U.S. AIR FORCE

INTEGRATED NATURAL RESOURCES MANAGEMENT PLAN

JOINT BASE SAN ANTONIO

(SEE INRMP SIGNATURE PAGES FOR PLAN APPROVAL DATE)

ABOUT THIS PLAN

This installation-specific Environmental Management Plan (EMP) 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), Air Force Manuals (AFMANs); Department of Defense Instructions (DoDIs); USAF Playbooks; federal, state, and local requirements; Biological Opinions (BO); 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/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.

Table of Contents

List of Tables

List of Figures

DOCUMENT CONTOL

Standardized INRMP Template

In accordance with (IAW) the Air Force Civil Engineer Center (AFCEC) Environmental Directorate (CZ) Business Rule (BR) 08, EMP 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 (SME).

This version of the template is current as of October 3, 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. In accordance with the Sikes Act and AFMAN 32-7003, *Environmental Conservation*, 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 National Oceanic and Atmospheric Administration (NOAA) Fisheries when applicable (AFMAN 32-7003).

Annual reviews and updates are accomplished by the Installation Natural Resources Manager (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, 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 updates are then made to the document, at a minimum updating the work plans.

INRMP APPROVAL/SIGNATURE PAGES

Integrated Natural Resources Management Plan
Joint Base San Antonio, TX

This INRMP has been prepared in accordance with regulations, standards and procedures of the Department of Defense and the United Stated Air Force in cooperation with the U. S. Fish and Wildlife Service and the Texas Parks and Wildlife Department.

DEPARTMENT of the AIR FORCE – JOINT BASE SAN ANTONIO

MILLER.CAROLIN E.M [redacted] Digitally signed by MILLER.CAROLINE.M[redacted] Date: 2020.10.05 16 41 00 -05 00'

CAROLINE M. MILLER
Brigadier General, USAF
Commander

DEPARTMENT of the INTERIOR

AMY LUEDERS
Regional Director
U.S. Fish and Wildlife Service

THE STATE of TEXAS

CARTER SMITH
Executive Director
Texas Parks and Wildlife Department

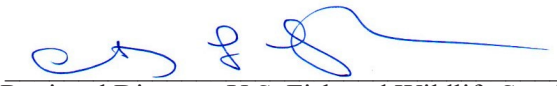
INRMP APPROVAL/SIGNATURE PAGES

Integrated Natural Resources Management Plan

Joint Base San Antonio, TX

Date

This INRMP has bee prepared in accordance with regulations, stadards and procedures of the Department of Defense and the United Stated Air Force in cooperation with the U. S. Fish and Wildlife Service and the Texas Parks and Wildlife Department.



09/23/2020

Regional Director, U.S. Fish and Wildlife Service

INRMP APPROVAL/SIGNATURE PAGES

Integrated Natural Resources Management Plan

Joint Base San Antonio, TX

This INRMP has been prepared in accordance with regulations, standards and procedures of the Department of Defense and the United Stated Air Force in cooperation with the U. S. Fish and Wildlife Service and the Texas Parks and Wildlife Department.

DEPARTMENT of the AIR FORCE – JOINT BASE SAN ANTONIO

_____ _____

CAROLINE M. MILLER
Brigadier General, USAF
Commander, 502d Air Base Wing

DATE

DEPARTMENT of the INTERIOR

_____ _____

AMY LUEDERS
Regional Director
U.S. Fish and Wildlife Service

DATE

THE STATE of TEXAS

24 September 2020

CARTER SMITH
Executive Director
Texas Parks and Wildlife Department

DATE

EXECUTIVE SUMMARY

The Sikes Act (Title 16 United States Code [U.S.C.] 670a et seq.), as amended, provides the legal basis for the Secretary of Defense to carry out a program that provides for the conservation and rehabilitation of natural resources on military installations. To facilitate such a program, the Act requires the secretary of each military department to prepare and implement an INRMP at appropriate military installations throughout the U.S. under their respective jurisdictions. The INRMPs are prepared in cooperation with, and reflect the mutual agreement of, the Secretary of the Interior (acting through the Director of the U.S. Fish and Wildlife Service [USFWS]) and the head of the appropriate state fish and wildlife agency in which the military installation concerned is located, which in Texas is the Texas Parks and Wildlife Department (TPWD).

The INRMP provides the installation commander and other decision makers a narrative of present natural resources and their status, outlines the management of these resources on all Joint Base San Antonio (JBSA) locations. The INRMP provides an adaptive management program to balance natural resources stewardship and military needs. It identifies a number of goals and objectives for specific natural resources and corresponding management strategies at JBSA. As a component of the JBSA Installation Development Plan (IDP), the INRMP is consistent with other components and related documents such as the Bird/Wildlife Aircraft Strike Hazard (BASH) Plan, Installation Pest Management Plan (IPMP), the Integrated Cultural Resources Management Plan (ICRMP), Area Development Plans (ADP), Golf Course Environmental Management (GEM) Plan, and Ground Maintenance contracts.

Natural Resource Management goals are:

- Implement the INRMP through compliance with existing laws while ensuring no net loss in the capability of installation lands to support the military mission.
- Protect and enhance desirable wildlife and plant species and their habitats that provide for current and future missions, including actions to address invasive species and wildland fire through use of adaptive management.
- Protect and enhance threatened and endangered species and their habitats.
- Promote education, awareness, and opportunities for conservation and enjoyment of the natural resources of Air Force lands.

These goals are developed to support and sustain the missions that rely on or are impacted by natural resources. None of these goals will have any significant impacts to the base mission through the implementation of the INRMP nor do they constitute a significant change in management direction from previous INRMPs.

1.0 OVERVIEW AND SCOPE

This 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 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 military mission of the installation. The plan outlines and assigns responsibilities for the management of natural resources,

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

Natural resources are defined as all plants, animals, soils, minerals, waters, and air. This INRMP sets forth management philosophy, outlines and assigns responsibilities, identifies concerns, and establishes procedures for the management of significant natural resources at JBSA. The purpose of this INRMP is to serve as the primary information source on which commanders can base their decisions regarding the conservation and management of the natural resources on JBSA. The INRMP also serves as a tool for short and long term planning and management of natural resources to support and sustain the missions of JBSA and JBSA's mission partners.

1.2 Management Philosophy

1.2.1 Mission Support and Cooperation

The INRMP serves as a key component of the IDP, which provides background and rationale for the policies and programming decisions related to land use, resource conservation, facilities and infrastructure development, and operations and maintenance to ensure that they meet current requirements and provide for future growth. The INRMP supports the mission by identifying the natural resources present on the installation, developing management goals for these resources, and integrating these management objectives into the military requirements for mission operations/support and regulatory compliance to minimize natural resource constraints.

Management issues and concerns, as well as goals and objectives, are developed from analysis of all the gathered information, and are reviewed by JBSA 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 JBSA. Information was obtained from a variety of documents, 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.

1.2.2 Ecosystem Management

The INRMP is based on an interdisciplinary approach to ecosystem-based management, focused on the health of the entire ecosystem, as opposed to any one species. This approach ensures that the military mission is successfully accomplished by integrating all aspects of natural resources management with each other and with the rest of the missions at JBSA.

The DoD (1994) has stated an overall goal with regard to ecosystem management: "The goal of ecosystem management is to preserve, improve, and enhance ecosystem integrity. Over the long term, this approach will maintain and improve the sustainability and biological diversity of terrestrial and aquatic ecosystems while supporting sustainable economies and communities." Biodiversity conservation is the foundation of sensible military natural resources management.

Biodiversity conservation:

- Helps maintain natural landscapes for realistic military training now and in the future;
- Provides for compliance with the Endangered Species Act (ESA), Clean Water Act (CWA), and other state and federal environmental regulations;
- Contributes to national security by helping maintain the natural resources upon which this country's strength depends;
- Involves military, civilian, and tribal partners in the important decision making for lands managed by the DoD;
- Enhances the quality of life for military personnel and the public by maintaining aesthetically pleasing surroundings; and
- Maintains natural resources for use by the public and tribes.

Principles and guidelines to achieve this goal are to:

- Maintain and improve the sustainability and native diversity of ecosystems
- Support sustainable human activities
- Develop coordinated approaches to work toward ecosystem sustainability
- Rely on the best scientific information available
- Use best management practices
- Use benchmarks to monitor and evaluate outcomes
- Use "adaptive management" (see next section)
- Natural resources conservation through installation plans and programs

Ecosystem management is best accomplished by a process termed adaptive management whereby management activities are carried out simultaneously with data collection. As new data and information are gathered, management decisions and activities are adapted to account for this new knowledge.

1.2.3 Adaptive Management

Adaptive management is a strategy used in conservation planning whereby goals for the plan are set, information is collected to evaluate whether the goals are being met, and management is adjusted if necessary to ensure success in achieving the goals. It is a repetitious learning process that produces improved understanding and improved management over time. As new information is gained it is taken into account to adjust management objectives and actions to enhance future actions and outcomes.

Figure 1-1. Adaptive management process.

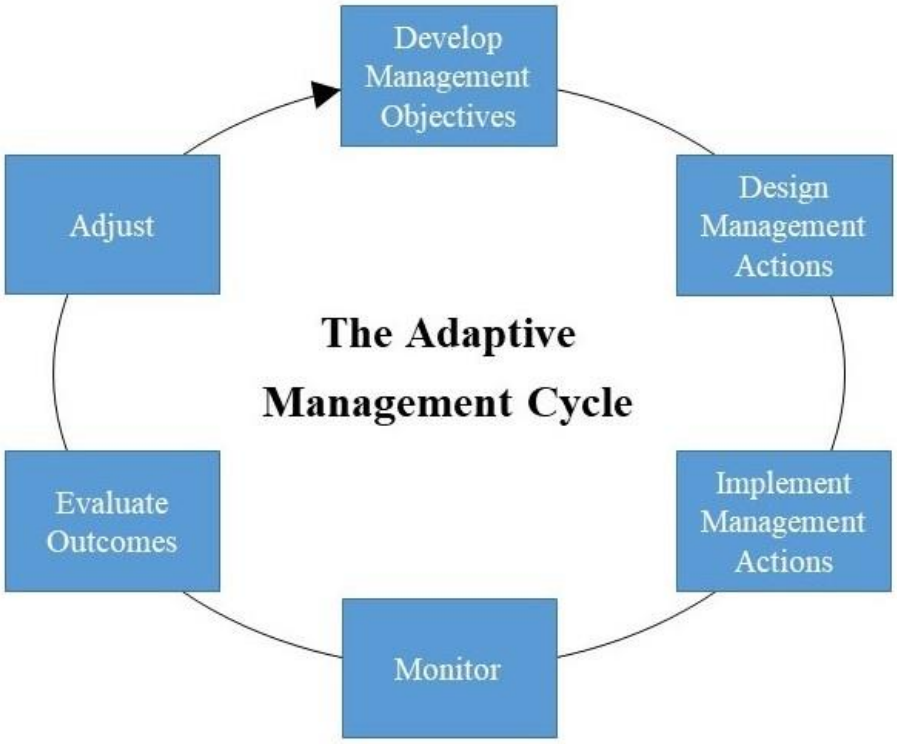


Figure adapted from U.S. Department of Interior *Adaptive Management Technical Guide* (2009).

The INRMP should be treated as a living document that changes as needed through consultation and data sharing with non-governmental organizations, tribal partners and federal and state agencies. It is with this intent that the INRMP seeks to stress the goal of natural resources management and military mission compatibility. Natural resources and the military missions on JBSA must be continually reviewed and evaluated for impact.

1.3 Authority

Laws, regulations and directives that authorize the development and implementation of this INRMP include:

- The Sikes Act of 1960 (16 U.S. Code [USC] 670 et. seq.), as amended, provides for cooperation between the Department of Interior (DOI), DoD, and state agencies in planning, developing, and maintaining natural resources on military installations.
- The Sikes Act Improvement Amendment, as contained in the Fiscal Year (FY) 1998 National Defense Authorization Act, specifically calls for the cooperative preparation and implementation of INRMPs on military installations.
- DoD Instruction 4715.03, Environmental Conservation Program, implements policy, assigns responsibilities, and prescribes procedures for the integrated management of natural and cultural resources on the property under DoD control.
- DoDD 4715.1E, "Environment, Safety, and Occupational Health (ESOH), Manages and applies the Department of Defense's installation assets to sustain the DoD national defense mission. ESOH evaluates all activities for current and emerging ESOH resource requirements and make prudent

investments in initiatives that support mission accomplishment, enhance readiness, reduce future funding needs, prevent pollution, prevent illness and injury, ensure cost-effective compliance, and maximize the existing resource capability and ensures, through a host-tenant agreement or otherwise, that all DoD tenants and non-DoD tenants comply with all applicable laws and DoD policies relating to ESOH requirements.

- Air Force Policy Directive (AFPD) 32-70, Environmental Quality, requires Air Force installations to conserve natural and cultural resources through effective environmental planning.
- AFMAN 32-7003, Environmental Conservation, implements the Sikes Act, DoD Instruction 4715.03, AFPD 32-70, and provides guidance in managing natural and cultural resources on Air Force installations in accordance with applicable federal, state, and local laws and regulations. AFMAN 32-7003 establishes the INRMP as the principal tool for managing natural resources on Air Force installations.

A complete list of applicable regulatory guidance is found in Appendix A.

Table 1-1. Installation Specific Policies

Installation Specific Policies (includes State and/or Local Laws and Regulations)	Description
JBSA Instruction 31-1002, *Energy and Water Conservation*	Establishes policies and procedures for the management of water and energy used at JBSA
Critical Period Management Plan for Edwards Aquifer Water Use at Joint Base San Antonio	Directive for all organizations at JBSA to comply with water conservation measures outlined in the plan

1.4 Integration with Other Plans

INRMP revisions and concurrence with the final plan must be coordinated through the installation chain of command and the 502 Civil Engineer Group, 502 Installation Support Group, 502 Security Forces Group, Army Support Activity (ASA), 12 Flying Training Wing, 37 Training Wing, 502 Wing XP Office, Legal, and Public Affairs. The NRM must ensure that the INRMP, IDP, ICRMP, BASH Plan, IPMP, ADP, Campus Development Plans (CDP), GEM, Integrated Training Area Management (ITAM) Plan and any other plans that may affect natural resources, are mutually supportive and not in conflict.

Activities implemented as part of the INRMP are considered in the Installation Development Plan, both for how natural resources impact development and how development impacts natural resources.

The INRMP and BASH Plan both cover bird/wildlife management activities to minimize the risk for potential wildlife strikes with aircraft, such as habitat management and wildlife relocation and depredation.

The INRMP and IPMP detail efforts to control pest animal and plant species that benefit both the mission and natural resources, including feral animal control and invasive species control.

The INRMP and ITAM Plan both cover vegetation management activities at JBSA-BUL to maintain training lands and support mission readiness.

The INRMP and ICRMP both discuss conservation and preservation of resources on JBSA. Both plans discuss effects of management activities on both cultural and natural resources.

2.0 INSTALLATION PROFILE

Table 1-2. Installation Profile

Office of Primary Responsibility (OPR)	802 CES/CEIEA has overall responsibility for implementing the natural resources management plan and is the organization for monitoring compliance with applicable federal, state, and local regulations
Natural Resources Manager/Point of Contact (POC)	Name: Rustin Tabor Phone: (210) 295-8339 Email: rustin.t.tabor.civ@mail.mil
USFWS, Austin Ecological Field Office	Name: Tanya Sommer Phone: (512) 490-0057 ext. 222 Email: tanya_sommer@fws.gov
TPWD, Wildlife Habitat Assessment Program	Name: Russell Hooten Phone: (361) 825-3240 Email: russell.hooten@tpwd.texas.gov
Total acreage managed by installation	45,704 ac.
Total acreage of wetland	144 ac.
Total acreage of forested land	22,350 ac.
Does installation have any Biological Opinions? (If yes, list title and date, and identify where they are maintained)	USFWS Consultation No. 02ETAU00-2013F-0060 Maintained at JBSA-BUL, Building 6201
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 Resources 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 ☒ Public Outreach ☒ Geographic Information Systems (GIS)

2.*1 Installation Overview*

2.1.1 Locations and Area

JBSA encompasses more than 45,000 acres in southcentral Texas, in and around the City of San Antonio (CoSA). The installation consists of four primary geographically separated units (GSU): JBSA-Lackland (JBSA-LAK), JBSA-Bullis (JBSA-BUL), JBSA-Sam Houston (JBSA-SAM), JBSA-Randolph (JBSA-RND), and seven smaller locations.

JBSA-LAK is situated about eight miles from downtown San Antonio. JBSA-Chapman Training Annex (JBSA-CTA) is located about a mile west of JBSA-LAK across Loop 410. JBSA-Kelly Field Annex (JBSA-KFA) is located adjacent to the east side of JBSA-LAK. It includes a joint use runway shared with Port San Antonio which lies on the east side of the runway. Port San Antonio was created after the closing of Kelly AFB, approximately 245 ac. is leased back to the Air Force for administrative functions. The leased back areas are referred to as JBSA-Port Annex (JBSA-PRT).

JBSA-Grayson Street Annex (JBSA-GSA) and JBSA-Medical Center Annex (JBSA-MCA) are adjacent to JBSA-SAM and lie just northeast of downtown San Antonio.

JBSA-Seguin Auxiliary Field (JBSA-SAF) is located three miles from Seguin, TX in Guadalupe, County. Prior to joint basing it was a sub installation of JBSA-RND and continues to support flying training from JBSA-RND.

