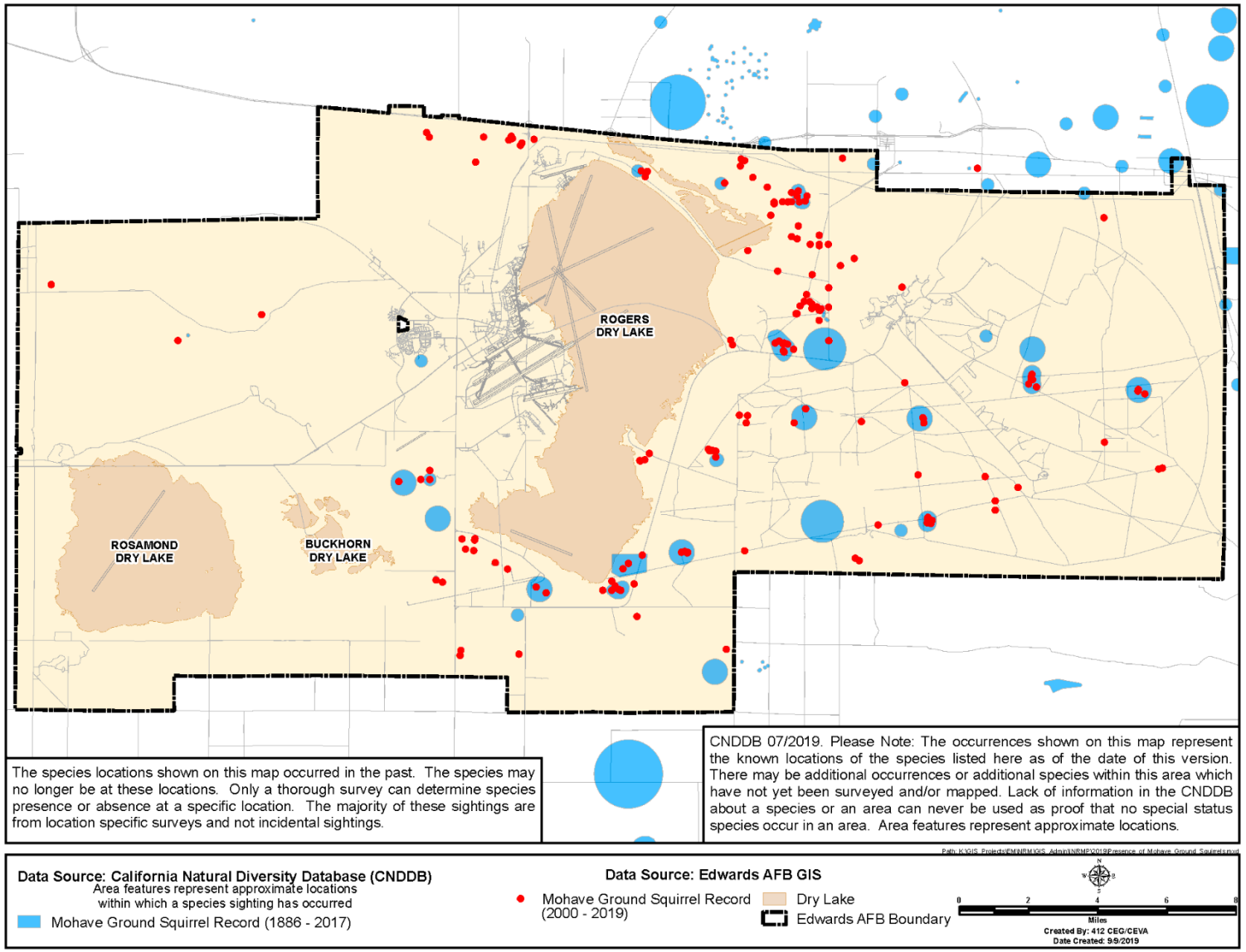

Figure 15. Presence of Mohave ground squirrel on Edwards AFB.

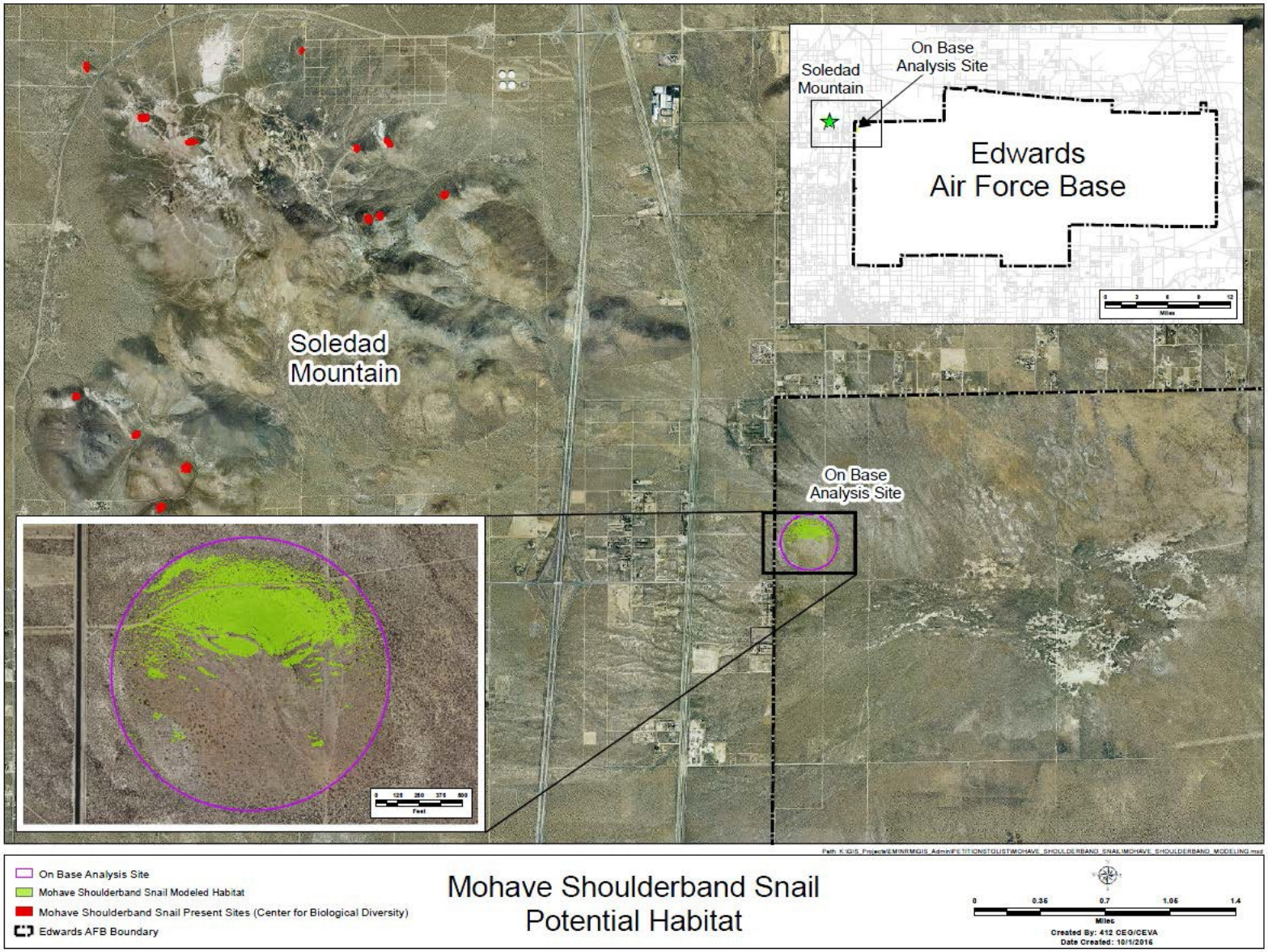

Figure 16. Mohave Shoulderband Snail Potential Habitat.

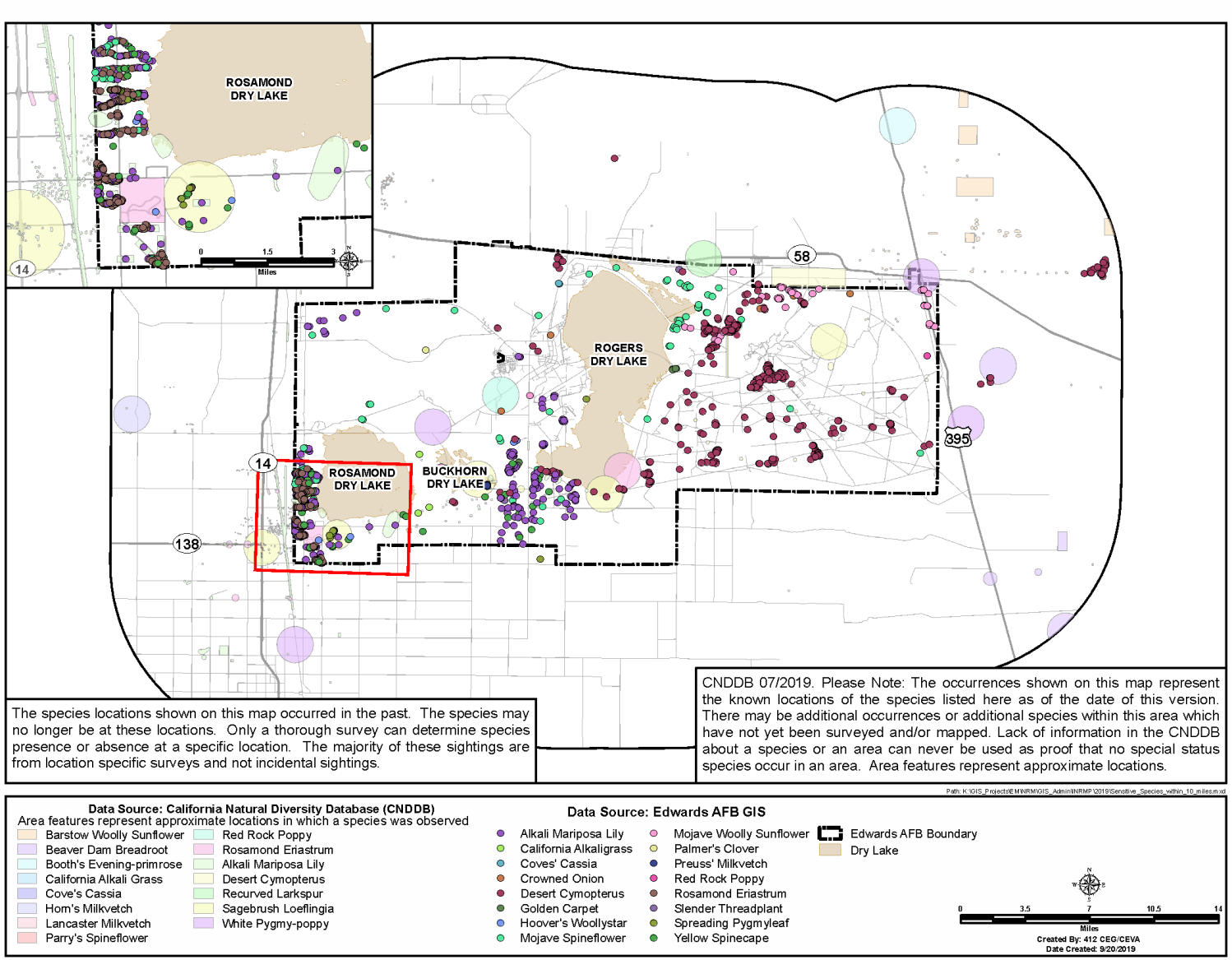

Figure 17. Sensitive plant species (California Native Plant Society List 1B and Lists 2–4) within 10 miles of Edwards AFB.

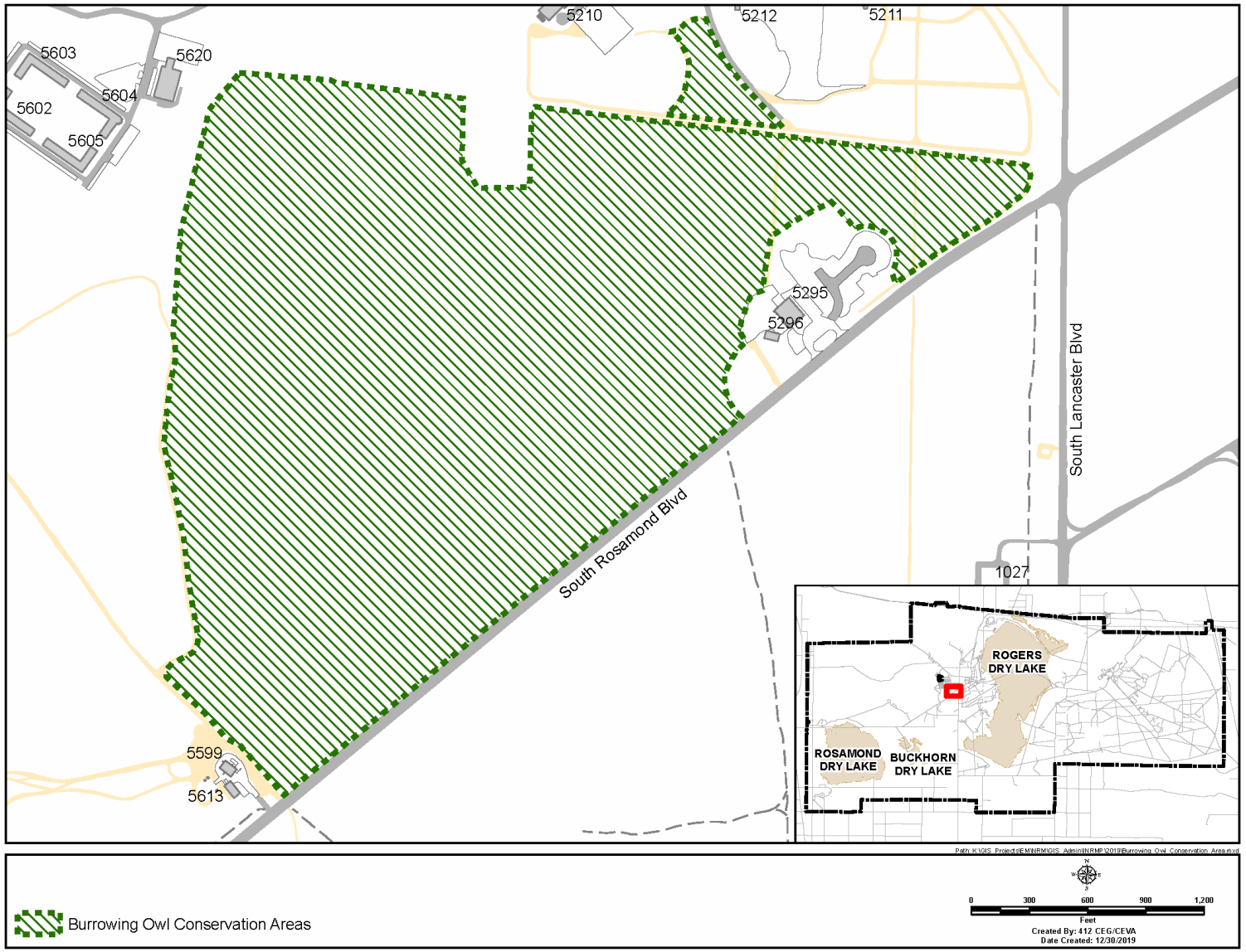

Figure 18. Burrowing Owl Conservation Area.