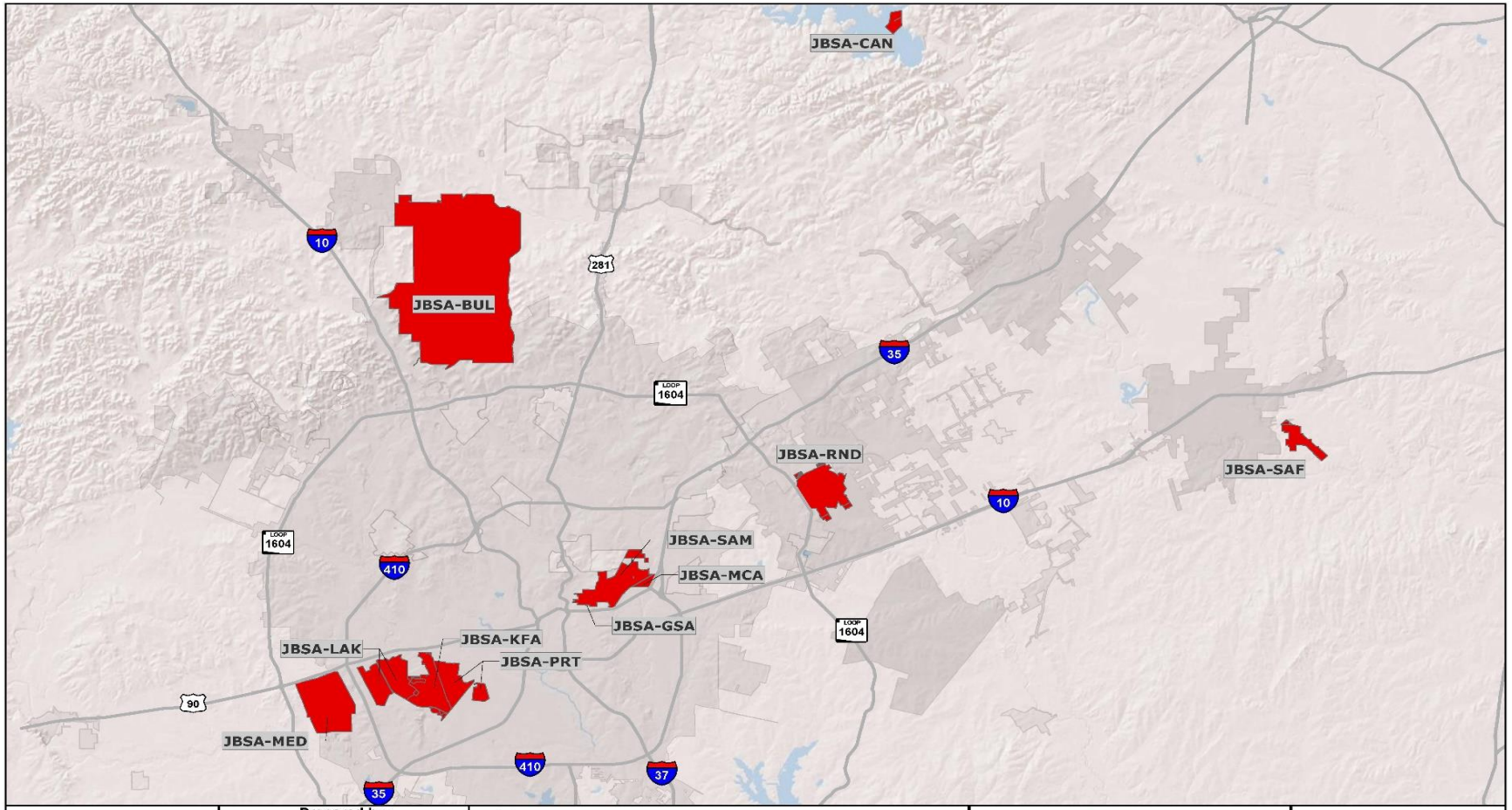
JBSA-Canyon Lake (JBSA-CAN) lies on the eastern shore of Canyon Lake, as U.S. Army Corps of Engineers managed lake, located approximately 13 miles northeast of New Braunfels, TX. JBSA-CAN was formed from joint basing combining one U.S. Army recreation site and one U.S. Air Force recreation site that were adjacent to one another.

Table 1-3. Installation/Geographically Separated Units and Area Description

GSU	Main Use/Mission	Acreage	Addressed in INRMP?	Described Natural Resources Implications
JBSA-CTA	• Basic military training • Working dog training • Small arms training • Technical training • Housing	3,969	Yes	Fish and Wildlife; Land Management; Invasive Species; Wetlands; Floodplains; Wildland Fires; Public Outreach
JBSA-LAK	• Basic military training • Working dog training • Administrative • Housing	2,643	Yes	Fish and Wildlife; Land Management; Invasive Species; Wetlands; Floodplains; Public Outreach
JBSA-KFA	• Flight training • Cyber/Intelligence • Administrative	2,118	Yes	Fish and Wildlife; Land Management; Invasive Species; Wetlands; Floodplains; Wildland Fires; BASH; Public Outreach
JBSA-PRT	• Administrative	245	Yes	BASH
JBSA-BUL	• Medical training • Field training • Small arms training	27,963	Yes	Fish and Wildlife; Land Management; Invasive Species; Wetlands; Floodplains; Wildland Fires; T&E Species; Public Outreach
JBSA-SAM	• Medical training • Administrative • Housing	2,717	Yes	Fish and Wildlife; Land Management; Invasive Species; Wetlands; Floodplains; Public Outreach

GSU	Main Use/Mission	Acreage	Addressed in INRMP?	Described Natural Resources Implications
JBSA-GSA	• Administrative	1	No	None
JBSA-MCA	• Medical training • Medical treatment	195	Yes	Fish and Wildlife; Land Management; Invasive Species; Wetlands
JBSA-RND	• Flight training • Administrative • Housing	2,881	Yes	Fish and Wildlife; Land Management; Invasive Species; Wetlands; Floodplains; BASH; Public Outreach
JBSA-SAF	• Flight Training	958	Yes	Fish and Wildlife; Land Management; Invasive Species; Wetlands; Floodplains; BASH
JBSA-CAN	• Recreation	381	Yes	Fish and Wildlife; Land Management; Invasive Species; Wetlands; Floodplains; Public Outreach

Figure 2-1. Installation Location Map



Document Path: C:\Users\mjreeb\Documents\FromAF\Projects\Rustin\2020_INRMP\JBSA_OverviewLandscape.mxd

2.1.2 Installation History

Joint Base San Antonio (JBSA) operates under the 502d Air Base Wing (ABW) and supports over 200 mission partners that include diverse training including flying, medical, cyber intelligence, and installation missions. In November 2005, the recommendations of the 2005 Defense Base Realignment and Closure (BRAC) Commission were enacted. One of the recommendations called for implementation of "joint basing," in which a single entity would manage the support functions of two or more adjacent DoD installations. The purpose of joint basing is to eliminate redundant and duplicate support functions. The BRAC Commission recommended joint basing for the three major installations and their sub installations around the city of San Antonio: Fort Sam Houston, Lackland AFB, and Randolph AFB. The installations were merged and JBSA was formed in October of 2010. Today, JBSA is the single largest entity in the DoD and continues to accomplish diverse training, flying, medical, cyber, and intelligence missions every day.

JBSA-LAK

JBSA-LAK (formerly Lackland Air Force Base, LAFB) was established in 1942 after the part of Kelly Field lying west of Leon Creek was separated and made an independent installation named San Antonio Aviation Cadet Center. That area had previously been used as a bivouac area and bombing range since 1922. Several missions were transferred to the installation at this time including preflight school, classification center, station hospital and the Air Force band. In 1946, the Army redesignated the installation as the Army Air Forces Military Training Center and transferred both basic military training (BMT) and the Officer Candidate School (OCS) there. Although JBSA-LAK still serves as the only installation to support AF BMT, OCS was transferred to Maxwell AFB in 1993. The installation was renamed in 1947 after Brig. Gen. Frank D. Lackland, who originated the ideas of an aviation cadet reception and training center at Kelly. LAFB received its first technical training in 1957, with the transfer of air police training from Parks AFB, CA. In 1958, the base gained two new mission connected with air police training: the USAF Marksmanship Center and a sentry dog handler course, both of which remain today. The Air Force Language School was formally established in 1954 to teach English to military personnel from foreign countries, now called the Defense Language Institute English Language Center it continues these same services. With the closure of Kelly AFB in 2001 the AF transferred the airfield operations mission and real property west of Kelly's hanger line to LAFB. The property east of the hangar line was turn over to CoSA.

JBSA-BUL

JBSA-BUL was originally established as a sub-installation of Fort Sam Houston in 1917 (U.S. Army, 2012). It served as home to the 90th Infantry Division "Tough Ombres" during World War I, an infantry division composed entirely of personnel from Texas and Oklahoma. During the 1920s and 1930s, Camp Bullis became a training center for the Civilian Conservation Corps, the Reserve Officer Training Corps, and the Officer Reserve Corps. At the end of World War II, most of the infantry divisions that the base had hosted were gone (U.S. Army, 2012). In 1946, the Surgeon General of the Army designated Fort Sam Houston as the new site for the U.S. Army Medical Field Service School, making its substation Camp Bullis the field-training site for the Army's medical schools (U.S. Army, 2012).

JBSA-SAM

JBSA-SAM was established in 1876, when the Army began construction of a Quartermaster supply depot on 92 ac. of land donated by the City of San Antonio. The initial depot was expanded the next two years to house the Headquarters, Department of Texas and was known as The Post at San Antonio. The Post at San Antonio continued to expand through the 1880s to include an infantry post. In 1890 the name was changed to Fort Sam Houston, at this time it was the second largest Army post in the US. A Calvary Post and Light

Artillery Poster were add following the Spanish-American War. By the outbreak of the Mexican Revolution, Fort Sam Houston was the largest post in the Army and was used as a staging point for troops mobilized to the border in 1911 and in 1916. Camp Wilson (later Camp Travis) was established on the east side of Fort Sam Houston to handle the troops needed in Mexico, the Camp was absorbed into Fort Sam Houston in 1922. The expansion resulted in the current boundary the installation maintains today.

What would become Brooke Hospital Center was established in 1938 as a 418 bed hospital it growing to a 7,800 bed hospital by 1945. The growth of San Antonio, as well as, improvements in weapons range and infantry needs made it so Fort Sam Houston could no longer support combat missions. The Army's Medical Field Service School transferred to the post in 1946. At the same time Brooke Hospital Center and several other medical activities on the post were combined to form Brooke Army Medical Center (BAMC). Growth of BAMC and medical training has continued since and with implementation of the 2005 BRAC, JBSA-SAM now supports medical training for all branches of the military.

JBSA-RND

The land occupied by JBSA-RND (formerly Randolph Air Force Base, RAFB) was donated to the DoD in 1928 by the San Antonio Airport Company (DoD, 2005). In 1931, the Air Corps Training Center moved its headquarters to RAFB. From 1931 to 1948 the primary mission of RAFB from was undergraduate pilot training. In 1943 the Central Instructor School began training instructors for the flying training program. Since that time, pilot instructor training has remained a central part of JBSA-RND's mission. In 1950 RAFB shifted emphasis to combat crew training in B-29s, B-57s and C-119s in preparation for combat in Korea. In January 1960, RAFB again reverted to a primary training mission with the establishment of the Air Training Command (now the Air Education and Training Command, [AETC]). As part of this effort, schools were established for the advanced training of pilots in instructor skills.

2.1.3 Military Missions

The 502 ABW and subordinate units are responsible to perform the various installation management missions for each JBSA location to support mission partner requirements. Primary missions at JBSA include:

- Airman BMT
- Advanced military training
- Joint-service technical training
- Military medical operations
- Flying training
- Air National Guard training
- Specialized rehabilitation services
- Medical training
- Medical treatment
- Cyber command
- International technical training
- Defense Language Institute (DLI)
- Homeland Security
- Central administration and services for Airmen and their dependents (JBSA 2018)

Per the *Joint Base San Antonio Memorandum of Agreement* and *Environmental Supplemental Guidance for Implementing and Operating a Joint Base*, the 502 ABW, as the supporting unit, is responsible for all environmental compliance, environmental conservation, pollution prevention and restoration functions.

Table 1-4. Listing of Major Tenants for Primary Locations

JBSA-LAK	JBSA-BUL	JBSA-SAM	JBSA-RND
16th Air Force	343rd Training Squadron	U.S. Army Medical Command	Air Education and Training Command
Air Force Installation Mission Support Center	AMEDDC&S	U.S. Army Medical Department Center of Excellence	19th Air Force
37th Training Wing	91st Whiskey Combat Medic Training	Brooks Army Military Medical Center	Air Force Recruiting Service
59th Medical Wing	32nd MED Brigade (MED BDE)	U.S. Army North	Air Force Audit Agency
Special Warfare Training Wing	6th Military Intelligence Battalion	Installation Management Command	Air Force Installation Contracting Center
433rd Airlift Wing	Southwest Army Reserve Intelligence Support Center	U.S. Army Environmental Command	Defense Civilian Personnel Management Service
340th Flying Training Squadron	3rd MED BDE	U.S. Army South	Air Force Legal Operations Agency
149th Fighter Wing	342nd Training Squadron	Army Support Activity	12th Flying Training Wing
Transportation Security Administration	Tactical Air Control Party	Mission Installation Contracting Command	Air Force Personnel Center

2.1.4 Natural Resources Needed to Support the Military Mission

Natural resources are important to every community and are especially vital to the military mission and mission requirements. Natural resources needed to support the military mission include healthy native ecosystems that provide lands for training, quality habitat for wildlife, healthy vegetation, stable soils, and clean surface waters for riparian ecosystems and aquifer recharge.

Training conducted on JBSA encompasses a wide spectrum of activities. These different missions have different needs in general and it's the same for natural resources needed to support each. At JBSA-KFA, JBSA-RND and JBSA-SAF minimal natural resources are needed and managed for around aircraft movement areas (AMA). Abundance of natural resources in these areas can be detrimental to safe launch and recovery of aircraft. At JBSA-CTA and JBSA-BUL field training requires realistic environments to facilitate training including military working dog training, orienteering, extended field bivouacs, land zones, drop zones, staging areas, and medical training. Varying terrain and differing vegetation communities provide a variety of environmental conditions in which to train. This diversity also contributes to the ability of the environment to withstand both natural and man-made disturbances and is critical for realistic and sustainable training of the DoD.

2.1.5 Surrounding Communities

The San Antonio metropolitan area which is made up of Bexar County and seven adjacent counties saw a 17% population growth between 2010 and 2018 (U.S. Census Bureau 2020).). The San Antonio area is one

of the fastest growing areas in the U.S. This growth has led to several encroachment issues, including those related to noise, airspace, light pollution, and water resources.

Encroachment associated with development around DoD installations may restrict missions and training requirements. These encroachment issues can result in negative impacts for both the military mission and natural resources management, such as, destruction of Edwards Aquifer recharge zone or T&E species habitat. JBSA has partnered with the Alamo Area Council of Governments (AACOG) and the local governments that make up AACOG to ensure the long term sustainability of JBSA. This partnership has resulted in Joint Land Use Studies (JLUS) and a Compatible Use Plan (CUP). The JLUS and CUP address issues such as land use, spectrum interference, bird strikes, drones, and energy. The CUP implements strategies relating to the preservation of JBSA.

2.1.6 Local and Regional Natural Areas

In general San Antonio and the surrounding areas around JBSA are highly developed. It is expected that urban sprawl will continue with the forecasted population growth in the San Antonio Metropolitan Area. Several parks and natural areas are managed by TPWD and local governments within five miles of the installation to provide for conservation and outdoor recreation. Many were created to preserve river corridors, Edwards Aquifer recharge zone, and/or threatened and endangered (T&E) species and their habitat.

- Local TPWD parks and natural areas:
- Government Canyon State Natural Area
- Honey Creek State Natural Area
- Guadalupe State Park

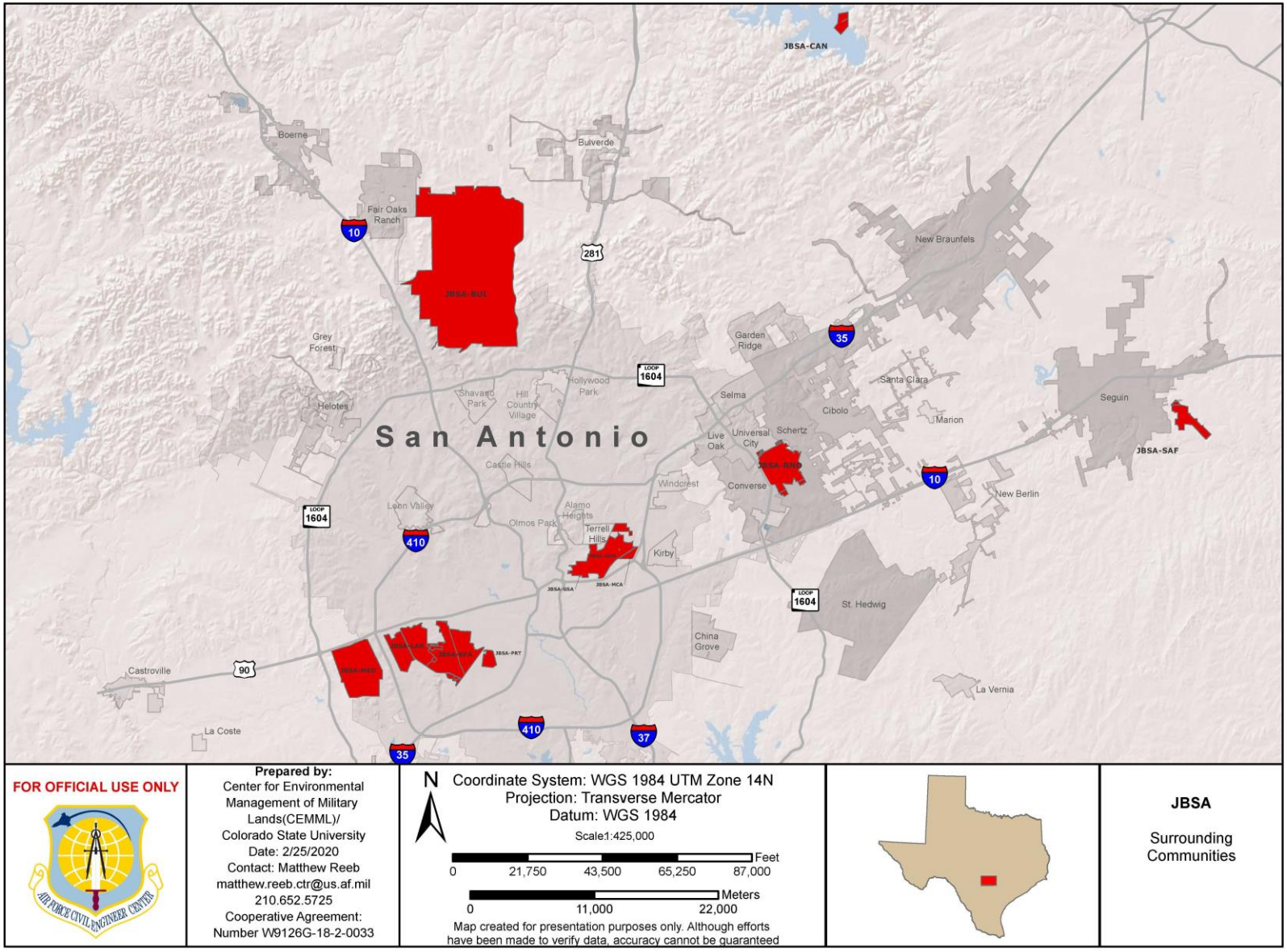
For more information on these and other parks and natural areas managed by TPWD refer to https://tpwd.texas.gov/state-parks.

- City of San Antonio parks and natural areas:
- Dwight D. Eisenhower Park
- Emilie & Albert Friedrich Wilderness Park
- Phil Hardberger Park
- Medina River Natural Area
- Rancho Diana
- Fay & William Sinkin Natural Area

For more information on these and other parks and natural areas managed by CoSA refer to https://www.sanantonio.gov/ParksAndRec/Parks-Facilities/All-Parks-Facilities.

Other notable natural areas are located 10 miles east of JBSA-BUL include the Bracken Bat Cave preserve managed by Bat Conservation International and the Cibolo Bluffs Preserve managed by the Nature Conservancy. Both of these preserves provide golden-cheeked warbler (*Setophaga chrysoparia*, GCWA) habitat, as well as, Edwards Aquifer recharge zone protection.

Figure 2-2. Surrounding Communities Map



2.2 Physical Environment

2.2.1 Climate

JBSA experiences a modified subtropical climate due to its location on the northwest edge of the Gulf Coastal Plain. The average temperature in winter is 50 degrees Fahrenheit (ºF) and the average in the summer is 90ºF. Temperatures in the winter are kept relatively mild due to the interaction of the colder continental climate to the north and west and the warmer maritime climate from the Gulf of Mexico to the south and southeast. Below freezing temperatures occur on average 22 days out of the year, with the first freezing day usually occurring around 1 December and the last occurring in late February (NOAA, 2017). The earliest recorded freeze occurred on 30 October 1917 and the latest occurred on 3 April 1987. The coldest low on record was a temperature of 0ºF on 31 January 1949. Summers in the San Antonio area tend to be long and hot, with temperatures over 90ºF during 80% of the season and with summer temperatures commonly lingering until September and October. The highest summer temperature recorded in San Antonio was 111ºF on 5 September 2000 (NOAA 2017).

Precipitation at JBSA varies due to its location between an arid area to the west and wet, more humid area to the east. The average yearly precipitation for the San Antonio area is 29 inches, though it can vary from 10 to 50 inches from year to year. The lowest annual precipitation level recorded in the San Antonio area was 10.11 inches in 1917, and the highest was 52.28 inches recorded in 1973. On average, the heaviest rains fall in May, September, and October, while the driest months are December through March as well as July and August. Relative humidity throughout most of the year is 80% in the morning hours, dropping to 50% in the late afternoon (NOAA 2017).

Small hail associated with springtime thunderstorms is common, but damaging events with large hail are infrequent. Given its relatively close proximity to the coast, San Antonio sometimes experiences tropical storms. Wind and heavy rains from these tropical events can affect the area; the fastest wind speed recorded in the area was 74 miles per hour (mph) in August 1942 (NOAA 2020). Strong winds can also occur as a result of thunderstorms not associated with tropical activity. Squall lines and cold fronts can also bring strong winds, with a squall in March 1994 creating a 104-mph wind gust recorded at JBSA-RND. Although rare, tornadoes have occurred; tornadoes are most often associated with dissipating tropical storms in the area.

Climate Change Projections

Climate projections for JBSA were completed by Colorado State University's Center for Environmental Management Military Lands (CEMML 2019), to provide information for installation stakeholder's considerations, as management action options are evaluated, to address natural resources issues. Climate projections for all JBSA GSUs. A suggest minimum and maximum temperatures will increase over time under two emission scenarios – a moderate carbon emission scenario (Representative Concentration Pathway [RCP] 4.5) and a high emission scenario (RCP 8.5). The potential impact of these two climate change scenarios on the site's natural resources was analyzed using extracted climate data from 2026 to 2035 to represent the decadal average for 2030, and extracted data from 2046 to 2055 for the decadal average for 2050. Methods of climate modeling in Appendix B.

The following sections present specific changes in in average annual temperature (TAVE) and average annual precipitation (PRECIP) and other projected climate parameters for each of the GSUs. Detailed temperature and precipitation data is presented in the summary climate data table for each GSU.

Understanding changes in daily intensity and total precipitation for multi-day precipitation events is helpful to evaluate precipitation patterns in addition to assessment of annual averages. Three-day storm events (design storms) were generated from projected precipitation data based on RCP 4.5 and 8.5 emission scenarios for target years 2030 and 2050. Historical precipitation data were used to calculate a baseline storm event for the year 2000 for comparison. These data are summarized in the projected design storm precipitation table for each GSU.

JBSA-CTA

For the decade centered around 2030, both scenarios project a similar degree of increase in TAVE of 2.2 oF (1.2 ºC) over historic average. For 2050, RCP 4.5 expresses a warming of 2.8 ºF (1.6 ºC) and RCP 8.5 expresses a warming of 4.1 ºF (2.3 ºC). For 2030, RCP 4.5 projects an increase in PRECIP of 19%, while RCP 8.5 projects an increase of 10% (RCP 8.5). For 2050 both scenarios project a PRECIP increase of between 15% (RCP 4.5) and 17% (RCP 8.5).

Table 2-1. Summary Climate Data for JBSA-CTA

Variable	Historical	RCP 4.5		RCP 8.5	
		2030	2050	2030	2050
PRECIP (inches)	30.3	36.1	34.9	33.3	35.5
TMIN (°F)	57.7	59.9	60.1	60.0	61.8
TMAX (°F)	81.2	83.4	84.6	83.5	85.3
TAVE (°F)	69.5	71.7	72.3	71.7	73.6
GDD (°F)	7404	7993	8144	7954	8345
HOTDAYS	115.2	143.7	158.3	141.9	164.5
WETDAYS	1.5	0.4	0.4	0.5	1.0
Notes: TAVE ºF = annual average temperature; TMAX ºF = annual average maximum temperature; TMIN °F = annual average minimum temperatures; PRECIP (inches) = average annual precipitation; GDD ºF = Average annual accumulated growing degree days with a base temperature of 50 ºF; HOTDAYS (average # of days per year) = average number of hot days exceeding 90 °F; WETDAYS (average # of days per year) = annual number of days with precipitation exceeding 2 inches in a day.					

Table 2-2. Design Storm Precipitation for JBSA-CTA

Design Storm		Baseline	RCP 4.5		RCP 8.5	
		2000	2030	2050	2030	2050
Precipitation (inches)	Day 1	1.7	1.4	1.1	1.1	1.4
	Day 2	2.4	1.7	2.0	2.0	2.9
	Day 3	1.8	1.4	1.7	1.4	1.7
	Total	5.9	4.5	4.8	4.5	6.0
Percent change from baseline			-24%	-19%	-24%	2%

JBSA-LAK

For 2030, both scenarios project a similar degree of increase in TAVE of between 2.2 ºF (1.2 ºC) and 2.3 ºF (1.3 ºC) over historic average. For 2050, RCP 4.5 expresses a warming of 2.9 ºF (1.6 ºC) with the RCP 8.5 expressing a higher warming of 4.1 ºF (2.3 ºC) for this period. For 2030, the scenarios project a PRECIP increase of 19% (RCP 4.5) and 11% (RCP 8.5). For 2050 both scenarios also project an increase in PRECIP of approximately 15%.

Table 2-3. Summary Climate Data for JBSA-LAK

Variable	Historical	RCP 4.5		RCP 8.5	
		2030	2050	2030	2050
PRECIP (inches)	30.5	36.4	35.0	33.8	35.4
TMIN (°F)	57.6	59.8	60.0	59.9	61.6
TMAX (°F)	81.1	83.3	84.4	83.4	85.2
TAVE (°F)	69.3	71.5	72.2	71.6	73.4
GDD (°F)	7378	7962	8109	7923	8309
HOTDAYS	114.4	142.6	157	141.2	163.3
WETDAYS	1.4	0.5	0.5	0.5	0.9
Notes: TAVE ºF = annual average temperature; TMAX ºF = annual average maximum temperature; TMIN °F = annual average minimum temperatures; PRECIP (inches) = average annual precipitation; GDD ºF = Average annual accumulated growing degree days with a base temperature of 50 ºF; HOTDAYS (average # of days per year) = average number of hot days exceeding 90 °F; WETDAYS (average # of days per year) = annual number of days with precipitation exceeding 2 inches in a day.					

Table 2-4. Design Storm Precipitation for JBSA-LAK

Design Storm		Baseline	RCP 4.5		RCP 8.5	
		2000	2030	2050	2030	2050
Precipitation (inches)	Day 1	1.7	1.1	1.2	1.0	1.4
	Day 2	2.6	1.9	2.1	2.1	2.6
	Day 3	2.0	1.5	1.6	1.3	1.6
	Total	6.3	4.5	4.9	4.4	5.6
Percent change from baseline			-29%	-22%	-30%	-11%

JBSA-BUL

For the decade centered around 2030, both scenarios project a similar degree of increase in average annual temperature (TAVE) of between 2.2 ºF (1.2 ºC) and 2.4 ºF (1.3 ºC) over historic average. The two emission scenario projections show higher warming by 2050, with the RCP 4.5 expressing a warming of 2.9 ºF (1.6 ºC) during the decade centered around 2050. RCP 8.5 expresses a slightly higher warming of 4.2 ºF (2.3 ºC) for this period. Maximum and minimum temperatures also show similar increasing trends over time under both scenarios. For 2030, both scenarios project PRECIP increases of between 14% (RCP 4.5) and 8% (RCP 8.5). For 2050, both scenarios project an increase in PRECIP of approximately 12%.

Table 2-5. Summary Climate Data for JBSA-BUL

Variable	Historical	RCP 4.5		RCP 8.5	
		2030	2050	2030	2050
PRECIP (inches)	35.6	40.6	40.0	38.4	40.1
TMIN (°F)	55.4	57.6	57.8	57.8	59.5
TMAX (°F)	79.0	81.2	82.4	81.5	83.2
TAVE (°F)	67.2	69.4	70.1	69.6	71.4
GDD (°F)	6842	7438	7589	7424	7810
HOTDAYS	92.1	123.8	136.7	127.1	148.9
WETDAYS	1.9	0.8	0.7	1.0	0.8
Notes: TAVE ºF = annual average temperature; TMAX ºF = annual average maximum temperature; TMIN °F = annual average minimum temperatures; PRECIP (inches) = average annual precipitation; GDD ºF = Average annual accumulated growing degree days with a base temperature of 50 ºF; HOTDAYS (average # of days per year) = average number of hot days exceeding 90 °F; WETDAYS (average # of days per year) = annual number of days with precipitation exceeding 2 inches in a day.					

Table 2-6. Design Storm Precipitation for JBSA-BUL

Design Storm		Baseline	RCP 4.5		RCP 8.5	
		2000	2030	2050	2030	2050
Precipitation (inches)	Day 1	2.0	1.1	1.2	1.3	1.4
	Day 2	3.5	2.0	2.3	2.4	3.0
	Day 3	2.4	1.6	1.9	1.6	1.9
	Total	7.9	4.7	5.4	5.3	6.3
Percent change from baseline			-41%	-32%	-33%	-20%

JBSA-SAM

For 2030, both scenarios project a similar degree of increase in TAVE of between 2.3 ºF (1.3 ºC) and 2.4 ºF (1.3 ºC) over historic average. By 2050, RCP 4.5 expresses a warming of 2.9 ºF (1.6 ºC) and RCP 8.5 express a warming of approximately 4.2 ºF (2.3 ºC) for this period. For 2030, RCP 4.5 projects an increase in PRECIP of 17%, while RCP 8.5 projects an increase of and 11%. For 2050, RCP 4.5 scenario projects a moderate increase in PRECIP of 15% while RCP 8.5 shows an increase of 14%.

Table 2-7. Summary Climate Data for JBSA-SAM

Variable	Historical	RCP 4.5		RCP 8.5	
		2030	2050	2030	2050
PRECIP (inches)	32.1	37.8	37.0	35.5	36.5
TMIN (°F)	57.5	59.7	59.9	59.8	61.6
TMAX (°F)	80.8	83.0	84.2	83.2	85.0
TAVE (°F)	69.1	71.4	72.0	71.5	73.3
GDD (°F)	7318	7926	8078	7889	8279
HOTDAYS	18.3	16.3	16.3	15.2	11.2
WETDAYS	1.5	0.5	0.5	0.7	0.8

Notes: TAVE ºF = annual average temperature; TMAX ºF = annual average maximum temperature; TMIN °F = annual average minimum temperatures; PRECIP (inches) = average annual precipitation; GDD ºF = Average annual accumulated growing degree days with a base temperature of 50 ºF; HOTDAYS (average # of days per year) = average number of hot days exceeding 90 °F; WETDAYS (average # of days per year) = annual number of days with precipitation exceeding 2 inches in a day.

Table 2-8. Design Storm Precipitation for JBSA-SAM

Design Storm		Baseline	RCP 4.5		RCP 8.5	
		2000	2030	2050	2030	2050
Precipitation (inches)	Day 1	2.3	1.2	1.3	1.1	1.2
	Day 2	4.0	2.0	2.3	2.4	2.7
	Day 3	1.5	1.6	1.5	1.5	1.9
	Total	7.8	4.8	5.1	5.0	5.8
Percent change from baseline			-38%	-35%	-36%	-26%

JBSA-RND

For 2030, both scenarios project a similar degree of increase in TAVE of 2.3 ºF (1.3 ºC) over historic average. The RCP 4.5 expresses a warming of 3.0 ºF (1.7 ºC) during the decade centered around 2050. RCP 8.5 expresses a higher warming of 4.1 ºF (2.3 ºC) for this period. For 2030, both scenarios project a PRECIP increase of between 14% (RCP 4.5) and 7% (RCP 8.5). For 2050, both scenarios also project an increase in PRECIP of between 13% (RCP 4.5) and 9% (RCP 8.5).

Table 2-9. Summary Climate Data for JBSA-RND

Variable	Historical	RCP 4.5		RCP 8.5	
		2030	2050	2030	2050
PRECIP (inches)	34.3	39.0	38.6	36.6	37.4
TMIN (°F)	57.0	59.4	59.6	59.4	61.2
TMAX (°F)	80.3	82.6	83.7	82.7	84.5
TAVE (°F)	68.7	71.0	71.7	71.1	72.8
GDD (°F)	7203	7815	7980	7781	8172
HOTDAYS	107.7	136.8	151.4	136.7	159.5
WETDAYS	1.4	0.4	0.5	0.3	0.8
Notes: TAVE ºF = annual average temperature; TMAX ºF = annual average maximum temperature; TMIN °F = annual average minimum temperatures; PRECIP (inches) = average annual precipitation; GDD ºF = Average annual accumulated growing degree days with a base temperature of 50 ºF; HOTDAYS (average # of days per year) = average number of hot days exceeding 90 °F; WETDAYS (average # of days per year) = annual number of days with precipitation exceeding 2 inches in a day.					

Table 2-10. Design Storm Precipitation for JBSA-RND

Design Storm		Baseline	RCP 4.5		RCP 8.5	
		2000	2030	2050	2030	2050
Precipitation (inches)	Day 1	1.8	1.4	1.3	1.5	1.4
	Day 2	4.2	2.1	2.4	2.6	2.8
	Day 3	2.5	1.7	1.9	1.4	2.0
	Total	8.5	5.2	5.6	5.5	6.2
Percent change from baseline			-39%	-34%	-35%	-27%

JBSA-SAF

For the decade centered around 2030, both scenarios project a similar degree of increase in TAVE of 2.4 ºF (1.3 ºC) over historic average. The two emission scenario projections show higher warming by 2050, with the RCP 4.5 expressing a warming of 3.1 ºF (1.7º C). RCP 8.5 expresses a slightly higher warming of 4.2 ºF (2.3 ºC) for this period. For 2030, the climate scenarios project a PRECIP increase of between 14% (RCP 4.5) and 8% (RCP 8.5). For 2050, both scenarios project a PRECIP increase of 10%.

Table 2-11. Summary Climate Data for JBSA-SAF

Variable	Historical	RCP 4.5		RCP 8.5	
		2030	2050	2030	2050
PRECIP (inches)	35.3	40.2	39.0	37.5	38.9
TMIN (°F)	57.3	59.7	60.0	59.6	61.5
TMAX (°F)	80.4	82.8	83.8	82.8	84.5
TAVE (°F)	68.8	71.2	71.9	71.2	73.0
GDD (°F)	7235	7883	8040	7821	8227
HOTDAYS	110.2	139.0	150.9	138.4	160.2
WETDAYS	1.6	0.3	0.6	0.4	0.8

Notes: TAVE ºF = annual average temperature; TMAX ºF = annual average maximum temperature; TMIN °F = annual average minimum temperatures; PRECIP (inches) = average annual precipitation; GDD ºF = Average annual accumulated growing degree days with a base temperature of 50 ºF; HOTDAYS (average # of days per year) = average number of hot days exceeding 90 °F; WETDAYS (average # of days per year) = annual number of days with precipitation exceeding 2 inches in a day.

Table 2-12. Design Storm Precipitation for JBSA-SAF

Design Storm		Baseline	RCP 4.5		RCP 8.5	
		2000	2030	2050	2030	2050
Precipitation (inches)	Day 1	1.5	0.9	1.3	1.5	1.4
	Day 2	2.1	2.4	2.4	2.5	2.8
	Day 3	3.2	1.4	1.5	1.0	1.4
	Total	6.8	4.7	5.2	5.0	5.6
Percent change from baseline			-30%	-24%	-27%	-18%

JBSA-CAN

For the decade centered around 2030, both scenarios project a similar degree of increase in TAVE of between 2.3 ºF (1.3 ºC) and 2.4 ºF (1.3 ºC) over historic average. The two emission scenario projections show higher warming by 2050, with the RCP 4.5 expresses a warming of 3.0 ºF (1.7 ºC) and RCP 8.5 expressing a warming of 4.1 ºF (2.3 ºC) for this period. For 2030, the scenarios project a PRECIP increase of 15% (RCP 4.5) and 7% (RCP 8.5). For 2050, both scenarios project an increase in PRECIP of approximately 12%.