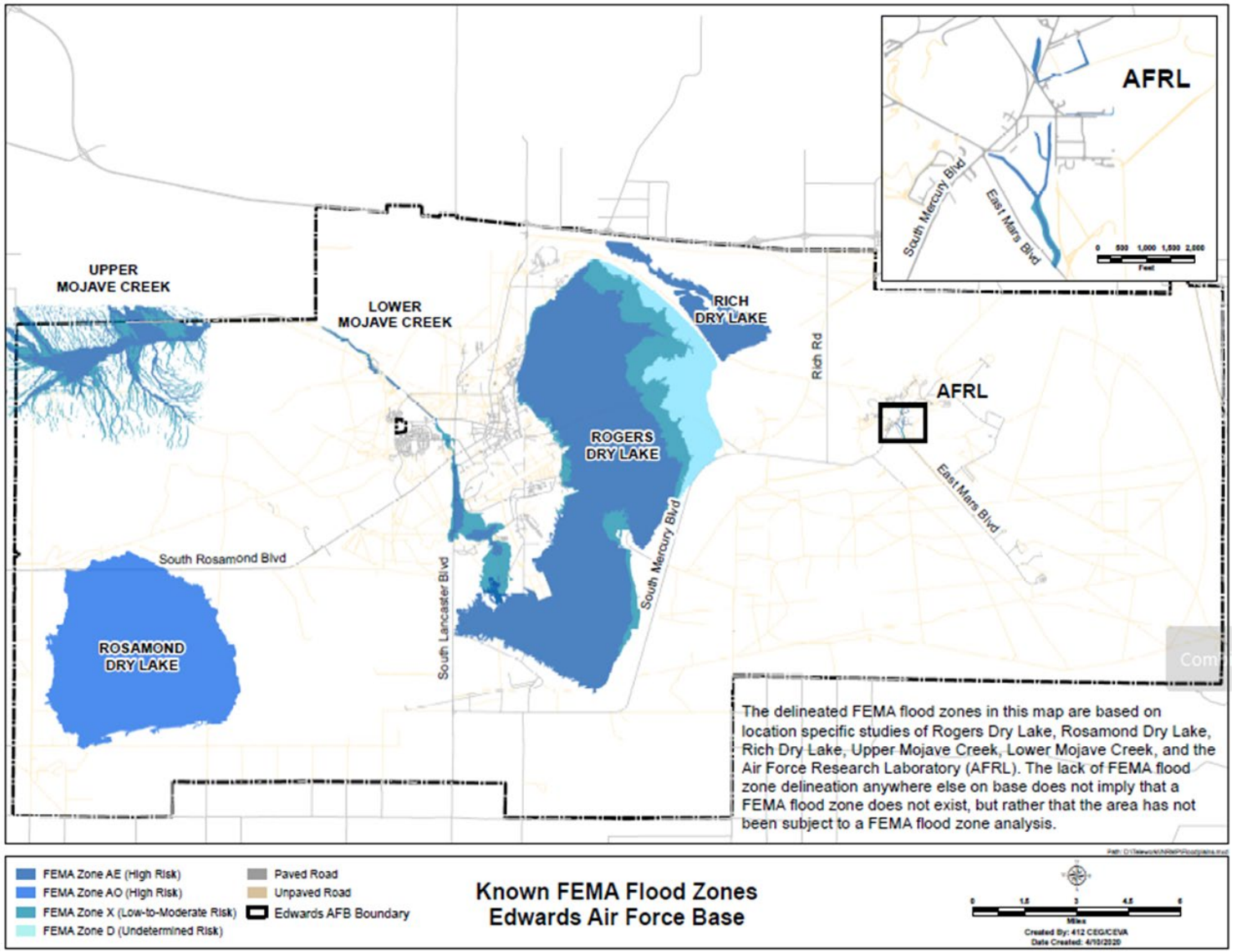

Figure 19. Federal Emergency Management Agency delineated 100-year floodplains on Edwards AFB.

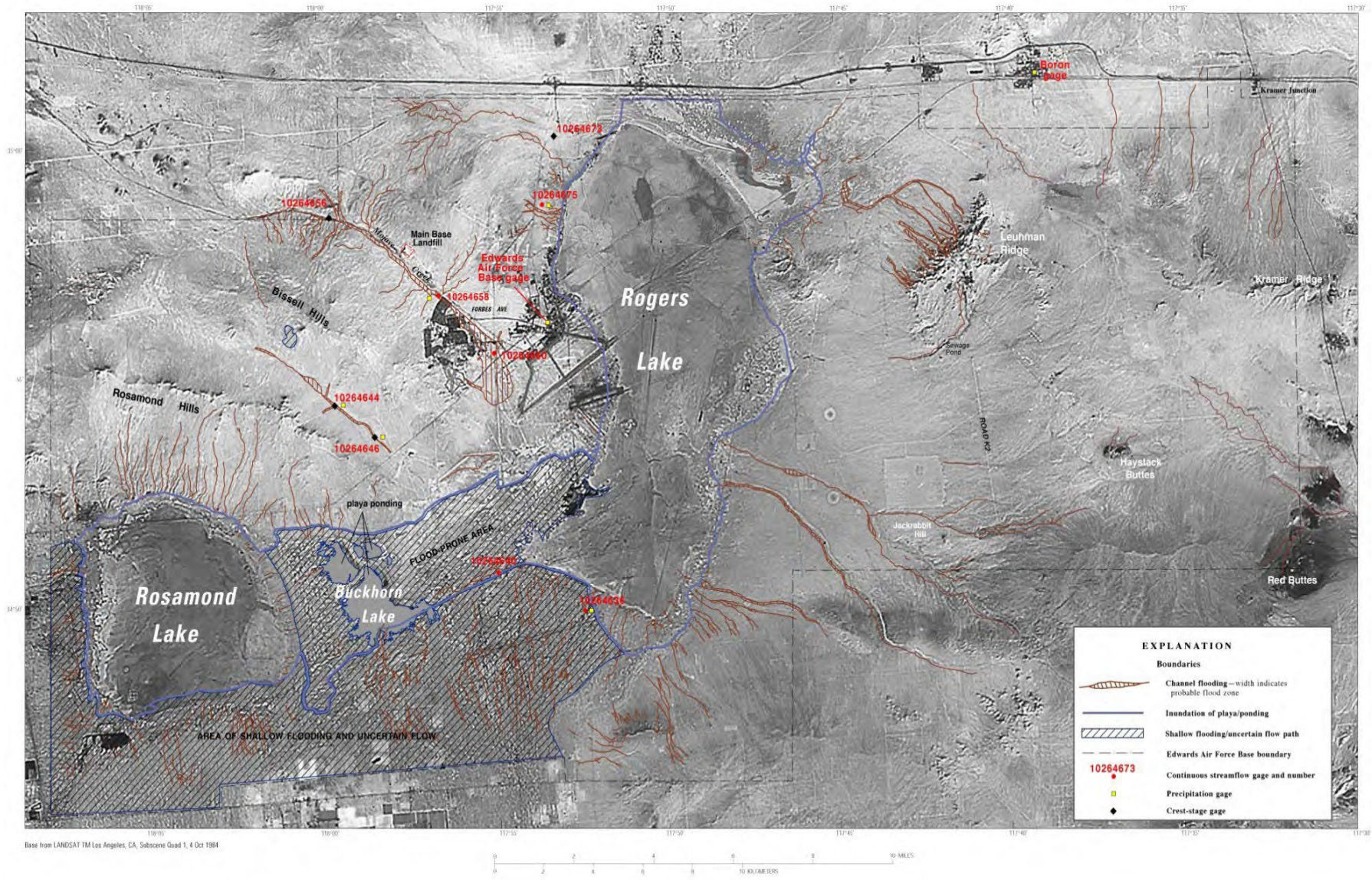

Figure 20. Flood-prone areas on Edwards AFB.

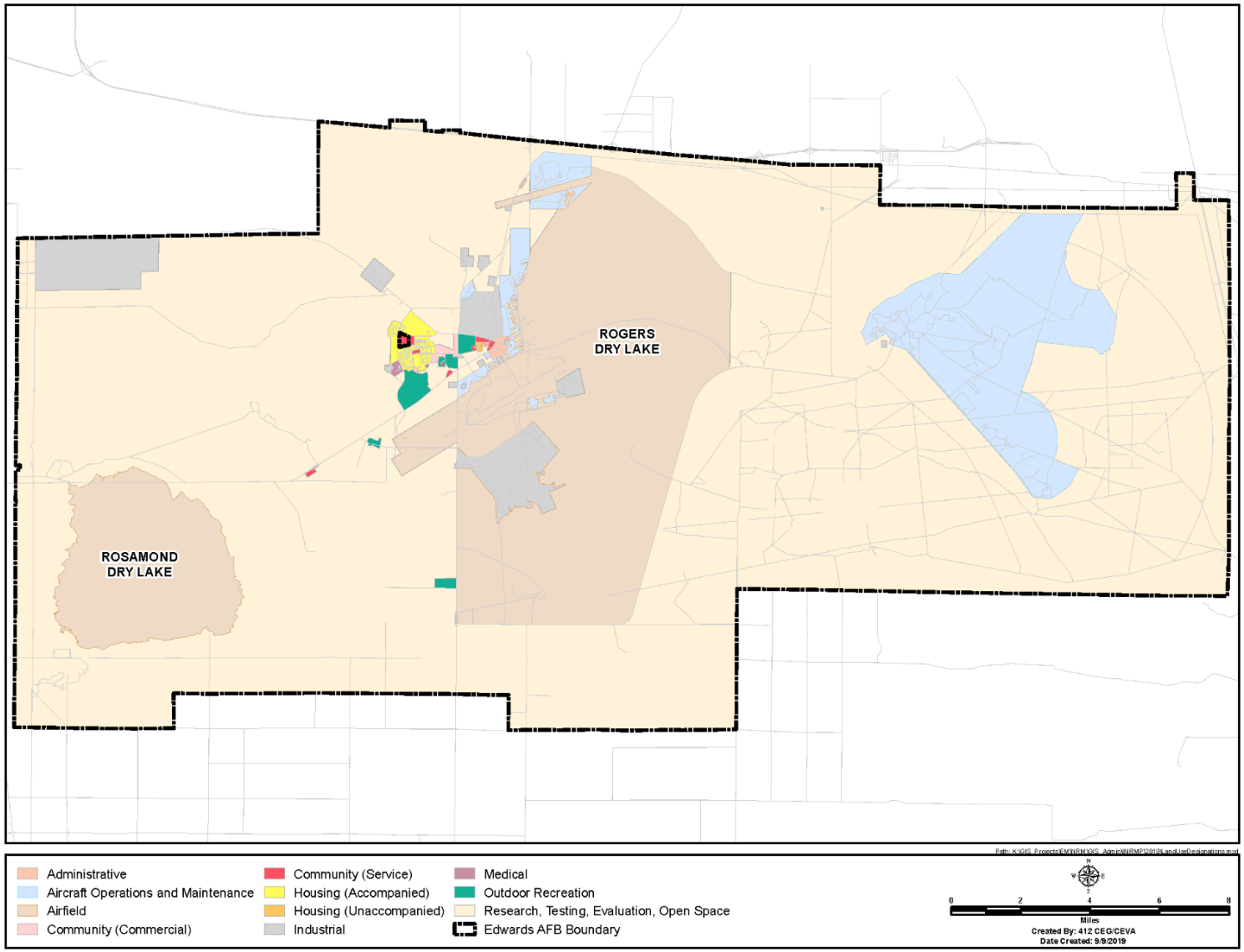

Figure 21. Land-use designations.

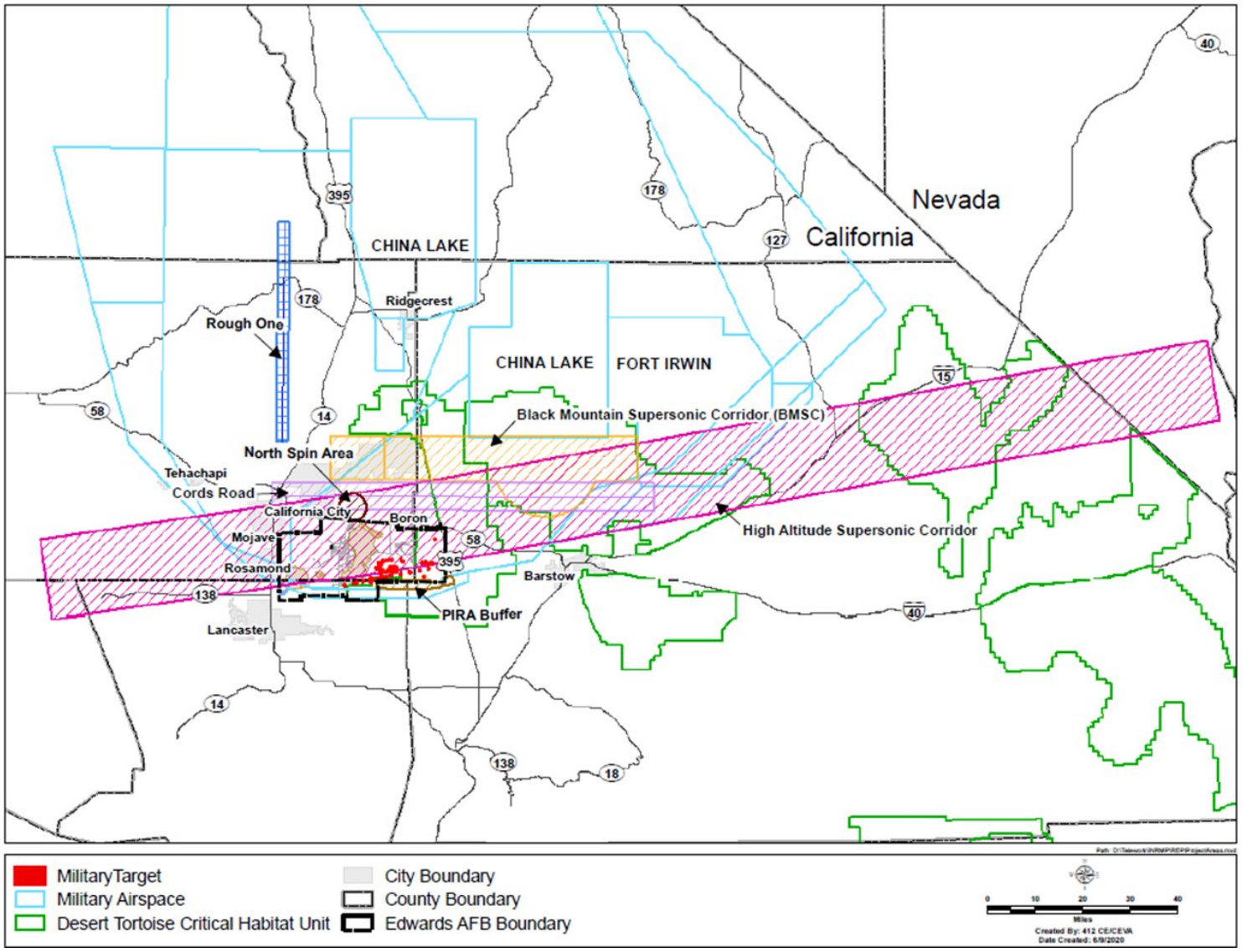

Figure 22. Edwards AFB Readiness and Environmental Protection Integration project areas.

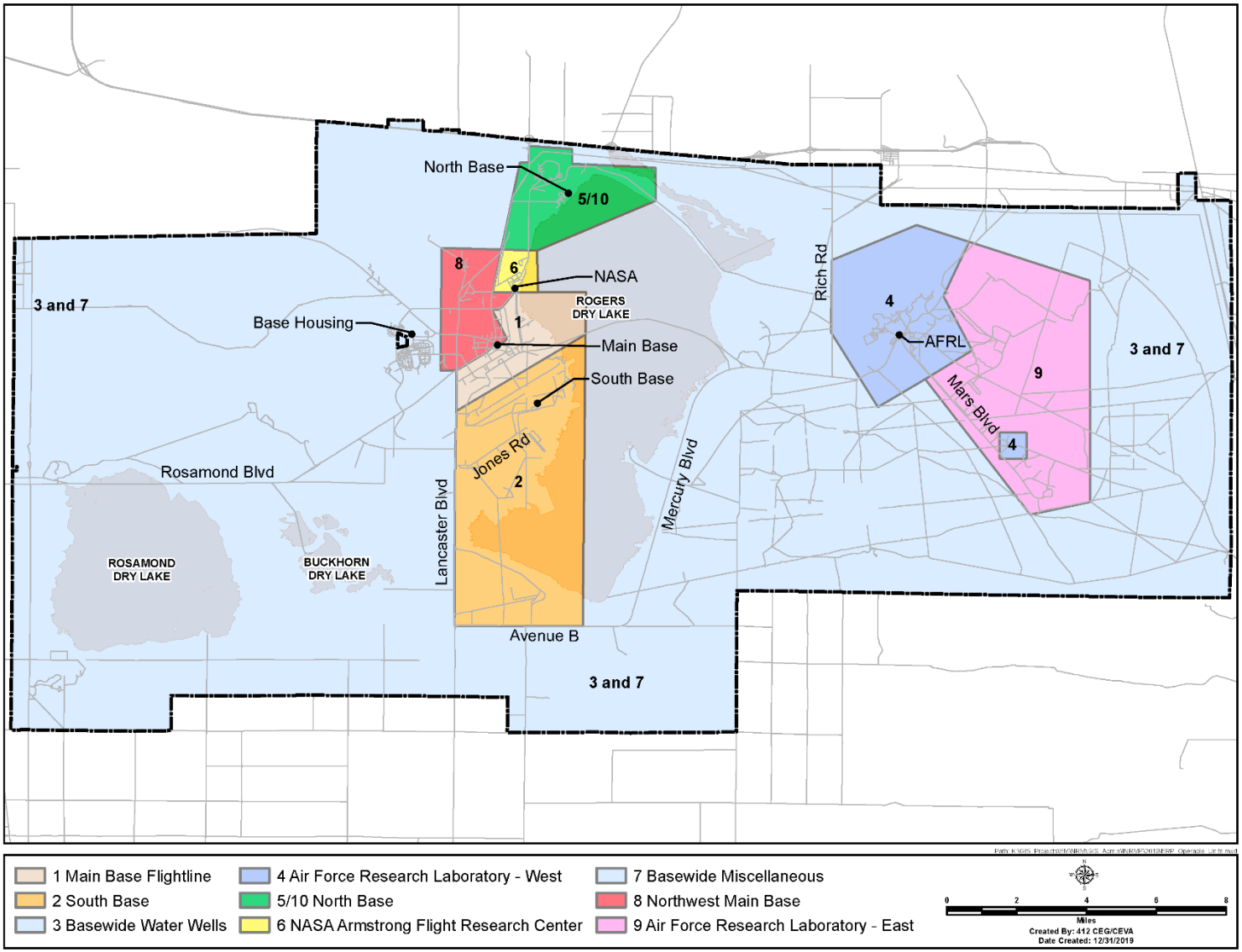

Figure 23. Environmental Restoration Program operable units.