Table 2-13. Summary Climate Data for JBSA-CAN

Variable	Historical	RCP 4.5		RCP 8.5	
		2030	2050	2030	2050
PRECIP (inches)	36.3	41.6	40.8	38.7	40.5
TMIN (°F)	56.0	58.3	58.6	58.5	60.2
TMAX (°F)	79.3	81.6	82.8	81.8	83.5
TAVE (°F)	67.7	70.0	70.7	70.1	71.8
GDD (°F)	6947	7546	7728	7529	7930
HOTDAYS	100.8	128.5	140.4	131.1	150.3
WETDAYS	2.0	0.4	0.8	0.6	1.2

Notes: TAVE ºF = annual average temperature; TMAX ºF = annual average maximum temperature; TMIN °F = annual average minimum temperatures; PRECIP (inches) = average annual precipitation; GDD ºF = Average annual accumulated growing degree days with a base temperature of 50 ºF; HOTDAYS (average # of days per year) = average number of hot days exceeding 90 °F; WETDAYS (average # of days per year) = annual number of days with precipitation exceeding 2 inches in a day.

Table 2-14. Design Storm Precipitation for JBSA-CAN

Design Storm		Baseline	RCP 4.5		RCP 8.5	
		2000	2030	2050	2030	2050
Precipitation (inches)	Day 1	1.6	1.3	1.7	1.0	1.5
	Day 2	2.3	2.2	2.4	2.6	3.2
	Day 3	3.3	1.5	1.5	2.1	1.7
	Total	7.2	5.0	5.6	5.7	6.4
Percent change from baseline			-31%	-22%	-21%	-11%

2.2.2 Landforms

The physiography of the area around San Antonio and JBSA is primarily influenced by the Balcones Escarpment, a broad area of faulted limestone forming the southern and eastern edge of the Edwards Plateau, separating the plateau from the Coastal Plains (TSHA 2012). San Antonio ranges from approximately 500 feet (ft) above mean sea level (msl) to 1,000 ft above msl. JBSA-BUL and JBSA-CAN lie within the Edwards Plateau Region of Texas with the Balcones Escarpment crossing the southeastern edge of JBSA-BUL. JBSA-BUL is hilly with landforms including King Ridge (1,515 ft), High Hill (1,490 ft), and Otis Ridge (1,480 ft) (Camp Bullis 2007).The remaining JBSA locations fall within the Blackland Prairie, an undulating (1-3% slopes), physiographic area with elevations ranging from 700 to 1,000 ft above msl.

2.2.3 Geology and Soils

Rock outcrops in Bexar County date from the Mesozoic to Cenozoic ages. Mesozoic rocks are exposed in the northern area of Bexar County and are composed of carbonate rocks. Cenozoic rocks have outcroppings throughout the county and are primarily composed of unconsolidated materials. The main stratigraphic units exposed in the San Antonio area are the Leona Formation, which consists of fine calcareous silt grading down into coarse gravel, 0 to 30 ft thick; and the Uvalde Formation, which includes silty, sandy gravel with caliche, reaching a maximum thickness of 20 ft. Normal faulting has exposed the Wilcox and Midway groups, which mainly consist of mudstone with varying amounts of sandstone and lignite. The measured thickness of the Wilcox Group ranges from 420 to 1,200 ft. The Midway Group is composed of clay and sand with an estimated thickness ranging from 100 to 400 ft (LAFB 2007; Fort Sam Houston 2007). See Figure 2-3 for geologic map of the San Antonio area.

Geology of the San Antonio area is characterized by karst landforms. Karst geology is a terrain, generally underlain by limestone or dolomite, in which the topography is chiefly formed by the dissolution of rock and which may be characterized by sinkholes, sinking streams, closed depressions, subterranean drainage, and caves. Karst geology impacts most JBSA locations either through the abundance of karst features and caves that provide habitat for endangered invertebrates or through water availability from the Edwards Aquifer. The JBSA location most impacted by karst geology is JBSA-BUL. Within JBSA-BUL, karst landforms including caves are located throughout the installation and are predominately found in the Lower Glen Rose formation and Kainer formation of the Edwards group (Zara 2011). Also, the whole of JBSA-BUL is either Edwards Aquifer recharge or contributing zones. No karst features have been mapped from any of the other JBSA locations nor are they anticipated to be present based on the geology present at each.

Details of the geology of JBSA-BUL are presented in the Karst Hydrology of Camp Bullis (Zara 2011). Surveys to identify karst features were conducted from 1994 to 2003, resulting in the identification of 111 known caves and 1,474 karst features.

Soils throughout the JBSA are varied given the amount of acreage the installation covers and the geographic separation of the locations. See Figures 2-3 to 2-8 for soils maps.

In general the dominant soil types at all JBSA locations except JBSA-BUL and JBSA-CAN are deep soils associated with the blackland prairie ecoregion. The soils also have slow to very slow permeability, moderate to high runoff potential dependent on slope and have a high to very high shrink-swell potential (USDA 2019). These soils historically supported tall and midgrass prairies. They are considered highly productive and are highly cultivated for that very reason.

Dominant soil types at JBSA-BUL and JBSA-CAN are more variable due to greater topographic relief than other JBSA locations. Typically the higher points on the landscape have very shallow to shallow soils and the valleys have deeper soils. Potential for erosion is greater at these locations due to the shallow soils and slope of the landscape.

Table 2-15. Percentage of Soil Series by JBSA Location.

Soil Series	JBSA-CTA	JBSA-LAK	JBSA-BUL	JBSA-SAM	JBSA-RND	JBSA-SAF	JBSA-CAN
Anhalt clay	-	-	3%	-	-	-	-
Bolar clay loam	-	-	-	-	-	13%	-
Bosque and Seguin soils	-	-	-	-	0%	-	-
Brackett gravelly clay loam	-	-	36%	-	-	-	-
Brackett-Rock outcrop-Comfort complex	-	-	0%	-	-	-	36%
Brackett-Rock outcrop-Real complex	-	-	-	-	-	-	25%
Brackett-Eckrant association	-	-	3%	-	-	-	-
Branyon clay, 0 to 1 percent slopes	7%	23%	-	1%	51%	65%	-
Burleson clay	-	-	-	-	-	2%	-
Comfort-Rock outcrop complex	-	-	1%	-	-	-	-
Crawford, stoney and Bexar soils	-	-	0%	-	-	-	-
Crockett fine sandy loam	-	-	-	-	-	1%	-
Eckrant cobbly clay	-	-	25%	-	-	-	-
Eckrant very cobbly clay	-	-	5%	-	-	-	-
Eddy gravelly clay loam	-	-	-	1%	-	-	-
Heiden clay	1%	-	-	-	-	-	-
Heiden-Ferris complex	2%	-	-	10%	-	-	-
Houston black clay	5%	-	-	17%	7%	-	-
Houston black gravelly clay	72%	33%	-	33%	1%	-	-
Krum clay	-	-	15%	-	-	-	-
Lewisville silty clay	6%	32%	0%	21%	34%	9%	-
Loire clay loam	-	4%	-	7%	-	-	-
Oakalla silty clay loam	-	-	1%	-	-	-	-
Orif soils	-	-	1%	-	-	-	-
Patrick soils	0%	3%	0%	-	5%	-	-
pits and quarries	-	1%	0%	-	0%	-	-
Perves clay	-	-	0%	-	-	-	-
Queeny gravelly loam	-	-	-	-	-	5%	-

Soil Series	JBSA-CTA	JBSA-LAK	JBSA-BUL	JBSA-SAM	JBSA-RND	JBSA-SAF	JBSA-CAN
Real-Comfort-Doss complex	-	-	0%	-	-	-	-
rock outcrop-Olmos complex	0%	-	-	-	-	-	-
Rumple-Comfort, rubbly association	-	-	0%	-	-	-	-
Sunev clay loam	-	5%	0%	9%	0%	-	-
Tarply clay	-	-	4%	-	-	-	-
Tinn Clay	-	-	3%	-	0%	5%	-
Tinn and Frio soils, frequently flooded	6%	0%	-	-	1%	-	-
Water	-	-	-	-	1%	-	40%

- signifies that the soil series does not occur at the location.

0% signifies soil series occurs at the location but at <0.5% of total acreage.