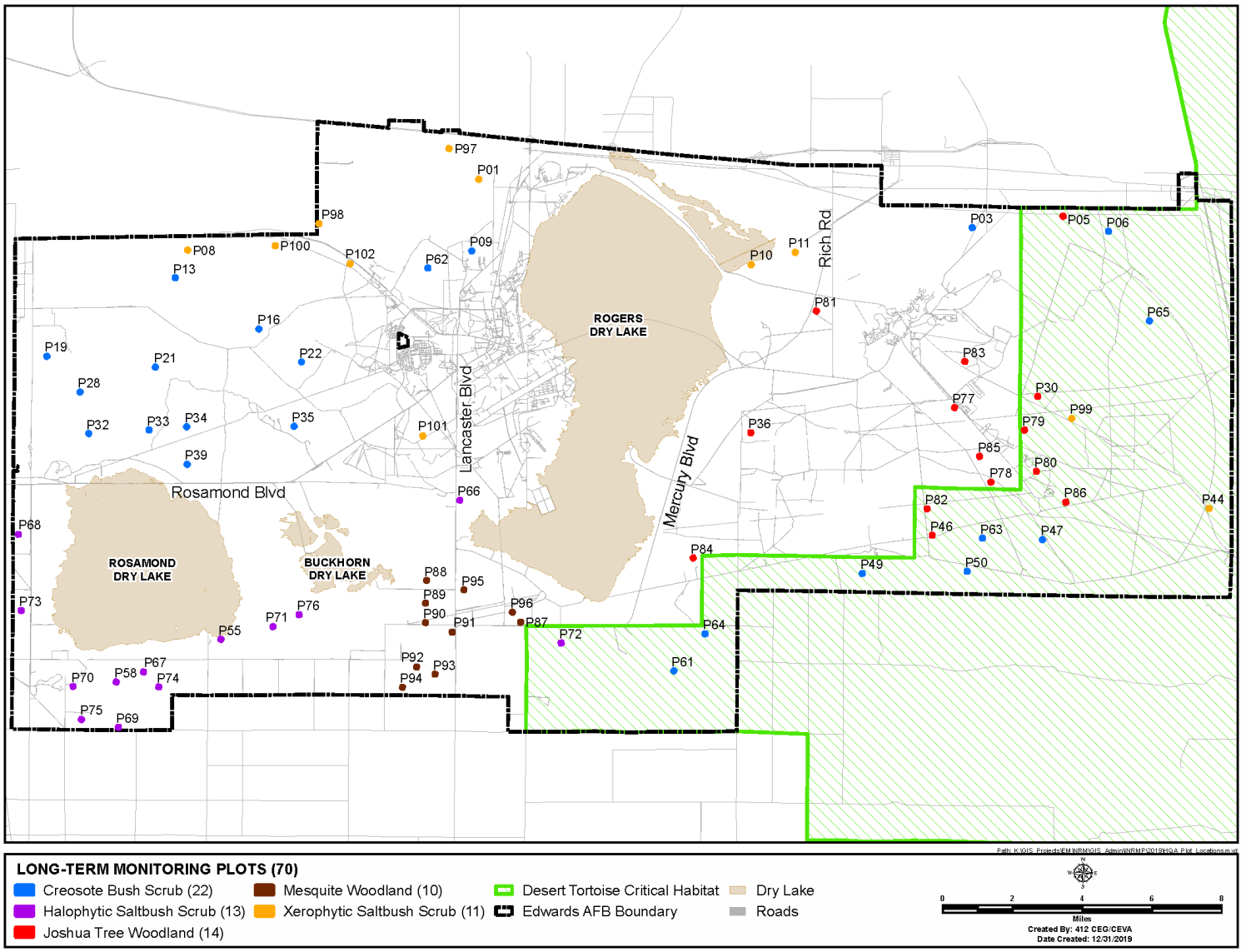

Figure 24. Habitat Quality Assessment plots on Edwards AFB.

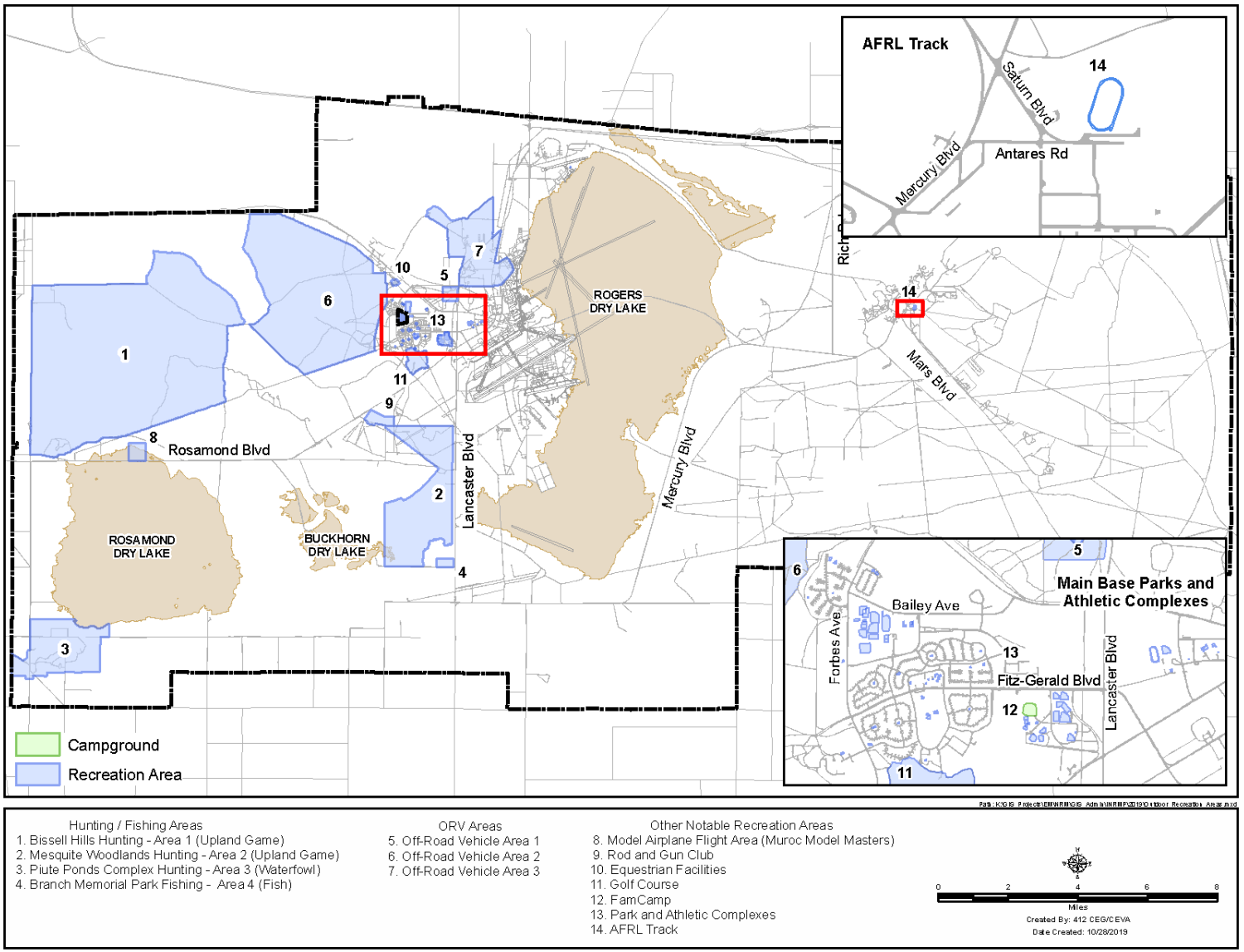

Figure 25. Outdoor Recreation Areas on Edwards AFB.

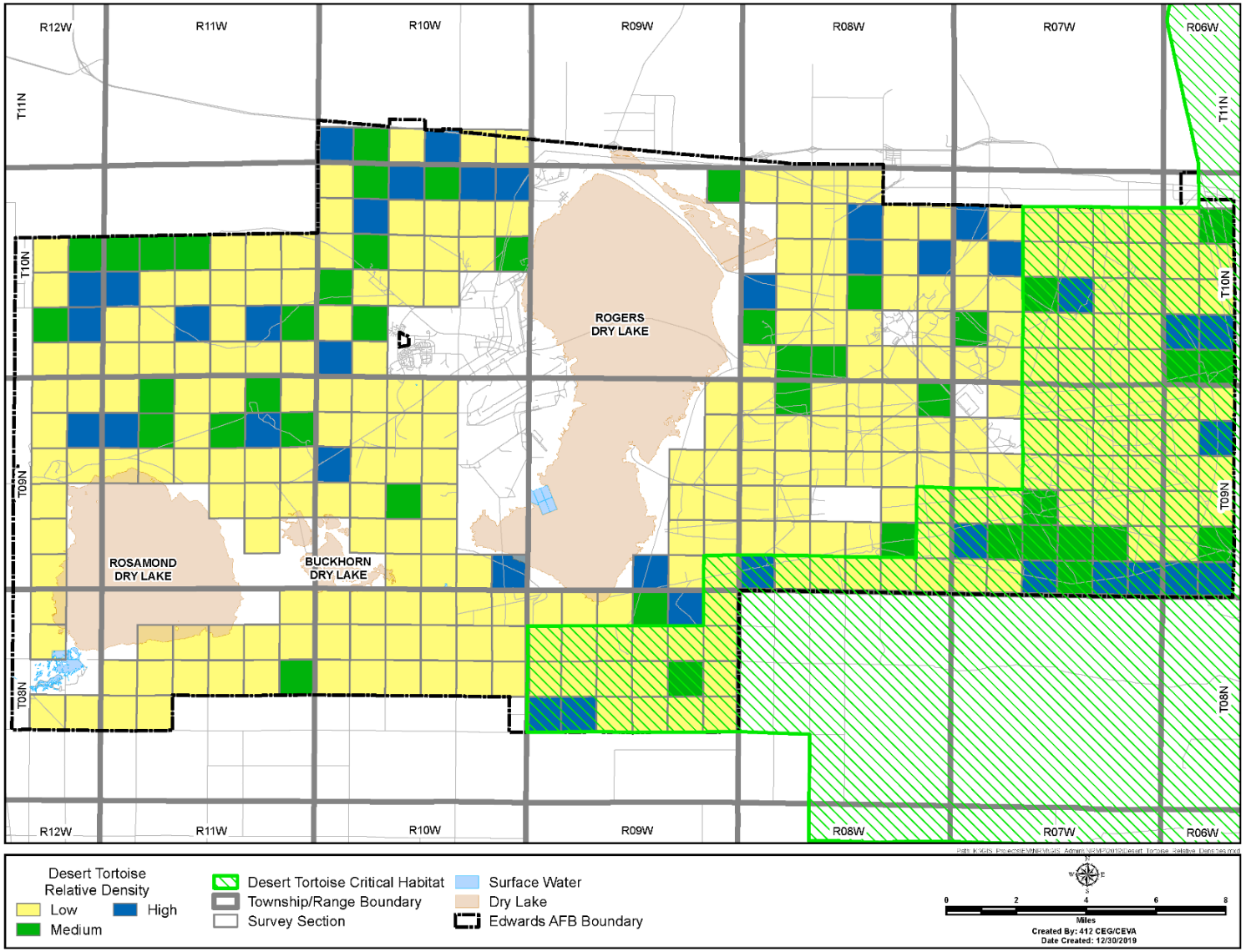

Figure 26. Relative densities of desert tortoises.

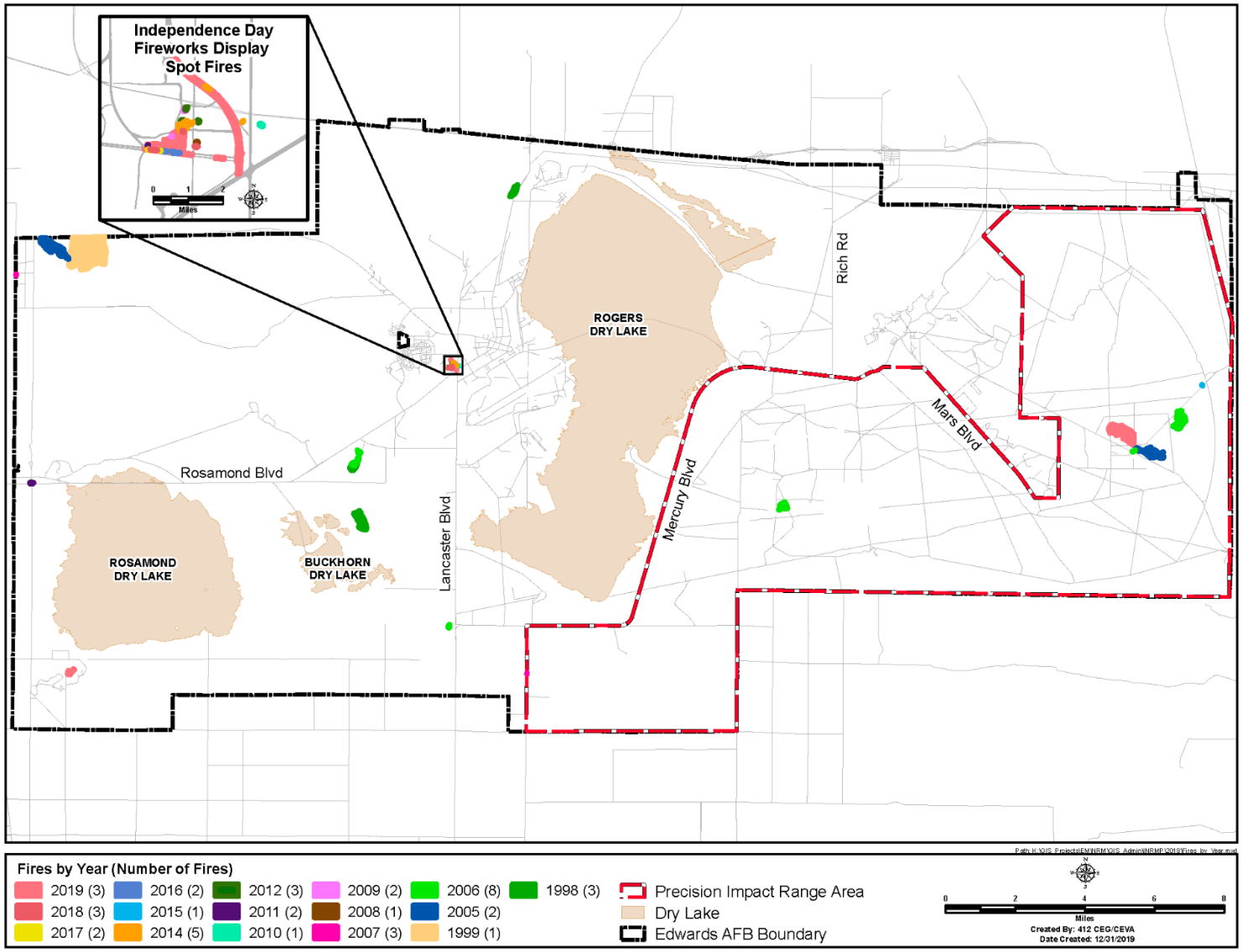

Figure 27. Fires, by year.

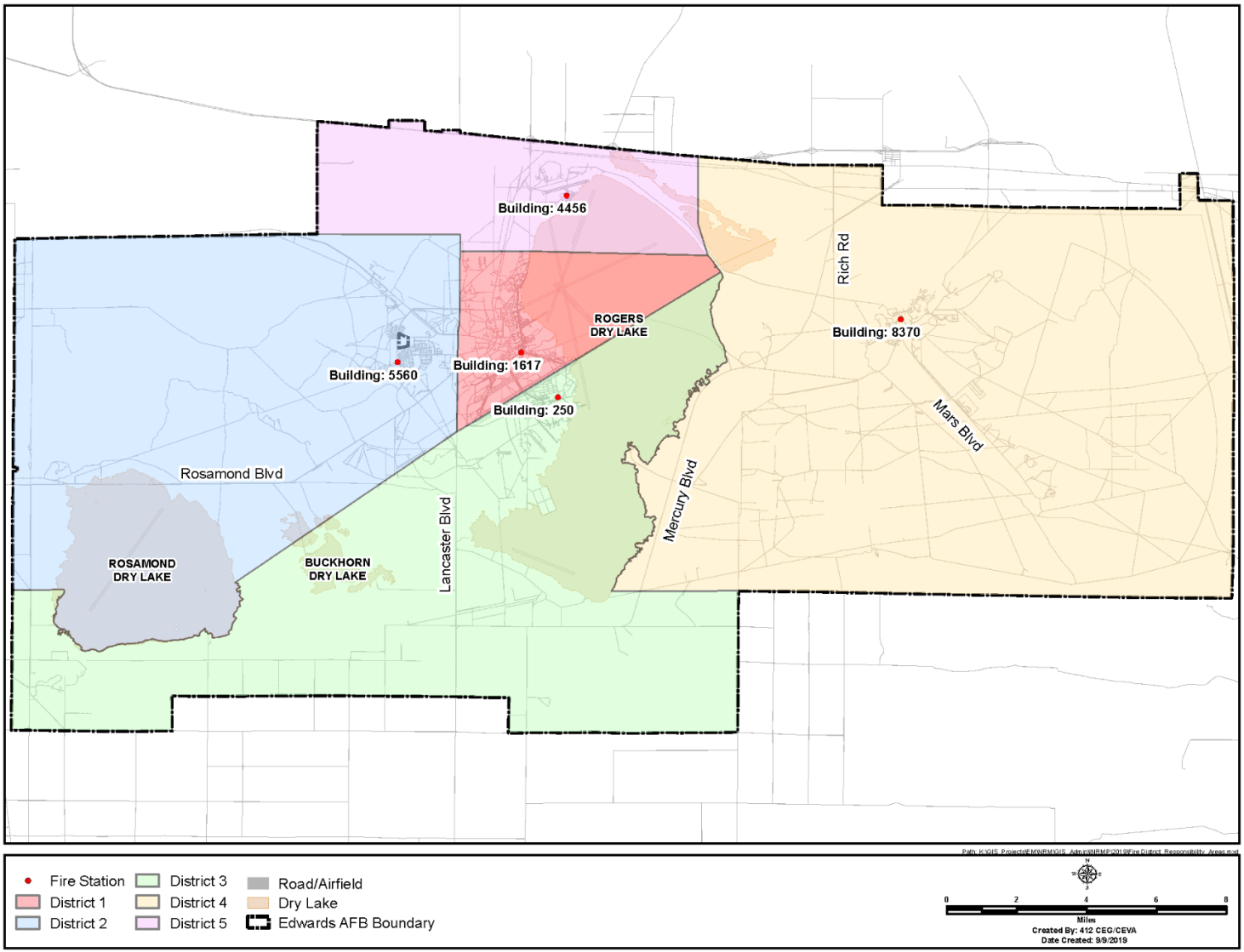

Figure 28. Fire District Responsibility Areas.

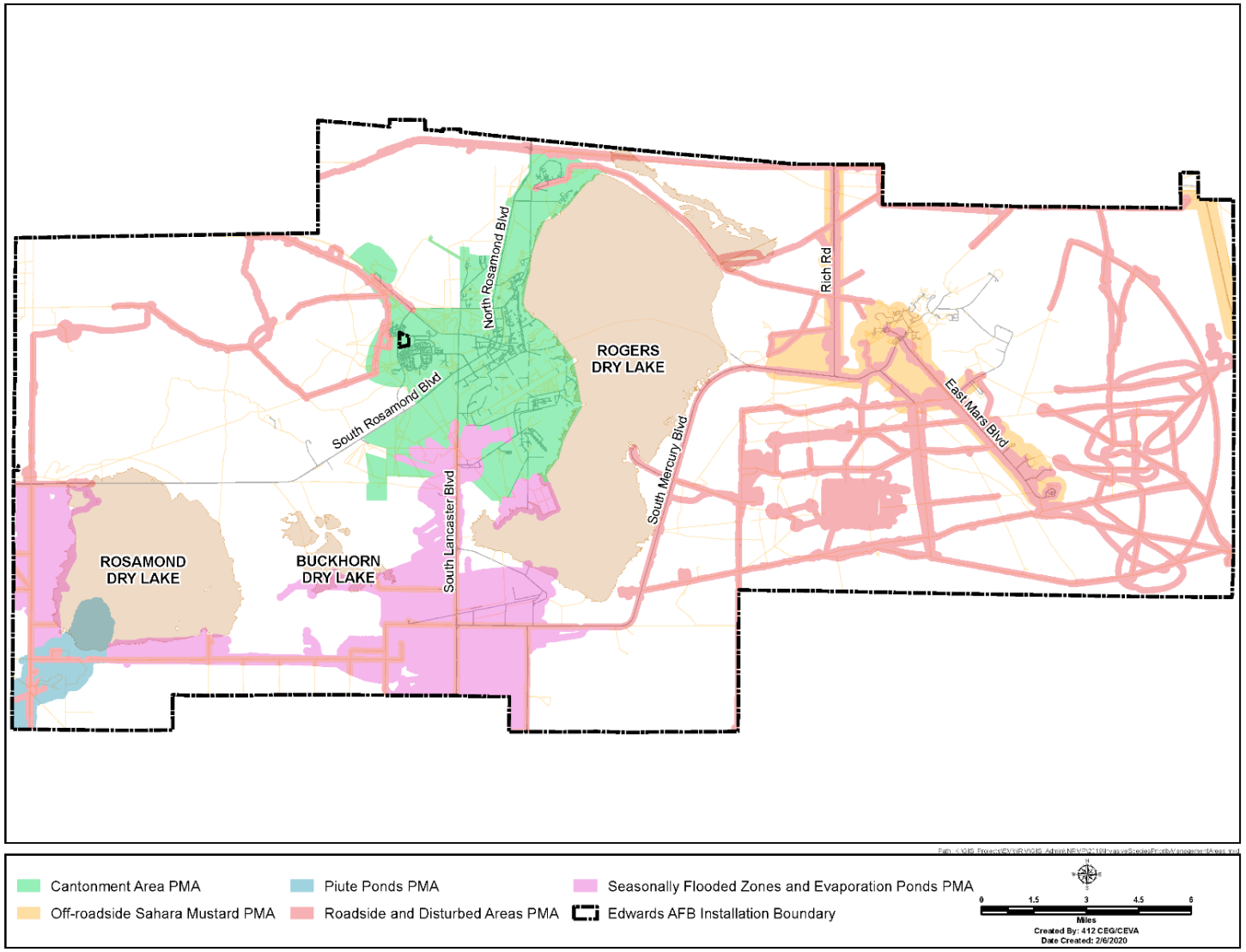

Figure 29. Invasive Species Priority Management Areas.

14.2.2 Appendix C. Tables

Table 1. Acres of habitat on Edwards AFB.

Zonal Habitats	Acreage[1]
Joshua tree woodland	52,719[a]
Halophytic saltbush	57,360[a]
Xerophytic saltbush	45,257[a]
Creosote bush	102,740[a]
Lakebeds	46,799[b]
Clay pans	3,264[c]
Azonal Habitats	**Acreage[1]**
Desert washes	501.1 (miles)[c]
Alkaline meadows	2,111[c]
Wetlands/ponds*[1]	1157[a,b]
Mesquite bosque	272[a]
Ruderal	2,741[c]
Sand dunes	Unknown[c]
Rock outcrops	3[c]
Caves/mines	1[c]
Urban	2,354[a]

[1] Sources: [a] Edwards AFB GIS LandCover layer, [b] Edwards AFB GIS WaterBody layer, [c] Unknown Data Source (possibly *Piute Ponds Management Plan*, and Lichvar and Sprecher [1996]).

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Abies concolor	White fir	Occurs	Unknown
Abronia pogonantha heimerl	Mojave sand verbena	Unknown	Unknown
Abronia villosa var. *villosa*	Desert sand verbena	Occurs	Unknown
Acamptopappus sphaerocephalus var. *hirtellus*	Rayless goldenhead	Occurs	Unknown
Achnatherum hymenoides	Indian ricegrass	Occurs	Occurs
Acmispon humistratus	Foothill deervetch	Unknown	Unknown
Acmispon strigosus	Strigose bird's-foot trefoil	Unknown	Unknown
Acmispon wrangelianus	Chilean bird's-foot trefoil	Unknown	Unknown
Agoseris retrorsa	Spearleaf agoseris	Unknown	Unknown
Aliciella hutchinsifolia	Desert pale aliciella	Unknown	Unknown
Aliciella leptomeria	Sand aliciella	Occurs	Unknown
Aliciella micromeria	Dainty aliciella	Occurs	Unknown
Allenrolfea occidentalis	Iodinebush	Unknown	Unknown
Allium fimbriatum var. *mohavense*	Mojave fringed onion	Unknown	Unknown
Alyssum desertorum	Desert madwort	Occurs	Unknown
Amaranthus albus	Tumbleweed	Unknown	Unknown
Amaranthus fimbriatus	Fringed amaranth	Unknown	Unknown
Ambrosia acanthicarpa	Annual bur-sage	Occurs	Unknown
Ambrosia dumosa	White bur-sage	Occurs	Unknown
Amsinckia intermedia	Common fiddleneck	Occurs	Unknown
Amsinckia menziesii	Common fiddleneck	Unknown	Unknown
Amsinckia tessellata	Bristly fiddleneck	Occurs	Occurs
Anisocoma acaulis	Scalebud	Unknown	Unknown
Arida parviflora	Small-flower tansy-aste	Unknown	Unknown
Artemisia tridentata parishii	Parish’s great basin sagebrush	Occurs	Unknown

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Arundo donax	Giant reed[1]	Occurs	Occurs
Asclepias erosa	Desert milkweed	Unknown	Unknown
Asclepias fascicularis	Narrow-leaf milkweed	Unknown	Unknown
Astragalus acutirostris	Sharpkeel milkvetch	Unknown	Unknown
Astragalus didymocarpus	Two-seeded milkvetch	Occurs	Unknown
Astragalus layneae	Layne Milkvetch	Occurs	Unknown
Astragalus lentiginosus	Freckled milkvetch	Occurs	Unknown
Astragalus preussii var. *laxiflorus*	Lancaster milkvetch	Occurs	Unknown
Astragalus purshii var. *tinctus*	Woollypod milkvetch	Unknown	Unknown
Atriplex argentea var. *expansa*	Silverscale saltbush	Occurs	Occurs
Atriplex canescens var. *canescens*	Fourwing saltbush	Occurs	Occurs
Atriplex confertifolia	Shadscale	Occurs	Occurs
Atriplex hymenelytra	Desert-holly	Occurs	Occurs
Atriplex lentiformis	Big saltbush	Occurs	Occurs
Atriplex parryi	Parry's saltbush	Occurs	Unknown
Atriplex phyllostegia	Leafcover saltweed	Occurs	Occurs
Atriplex polycarpa	Allscale saltbush	Occurs	Occurs
Atriplex semibaccata	Australian saltbush[3]	Unknown	Unknown
Atriplex serenana var. *serenana*	Bractscale	Occurs	Occurs
Atriplex spinifera	Spiny saltbush	Occurs	Occurs
Atriplex torreyi var. *torreyi*	Torrey's saltbush	Occurs	Unknown
Avena barbata	Slender wild oat[3]	Occurs	Unknown
Baccharis salicifolia	Mule-fat	Unknown	Unknown
Baileya pleniradiata	Woolly desert marigold	Unknown	Unknown
Bassia hyssopifolia	Five-hook bassia[4]	Occurs	Occurs

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Brassica tournefortii	Sahara mustard[2]	Occurs	Occurs
Brickellia desertorum	Desert brickelbush	Occurs	Unknown
Bromus arizonicus	Arizona brome	Occurs	Unknown
Bromus berteroanus	Chilean chess	Occurs	Occurs
Bromus diandrus	Ripgut brome[3]	Unknown	Unknown
Bromus madritensis	Foxtail chess[2]	Occurs	Unknown
Bromus rubens	Red brome[2]	Occurs	Occurs
Bromus tectorum	Cheat grass[2]	Occurs	Occurs
Callitropsis arizonica	Arizona cypress	Unknown	Unknown
Calochortus kennedyi var. *kennedyi*	Desert mariposa lily	Unknown	Unknown
Calochortus striatus	Alkali mariposa lily	Occurs	Occurs
Calycoseris parryi	Yellow tack-stem	Unknown	Unknown
Camissonia brevipes	Golden suncups	Occurs	Unknown
Camissonia campestris	Mojave suncup	Occurs	Occurs
Camissonia strigulosa	Sandysoil suncup	Occurs	Unknown
Camissonia claviformis	Brown-eye suncup	Occurs	Unknown
Canbya candida	White pygmy-poppy	Occurs[1]	Unknown
Capsella bursa-pastoris	Shepherd's purse	Unknown	Unknown
Cardamine hirsuta	Hairy bittercress	Occurs	Unknown
Castilleja exsert	Purple owl's-cover	Occurs	Unknown
Castilleja exserta ssp. *venusta*	Exserted Indian paintbrush	Occurs	Unknown
Caulanthus cooperi	Cooper's wild cabbage	Occurs	Unknown
Caulanthus inflatus	Desert candle	Occurs	Unknown
Caulanthus lasiophyllus	California mustard	Occurs	Unknown
Cenchrus longispinus	Mat sandbur	Unknown	Unknown
Centaurea melitensis	Maltese star-thisle[3]	Occurs	Unknown

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Centaurea solstitialis	Yellow star-thistle	Occurs	Unknown
Centaurea stoebe ssp. *micranthos*	Spotted knapweed[2]	Unknown	Unknown
Centromadia pungens	Common tarweed	Occurs	Unknown
Centromadia pungens ssp. *pungens*	Common spikeweed	Unknown	Unknown
Centrostegia thurberi	Red triangles	Occurs	Unknown
Chaenactis carphoclinia	Pebble pincushion	Unknown	Unknown
Chaenactis fremontii	Fremont pincushion	Occurs	Occurs
Chaenactis macrantha	Mojave pincushion	Occurs	Unknown
Chaenactis stevioides	Desert pincushion	Occurs	Occurs
Chaenactis xantiana	Fleshy pincushion	Occurs	Occurs
Chamaesyce polycarp	Smallseed sandmat	Occurs	Unknown
Chamaesyce serpyllifoliaa	Thymeleaf sandmat	Unknown	Unknown
Chenopodium album	Lamb's quarters	Occurs	Occurs
Chenopodium murale	Nettleleaf goosefoot	Unknown	Unknown
Chenopodium rubrum	Red pigweed	Unknown	Unknown
Chloris virgata	Feather finger grass	Unknown	Unknown
Chloropyron maritimum ssp. *canescens*	Saltmarsh bird's beak	Unknown	Unknown
Chorizanthe brevicornu	Brittle spineflower	Occurs	Unknown
Chorizanthe rigida	Devil's spineflower	Occurs	Unknown
Chorizanthe spinosa	Mojave spineflower	Occurs	Occurs
Chorizanthe watsonii	Watson's spineflower	Occurs	Unknown
Cirsium vulgare	Bull thistle	Occurs	Occurs
Cistanthe monandra	Common pussypaws	Occurs	Unknown
Cleomella obtusifolia	Mojave stinkweed	Occurs	Occurs

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Collinsia bartsiifolia var. *davidsonii*	Davidson's blue eyed Mary	Unknown	Unknown
Convolvulus arvensis	Bindweed	Unknown	Unknown
Conyza bonariensis	Asthmaweed	Unknown	Unknown
Conyza canadensis	Canadian horseweed	Unknown	Unknown
Coreopsis bigelovii	Bigelow's tickseed	Occurs	Occurs
Coreopsis californica	California tickseed	Occurs	Unknown
Coreopsis calliopsidea	Leafstem tickseed	Occurs	Unknown
Crassula connata	Pygmy-weed	Unknown	Unknown
Cressa truxillensis	Spreading alkaliweed	Occurs	Occurs
Croton californicus	California croton	Occurs	Unknown
Croton setiger	Doveweed	Unknown	Unknown
Crypsis schoenoides	Swamp prickle grass	Unknown	Unknown
Cryptantha circumscissa var. *circumscissa*	Cushion cryptantha	Occurs	Unknown
Cryptantha decipiens	Gravel cryptantha	Unknown	Unknown
Cryptantha dumetorum	Scrambling cryptantha	Occurs	Unknown
Cryptantha micrantha	Redroot cryptantha	Occurs	Unknown
Cryptantha nevadensis var. *nevadensis*	Nevada cryptantha	Unknown	Unknown
Cryptantha nevadensis var. *rigida*	Rigid cryptantha	Occurs	Unknown
Cryptantha pterocarya	Winged-nut cryptantha	Occurs	Unknown
Cryptantha similis	Dome cryptantha	Unknown	Unknown
Cucurbita palmata	Coyote melon	Unknown	Unknown
Cuscuta californica	Chaparral dodder	Occurs	Unknown
Cylindropuntia acanthocarpa	Buckhorn cholla	Occurs	Occurs
Cylindropuntia arbuscula	Arizona pencil cholla	Occurs	Unknown

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Cylindropuntia bigelovii	Teddy-bear cholla	Occurs	Occurs
Cylindropuntia echinocarpa	Golden or silver cholla	Occurs	Unknown
Cylindropuntia ramosissima	Diamond cholla	Unknown	Unknown
Cymopterus deserticola	Desert cymopterus	Occurs	Unknown
Cynodon dactylon	Bermuda grass[3]	Unknown	Unknown
Dasyochloa pulchella	Low woollygrass	Occurs	Unknown
Datura wrightii	Sacred thorn-apple	Unknown	Unknown
Delphinium parishii ssp. *parishii*	Desert larkspur	Occurs	Unknown
Delphinium recurvatum	Recurved larkspur	Occurs[1]	Unknown
Descurainia pinnata ssp. *glabra*	Western tansymustard	Occurs	Unknown
Descurainia sophia	Herb sophia[4]	Occurs	Unknown
Dichelostemma capitatum ssp. *pauciflorum*	Bluedicks	Occurs	Unknown
Dicoria canescens	Desert twinbugs	Unknown	Unknown
Digitaria sanguinalis	Hairy crab grass	Unknown	Unknown
Distichlis spicata	Saltgrass	Occurs	Occurs
Dithyrea californica	California shieldpod	Unknown	Unknown
Echinocactus polycephalus var. *polycephalus*	Cottontop cactus	Unknown	Unknown
Echinochloa colona	Jungle rice	Unknown	Unknown
Eleocharis montevidensis	Sand spikerush	Unknown	Unknown
Elymus elymoides	Squirreltail	Occurs	Unknown
Emmenanthe penduliflora	Whispering bells	Unknown	Unknown
Encelia farinosa	Brittlebush	Occurs	Unknown
Ephedra aspera	Boundary ephedra	Occurs	Unknown
Ephedra californica	Desert tea	Occurs	Unknown
Ephedra nevadensis	Nevada ephedra	Occurs	Unknown