Figure 2-3. Geological Map of JBSA and Surrounding Area

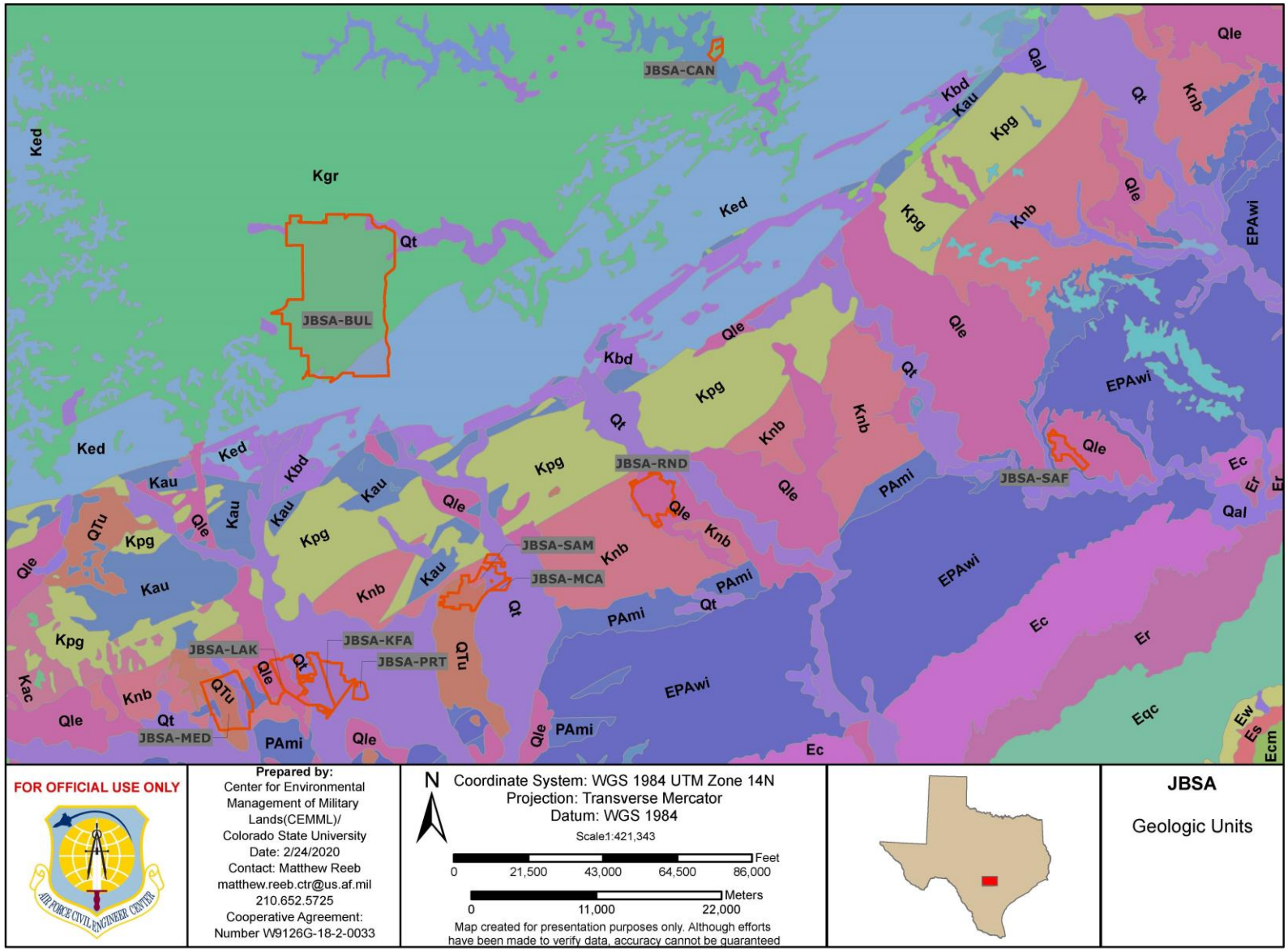


Figure 2-4. Soils Map for JBSA-CTA, JBSA-LAK, JBSA-KFA and JBSA-PRT

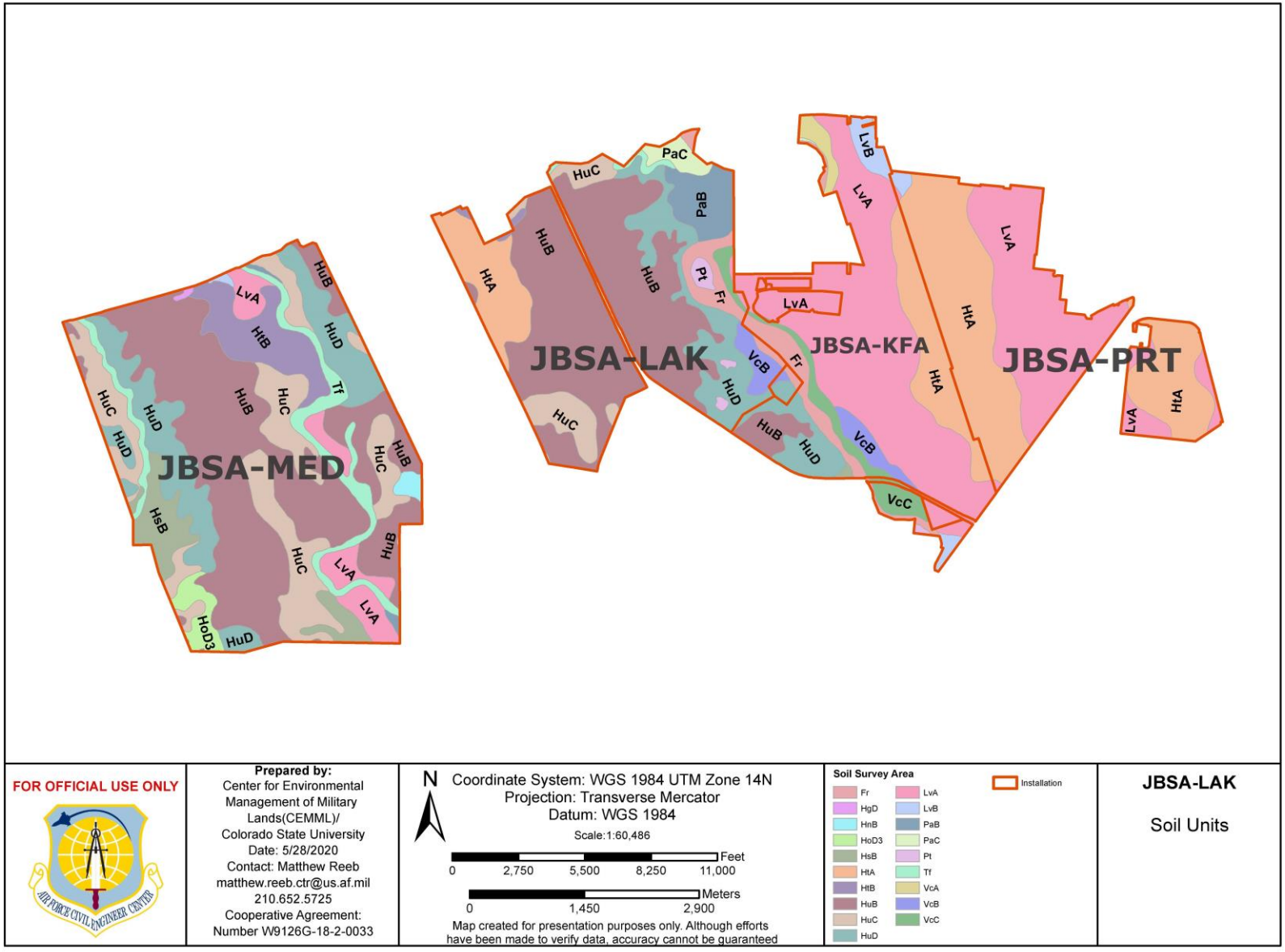


Figure 2-5. Soils Map for JBSA-BUL

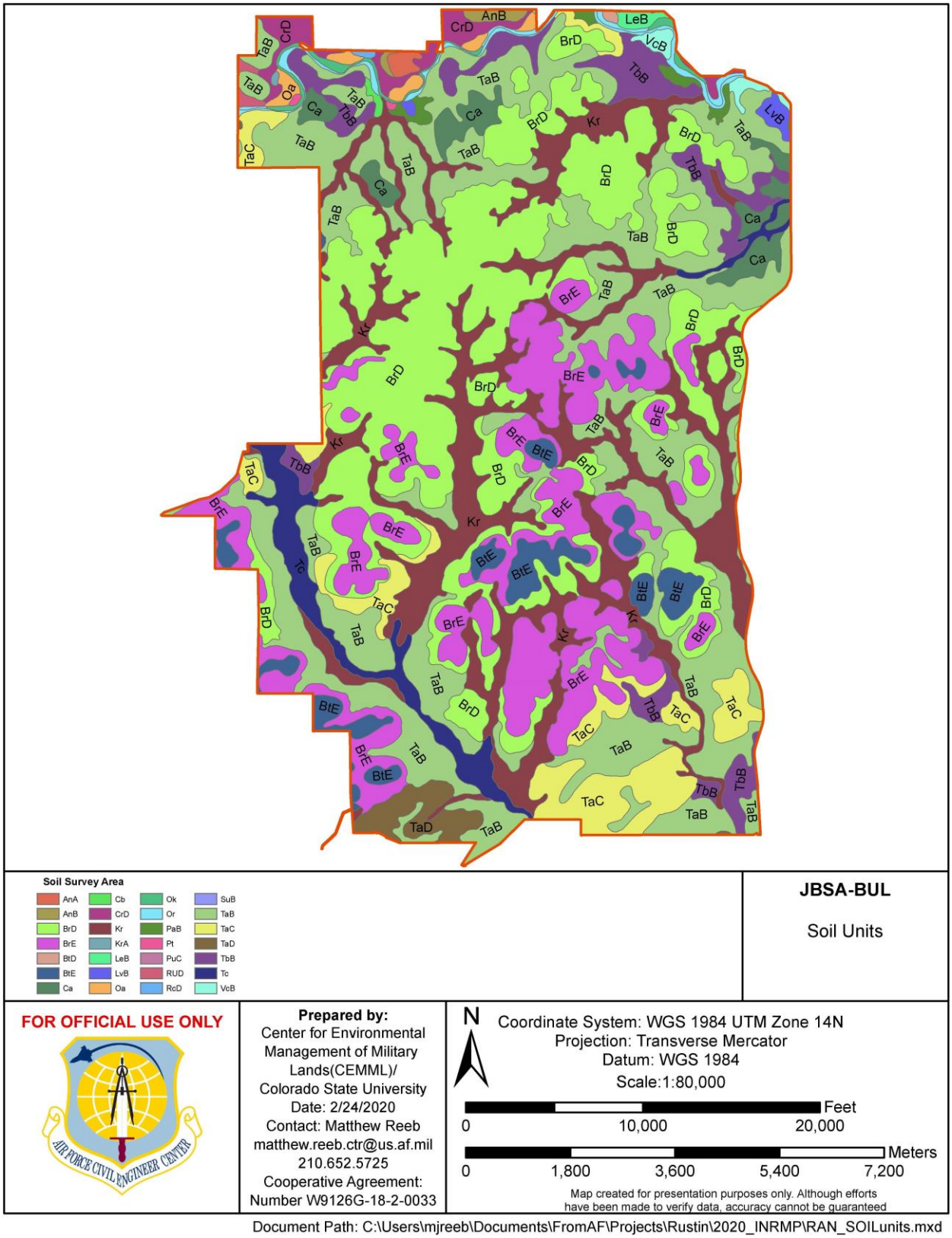


Figure 2-6. Soils Map for JBSA-SAM, JBSA-GSA and JBSA-MCA

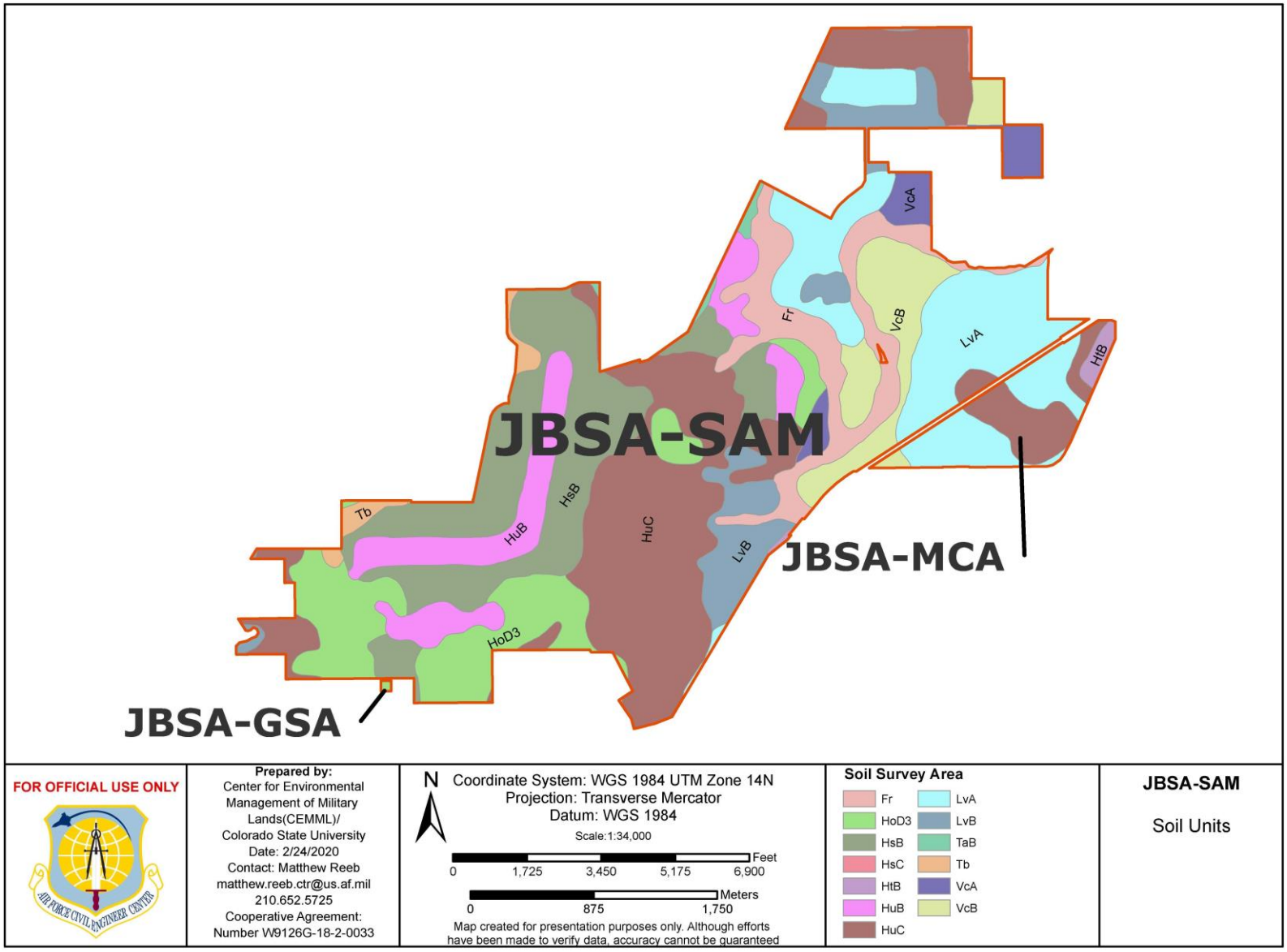


Figure 2-7. Soils Map for JBSA-RND

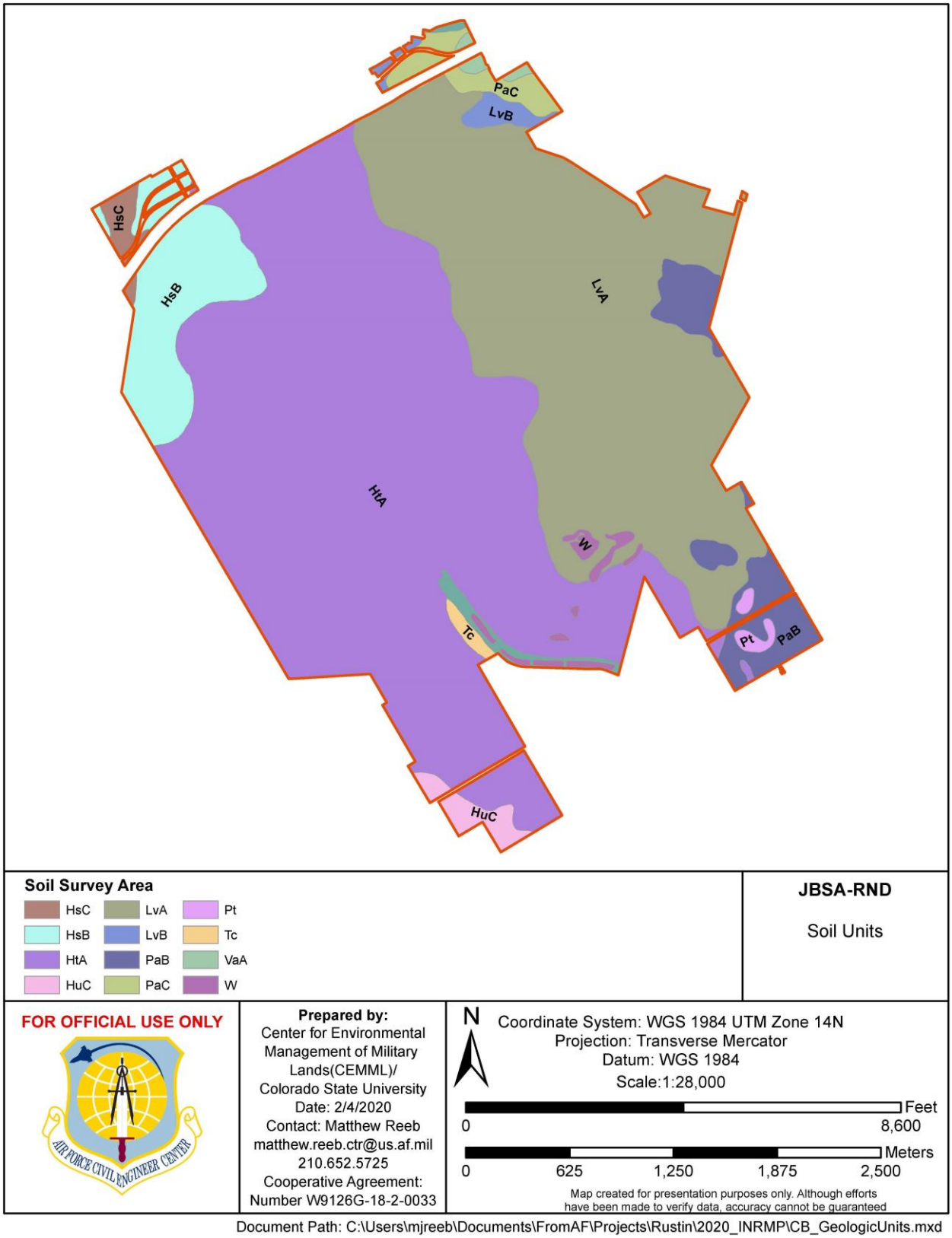


Figure 2-8. Soils Map for JBSA-SAF

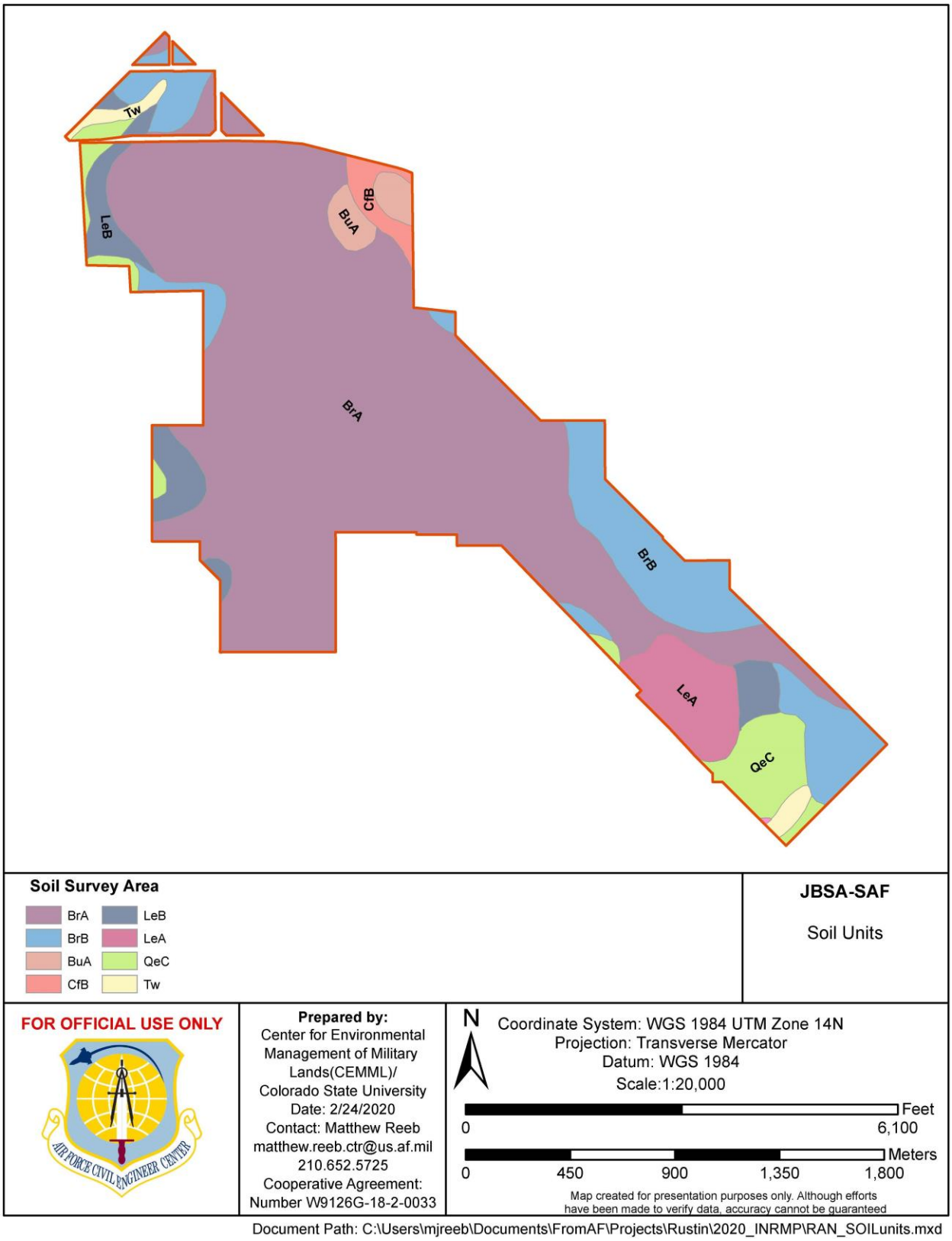
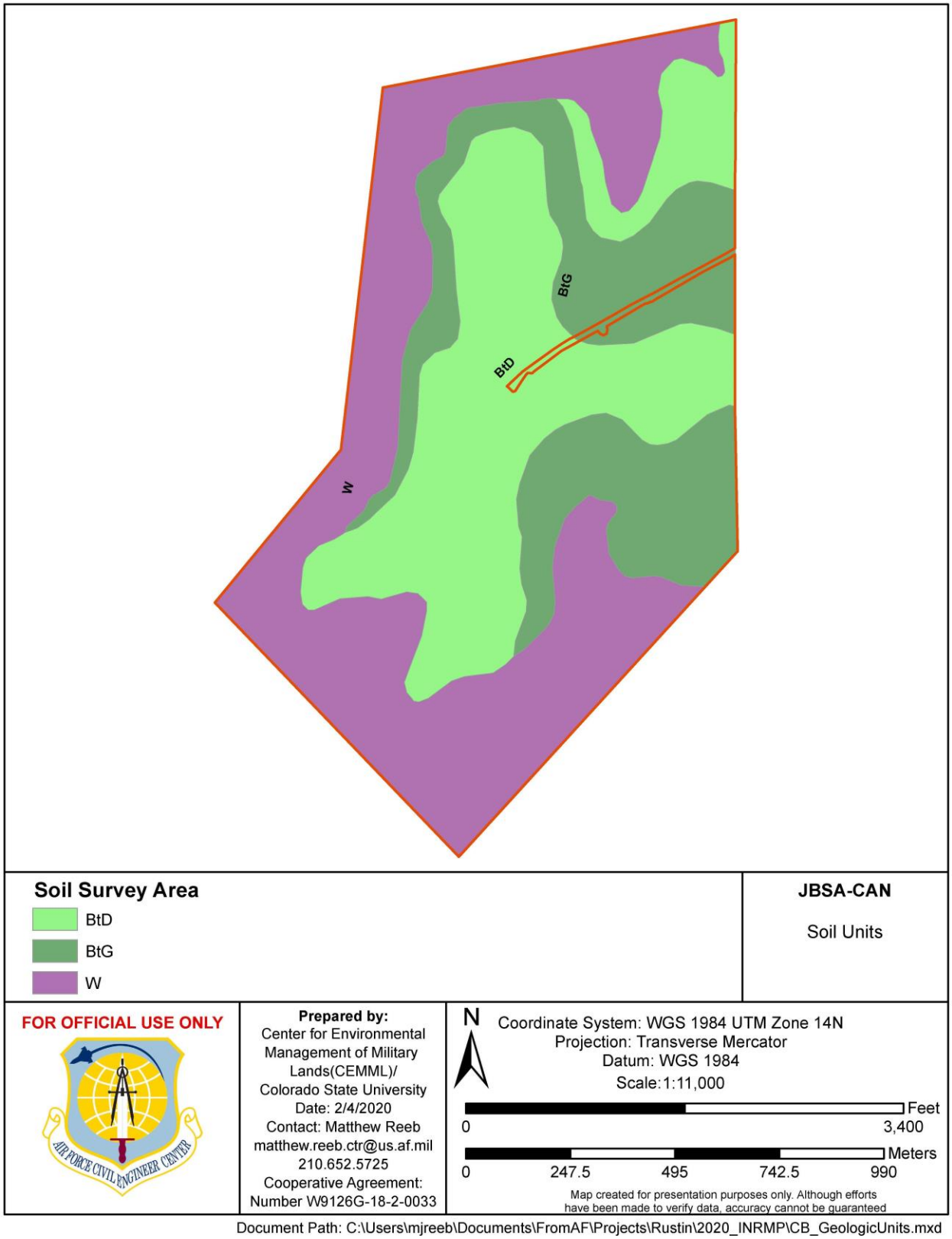


Figure 2-9. Soils Map for JBSA-CAN



2.2.4 Hydrology

Watershed and Drainage Patterns

Most JBSA locations are within in the San Antonio River watershed with the exception of JBSA-CAN and JBSA-SAF that are within the Guadalupe River watershed, see Figure 2-10 for watershed map. The San Antonio River feeds in to the Guadalupe River approximately 10 miles from its discharge into San Antonio Bay near Sea Drift, TX on the Gulf of Mexico (SARA 2017).

JBSA-CTA is drained by Medio Creek and Long Hollow Creeks that both run north to south through the base. There are small impoundments on both creeks as they flow through.

JBSA-LAK is within the catchment basins of Leon Creek and Indian Creek. Leon Creek serves as the main discharge for storm water from JBSA-LAK. The portion of Leon Creek that runs through JBSA-LAK is categorized as an impaired waterbody by the Texas Commission on Environmental Quality's (TCEQ) 303(d) list. It is considered impaired for PCBs in edible tissues (TCEQ 2020). There are also several small, constructed ponds on JBSA-LAK designed for storm water catchment and golf course water hazards.