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Epilobium brachycarpum	Tall annual willowherb	Occurs	Unknown
Eremalche exilis	White mallow	Occurs	Unknown
Eremalche rotundifolia	Desert fivespot	Occurs	Unknown
Eremothera boothii ssp. *desertorum*	Desert suncup	Occurs	Occurs
Eriastrum densifolium	Giant woollystar	Occurs	Unknown
Eriastrum diffusum	Miniature woollystar	Occurs	Unknown
Eriastrum eremicum	Desert woollystar	Occurs	Occurs
Eriastrum hooveri	Hoover's woollystar	Occurs	Occurs
Eriastrum pluriflorum ssp. *sherman-hoytae*	Many-flowered Eriastrum	Occurs	Unknown
Eriastrum rosamondense	Rosamond eriastrum	Occurs	Occurs
Eriastrum sapphirinum ssp. *sapphirinum*	Sapphire woollystar	Occurs	Occurs
Ericameria cooperi	Cooper's goldenbush	Occurs	Occurs
Ericameria linearifolia	Interior goldenbrush	Unknown	Unknown
Ericameria nauseosa var. *hololeuca*	White rabbitbrush	Unknown	Unknown
Ericameria nauseosa var. *mohavensis*	Mojave rabbitbrush	Occurs	Occurs
Ericameria nauseosa var. *nauseosa*	Rubber rabbitbrush	Occurs	Occurs
Ericameria teretifolia	Green or Round-leaf rabbitbrush	Occurs	Occurs
Eriogonum angulosum	Angle-stem wild buckwheat	Occurs	Occurs
Eriogonum baileyi var. *baileyi*	Bailey's wild buckwheat	Unknown	Unknown
Eriogonum brachyanthum	Short-flower wild buckwheat	Unknown	Unknown
Eriogonum clavatum	Hoover's desert trumpet	Unknown	Unknown

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Eriogonum deflexum var. *deflexum*	Flat-topped skeleton weed	Unknown	Unknown
Eriogonum fasciculatum var. *foliolosum*	Leafy California buckwheat	Occurs	Unknown
Eriogonum fasciculatum var. *polifolium*	Mojave desert California buckwheat	Occurs	Unknown
Eriogonum gracillimum	Rose-and-white wild buckwheat	Occurs	Occurs
Eriogonum inflatum	Desert trumpet	Occurs	Unknown
Eriogonum maculatum	Spotted wild buckwheat	Unknown	Unknown
Eriogonum mohavense	Western mojave wild buckwheat	Occurs	Unknown
Eriogonum nidularium	Birdnest wild buckwheat	Unknown	Unknown
Eriogonum plumatella	Yucca wild buckwheat	Unknown	Unknown
Eriogonum pusillum	Yellow turbans	Occurs	Occurs
Eriogonum thomasii	Thomas' wild buckwheat	Occurs	Unknown
Eriogonum trichopes	Little desert trumpet	Occurs	Unknown
Eriogonum viridescens	Two-toothed wild buckwheat	Unknown	Unknown
Eriophyllum mohavense	Barstow woolly sunflower	Occurs	Unknown
Eriophyllum pringlei	Pringle's woolly sunflower	Occurs	Unknown
Eriophyllum wallacei	Wallace's woolly daisy	Occurs	Unknown
Erodium cicutarium	Red-stem filaree[4]	Occurs	Occurs
Erodium texanum	Texas filaree	Occurs	Unknown
Erysimum capitatum var. *capitatum*	Sanddune wallflower	Unknown	Unknown
Eschscholzia glyptosperma	Desert poppy	Occurs	Unknown
Eschscholzia minutiflora ssp. *minutiflora*	Pygmy poppy	Occurs	Unknown

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Eschscholzia minutiflora ssp. *twisselmannii*	Red Rock poppy	Occurs	Unknown
Eucrypta chrysanthemifolia var. *bipinnatifida*	Spotted hideseed	Unknown	Unknown
Eucrypta micrantha	Dainty desert hideseed	Unknown	Unknown
Euphorbia albomarginata	Rattlesnake sandmat	Occurs	Unknown
Euphorbia micromera	Sonoran sandmat	Occurs	Unknown
Euphorbia ocellata ssp. *Arenicola*	Dune spurge	Occurs	Unknown
Euthamia occidentalis	Western goldenrod	Unknown	Unknown
Forestiera pubescens	Desert olive	Occurs	Unknown
Frankenia salina	Alkali heath	Unknown	Unknown
Gilia aliquanta	Western gilia	Unknown	Unknown
Gilia cana	Desert gilia	Occurs	Unknown
Gilia latiflora	Broad-flowered gilia	Occurs	Occurs
Gilia minor	Little gilia	Occurs	Occurs
Gilia ochroleuca	Volcanic gilia	Unknown	Unknown
Gilia sinuata	Rosy gilia	Unknown	Unknown
Gilia tricolor	Bird's-eye gilia	Occurs	Unknown
Gilmania luteola	Golden-carpet gilmania	Occurs	Unknown
Gnaphalium palustre	Western marsh cudweed	Unknown	Unknown
Goodmania luteola	Golden goodmania	Occurs	Occurs
Grayia spinosa	Spiny hopsage	Occurs	Occurs
Grindelia squarrosa var. *serrulata*	Curlycup gumweed	Unknown	Unknown
Gutierrezia microcephala	Sticky snakeweed	Occurs	Unknown
Helianthus annuus	Common sunflower	Unknown	Unknown

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Heliotropium curassavicum var. *oculatum*	Alkali heliotrope	Occurs	Unknown
Hesperocallis undulata	Desert lily	Occurs	Unknown
Heterotheca grandiflora	Telegraph weed	Occurs	Unknown
Hilaria rigida	Big Galleta	Occurs	Unknown
Hirschfeldia incana	Shortpod mustard	Occurs	Unknown
Hordeum marinum	Mediterranean barley	Occurs	Occurs
Hordeum murinum ssp. *glaucum*	Smooth barley	Occurs	Unknown
Hordeum murinum ssp. *leporinum*	Hare barley	Occurs	Occurs
Hornungia procumbens	Prostrate hutchinsia	Unknown	Unknown
Isocoma acradenia var. *acradenia*	Alkali goldenbush	Occurs	Unknown
Iva axillaris	Poverty weed	Unknown	Unknown
Juncus balticus var. *mexicanus*	Mexican rush	Unknown	Unknown
Juncus bufonius	Toad rush	Occurs	Occurs
Kochia californica	Rusty molly	Occurs	Occurs
Krascheninnikovia lanata	Winter fat	Occurs	Occurs
Lactuca sativa	Garden Lettuce	Occurs	Unknown
Lactuca serriola	Prickly lettuce	Occurs	Occurs
Laennecia coulteri	Coulter's horseweed	Unknown	Unknown
Langloisia matthewsii	Desert calico	Occurs	Occurs
Langloisia setosissima	Bristly langloisia	Unknown	Unknown
Langloisia setosissima ssp. *punctata*	Lilac sunbonnet	Unknown	Unknown
Larrea tridentata	Creosote bush	Occurs	Unknown
Lasthenia californica	California goldfields	Occurs	Occurs
Lasthenia glabrata ssp. *glabrata*	Yellow-ray goldfields	Occurs	Unknown

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Lasthenia gracilis	Common goldfields	Occurs	Unknown
Layia glandulosa	White layia	Occurs	Unknown
Layia platyglossa	Tidy-tips	Occurs	Unknown
Lemna	Duckweed	Unknown	Unknown
Lepidium appelianum	White-top[4]	Unknown	Unknown
Lepidium dictyotum	Alkali pepperweed	Occurs	Unknown
Lepidium draba	Heart-podded hoary cress	Occurs	Unknown
Lepidium flavum	Yellow pepperweed	Occurs	Occurs
Lepidium fremontii	Desert pepperweed	Occurs	Unknown
Lepidium lasiocarpum	Southern pepperwort	Occurs	Unknown
Lepidium latifolium	Perennial pepperweed	Occurs	Occurs
Lepidium nitidum	Shining pepperweed	Unknown	Unknown
Lepidium perfoliatum	Clasping pepperweed	Occurs	Unknown
Leptochloa fusca ssp. *fascicularis*	Bearded sprangletop	Unknown	Unknown
Leptosiphon aureus ssp. *aureus*	Golden linanthus	Occurs	Unknown
Lessingia glandulifera var. *glandulifera*	Valley lessingia	Occurs	Unknown
Leymus cinereus	Basin wildrye	Occurs	Unknown
Linanthus arenicola	Sand linanthus	Unknown	Unknown
Linanthus bigelovii	Bigelow's linanthus	Unknown	Unknown
Linanthus dichotomus	Evening snow	Occurs	Unknown
Linanthus parryae	Sandblossoms	Occurs	Unknown
Loeflingia squarrosa var. *lartemisiarum*	Spreading pygmyleaf	Occurs	Occurs
Loeseliastrum schottii	Schott's calico	Occurs	Unknown
Logfia depressa	Hierba limpia	Occurs	Occurs

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Lomatium mohavense	Mojave desertparsley	Occurs	Unknown
Lotus scoparius	Common deerweed	Occurs	Unknown
Lupinus bicolor	Miniature lupine	Occurs	Unknown
Lupinus horizontalis var. *horizontalis*	Sunset lupine	Occurs	Unknown
Lupinus odoratus	Mohave lupine	Occurs	Unknown
Lupinus shockleyi	Desert lupine	Unknown	Unknown
Lycium andersonii	Water jacket	Occurs	Occurs
Lycium cooperi	Peach thorn	Occurs	Unknown
Lycium fremontii	Fremont's desert-thorn	Occurs	Unknown
Malacothrix coulteri	Snake's-head	Occurs	Occurs
Malacothrix glabrata	Desert dandelion	Occurs	Occurs
Malacothrix sonchoides	Sowthistle dandelion	Occurs	Unknown
Malva neglecta	Common mallow	Occurs	Unknown
Marah fabacea	California man-root	Occurs	Unknown
Marah macrocarpa	Chilicothe	Occurs	Unknown
Marrubium vulgare	Horehound[4]	Occurs	Unknown
Matricaria discoidea	Pineapple weed	Occurs	Occurs
Matricaria occidentalis	Valley mayweed	Occurs	Occurs
Medicago sativa	Alfalfa	Unknown	Unknown
Melilotus albus	White sweetclover	Unknown	Unknown
Melilotus officinalis	Yellow sweetclover	Unknown	Unknown
Mentzelia affinis	Yellowcomet	Occurs	Unknown
Mentzelia albicaulis	Whitestem blazingstar	Occurs	Occurs
Mentzelia obscura	Pacific blazingstar	Unknown	Unknown
Mentzelia veatchiana	Veatch's blazingstar	Unknown	Unknown
Mimulus fremontii	Fremont's monkeyflower	Unknown	Unknown

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Mimulus pilosus	False monkeyflower	Unknown	Unknown
Mimulus rubellus	Little redstem monkeyflower	Unknown	Unknown
Mirabilis laevis var. *crassifolia*	California four o'clock	Occurs	Unknown
Mirabilis laevis var. *retrorsa*	Wishbone-bush	Occurs	Unknown
Mirabilis laevis var. *villosa*	Wishbone-bush	Occurs	Unknown
Mollugo cerviana	Threadstem carpetweed	Occurs	Unknown
Monardella exilis	Desert monardella	Occurs	Unknown
Monolepis nuttalliana	Nuttall's poverty weed	Occurs	Occurs
Monoptilon bellidiforme	Daisy desertstar	Occurs	Unknown
Monoptilon bellioides	Mojave desertstar	Occurs	Unknown
Mucronea perfoliata	Perfoliate spineflower	Occurs	Unknown
Muilla coronata	Crowned muilla	Occurs	Unknown
Nama demissa	Purple mat	Occurs	Unknown
Nama pusilla	Smallleaf nama	Unknown	Unknown
Nemacladus gracilis	Slender nemacladus	Occurs	Unknown
Nemacladus orientalis	Eastern thread-stem	Unknown	Unknown
Nicolletia occidentalis	Hole-in-the-sand plant	Occurs	Unknown
Nitrophila occidentalis	Boraxweed	Occurs	Unknown
Oenothera californica ssp. *avita*	California evening primrose	Unknown	Unknown
Oenothera deltoides	Basket evening-primrose	Occurs	Unknown
Oenothera primiveris	Desert evening primrose	Occurs	Unknown
Opuntia basilaris	Beavertail	Occurs	Unknown
Oxytheca perfoliata	Round-leaf puncturebract	Occurs	Unknown
Palafoxia arida	Desert palafox	Occurs	Unknown
Panicum capillare	Witchgrass	Unknown	Unknown
Pectis papposa	Chinch-weed	Unknown	Unknown

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Pectocarya heterocarpa	Mixed-nut pectocarya	Occurs	Unknown
Pectocarya linearis	Sagebrush combseed	Occurs	Occurs
Pectocarya penicillata	Northern pectocarya	Occurs	Occurs
Pectocarya platycarpa	Wide-toothed pectocarya	Occurs	Unknown
Pectocarya recurvata	Arched-nut pectocarya	Unknown	Unknown
Pectocarya setosa	Round-nut pectocarya	Occurs	Unknown
Peganum harmala	African rue	Occurs	Unknown
Peritoma arborea	Bladderpod	Unknown	Unknown
Peritoma arborea var. *arborea*	Bladderpod	Unknown	Unknown
Persicaria lapathifolia	Willow weed	Unknown	Unknown
Petalonyx thurberi ssp. *thurberi*	Thurber's sandpaper plant	Unknown	Unknown
Phacelia austromontana	Southern sierra phacelia	Unknown	Unknown
Phacelia bicolor	Twocolor phacelia	Occurs	Unknown
Phacelia crenulata var. *crenulata*	Cleftleaf wildheliotrope	Occurs	Occurs
Phacelia fremontii	Fremont's phacelia	Occurs	Occurs
Phacelia tanacetifolia	Lacy phacelia	Occurs	Unknown
Pholisma arenarium	Desert Christmas tree	Unknown	Unknown
Picrothamnus desertorum	Bud sagebrush	Occurs	Occurs
Plagiobothrys canescens	Valley popcornflower	Occurs	Unknown
Plagiobothrys leptocladus	Alkali plagiobothrys	Unknown	Unknown
Plantago major	Common plantain	Unknown	Unknown
Plantago ovata	Desert Indianwheat	Unknown	Unknown
Platystemon californicus	Cream cups	Unknown	Unknown
Poa secunda	Nevada blue grass	Occurs	Occurs
Polygonum aviculare ssp. *depressum*	Knotweed	Unknown	Unknown

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Polypogon monspeliensis	Rabbitfoot grass[4]	Occurs	Unknown
Populus fremontii	Fremont cottonwood	Occurs	Unknown
Portulaca oleracea	Purslane	Occurs	Unknown
Prenanthella exigua	Brightwhite	Occurs	Unknown
Prosopis glandulosa var. *torreyana*	Honey mesquite	Occurs	Unknown
Psathyrotes ramosissima	Turtleback	Occurs	Unknown
Psorothamnus arborescens	Mojave indigo-bush	Occurs	Unknown
Puccinellia simplex	California alkaligrass	Occurs	Unknown
Rafinesquia neomexicana	Desert chicory	Occurs	Unknown
Rhaponticum repens	Russian knapweed	Occurs	Occurs
Rumex crispus	Curly dock	Unknown	Unknown
Rumex hymenosepalus	Wild-rhubarb	Occurs	Unknown
Salix exigua	Narrow-leaved willow	Unknown	Unknown
Salix gooddingii	Goodding's black Willow	Unknown	Unknown
Salix lasiolepis	Arroyo willow	Unknown	Unknown
Salsola australis	Prickly Russian thistle	Occurs	Occurs
Salsola paulsenii	Barbwire Russian thistle[4]	Occurs	Unknown
Salsola tragus	Russian thistle[4]	Occurs	Unknown
Salvia carduacea	Thistle sage	Occurs	Unknown
Salvia columbariae var. *columbariae*	Chia	Occurs	Unknown
Sarcobatus vermiculatus	Greasewood	Unknown	Unknown
Sarcocornia utahensis	Utah swampfire	Unknown	Unknown
Schismus arabicus	Arabian schismus[4]	Occurs	Unknown
Schismus barbatus	Common Mediterranean grass[4]	Occurs	Occurs

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Schoenoplectus acutus var. *occidentalis*	Common tule	Unknown	Unknown
Scutellaria ovata	Heartleaf skullcap	Occurs	Unknown
Senecio mohavensis	Mojave ragwort	Occurs	Unknown
Senecio vulgaris	Common groundsel	Unknown	Unknown
Senna covesii	Coues' cassia	Occurs	Unknown
Sesuvium verrucosum	Western sea-purslane	Unknown	Unknown
Setaria pumila	Yellow bristle grass	Occurs	Occurs
Sisymbrium altissimum	Tumble mustard	Occurs	Occurs
Sisymbrium irio	London rocket	Occurs	Unknown
Sisymbrium orientale	Indian hedgemustard	Occurs	Unknown
Solanum elaeagnifolium	White horse-nettle	Unknown	Unknown
Solanum nigrum	Black nightshade	Unknown	Unknown
Sonchus asper	Prickly sow thistle	Unknown	Unknown
Sonchus oleraceus	Common sow thistle	Unknown	Unknown
Spergularia atrosperma	Black seeded sand-spurrey	Unknown	Unknown
Spergularia macrotheca var. *leucantha*	Sticky sandspurry	Unknown	Unknown
Spergularia salina	Salt sandspurry	Occurs	Unknown
Sphaeralcea ambigua ssp. *ambigua*	Apricot globemallow	Occurs	Unknown
Sporobolus airoides	Alkali sacaton	Occurs	Occurs
Stanleya pinnata var. *pinnata*	Desert princesplume	Occurs	Unknown
Stephanomeria exigua	Small wirelettuce	Occurs	Unknown
Stephanomeria parryi	Parry's wirelettuce	Occurs	Unknown
Stephanomeria pauciflora	Wire-lettuce	Occurs	Occurs
Stephanomeria tenuifolia	Narrow-leaved wire-lettuce	Occurs	Unknown

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Stillingia linearifolia	Queen's-root	Occurs	Unknown
Stillingia paucidentata	Mojave toothleaf	Occurs	Unknown
Stipa speciosa	Desert needle grass	Occurs	Occurs
Streptanthella longirostris	Longbeak streptanthella	Occurs	Unknown
Stutzia covillei	Coville's orach	Occurs	Occurs
Stylocline micropoides	Desert neststraw	Unknown	Unknown
Stylocline psilocarphoides	Peck neststraw	Unknown	Unknown
Suaeda nigra	Bush seepweed	Occurs	Occurs
Symphyotrichum frondosum	Short-rayed alkali aster	Occurs	Unknown
Syntrichopappus fremontii	Yellowray Fremont's-gold	Occurs	Unknown
Tamarix aphylla	Athel[3]	Occurs	Occurs
Tamarix chinensis	Fivestamen tamarisk	Occurs	Occurs
Tamarix gallica	French tamarisk	Unknown	Unknown
Tamarix parviflora	Smallflower tamarisk[2]	Unknown	Unknown
Tamarix ramosissima	Saltcedar[2]	Occurs	Unknown
Tetradymia axillaris	Longspine horsebrush	Occurs	Unknown
Tetradymia canescens	Spineless horsebrush	Occurs	Unknown
Tetradymia glabrata	Littleleaf horsebrush	Occurs	Unknown
Tetradymia spinosa	Shortspine horsebrush	Occurs	Unknown
Tetradymia stenolepis	Mojave cottonthorn	Occurs	Occurs
Tetrapteron palmeri	Palmers primrose	Occurs	Unknown
Thysanocarpus laciniatus	Mountain fringepod	Unknown	Unknown
Tiquilia nuttallii	Annual tiquilia	Unknown	Unknown
Tiquilia plicata	Fan-leaved tiquilia	Occurs	Unknown
Toxicoscordion brevibracteatum	Desert deathcamas	Unknown	Unknown
Tribulus terrestris	Puncture vine	Unknown	Unknown

Table 2. Plants observed on Edwards AFB.

Scientific Name[a]	Common Name[a] *	Presence on EAFB[b]	Presence at Piute Ponds[b]
Tricardia watsonii	Threehearts	Occurs	Unknown
Trifolium gracilentum var. palmeri	Palmer's clover	Occurs	Unknown
Triticum aestivum	Common wheat	Unknown	Unknown
Tropidocarpum gracile	Dobie pod	Occurs	Unknown
Typha angustifolia	Narrow-leaved cattail	Unknown	Unknown
Uropappus lindleyi	Lindley's silverpuffs	Occurs	Unknown
Urtica dioica ssp. *holosericea*	Stinging nettle	Unknown	Unknown
Veronica sp.	Speedwell	Unknown	Unknown
Vulpia bromoides	Brome fescue	Unknown	Unknown
Vulpia microstachys	Small fescue	Occurs	Occurs
Vulpia myuros	Annual fescue	Occurs	Occurs
Vulpia octoflora	Sixweeks fescue[3]	Occurs	Occurs
Xanthium spinosum	Spiny cocklebur	Unknown	Unknown
Xylorhiza tortifolia	Mojave-aster	Occurs	Unknown
Yucca brevifolia	Joshua tree	Occurs	Occurs

[a] Species nomenclature according to the California Invasive Species Council (2020), Integrated Taxonomic Information System (2020), Jepson Flora, (Jepson; 2020), NatureServe (2020), and U.S. Department of Agriculture Plants (USDA; 2020).

[b] Presence Source: Edwards AFB Geographic Information System. ([1]Denotes a source other than the Edwards AFB GIS database.)

***** California Invasive Plants Council Inventory Categories.

[2] 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.

[3] 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.

[4] 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.

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Crustaceans			
Branchinecta mackini	Alkali fairy shrimp	Occurs	Occurs
Branchinecta coloradensis	Colorado fairy shrimp	Occurs	Occurs
Eocyzicus digueti	Common clam shrimp	Unknown	Unknown
Branchinecta gigas	Giant fairy shrimp	Occurs	Occurs
Lepidurus lemmoni	Lynch tadpole shrimp	Occurs	Occurs
Branchinecta lindahli	Versatile fairy shrimp	Occurs	Occurs
Amphibians			
Xenopus laevis	African clawed frog	Occurs	Occurs
Lithobates catesbeianus	American bullfrog	Occurs	Unknown
Pseudacris regilla	Pacific treefrog	Occurs	Occurs
Anaxyrus punctatus	Red-spotted toad	Unknown	Unknown
Bufo boreas	Western toad	Occurs	Occurs
Reptiles			
Tortoises and Turtles			
Centrochelys sulcata	African Spurred Tortoise	Occurs	Unknown
Testudo horsfieldii	Horsfield's tortoise	Occurs	Unknown
Gopherus agassizii	Mohave desert tortoise	Occurs	Occurs
Chrysemys picta	Painted turtle	Occurs	Occurs
Actinemys marmorata	Western pond turtle	Occurs	Occurs
Lizards			
Crotaphytus insularis	Black collared lizard	Occurs[1]	Unknown
Sauromalus ater	Common chuckwalla	Occurs	Unknown
Uta stansburiana	Common side-blotched lizard	Occurs	Occurs
Phrynosoma platyrhinos	Desert horned lizard	Occurs	Occurs
Dipsosaurus dorsalis	Desert iguana	Occurs	Unknown

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Xantusia vigilis	Desert night lizard	Occurs	Occurs
Sceloporus magister	Desert spiny lizard	Occurs	Occurs
Plestiodon gilbertii	Gilbert's skink	Occurs	Unknown
Sceloporus orcutti	Granite spiny lizard	Occurs	Unknown
Crotaphytus bicinctores	Great Basin Collared Lizard	Occurs	Unknown
Gambelia wislizenii	Long-nosed leopard lizard	Occurs	Occurs
Urosaurus graciosus	Long-tailed brush lizard	Unknown	Unknown
Uma scoparia	Mojave fringe-toed lizard	Unknown	Unknown
Anniella pulchra	Northern legless lizard	Occurs[1]	Occurs[1]
Aspidosceli tigris	Tiger whiptail	Occurs	Occurs
Coleonyx variegatus	Western banded gecko	Occurs	Unknown
Sceloporus occidentalis	Western fence lizard	Occurs	Unknown
Callisaurus draconoides	Zebra-tailed lizard	Occurs	Unknown
Snakes			
Lampropeltis californiae	California kingsnake	Occurs	Unknown
Masticophis flagellum	Coachwhip	Occurs	Occurs
Hypsiglena chlorophaea	Desert nightsnake	Occurs	Unknown
Lampropeltis getula	Eastern kingsnake	Occurs	Occurs
Arizona elegans	Glossy snake	Occurs	Unknown
Pituophis catenifer	Gophersnake	Occurs	Unknown
Rhinocheilus lecontei	Long-nosed snake	Occurs	Unknown
Trimorphodon biscutatus	Lyre snake	Unknown	Unknown
Crotalus scutulatus	Mojave rattlesnake	Occurs	Occurs
Crotalus cerastes	Sidewinder	Occurs	Unknown
Phyllorhynchus decurtatus	Spotted leaf-nosed snake	Occurs	Unknown
Lichanura trivirgata	Three-lined boa	Unknown	Unknown

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Thamnophis hammondii	Two-striped gartersnake	Unknown	Unknown
Chilomeniscus stramineus	Variable Sandsnake	Occurs	Unknown
Sonora semiannulata	Western groundsnake	Unknown	Unknown
Salvadora hexalepis	Western patch-nosed snake	Occurs	Unknown
Chionactis occipitalis	Western shovel-nosed snake	Occurs	Unknown
Birds			
Melozone aberti	Abert's towhee	Unknown	Unknown
Melanerpes formicivorus	Acorn woodpecker	Occurs	Occurs
Selasphorus sasin	Allen's hummingbird	Unknown	Unknown
Recurvirostra americana	American avocet	Occurs	Occurs
Botaurus lentiginosus	American bittern	Occurs	Occurs
Fulica americana	American coot	Occurs	Occurs
Corvus brachyrhynchos	American crow	Occurs	Occurs
Phoenicopterus ruber	American flamingo	Unknown	Unknown
Pluvialis dominica	American golden plover	Occurs	Occurs
Spinus tristis	American goldfinch	Occurs	Occurs
Falco sparverius	American kestrel	Occurs	Occurs
Anthus rubescens	American pipit	Occurs	Occurs
Setophaga ruticilla	American redstart	Occurs	Unknown
Turdus migratorius	American robin	Occurs	Occurs
Pelecanus erythrorhynchos	American white pelican	Occurs	Occurs
Anas americana	American wigeon	Occurs	Occurs
Calypte anna	Anna's hummingbird	Occurs	Occurs
Sterna paradisaea	Arctic tern	Occurs	Occurs
Myiarchus cinerascens	Ash-throated flycatcher	Occurs	Occurs
Calidris bairdii	Baird's sandpiper	Occurs	Occurs

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Haliaeetus leucocephalus	Bald eagle	Occurs	Occurs
Patagioenas fasciata	Band-tailed pigeon	Occurs	Unknown
Riparia	Bank swallow	Occurs	Occurs
Tyto alba	Barn owl	Occurs	Occurs
Hirundo rustica	Barn swallow	Occurs	Occurs
Limosa lapponica	Bar-tailed Godwit	Unknown	Unknown
Artemisiospiza belli	Bell's Sparrow	Occurs	Unknown
Megaceryle alcyon	Belted kingfisher	Occurs	Occurs
Thryomanes bewickii	Bewick's wren	Occurs	Occurs
Mniotilta varia	Black and white warbler	Unknown	Unknown
Sayornis nigricans	Black phoebe	Occurs	Occurs
Cypseloides niger	Black swift	Unknown	Unknown
Chlidonias niger	Black tern	Occurs	Occurs
Arenaria melanocephala	Black turnstone	Occurs	Unknown
Pluvialis squatarola	Black-bellied plover	Occurs	Occurs
Archilochus alexandri	Black-chinned hummingbird	Occurs	Occurs
Spizella atrogularis	Black-chinned sparrow	Unknown	Unknown
Nycticorax	Black-crowned night-heron	Occurs	Occurs
Pheucticus melanocephalus	Black-headed grosbeak	Occurs	Occurs
Himantopus mexicanus	Black-necked stilt	Occurs	Occurs
Setophaga striata	Blackpoll Warbler	Occurs	Unknown
Polioptila melanura	Black-tailed gnatcatcher	Occurs	Unknown
Setophaga nigrescens	Black-throated gray warbler	Occurs	Occurs
Amphispiza bilineata	Black-throated sparrow	Occurs	Occurs
Passerina caerulea	Blue grosbeak	Occurs	Occurs
Polioptila caerulea	Blue-gray gnatcatcher	Occurs	Occurs

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Anas discors	Blue-winged teal	Occurs	Occurs
Chroicocephalus philadelphia	Bonepart's gull	Occurs	Occurs
Branta bernicla	Brant	Occurs	Occurs
Euphagus cyanocephalus	Brewer's blackbird	Occurs	Occurs
Spizella breweri	Brewer's sparrow	Occurs	Occurs
Selasphorus platycercus	Broad-tailed hummingbird	Unknown	Unknown
Pelecanus occidentalis	Brown pelican	Occurs	Unknown
Molothrus ater	Brown-headed cowbird	Occurs	Occurs
Tryngites subruficollis	Buff-breasted sandpiper	Occurs	Occurs
Bucephala albeola	Bufflehead	Occurs	Occurs
Icterus bullockii	Bullock's oriole	Unknown	Unknown
Athene cunicularia	Burrowing owl	Occurs	Occurs
Psaltriparus minimus	Bushtit	Occurs	Occurs
Branta hutchinsii	Cackling goose	Occurs	Occurs
Campylorhynchus brunneicapillus	Cactus wren	Occurs	Occurs
Larus californicus	California gull	Occurs	Occurs
Sternula antillarum browni	California least tern	Occurs	Occurs
Callipepla californica	California quail	Occurs	Occurs
Aphelocoma californica	California scrub-jay	Unknown	Unknown
Toxostoma redivivum	California thrasher	Unknown	Unknown
Melozone crissalis	California towhee	Occurs	Unknown
Selasphorus calliope	Calliope hummingbird	Unknown	Unknown
Branta canadensis	Canada goose	Occurs	Occurs
Cardellina canadensis	Canada warbler	Occurs	Unknown
Aythya valisineria	Canvasback	Occurs	Occurs
Catherpes mexicanus	Canyon wren	Occurs	Unknown

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Hydroprogne caspia	Caspian tern	Occurs	Occurs
Tyrannus vociferans	Cassin's kingbird	Occurs	Unknown
Vireo cassinii	Cassin's vireo	Occurs	Unknown
Haemorhous cassinii	Cassin's Finch	Occurs	Unknown
Bombycilla cedrorum	Cedar waxwing	Occurs	Occurs
Calcarius ornatus	Chestnut-collared longspur	Occurs	Unknown
Spizella passerina	Chipping sparrow	Occurs	Occurs
Alectoris chukar	Chukar	Occurs	Unknown
Anas cyanoptera	Cinnamon teal	Occurs	Occurs
Aechmophorus clarkii	Clark's grebe	Occurs	Occurs
Spizella pallida	Clay-colored sparrow	Unknown	Unknown
Petrochelidon pyrrhonota	Cliff swallow	Occurs	Occurs
Bucephala clangula	Common goldeneye	Occurs	Occurs
Quiscalus quiscula	Common grackle	Occurs	Unknown
Gavia immer	Common loon	Occurs	Occurs
Mergus merganser	Common merganser	Occurs	Occurs
Gallinula chloropus	Common moorhen	Occurs	Occurs
Chordeiles minor	Common nighthawk	Occurs	Unknown
Phalaenoptilus nuttallii	Common poorwill	Occurs	Unknown
Corvus corax	Common raven	Occurs	Occurs
Gallinago	Common snipe	Occurs	Occurs
Sterna hirundo	Common tern	Occurs	Occurs
Geothlypis trichas	Common yellowthroat	Occurs	Occurs
Accipiter cooperii	Cooper's hawk	Occurs	Occurs
Calypte costae	Costa's hummingbird	Occurs	Occurs
Calidris ferruginea	Curlew Sandpiper	Unknown	Unknown

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Junco hyemalis	Dark-eyed junco	Occurs	Occurs
Phalacrocorax auritus	Double-crested cormorant	Occurs	Occurs
Calidris alpina	Dunlin	Occurs	Occurs
Empidonax oberholseri	Dusky flycatcher	Occurs	Occurs
Podiceps nigricollis	Eared grebe	Occurs	Occurs
Sayornis phoebe	Eastern phoebe	Occurs	Occurs
Chen canagica	Emperor goose	Unknown	Unknown
Streptopelia decaocto	Eurasian collared-dove	Occurs	Occurs
Anas penelope	Eurasian wigeon	Unknown	Unknown
Sturnus vulgaris	European starling	Occurs	Occurs
Coccothraustes vespertinus	Evening Grosbeak	Unknown	Unknown
Buteo regalis	Ferruginous hawk	Occurs	Occurs
Sterna forsteri	Forster's tern	Occurs	Occurs
Passerella iliaca	Fox sparrow	Occurs	Occurs
Leucophaeus pipixcan	Franklin's gull	Occurs	Occurs
Dendrocygna bicolor	Fulvous whistling-duck	Unknown	Unknown
Anas strepera	Gadwall	Occurs	Occurs
Callipepla gambelii	Gambel's quail	Occurs	Occurs
Larus glaucescens	Glaucous-winged gull	Unknown	Unknown
Aquila chrysaetos	Golden eagle	Occurs	Occurs
Regulus satrapa	Golden-crowned kinglet	Occurs	Unknown
Zonotrichia atricapilla	Golden-crowned sparrow	Occurs	Occurs
Ammodramus savannarum	Grasshopper sparrow	Occurs	Unknown
Dumetella carolinensis	Gray catbird	Unknown	Unknown
Empidonax wrightii	Gray flycatcher	Occurs	Occurs
Vireo vicinior	Gray vireo	Occurs	Unknown