JBSA-BUL is drained by six seasonal creeks (Cibolo, Lewis Valley, Meusebach, Salado, Panther Springs and Geronimo Trail). Cibolo Creek is the largest creek in the surrounding area and it flows west to east in the northern portion of JBSA-BUL. It is listed on the TCEQ 303(d) list as an impaired waterbody for recreational use due to high levels of bacteria (TCEQ 2020). Meusebach Creek also runs along the north side of JBSA-BUL. The remainder of the creeks flow in a south or southeasterly direction, see Figure 2-25. All the creeks are intermittent in nature, subject to some flooding during high rainfall periods, and exist as dry streambeds the remainder of the year. Water flow in Leon Creek and Panther Springs Creek are longer lived than the other creeks on base as they have associated springs that flow under wetter conditions. San Antonio River Authority maintains flood control structures on Salado Creek, Lewis Valley Creek and Geronimo Trail Creek. These damns also act as recharge structures allowing greater infiltration into the ground water system. Additionally there are several stock tanks, erosion control swales. Treated waste water ponds are located in the cantonment area, this water is chlorinated and applied to firing ranges.

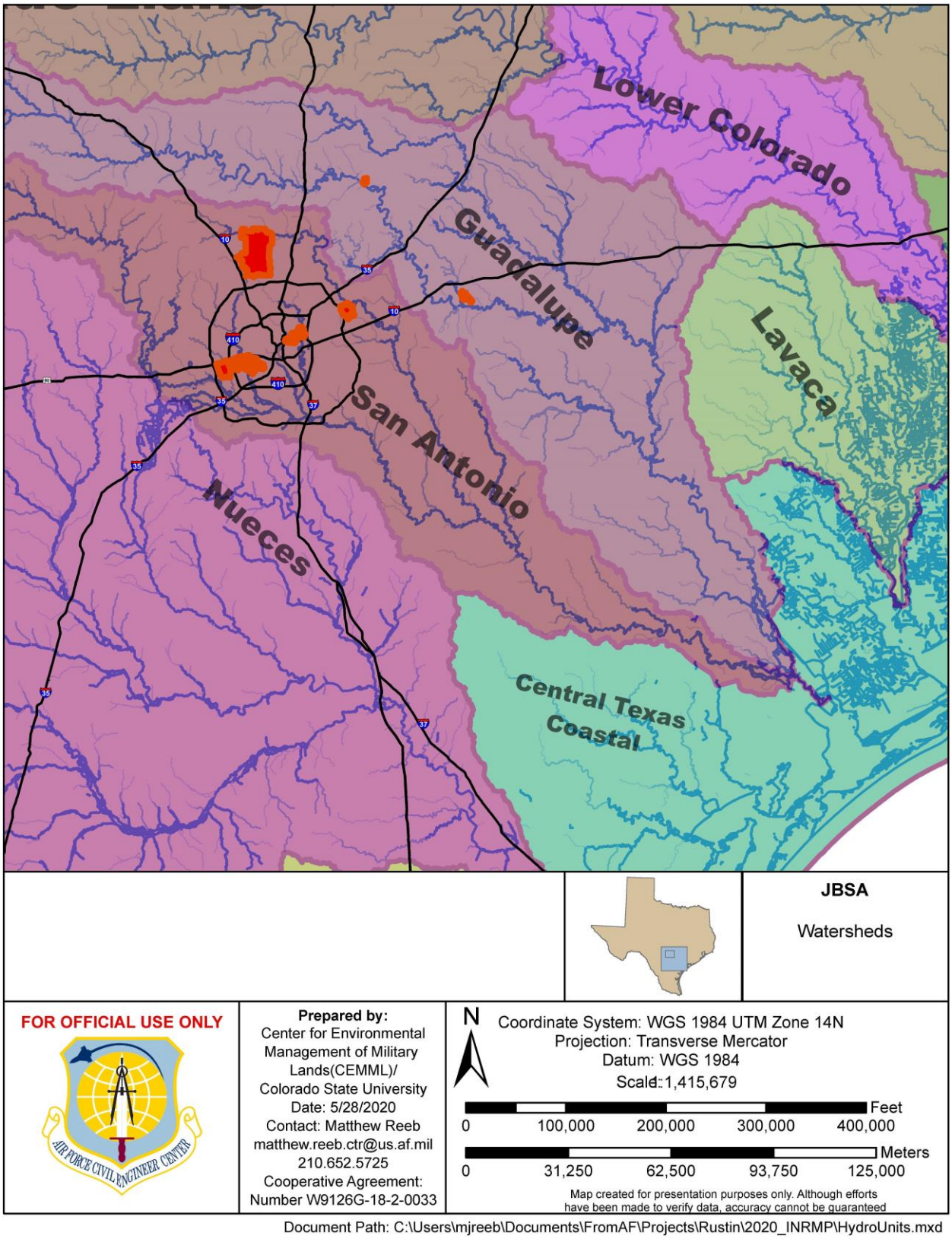
JBSA-SAM is drained by the Salado Creek that runs north to south through the east side of base. Salado Creek is listed on the TCEQ 303(d) list for impaired fish and microbenthic communities. Impoundments at this location are limited to golf course water hazards.

JBSA-RND is within the Cibolo Creek watershed and is primarily drained by Woman Hollering Creek that flows off the south side of base near the golf course. Woman Hollering Creek has three impoundments on JBSA-RND that were initially designed as detention ponds to limit flooding but have become retention ponds holding water year round due to lack of maintenance.

Portions of JBSA-SAF drain to Geronimo Creek on the west side of the location and Saul Creek on the east side. Geronimo Creek is listed on the TCEQ 303(d) list as an impaired waterbody for recreational use due to high levels of bacteria.

JBSA-CAN sits on the edge of Canyon Lake with any drainage going directly into the lake. Canyon Lake is listed on the TCEQ 303(d) list for Mercury in edible tissue.

Figure 2-10. JBSA Watersheds



Flood Modeling

Flood modeling was conducted for JBSA-BUL, JBSA-SAM, JBSA-LAK, JBSA-CTA, JBSA-RND, and JBSA-SAF to examine the extent of flooding associated with climate change projections. Flood modeling was not conducted for JBSA-CAN because existing surface water features are not within the scope of the stream channel modeling constraints. The scope of flood modeling was limited to stream channel networks and did not consider flooding of independent surface bodies, stormwater systems, or surface ponding. The projected design storms do not represent extreme weather events (e.g., hurricanes, extraordinary storm fronts).

Inundation projections were influenced by four variable inputs: (1) variation in total precipitation between design storms, (2) variation between the daily distribution of precipitation over the three-day period, (3) land cover change over the watershed area used in hydrologic modeling, and (4) land cover change in the area within the installation used in hydraulic modeling. Projected inundation associated with each climate scenario and the relative change from baseline conditions are summarized below. The spatial extent of projected flooding is depicted in a series of maps included in ***Appendix C.*** Projected changes in stream channel overflow can be used to assess potential vulnerabilities to species, habitat, mission, and built and natural infrastructure.

JBSA-CTA

Flood modeling was conducted along Medio Creek for JBSA-CTA. Table 2-16 presents the projected changes in area flooded due to rainfall events. The baseline storm event was projected to inundate approximately 160 ac. at JBSA-CTA. Flood inundation along Medio Creek at JBSA-CTA is projected to decrease by between 25-33 ac. in three of the four scenarios. Inundation is projected to slightly increase, by about 9 ac., for the RCP 8.5 scenario in 2050. Total design storm precipitation also slightly increased for this scenario. Reduction in total inundation area is influenced by decreasing storm intensity across all scenarios and changes in projected land cover over the modeled watershed and the installation.

Table 2-16. Area Inundated by Stream Channel Overflow at JBSA-CTA

	Baseline	RCP 4.5		RCP 8.5	
	2000	2030	2050	2030	2050
Projected inundation (ac)	159.8	126.2	134.9	134.9	169.1
Change in inundation area from baseline (ac)		-33.7	-24.9	-24.9	9.2
Percent change from baseline		-21.1%	-15.6%	-15.6%	5.8%

JBSA-LAK and JBSA-KFA

Flood modeling was conducted along Leon Creek at JBSA-LAK (the main base). Table 2-17 presents the projected changes in area flooded due to rainfall events. The baseline storm event was projected to inundate approximately 165 ac.at JBSA-LAK along Leon Creek. Although storm discharge for projected storms followed a different pattern than the baseline event, projected inundation stayed approximately the same. The RCP 8.5 emission scenario in 2050 had the largest projected increase in inundation area of 25 ac. Reduction in total inundation area is influenced by decreasing storm intensity across all scenarios and changes in projected land cover over the modeled watershed and the installation.

Table 2-17. Area Inundated by Stream Channel Overflow at JBSA-LAK and JBSA-KFA

	Baseline	RCP 4.5		RCP 8.5	
	2000	2030	2050	2030	2050
Projected inundation (ac)	165.3	164.7	171.4	171.4	190.7
Change in inundation area from baseline (ac)		-0.6	6.1	6.1	25.4
Percent change from baseline		-0.4%	3.7%	3.7%	15.4%

JBSA-BUL

Flood modeling was conducted for Cibolo Creek at JBSA-BUL. Cibolo Creek flows across the northern portion of JBSA-BUL from west to east, with a contributing drainage basin of approximately 100 square miles. Table 2-18 presents the projected changes in area flooded due to rainfall events. The baseline design storm was projected to have inundated 315 ac. within the boundaries of JBSA-BUL along Cibolo Creek. Inundation is expected to decrease by 47-71 ac., or 15-23%, for the projected climate scenarios. Reduction in total inundation area is influenced by decreasing storm intensity across all scenarios and changes in projected land cover over the modeled watershed and installation.

Table 2-18. Area Inundated by Stream Channel Overflow at JBSA-BUL

	Baseline	RCP 4.5		RCP 8.5	
	2000	2030	2050	2030	2050
Projected inundation (ac)	314.9	243.6	255.8	268.1	261.7
Change in inundation area from baseline (ac)		-71.3	-59.1	-46.8	-53.2
Percent change from baseline		-22.6	-18.8	-14.9	-16.9

JBSA-SAM

Flood modeling was conducted along Salado Creek at JBSA-SAM. Table 2-19 presents the projected changes in area flooded due to rainfall events. Stream channel overflow associated with the baseline design storm was estimated to inundate approximately 458 ac. of installation area along Salado Creek. Decreased total precipitation from projected design storms resulted in less inundation for all climate scenarios. Flood modeling was also affected by daily distribution of storm precipitation and changes in projected land cover over the modeled watershed and the installation. Inundation is projected to decrease by as much as 213 ac. under the RCP 4.5 emission scenario in 2030.

Table 2-19. Area Inundated by Stream Channel Overflow at JBSA-SAM

	Baseline	RCP 4.5		RCP 8.5	
	2000	2030	2050	2030	2050
Projected inundation (ac)	457.5	244.4	274.7	267.2	274.7
Change in inundation area from baseline (ac)		-213.1	-182.8	-190.3	-182.8
Percent change from baseline		-46.6%	-40.0%	-41.6%	-40.0%

JBSA-RND

Flood modeling was conducted along Cibolo Creek for JBSA-RND. Table 2-20 presents the projected changes in area flooded due to rainfall events. The baseline storm event was projected to inundate only 2.6 ac. at JBSA-RND along Cibolo Creek. Decreased total precipitation from projected design storms resulted in less inundation for all climate scenarios. Flood modeling was also affected by daily distribution of storm precipitation and changes in projected land cover over the modeled watershed and the installation.

Table 2-20. Area Inundated by Stream Channel Overflow at JBSA-RND

	Baseline	RCP 4.5		RCP 8.5	
	2000	2030	2050	2030	2050
Projected inundation (ac)	2.6	1.2	1.4	1.5	1.6
Change in inundation area from baseline (ac)		-1.3	-1.2	-1.0	-0.9
Percent change from baseline		-52.7%	-46.1%	-40.8%	-36.4 %

JBSA-SAF

Flood modeling was conducted along Geronimo Creek for JBSA-SAF. Modeling showed that overflow from projected storm events is not likely to impact resources or infrastructure within the installation boundary.

Groundwater

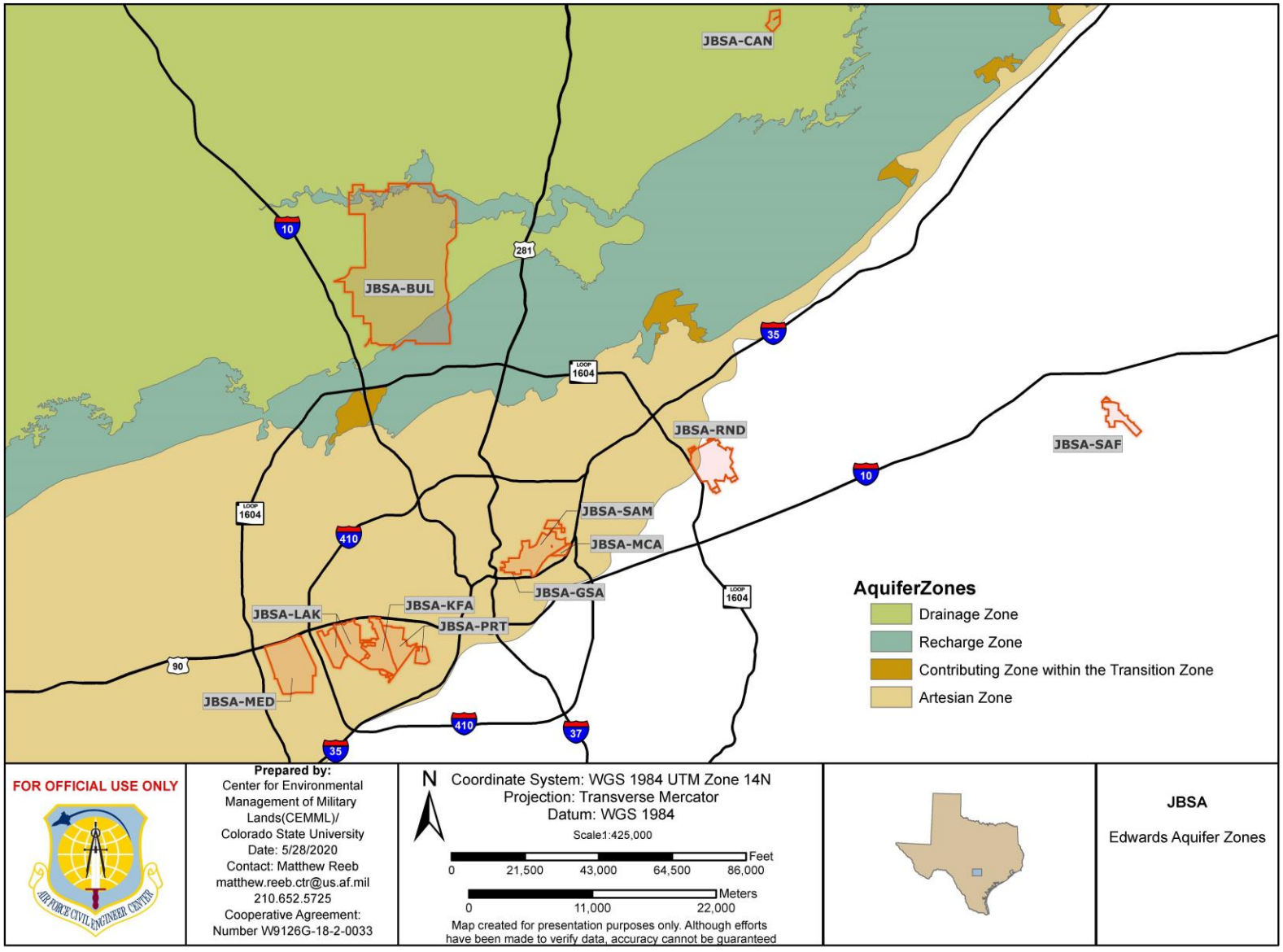
JBSA-CTA, JBSA-LAK, JBSA-KFA, JBSA-PRT, JBSA-SAM, JBSA-MCA and JBSA-RND all lay in the artesian zone of the Edwards Aquifer. All of these locations withdraw water from the Edwards Aquifer as their primary source of water. Approximately 4,000 ac of JBSA-BUL fall within the Edwards Aquifer recharge zone and the remaining 24,000 ac are within the contributing zone. The primary source of water for JBSA-BUL is the Trinity Aquifer.

The Edwards Aquifer is designated by the Environmental Protection Agency (EPA) (40 FR 58344) as a sole source aquifer. That designation is given to aquifers that supply at least 50% of the drinking water for its service area and there is no reasonable alternative drinking water sources available. The Edwards Aquifer is approximately 180 miles in length and varies in width from 5 to 40 miles and provides water to over 2 million people based on Edwards Aquifer Authority estimates (EAA 2020). The Edwards Aquifer or springs

from the Edwards Aquifer also support habitat for several endangered species. Concerns over the impact of water levels within the aquifer on local economies and the welfare of endangered species have led to an increase in regulation on aquifer users.

The demand for water withdrawal from the Edwards Aquifer is expected to continue to increase in the future based on increased population estimates. Based on data provided by the Texas Water Development Board (TWDB), the EAA predicts that water withdrawal will increase from an estimated 514,144 acre-feet (ac-ft) per year in 2010 to an estimated 718,021 ac-ft per year in 2060.

Figure 2-11. Edwards Aquifer Zones



2.3 Ecosystem and the Biotic Environment

2.3.1 Ecosystem Classification

Ecoregions denote areas of general similarity in ecosystems and in the type, quality, and quantity of environmental resources. According to the EPA's ecoregion framework JBSA-CTA, JBSA-LAK, JBSA-KFA, JBSA-SAM, JBSA-RND and JBSA-SAF are located in the Great Plains, South Central Semi-arid Prairies. Texas Blackland Prairies and Northern Blackland Prairie. JBSA-BUL and JBSA-CAN are located in the Great Plains, South Central Semi-arid Prairies, Edwards Plateau and Balcones Canyonlands (Griffith et al. 2007).

2.3.2 Vegetation

2.3.2.1 Historic Vegetation Cover

The historic vegetation of JBSA's locations would have been similar to those described for the respective ecoregions (below) prior to European presence. Those locations in the Northern Blackland Prairie ecoregion had a tallgrass prairie vegetative community maintained by frequent fire and grazing mammals. Common species were big bluestem (*Andropogen gerardii*), Indiangrass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*), switchgrass (*Panicum virgatum*), and eastern gamagrass (*Tripascum dactyloides*) (Griffith et al. 2007).

The vegetative communities in the Balcones Canyonlands are more diverse due to more varied topography, and range from upland woodlands, grassland savannahs and riparian areas. Upland woodlands were comprised mostly of oak species (*Quercus* spp.), Ashe juniper (*Juniperus ashei*), cedar elm (*Ulmus crassifolia*) and Texas persimmon (*Diospyros texana*). Grasslands savannahs consisted mostly of little bluestem, Indiangrass, big bluestem and sideoats grama (*Bouteloua curtipendula*) with 10% woody canopy cover mostly consisting of Texas live oak (*Quercus fusiformis*) trees or motts. Riparian areas were comprised mostly of black walnut (*Juglans nigra*), pecan (*Carya illinoinensis*), oaks, American sycamore (*Platanus occidentalis*), and elms (*Ulmus* spp.) (Griffith et al. 2007).

Texas A&M University Natural Resources Institute (NRI) used historic aerial photography to analyze trends in woody species at JBSA-BUL from 1938 to 2010. Results indicated a steady increase in woody coverage through that time. In 1938 approximately 41% of JBSA-BUL had woody canopy cover which increased to 74% by 2010 (NRI 2012)

2.3.2.2 Current Vegetation Cover

Due to the geographic separation of JBSA locations, development and management practices to support of the military mission, current native vegetation cover differs drastically between locations. Descriptions of vegetation cover types are below along with a table and maps that reference the acres of each type of vegetation cover and location on JBSA.

Developed/Urban – Areas with buildings, roads, or other infrastructure and associated landscaped areas and open spaces. Vegetation in these areas is limited to yards, grassed areas in between buildings and landscape shrubs and trees for aesthetic purposes.

Managed Grasses – Areas of grasslands or savannah outside of the developed areas. Managed for operational or recreational purposes, such as, infield areas near AMAs, ranges, ammunitions storage, other mission purposes, golf courses and parks. Vegetation may consist of native or non-native grasses as the primary cover.

Herbaceous/Grasslands – Areas where forbs and grasses are the predominant cover. Grasslands may have scattered trees usually less than 20% of area. These areas are not regularly maintained but may be managed for woody species encroachment with prescribed fire or mechanical means depending on mission needs, safety, and natural resources priorities. This category also includes savannahs.

Shrubland – Areas dominated by shrubs. These areas are not regularly maintained but may be managed to reduce density with prescribed fire or mechanical means depending on mission needs, safety, and natural resources priorities.

Woodland – Areas dominated by mature trees of varying canopy densities from open woodlands to more dense riparian forests and may have little understory vegetation depending on the density of the tree canopy.

Table 2-21. Acres of Vegetation Cover by Type.

Vegetative Cover Type	JBSA-CTA	JBSA-LAK[1]	JBSA-BUL	JBSA-SAM[1]	JBSA-RND	JBSA-SAF
Developed/Urban	392	1,866	370	1,602	1,073	92
Managed Grasses	944	2,262	618	1,002	1,747	787
Herbaceous/Grassland	2	161	2,629	0	0	0
Shrubland	2,399	212	2,593	0	36	80
Woodland/Forest	226	133	21,685	307	0	0
Water	6	14	7	4	26	0