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Ardea herodias	Great blue heron	Occurs	Occurs
Ardea alba	Great egret	Occurs	Occurs
Bubo virginianus	Great horned owl	Occurs	Occurs
Geococcyx californianus	Greater roadrunner	Occurs	Occurs
Aythya marila	Greater scaup	Occurs	Occurs
Anser albifrons	Greater white-fronted goose	Occurs	Occurs
Tringa melanoleuca	Greater yellowlegs	Occurs	Occurs
Quiscalus mexicanus	Great-tailed grackle	Occurs	Occurs
Butorides virescens	Green heron	Occurs	Occurs
Pipilo chlorurus	Green-tailed towhee	Occurs	Occurs
Anas crecca	Green-winged teal	Occurs	Unknown
Gelochelidon nilotica	Gull-billed tern	Unknown	Unknown
Empidonax hammondii	Hammond's flycatcher	Occurs	Occurs
Parabuteo unicinctus	Harris hawk	Unknown	Unknown
Zonotrichia querula	Harris' sparrow	Occurs	Unknown
Larus heermanni	Heermann's gull	Unknown	Unknown
Catharus guttatus	Hermit thrush	Occurs	Occurs
Setophaga occidentalis	Hermit warbler	Occurs	Occurs
Larus argentatus	Herring gull	Occurs	Occurs
Lophodytes cucullatus	Hooded merganser	Occurs	Occurs
Icterus cucullatus	Hooded oriole	Occurs	Occurs
Setophaga citrina	Hooded warbler	Occurs	Unknown
Podiceps auritus	Horned grebe	Unknown	Unknown
Eremophila alpestris	Horned lark	Occurs	Occurs
Haemorhous mexicanus	House finch	Occurs	Occurs
Passer domesticus	House sparrow	Occurs	Occurs

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Troglodytes aedon	House wren	Occurs	Occurs
Vireo huttoni	Hutton's vireo	Unknown	Unknown
Charadrius vociferus	Killdeer	Occurs	Occurs
Picoides scalaris	Ladder-backed woodpecker	Occurs	Occurs
Calcarius lapponicus	Lapland longspur	Unknown	Unknown
Chondestes grammacus	Lark sparrow	Occurs	Occurs
Leucophaeus atricilla	Laughing gull	Unknown	Unknown
Spinus lawrencei	Lawrence’s goldfinch	Occurs	Unknown
Passerina amoena	Lazuli bunting	Occurs	Occurs
Vireo bellii pusillus	Least Bell’s vireo	Unknown	Unknown
Ixobrychus exilis	Least bittern	Unknown	Unknown
Empidonax minimus	Least flycatcher	Occurs	Unknown
Calidris minutilla	Least sandpiper	Occurs	Occurs
Toxostoma lecontei	LeConte's thrasher	Occurs	Occurs
Phoeniconaias minor	Lesser flamingo	Occurs	Occurs
Spinus psaltria	Lesser goldfinch	Occurs	Occurs
Chordeiles acutipennis	Lesser nighthawk	Occurs	Occurs
Aythya affinis	Lesser scaup	Occurs	Occurs
Tringa flavipes	Lesser yellowlegs	Occurs	Occurs
Melanerpes lewis	Lewis's woodpecker	Unknown	Unknown
Melospiza lincolnii	Lincoln's sparrow	Occurs	Occurs
Egretta caerulea	Little blue heron	Unknown	Unknown
Lanius ludovicianus	Loggerhead shrike	Occurs	Occurs
Numenius americanus	Long-billed curlew	Occurs	Occurs
Limnodromus scolopaceus	Long-billed dowitcher	Occurs	Occurs
Asio otus	Long-eared owl	Occurs	Unknown

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Clangula hyemalis	Long-tailed duck	Occurs	Occurs
Stercorarius longicaudus	Long-tailed jaeger	Occurs	Occurs
Leiothlypis luciae	Lucy's warbler	Occurs	Unknown
Geothlypis tolmiei	MacGillivray's warbler	Occurs	Occurs
Anas platyrhynchos	Mallard	Occurs	Occurs
Limosa fedoa	Marbled godwit	Occurs	Occurs
Cistothorus palustris	Marsh wren	Occurs	Occurs
Rhynchophanes mccownii	McCown's longspur	Unknown	Unknown
Falco columbarius	Merlin	Occurs	Occurs
Larus canus	Mew gull	Unknown	Unknown
Sialia currucoides	Mountain bluebird	Occurs	Unknown
Poecile gambeli	Mountain chickadee	Unknown	Unknown
Charadrius montanus	Mountain plover	Occurs	Occurs
Oreortyx pictus	Mountain quail	Unknown	Unknown
Zenaida macroura	Mourning dove	Occurs	Occurs
Geothlypis philadelphia	Mourning warbler	Occurs	Occurs
Cygnus olor	Mute swan	Occurs	Occurs
Leiothlypis ruficapilla	Nashville warbler	Occurs	Occurs
Colaptes auratus	Northern flicker	Occurs	Occurs
Circus hudsonius	Northern harrier	Occurs	Occurs
Mimus polyglottos	Northern mockingbird	Occurs	Occurs
Setophaga americana	Northern Parula	Occurs	Unknown
Anas acuta	Northern pintail	Occurs	Occurs
Stelgidopteryx serripennis	Northern rough-winged swallow	Occurs	Occurs
Anas clypeata	Northern shoveler	Occurs	Occurs
Picoides nuttallii	Nuttall's woodpecker	Unknown	Unknown

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Contopus cooperi	Olive-sided flycatcher	Occurs	Occurs
Leiothlypis celata	Orange-crowned warbler	Occurs	Occurs
Icterus spurius	Orchard oriole	Unknown	Unknown
Pandion haliaetus	Osprey	Occurs	Occurs
Pluvialis fulva	Pacific golden-plover	Unknown	Unknown
Troglodytes pacificus	Pacific wren	Occurs	Occurs
Empidonax difficilis	Pacific-slope flycatcher	Occurs	Occurs
Myioborus pictus	Painted redstart	Occurs	Unknown
Calidris melanotos	Pectoral sandpiper	Occurs	Occurs
Falco peregrinus	Peregrine falcon	Occurs	Occurs
Phainopepla nitens	Phainopepla	Occurs	Occurs
Podilymbus podiceps	Pied-billed grebe	Occurs	Occurs
Spinus pinus	Pine siskin	Occurs	Unknown
Stercorarius pomarinus	Pomarine Jaeger	Occurs	Occurs
Falco mexicanus	Prairie falcon	Occurs	Occurs
Haemorhous purpureus	Purple finch	Unknown	Unknown
Progne subis	Purple martin	Occurs	Occurs
Sitta pygmaea	Pygmy nuthatch	Occurs	Occurs
Loxia curvirostra	Red crossbill	Occurs	Unknown
Calidris canutus	Red knot	Occurs	Unknown
Phalaropus fulicarius	Red phalarope	Occurs	Occurs
Mergus serrator	Red-breasted merganser	Occurs	Occurs
Sitta canadensis	Red-breasted nuthatch	Unknown	Unknown
Sphyrapicus ruber	Red-breasted sapsucker	Occurs	Unknown
Aythya americana	Redhead	Occurs	Occurs
Sphyrapicus nuchalis	Red-naped sapsucker	Unknown	Unknown

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Podiceps grisegena	Red-necked grebe	Unknown	Unknown
Phalaropus lobatus	Red-necked phalarope	Occurs	Occurs
Calidris ruficollis	Red-necked stint	Unknown	Unknown
Buteo lineatus	Red-shouldered hawk	Occurs	Occurs
Buteo jamaicensis	Red-tailed hawk	Occurs	Occurs
Gavia stellata	Red-throated loon	Unknown	Unknown
Agelaius phoeniceus	Red-winged blackbird	Occurs	Occurs
Larus delawarensis	Ring-billed gull	Occurs	Occurs
Aythya collaris	Ring-necked duck	Occurs	Occurs
Phasianus colchicus	Ring-necked pheasant	Unknown	Unknown
Columba livia	Rock pigeon	Occurs	Occurs
Salpinctes obsoletus	Rock wren	Occurs	Occurs
Pheucticus ludovicianus	Rose-breasted Grosbeak	Occurs	Unknown
Anser rossii	Ross's goose	Occurs	Occurs
Buteo lagopus	Rough-legged hawk	Unknown	Unknown
Regulus calendula	Ruby-crowned kinglet	Occurs	Occurs
Oxyura jamaicensis	Ruddy duck	Occurs	Occurs
Arenaria interpres	Ruddy turnstone	Occurs	Occurs
Calidris pugnax	Ruff	Occurs	Occurs
Selasphorus rufus	Rufous hummingbird	Occurs	Occurs
Euphagus carolinus	Rusty blackbird	Unknown	Unknown
Xema sabini	Sabine's gull	Unknown	Unknown
Oreoscoptes montanus	Sage thrasher	Occurs	Occurs
Amphispiza nevadensis	Sagebrush sparrow	Occurs	Occurs
Calidris alba	Sanderling	Occurs	Occurs
Antigone canadensis	Sandhill crane	Unknown	Unknown

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Passerculus sandwichensis	Savannah sparrow	Occurs	Occurs
Sayornis saya	Say's phoebe	Occurs	Occurs
Piranga olivacea	Scarlet tanager	Unknown	Unknown
Icterus parisorum	Scott's oriole	Occurs	Unknown
Charadrius semipalmatus	Semipalmated plover	Occurs	Occurs
Calidris pusilla	Semipalmated sandpiper	Occurs	Occurs
Accipiter striatus	Sharp-shinned hawk	Occurs	Occurs
Calidris acuminata	Sharp-tailed sandpiper	Unknown	Unknown
Limnodromus griseus	Short-billed dowitcher	Occurs	Occurs
Asio flammeus	Short-eared owl	Occurs	Unknown
Plectrophenax nivalis	Snow bunting	Occurs	Unknown
Anser caerulescens	Snow goose	Occurs	Occurs
Egretta thula	Snowy egret	Occurs	Occurs
Charadrius nivosus	Snowy plover	Occurs	Occurs
Tringa solitaria	Solitary sandpiper	Occurs	Occurs
Melospiza melodia	Song sparrow	Occurs	Occurs
Porzana carolina	Sora	Occurs	Occurs
Streptopelia chinensis	Spotted dove	Unknown	Unknown
Actitis macularius	Spotted sandpiper	Occurs	Occurs
Pipilo maculatus	Spotted towhee	Occurs	Occurs
Calidris himantopus	Stilt sandpiper	Unknown	Unknown
Butorides striata	Striated heron	Unknown	Unknown
Piranga rubra	Summer tanager	Unknown	Unknown
Melanitta perspicillata	Surf scoter	Occurs	Occurs
Buteo swainsonii	Swainson's hawk	Occurs	Occurs
Catharus ustulatus	Swainson's thrush	Occurs	Occurs

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Melospiza georgiana	Swamp sparrow	Occurs	Unknown
Leiothlypis peregrina	Tennessee warbler	Unknown	Unknown
Larus thayeri	Thayer's gull	Unknown	Unknown
Myadestes townsendi	Townsend's solitaire	Unknown	Unknown
Setophaga townsendi	Townsend's warbler	Occurs	Occurs
Tachycineta bicolor	Tree swallow	Occurs	Occurs
Agelaius tricolor	Tricolored blackbird	Occurs	Occurs
Tyrannus melancholicus	Tropical kingbird	Unknown	Unknown
Cygnus buccinator	Trumpeter swan	Unknown	Unknown
Cygnus columbianus	Tundra swan	Occurs	Occurs
Cathartes aura	Turkey vulture	Occurs	Occurs
Ixoreus naevius	Varied thrush	Occurs	Unknown
Chaetura vauxi	Vaux’s swift	Occurs	Occurs
Auriparus flaviceps	Verdin	Occurs	Occurs
Pyrocephalus rubinus	Vermilion flycatcher	Occurs	Occurs
Pooecetes gramineus	Vesper sparrow	Occurs	Occurs
Tachycineta thalassina	Violet-green swallow	Occurs	Occurs
Rallus limicola	Virginia rail	Occurs	Occurs
Leiothlypis virginiae	Virginia's warbler	Occurs	Occurs
Tringa incana	Wandering tattler	Unknown	Unknown
Vireo gilvus	Warbling vireo	Occurs	Occurs
Sialia mexicana	Western bluebird	Occurs	Unknown
Bubulcus ibis	Western cattle egret	Occurs	Occurs
Aechmophorus occidentalis	Western grebe	Occurs	Occurs
Larus occidentalis	Western gull	Unknown	Unknown
Tyrannus verticalis	Western kingbird	Occurs	Occurs

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Sturnella neglecta	Western meadowlark	Occurs	Occurs
Calidris mauri	Western sandpiper	Occurs	Occurs
Piranga ludoviciana	Western tanager	Occurs	Occurs
Contopus sordidulus	Western wood-pewee	Occurs	Occurs
Numenius phaeopus	Whimbrel	Occurs	Occurs
Sitta carolinensis	White-breasted nutchatch	Occurs	Occurs
Zonotrichia leucophrys	White-crowned sparrow	Occurs	Occurs
Plegadis chihi	White-faced ibis	Occurs	Occurs
Calidris fuscicollis	White-rumped sandpiper	Unknown	Unknown
Elanus leucurus	White-tailed kite	Occurs	Occurs
Aeronautes saxatalis	White-throated swift	Occurs	Occurs
Zenaida asiatica	White-winged dove	Occurs	Unknown
Melanitta fusca	White-winged scoter	Unknown	Unknown
Meleagris gallopavo	Wild turkey	Occurs	Unknown
Tringa semipalmata	Willet	Occurs	Occurs
Empidonax traillii	Willow flycatcher	Occurs	Occurs
Phalaropus tricolor	Wilson's phalarope	Occurs	Occurs
Gallinago delicata	Wilson's snipe	Occurs	Occurs
Cardellina pusilla	Wilson's warbler	Occurs	Occurs
Aix sponsa	Wood duck	Occurs	Occurs
Aphelocoma woodhouseii	Woodhouse's scrub-jay	Occurs	Unknown
Chamaea fasciata	Wrentit	Occurs	Unknown
Setophaga petechia	Yellow warbler	Occurs	Occurs
Sphyrapicus varius	Yellow-bellied sapsucker	Occurs	Occurs
Coccyzus americanus	Yellow-billed cuckoo	Occurs	Occurs
Icteria virens	Yellow-breasted chat	Occurs	Occurs

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Xanthocephalus	Yellow-headed blackbird	Occurs	Occurs
Setophaga coronata	Yellow-rumped warbler	Occurs	Occurs
Setophaga dominica	Yellow-throated warbler	Unknown	Unknown
Geopelia striata	Zebra Dove	Occurs	Occurs
Mammals			
Bats			
Eumops perotis californicus	California mastiff bat	Unknown	Unknown
Myotis californicus	California myotis	Occurs	Occurs
Parastrellus hesperus	Canyon bat	Occurs	Unknown
Tadarida brasiliensis	Mexican free-tailed bat	Occurs	Occurs
Aeorestes cinereus	North American Hoary Bat	Occurs	Unknown
Antrozous pallidus	Pallid bat	Occurs	Unknown
Corynorhinus townsendii	Townsends's big-eared bat	Unknown	Unknown
Lasiurus frantzii	Western red bat	Occurs	Occurs
Myotis ciliolabrum	Western small-footed bat	Occurs	Unknown
Myotis yumanensis	Yuma myotis	Occurs	Occurs
Carnivores			
Taxidea taxus	American badger	Occurs	Unknown
Ursus americanus	American black bear	Occurs	Unknown
Lynx rufus	Bobcat	Occurs	Occurs
Canis latrans	Coyote	Occurs	Occurs
Urocyon cinereoargenteus	Gray fox	Occurs	Occurs
Vulpes macrotis	Kit fox	Occurs	Occurs
Puma concolor	Mountain lion	Occurs	Unknown
Procyon lotor	Northern Raccoon	Occurs	Occurs
Bassariscus astutus	Ringtail	Occurs	Unknown

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Spilogale gracilis	Western spotted skunk	Occurs	Unknown
Rodents			
Thomomys bottae	Botta's pocket gopher	Occurs	Unknown
Peromyscus boylii	Brush deermouse	Unknown	Unknown
Otospermophilus beecheyi	California ground squirrel	Occurs	Unknown
Microtus californicus	California vole	Occurs	Occurs
Peromyscus crinitus	Canyon deermouse	Unknown	Unknown
Chaetodipus eremicus	Chihuahuan pocket mouse	Unknown	Unknown
Dipodomys microps	Chisel-toothed kangaroo rat	Occurs	Occurs
Perognathus parvus	Columbia plateau pocket mouse	Unknown	Unknown
Ondatra zibethicus	Common muskrat	Unknown	Unknown
Dipodomys deserti	Desert kangaroo rat	Occurs	Unknown
Chaetodipus penicillatus	Desert pocket mouse	Occurs	Unknown
Neotoma lepida	Desert woodrat	Occurs	Occurs
Felis catus	Domestic cat	Occurs	Unknown
Bos taurus	Domestic cattle	Occurs	Unknown
Canis familiaris domesticus	Domestic dog	Occurs	Occurs
Ovis aries	Domestic sheep	Occurs	Unknown
Mus musculus	House mouse	Occurs	Unknown
Perognathus longimembris	Little pocket mouse	Occurs	Occurs
Chaetodipus formosus	Long-tailed pocket mouse	Occurs	Unknown
Dipodomys merriami	Merriam's kangaroo rat	Occurs	Occurs
Xerospermophilus mohavensis	Mohave ground squirrel	Occurs	Unknown
Peromyscus maniculatus	North American deermouse	Occurs	Occurs
Dipodomys panamintinus	Panamint kangaroo rat	Occurs	Occurs
Thomomys umbrinus	Pocket gopher	Unknown	Unknown

Table 3. Fauna observed on Edwards AFB.

Scientific Name[a]	Common Name[a]	Presence on EAFB[b]	Presence at Piute Ponds[b]
Perognathus inornatus	San Joaquin pocket mouse	Occurs	Unknown
Onychomys torridus	Southern grasshopper mouse	Occurs	Occurs
Reithrodontomys megalotis	Western harvest mouse	Occurs	Unknown
Ammospermophilus leucurus	White-tailed antelope squirrel	Occurs	Unknown
Rabbits and Hares			
Lepus californicus	Black-tailed jackrabbit	Occurs	Occurs
Sylvilagus audubonii	Desert cottontail	Occurs	Occurs
Invertebrates			
Bombus crotchii	Crotch's bumble bee	Occurs[1]	Unknown
Hadrurus arizonensis	Desert hairy scorpion	Unknown	Unknown
Smeringurus mesaensis	Dune scorpion	Unknown	Unknown
Helminthoglypta greggii	Mohave shoulderband snail	Unknown	Unknown
Danaus plexippus	Monarch butterfly	Unknown	Unknown
Vaejovis confusus	Yellow ground scorpion	Unknown	Unknown

[a] Species nomenclature according to the American Ornithological Union (2020), American Society of Mammalogists (2020), Bat Conservation International (2020), Integrated Taxonomic Information System (2020), NatureServe (2020), and Society for the Study of Amphibians and Reptiles (2020).

[b] Presence Source—Edwards AFB Geographic Information System ([1] denotes a source other than the Edwards AFB GIS database).

Table 4. Species of Interest, including their status and occurrence at Edwards AFB.

Scientific Name[a]	Common Name[a] *	Federal Status[b]	California Status[b]	NatureServe Ranks	CRPR	Presence on EAFB[c]	Presence at Piute Ponds[c]
Plants							
Calochortus striatus	Alkali mariposa lily			G3? S2S3	1B.2	Occurs	Occurs
Eriophyllum mohavense	Barstow woolly sunflower			G3 S2	1B.2	Occurs	Unknown
Puccinellia simplex	California alkaligrass			G5 S3	2B.2	Occurs	Unknown
Senna covesii	Coues' cassia			G3 S3	4.2	Occurs	Unknown
Muilla coronata	Crowned muilla			G2 S2	1B.2	Occurs	Unknown
Cymopterus deserticola	Desert cymopterus			G2G3 S2S3	1B.3	Occurs	Unknown
Gilmania luteola	Golden-carpet gilmania			G3 S3	4.2	Occurs	Occurs
Goodmania luteola	Goodmania luteola			G3 S4	4.2	Occurs	Occurs
Eriastrum hooveri	Hoover's eriastrum			G2 S2	1B.2	Occurs	Unknown
Astragalus preussii var. laxiflorus	Lancaster milkvetch			G5T3T4 S3	4.2	Occurs	Unknown
Chorizanthe spinosa	Mojave spineflower			G4T2 S1	1B.1	Occurs	Unknown
Trifolium gracilentum var. palmeri	Palmer's clover			G2? S2?	1B.2	Occurs[1]	Unknown
Delphinium recurvatum	Recurved larkspur			G5T2 S2	1B.2	Occurs	Unknown
Eschscholzia minutiflora ssp. twisselmannii	Red Rock poppy			G1? S1?	1B.1	Occurs	Occurs
Eriastrum rosamondense	Rosamond eriastrum			G4 S4	4.3	Occurs	Unknown

Table 4. Species of Interest, including their status and occurrence at Edwards AFB.

Scientific Name[a]	Common Name[a] *	Federal Status[b]	California Status[b]	NatureServe Ranks	CRPR	Presence on EAFB[c]	Presence at Piute Ponds[c]
Nemacladus gracilis	Slender nemacladus			G5T3 S2	2B.2	Occurs	Occurs
Loeflingia squarrosa var. lartemisiarum	Spreading pygmyleaf			G3G4 S3S4	4.2	Occurs[1]	Unknown
Canbya candida	White pygmy-poppy			G3 S3	4.2	Occurs	Occurs
Calochortus striatus	Alkali mariposa lily			G3? S2S3	1B.2	Occurs	Occurs
Reptiles							
Gopherus agassizii	Mohave desert tortoise	FT	ST	G3 S2S3		Occurs	Occurs
Uma scoparia	Mojave fringe-toed lizard		SSC	G3G4 S3S4		Unknown	Unknown
Anniella pulchra	Northern legless lizard		SSC	G3 S3		Occurs[1]	Occurs[1]
Actinemys marmorata	Western pond turtle[4]	12M FY21	SSC	G3G4 S3		Occurs	Occurs
Birds							
Pelecanus erythrorhynchos	American white pelican		SSC	G4 S1S2		Occurs	Occurs
Haliaeetus leucocephalus	Bald eagle	BCC	SE/FP	G5 S3		Occurs	Occurs
Riparia riparia	Bank swallow		ST	G5 S2		Occurs	Occurs
Cypseloides niger	Black swift[1]	BCC	SSC	G4 S2		Unknown	Unknown
Chlidonias niger	Black tern[1]	BCC	SSC	G4 S2		Occurs	Occurs
Spizella atrogularis	Black-chinned sparrow[3]	BCC		G5 S4		Unknown	Unknown
Branta bernicla	Brant		SSC	G5 S2?		Occurs	Occurs
Pelecanus occidentalis	Brown pelican		FP	G4		Occurs	Unknown
Athene cunicularia	Burrowing owl[1 2]	BCC	SSC	G4 S3		Occurs	Occurs

Table 4. Species of Interest, including their status and occurrence at Edwards AFB.

Scientific Name[a]	Common Name[a] *	Federal Status[b]	California Status[b]	NatureServe Ranks	CRPR	Presence on EAFB[c]	Presence at Piute Ponds[c]
Sternula antillarum browni	California least tern	FE	SE/FP	G4T2T3Q S2		Occurs	Occurs
Gavia immer	Common loon[1]		SSC	G5 S1		Occurs	Occurs
Calypte costae	Costa's hummingbird[1]	BCC		G5 S4		Occurs	Occurs
Dendrocygna bicolor	Fulvous whistling-duck[1]		SSC	G5 S1		Unknown	Unknown
Aquila chrysaetos	Golden eagle[3]	BCC	FP/WL	G5 S3		Occurs	Occurs
Ammodramus savannarum	Grasshopper sparrow[1 3]	BCC	SSC	G5 S3		Occurs	Unknown
Vireo vicinior	Gray vireo[1 3]	BCC	SSC	G4 S2		Occurs	Unknown
Gelochelidon nilotica	Gull-billed tern[1]	BCC	SSC	G5 S1		Unknown	Unknown
Spinus lawrencei	Lawrence's goldfinch[3]	BCC		G3G4 S3S4		Unknown	Unknown
Vireo bellii pusillus	Least Bell's vireo	FE	SE	G5T2 S2		Occurs	Occurs
Ixobrychus exilis	Least bittern[2]	BCC	SSC	G4G5 S2		Occurs	Occurs
Toxostoma lecontei	LeConte's thrasher[3]	BCC	SSC	G4 S3		Unknown	Unknown
Lanius ludovicianus	Loggerhead shrike[1 3]	BCC	SSC	G4 S4		Unknown	Unknown
Numenius americanus	Long-billed curlew[1 3]	BCC	WL	G5 S2		Occurs	Occurs
Asio otus	Long-eared owl[1]		SSC	G5 S3?		Occurs	Occurs
Leiothlypis luciae	Lucy's warbler[1]	BCC	SSC	G5 S2S3		Occurs	Unknown
Limosa fedoa	Marbled godwit	BCC		G5		Occurs	Unknown
Charadrius montanus	Mountain plover[2]	BCC	SSC	G3 S2S3		Occurs	Occurs

Table 4. Species of Interest, including their status and occurrence at Edwards AFB.

Scientific Name[a]	Common Name[a] *	Federal Status[b]	California Status[b]	NatureServe Ranks	CRPR	Presence on EAFB[c]	Presence at Piute Ponds[c]
Circus hudsonius	Northern harrier[1]		SSC	G5 S3		Occurs	Occurs
Contopus cooperi	Olive-sided flycatcher[1 3]	BCC	SSC	G4 S4		Occurs	Occurs
Falco peregrinus	Peregrine falcon	BCC	FP	G4T4 S3S4		Unknown	Unknown
Falco mexicanus	Prairie falcon	BCC	WL	G5 S4		Occurs	Occurs
Progne subis	Purple martin[1]		SSC	G5 S3		Occurs	Occurs
Aythya americana	Redhead[1]		SSC	G5 S3S4		Occurs	Occurs
Asio flammeus	Short-eared owl[1]		SSC	G5 S3		Occurs	Unknown
Charadrius nivosus	Snowy plover[1]	BCC	SSC	G3T3 S2S3		Occurs	Occurs
Piranga rubra	Summer tanager[1]		SSC	G5 S1		Unknown	Unknown
Buteo swainsoni	Swainson's hawk	BCC	ST	G5 S3		Occurs	Occurs
Agelaius tricolor	Tricolored blackbird[1 2]	BCC	ST/SSC	G2G3 S1S2		Occurs	Occurs
Cygnus buccinator	Trumpeter swan		FP	G4		Unknown	Unknown
Chaetura vauxi	Vaux's swift[1]		SSC	G5 S2S3		Occurs	Occurs
Pyrocephalus rubinus	Vermilion flycatcher[1]		SSC	G5 S2S3		Occurs	Occurs
Numenius phaeopus	Whimbrel	BCC		G5		Occurs	Occurs
Elanus leucurus	White-tailed kite		FP	G5 S3S4		Occurs	Occurs
Empidonax traillii	Willow flycatcher	BCC	SE	G5 S1S2		Occurs	Occurs
Setophaga petechia	Yellow warbler[1]	BCC	SSC	G5 S3S4		Occurs	Occurs
Coccyzus americanus	Yellow-billed cuckoo	FT/BCC	SE	G5T2T3 S1		Occurs	Occurs

Table 4. Species of Interest, including their status and occurrence at Edwards AFB.

Scientific Name[a]	Common Name[a] *	Federal Status[b]	California Status[b]	NatureServe Ranks	CRPR	Presence on EAFB[c]	Presence at Piute Ponds[c]
Icteria virens	Yellow-breasted chat[1]		SSC	G5 S3		Occurs	Occurs
Xanthocephalus xanthocephalus	Yellow-headed blackbird[1]		SSC	G5 S3		Occurs	Occurs
Mammals							
Taxidea taxus	American badger		SSC	G5 S3		Occurs	Unknown
Eumops perotis californicus	California mastiff bat		SSC	G5T4 S3S4		Unknown	Unknown
Xerospermophilus mohavensis	Mohave ground squirrel		ST	G2G3 S2S3		Occurs	Unknown
Antrozous pallidus	Pallid bat		SSC	G5 S3		Occurs	Unknown
Bassariscus astutus	Ringtail		FP	G5		Occurs	Unknown
Corynorhinus townsendii	Townsends's big-eared bat		SSC	G3G4 S2		Unknown	Unknown
Lasiurus frantzii	Western red bat		SSC	G5 S3		Occurs	Occurs
Invertebrates							
Bombus crotchii	Crotch's bumble bee		SCE	G3G4 S1S2		Occurs[1]	Unknown
Helminthoglypta greggi	Mohave shoulderband snail			G1 S1		Unknown	Unknown
Danaus plexipus	Monarch butterfly	FPT		G4 SNR		Unknown	Unknown

[a] Species nomenclature according to the American Ornithological Union (AOS; 2020), American Society of Mammalogists (2020), Bat Conservation International (2020), California Invasive Species Council (2020), Integrated Taxonomic Information System (2020), Jepson Flora, (Jepson; 2020), NatureServe (2020), Society for the Study of Amphibians and Reptiles (2020), and U.S. Department of Agriculture Plants (USDA; 2020).

[b] Status sources and status/ranking codes—NatureServe (2020), U.S. Fish and Wildlife Service (USFWS), National Listing Workplan, 7-Year Workplan (September 2016); California Native Plant Society, Rare Plant Program (October 2017); Inventory of Rare and Endangered Plants of California; CDFW (2017), Natural Diversity Database (October); Special Animals List, USFWS, Birds of Conservation Concern in Bird Conservation Region 33 (USFWS 2008a).

Federal Status

FE=Federally endangered

FT=Federally threatened

FC=Federal candidate species

FPE=Federally proposed for listing as endangered

FPT=Federally proposed for listing as threatened

FPD=Federally proposed for delisting

12-MO=12-month finding on a petition to list a species; FY=fiscal year of anticipated completion

Federal Status—USFWS Special Status

BCC=Birds of Conservation Concern

California Status—California Environmental Quality Act

SE=Listed as state of California endangered

ST=Listed as state of California threatened

SCE=State candidate for listing as endangered

SCT=State candidate for listing as threatened

SCD=State candidate for delisting

California Status—CDFW

FP=Fully Protected

SSC=Species of Special Concern

B=Breeding

W=Wintering

Y=Year round

WL=Watch List

NatureServe Ranks

Global Ranking (Entire Species)

G1=Critically Imperiled

G2=Imperiled

G3=Vulnerable

G4=Apparently Secure

G5=Secure

NatureServe Ranks

Taxon Ranking (Subspecies)

T1 Critically imperiled

T2=Imperiled

T3=Vulnerable

T4 Apparently secure

T= Secure

State Ranking (California)

S1 Critically imperiled

S2=Imperiled

S3=Vulnerable

S4=Apparently secure

S5=Secure

SNR=Unranked

California Native Plant Society (CNPS), California Rare Plant Ranking (CRPR)

1B=Plants rare, threatened, or endangered in California and elsewhere

2B=Plants rare, threatened, or endangered in California but more common elsewhere

3B=Plants about which more information is needed—a review list

4=Plants of limited distribution—a watch list

CBR=Considered but rejected

Threat Ranking

0.1=Seriously threatened in California

0.2=Moderately threatened in California

0.3=Not very threatened in California

[c] Presence Source—Edwards AFB Geographic Information System ([1] denotes a source other than the Edwards AFB GIS database).

*Additional Species Notes—[1] These avian special status species have the potential to nest on EAFB; [2] DoD Partners in Flight (PIF) Mission-Sensitive Species; [3] DoD PIF Tier 2 Species; [4] DoD At-Risk Herpetofaunal Priority Species.

Table 5. Estimates of desert tortoise (DT) abundance and relative density, by area, on Edwards AFB, 2017.

Area	DT Observed on Plots	Abundance Estimate	95% Confidence Interval (CI)	DT Density[3]
Edwards Air Force Base	12	881	381/2036	2.6
Critical habitat	5	367	181/745	3.7
Non-critical habitat	7	514	238/1111	2.1
West base	4	294	147/588	1.8
East base	8	587	268/1284	3.4
Air Force Research Laboratory	0	N/A2	N/A	N/A
PIRA	6	440	214/909	3.1
Other	6	440	207/939	2.4
Northwest base	2	147	76/284	1.7
Southwest base	2	147	76/284	1.8
Northeast base	6	440	208/937	5.1
Southeast base	2	147	76/284	1.8

[1] 95% confidence interval indicates a range from 381 to 2,036 tortoises on EAFB.

[2]Abundance cannot be calculated when the area is less than 62 square miles because the probabilistic sampling does not meet the minimum transect threshold (431 kilometers). AFRL area totals 17 one-mile sections.

[3] Per square mile.

Table 6. Estimates of desert tortoise (DT) abundance and relative density, by habitat, on Edwards AFB, 2017.

Zonal Habitat[1]	DT Observed on Plots	Abundance Estimate	95% Confidence Interval (CI)	DT Density[2]
Creosote bush scrub—basewide	11	808	356/1183	5.5
Creosote bush scrub—east base	7	514	329/1105	6.3
Creosote bush scrub—west base	4	294	147/587	4.5

[1]Abundance for xerophytic saltbush scrub cannot be calculated when the area is less than 62 square miles because the probabilistic sampling does not meet the minimum transect threshold (431 kilometers). Joshua tree woodland and halophytic saltbush scrub habitats that met the 62-section threshold, but did not have at least one live tortoise observed on a plot could not be calculated.

[2] Per square mile.

15.0 ASSOCIATED PLANS

15.1 Bird/Wildlife Aircraft Strike Hazard Plan, Volume 1—Edwards Air Force Base

Please contact Edwards AFB if you wish to request a copy of the Bird/Wildlife Aircraft Strike Hazard Plan

15.2 Conservation Law Enforcement Program—Operations Plan

15.3 Integrated Pest Management Plan

15.4 Invasive Species Management Plan

15.5 Piute Ponds Complex Management Plan

15.6 Wildland Fire Management Plan

16.0 INRMP ANNUAL REPORTS