[1]Includes acreage for adjacent properties

Figure 2-12. JBSA-CTA Vegetation Map

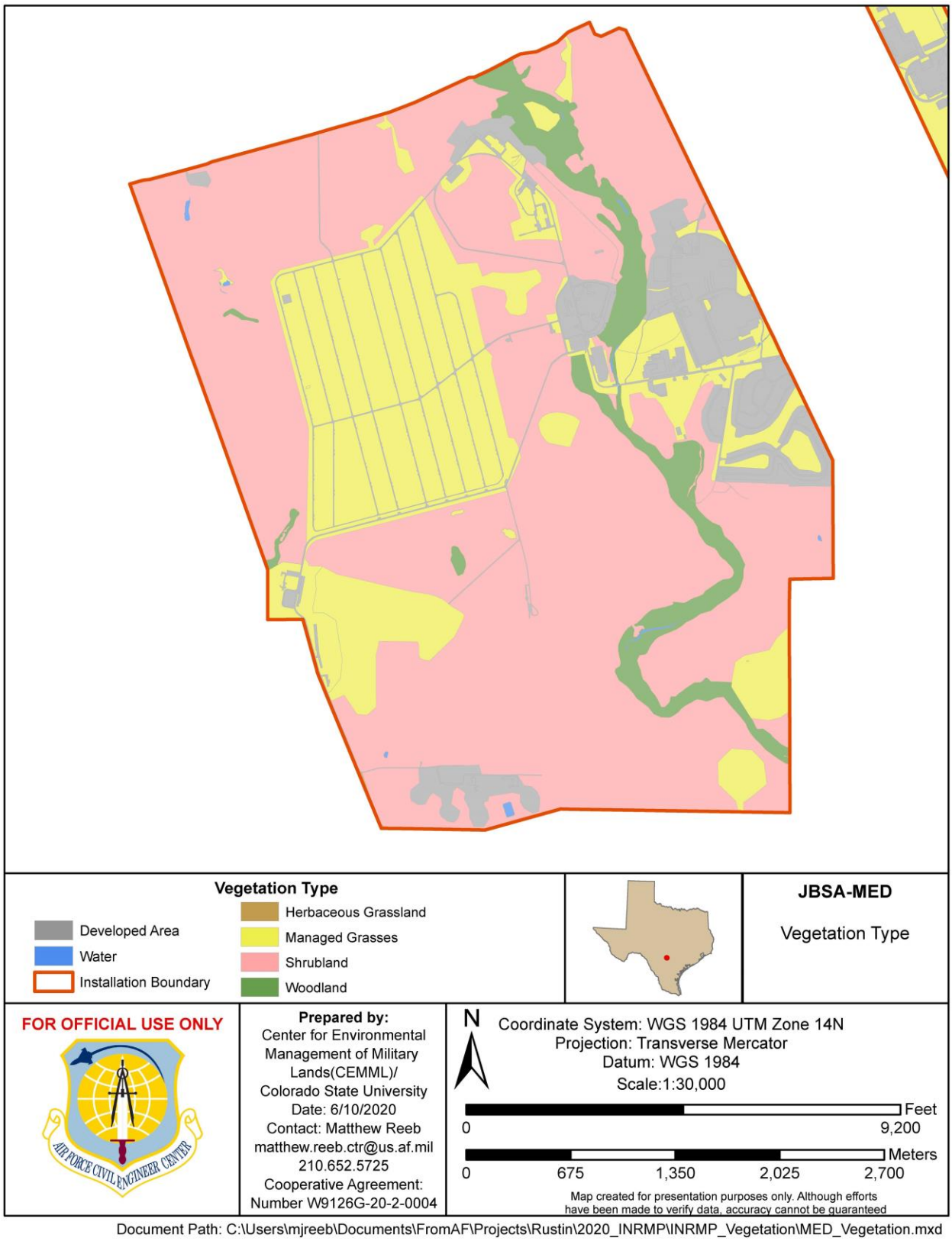


Figure 2-13. JBSA-LAK, JBSA-KFA, and JBSA-PRT Vegetation Map

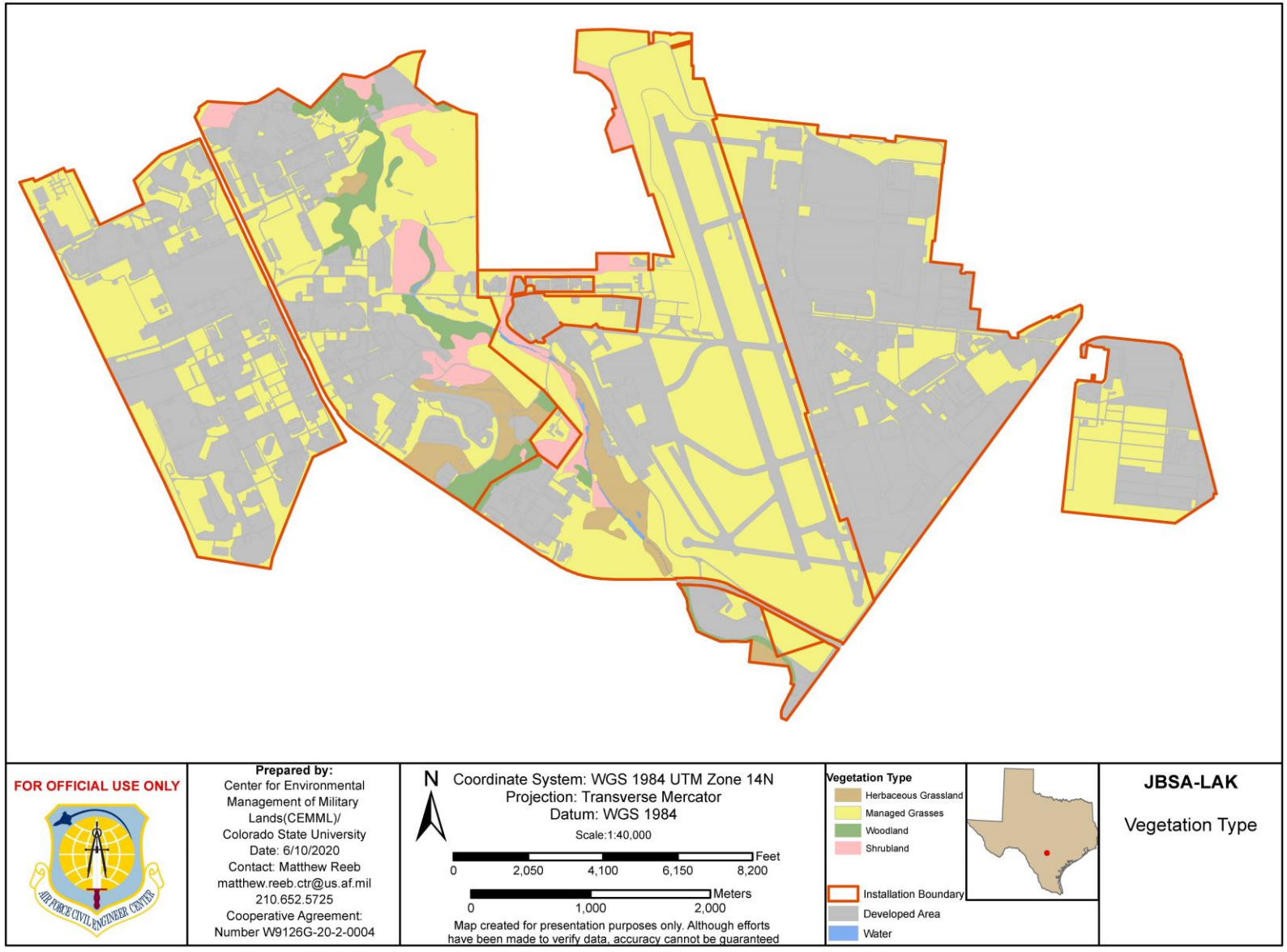


Figure 2-14. JBSA-BUL Vegetation Map

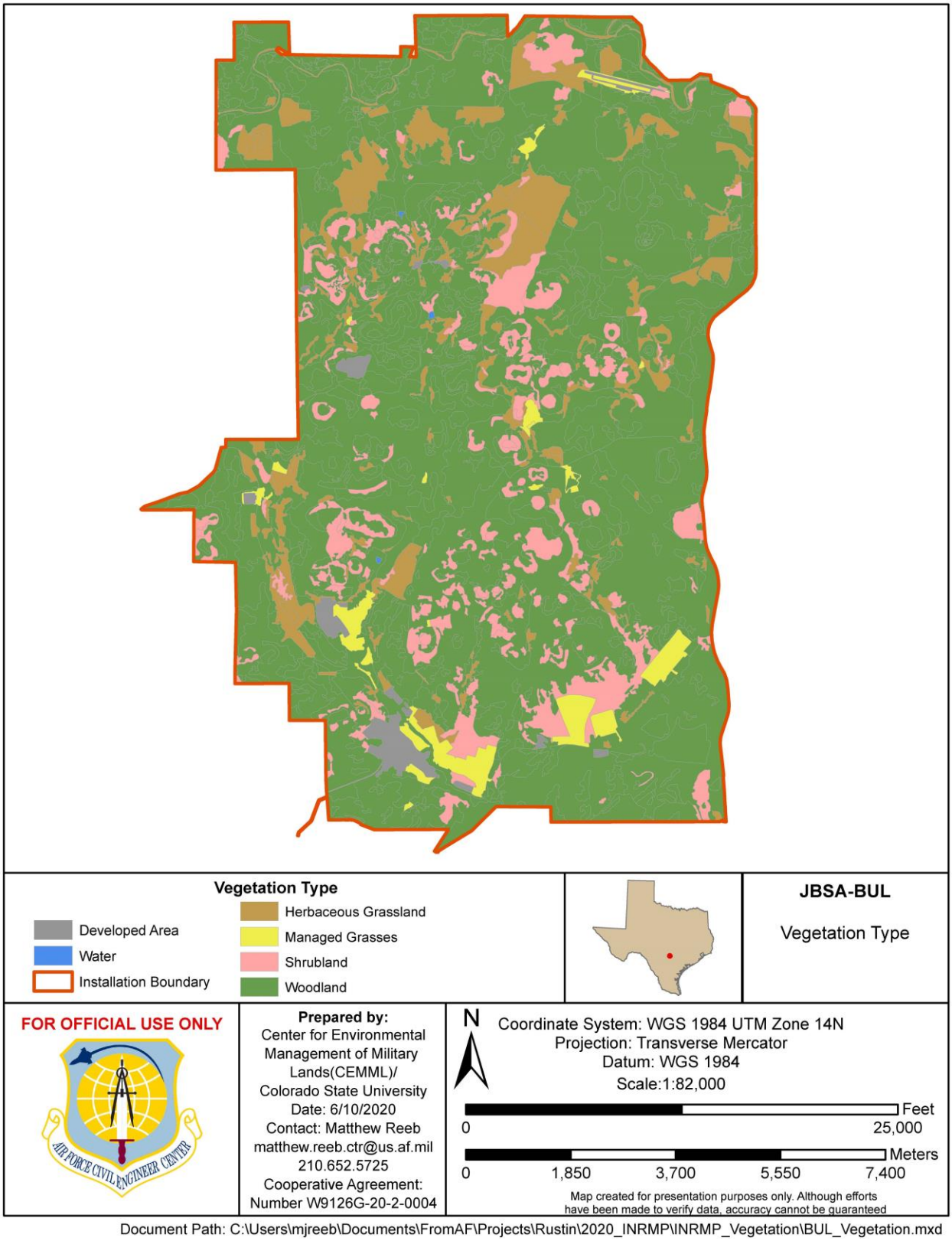


Figure 2-15. JBSA-SAM, JBSA-GSA, and JBSA-MCA Vegetation Map

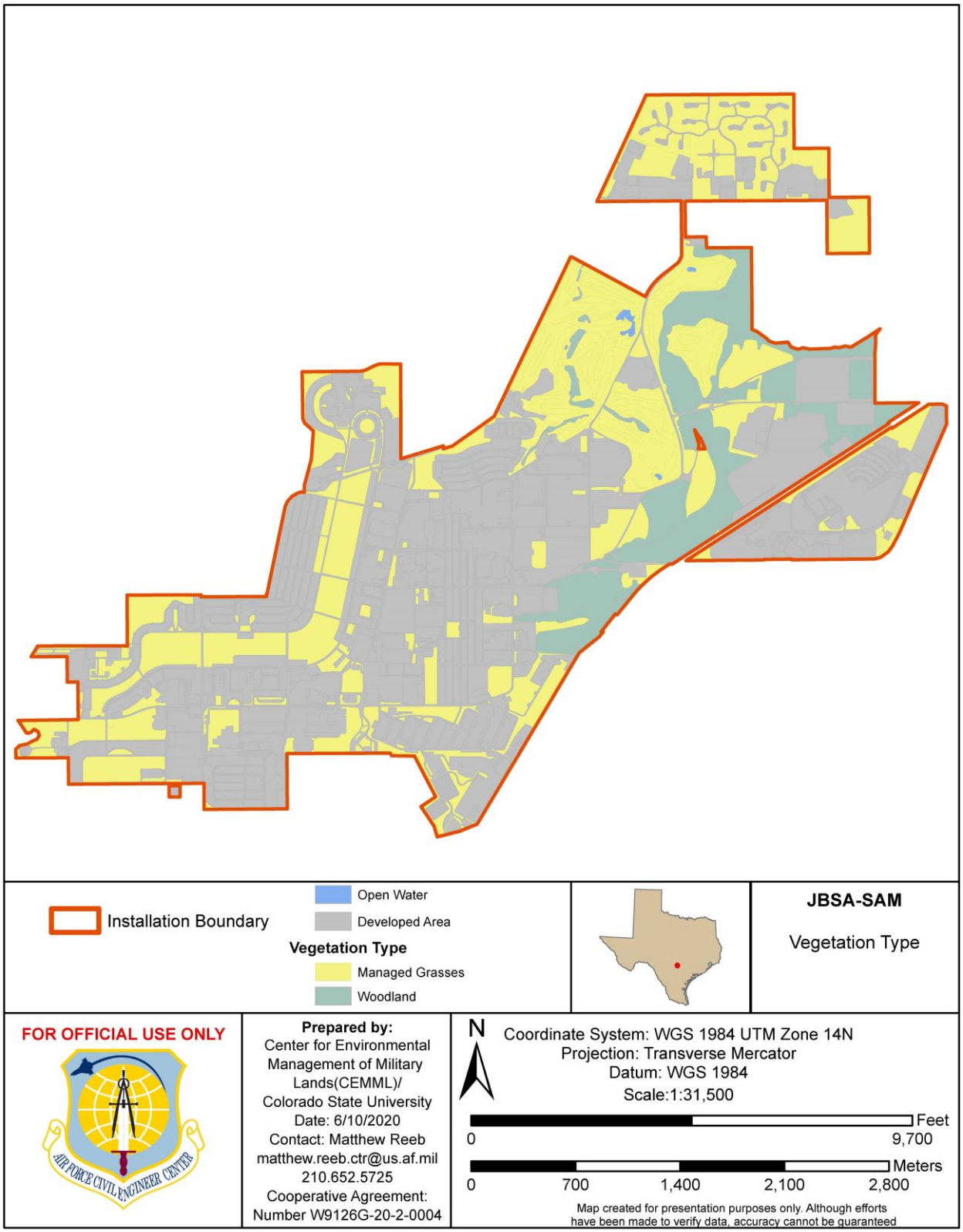


Figure 2-16. JBSA-RND Vegetation Map

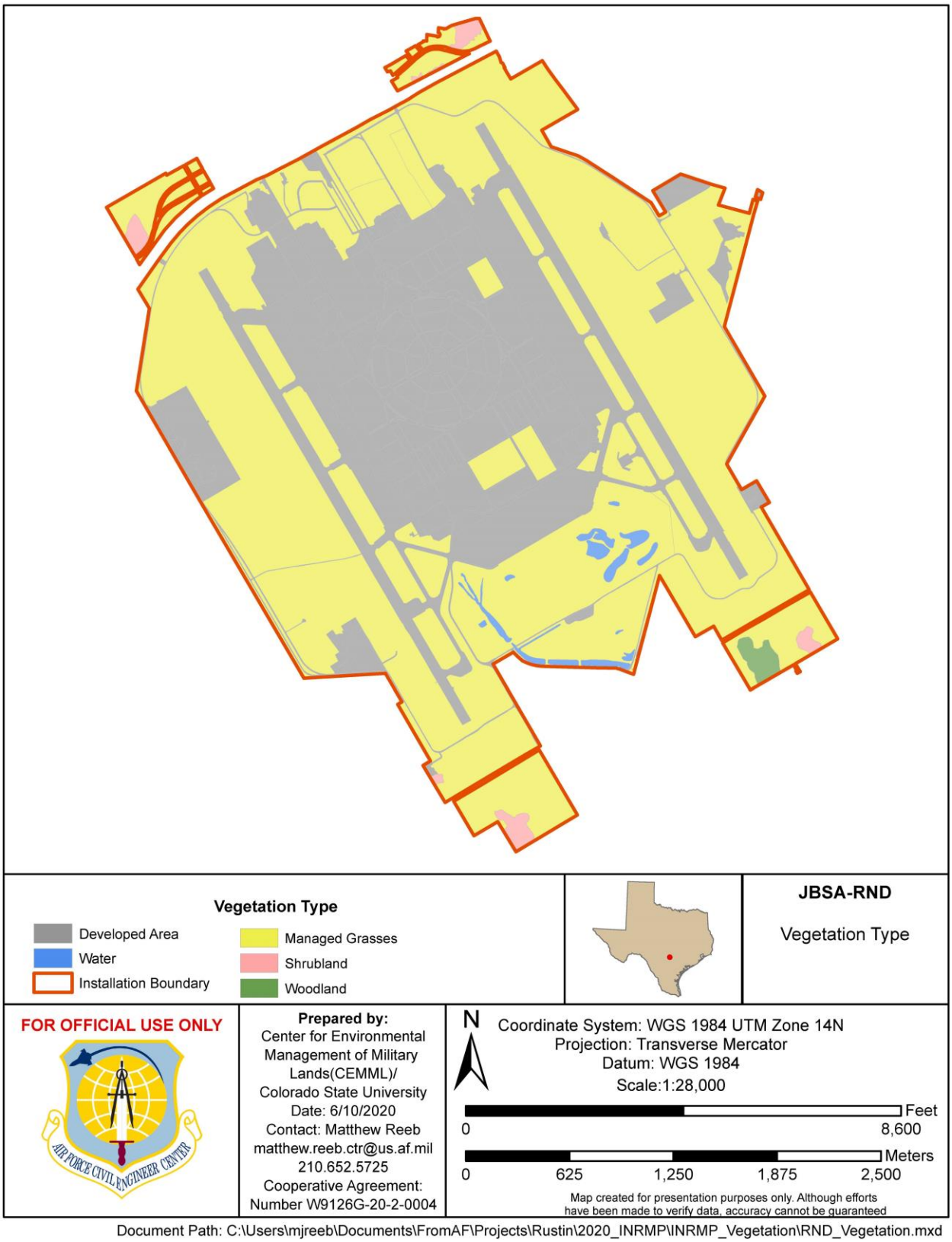


Figure 2-17. JBSA-SAF Vegetation Map

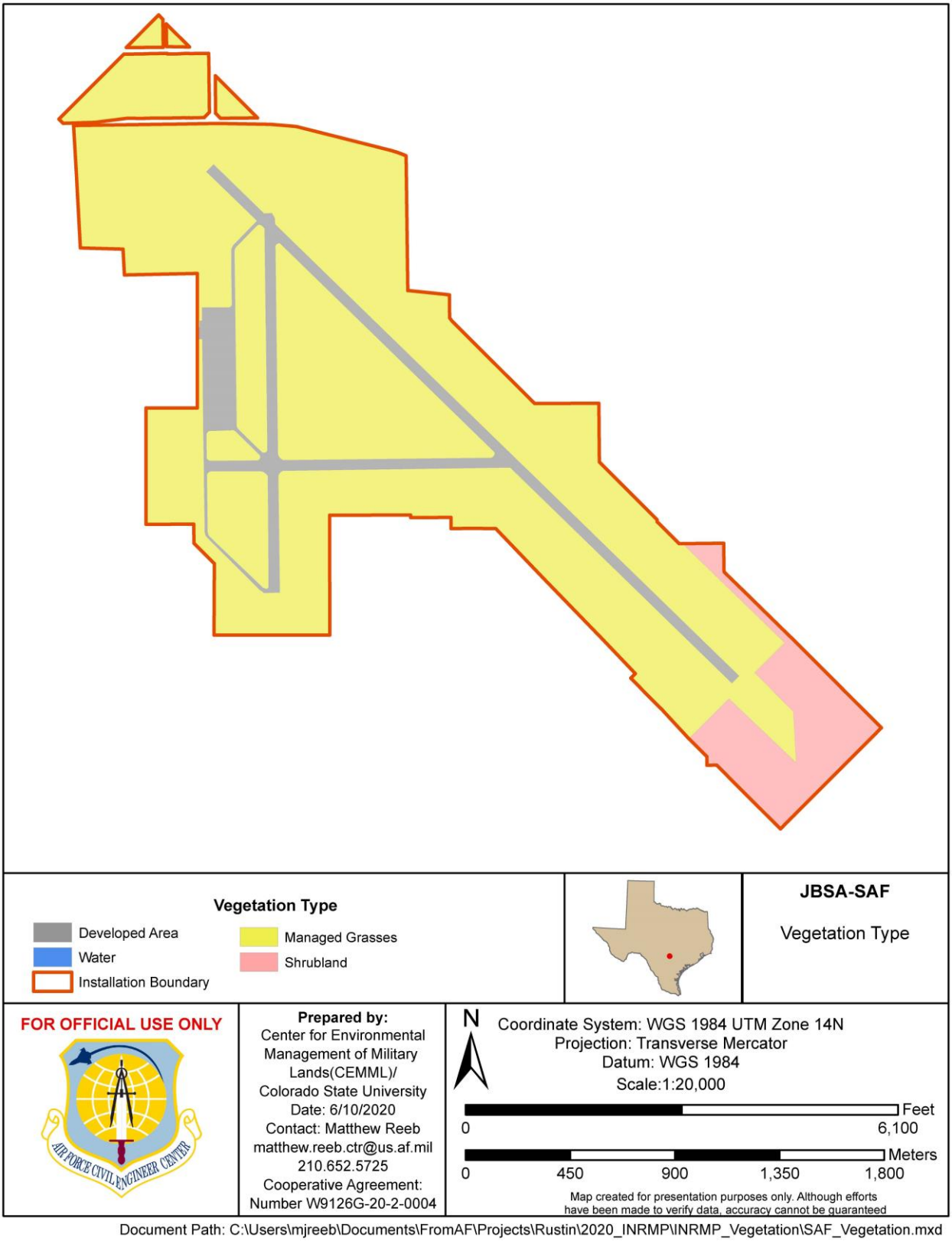
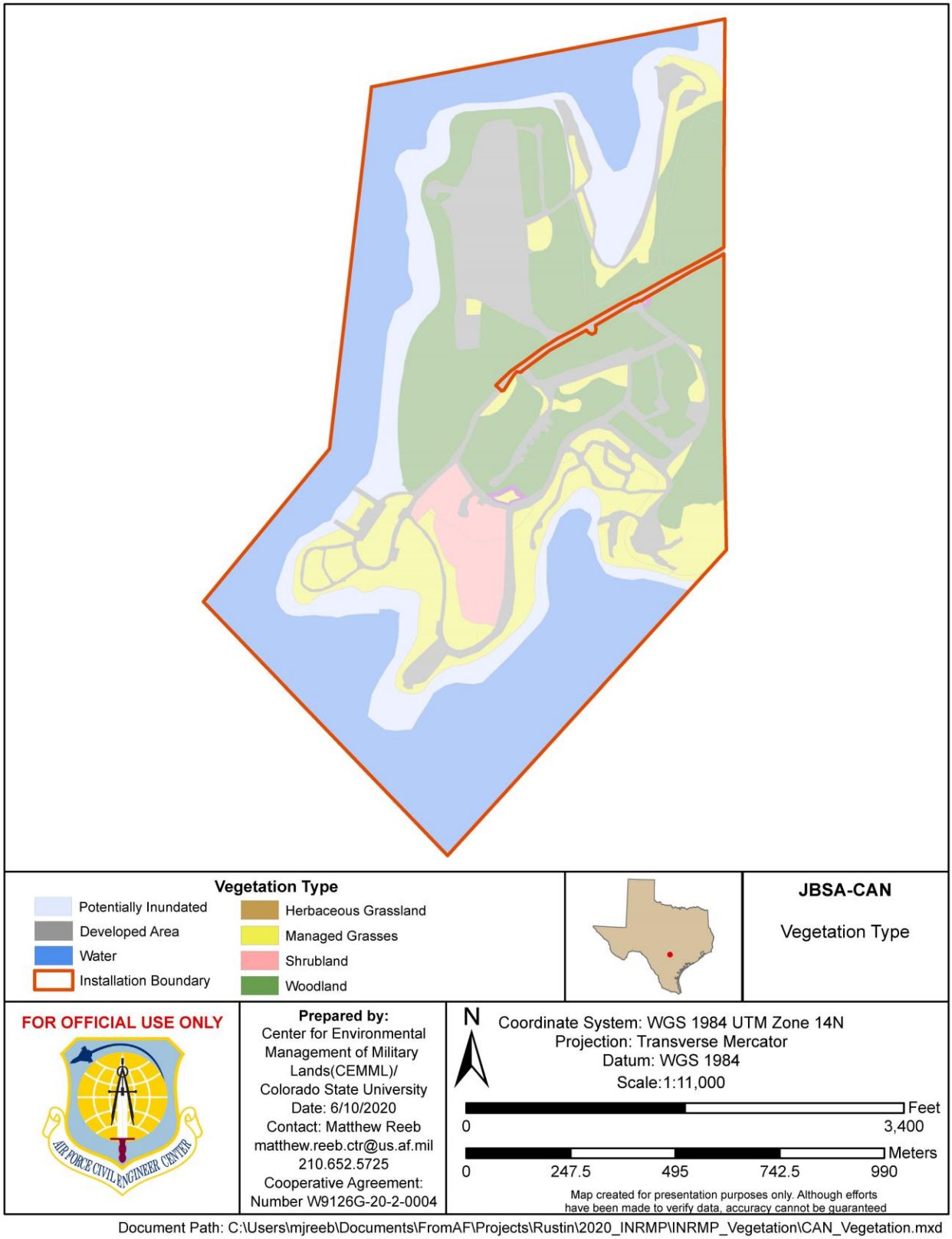


Figure 2-18. JBSA-CAN Vegetation Map



2.3.2.3 Future Vegetation Cover

The NRM has carried out brush management activities to reduce understory vegetation in the southwest corner of JBSA-CTA and around the dog kennels and dog training areas on the northern side of JBSA-CTA. This effort will continue to expand to enable the Wildland Support Module (WSM) to restore fire back to the ecosystem and grassland communities. These management activities will occur along the exterior of JBSA-CTA working towards the center to reduce the risk of uncontrolled wildland fire.

The NRM and WSM are currently planning prescribed fires and mechanical fuels management activities to reduce fine fuels, better manage habitats, reduce mulch created during ITAM vegetation management activities, reduce encroachment of woody and invasive plant species. Any vegetation management activities planned in the future that would impact T&E species would be consulted with USFWS and would go through the environmental impact analysis process (EIAP) before it commences.

Changes in climate will also likely effect vegetation communities on the installation. Slight changes in temperature and precipitation can substantially alter the composition, distribution, and abundance of species in these ecosystems, and the services they provide. The extent of these changes could increase drought and wildfire frequency, which could result in major changes to vegetation cover and wildlife habitat. Losses of vegetative cover coupled with increases in precipitation intensity and climate-induced reductions in soil aggregate stability will dramatically increase potential erosion rates.

As warmer temperatures increase evaporation and water used by plants, soils are likely to continue to become drier. Average rainfall is likely to decrease during winter, spring, and summer. Increased evaporation and decreased rainfall are both likely to reduce the average flow of rivers and streams, and will likely negatively affect Edwards Aquifer levels. Drier soils will increase the need for irrigation, but sufficient water might not be available (EPA 2016).

Climate change impacts to grassland and pasture bioregions include increased seasonal, annual, minimum, and maximum temperature and changing precipitation patterns. Because these ecosystems are relatively dry with a strong seasonal climate, they are sensitive to climatic changes and vulnerable to shifts in climatic regime. Rising temperatures under various climate change scenarios will likely enhance solid decomposition. Together with reductions in rainfall, this may also reduce plant productivity over large areas.

In general, woodland and forests are susceptible to climate change. There is a temperature below which the equilibrium state of the ecosystem appears constant, but above which the equilibrium of this vegetation cover declines steadily. The canopy exerts a profound influence on neighboring vegetation, soils, subcanopy microclimate, wildlife, and insect populations. High densities of woodland species (>25% canopy cover) suppress grass growth and may reduce understory species diversity (Texas Natural Resources Server, n.d.).

2.3.2.4 Turf and Landscaped Areas

Most turf and landscaped areas occur in the improved and sem-improved sections of JBSA, including AMAs, around buildings and housing, along roadways, and in recreational areas such as golf courses or athletic fields. Most vegetative cover consists of bermudagrass (*Cynodon spp*.), St. Augustine grass (*Stenotaphrum secundatum*), and crabgrass (*Digitaria spp*.). Woody vegetation in the developed areas consists mainly of live oak but also include Texas red oak (*Quercus buckleyi*), cedar elm, crape myrtle (*Lagerstroemia spp.*), privet (*Ligustrum spp.*), Red-tipped photinia (*Photinia fraseri*), pecan and yaupon holly (*Ilex vomitoria*). Privet and red-tipped photinia were commonly used for landscaping, these species

are considered invasive by Invasive Plant Atlas of the United States (IPAUS 2020). They additionally are attractive to bird species increasing BASH risks in areas close to AMAs. JBSA uses, to the maximum extent possible, regionally native, drought tolerant plants in landscape design. When feasible, JBSA will convert landscapes dominated by non-native plants to native. See Appendix B for approved plant list.

2.3.3 Fish and Wildlife

Fish and wildlife species can be found throughout JBSA locations in varying degrees of diversity. JBSA-LAK, JBSA-KFA, JBSA-SAM, JBSA-RND and JBSA-SAF have a limited ability to support fish and wildlife species due to development and mission requirements for vegetation management. Most species found at these JBSA locations are adapted to surviving in urban landscapes. Comprehensive surveys have not been completed for all JBSA locations and faunal groups. JBSA-BUL and JBSA-CTA have a higher degree of diversity due to them remaining largely undeveloped. JBSA has recorded a total of 265 species of birds, 47 species of mammals, 64 species of reptiles and amphibians, 24 fish species, 272 invertebrate species and 561 species of plants. See species list in Appendix B for species recorded at JBSA locations.

2.3.4 Threatened and Endangered Species and Species of Concern

Thirteen federally and/or state listed species have been recorded on JBSA and eleven federally and/or state listed species are or may be impacted by JBSA's withdrawal from the Edwards Aquifer. Additionally twelve karst invertebrate species are endemic to JBSA-BUL. Although not listed, future activities could have profound implications for these species and, as such, endemics are managed much the same as the listed karst invertebrates that occur on JBSA-BUL.

Table 2-1. Federal & State Listed T&E Species and Endemic Species Associated With JBSA

Common Name	Scientific Name	Federal Status	State Status
Listed Species Recorded on JBSA			
Cascade Caverns salamander	*Eurycea latitans*	-	T
Texas salamander	*Eurycea neotenes*	-	T
Golden-cheeked warbler	*Setophaga chrysoparia*	E	E
White-faced ibis	*Plegadis chihi*	-	T
Zone-tailed hawk	*Buteo albonotatus*	-	T
Ground Beetle [unnamed]	*Rhadine exilis*	E	-
Ground Beetle [unnamed]	*Rhadine infernalis*	E	-
Madla Cave meshweaver	*Cicurina madla*	E	-
Texas tortoise	*Gopherus berlandieri*	-	T
Texas horned lizard	*Phrynosoma cornutum*	-	T
Bracted twistflower	*Streptanthus bracteatus*	C	-
Edwards Aquifer Dependent Species Affected by JBSA Withdrawal			
San Marcos salamander	*Eurycea nana*	T	T
Texas blind salamander	*Typhlomolge rathbuni*	E	E
Widemouth blindcat	*Satan eurystomus*	-	T
Toothless blindcat	*Trogloglanis pattersoni*	-	T
Fountain darter	*Etheostoma fonticola*	E	E
Guadalupe darter	*Percina apristis*	-	T

San Marcos gambusia	*Gambusia georgei*	E	-
Comal Springs riffle beetle	*Heterelmis comalensis*	E	E
Comal Springs dryopid beetle	*Stygoparnus comalensis*	E	E
Peck's cave amphipod	*Stygobromus pecki*	E	E
Texas wildrice	*Zizania texana*	E	-
Species Endemic to JBSA-BUL			
Ground Beetle [unnamed]	*Rhadine bullis*	-	-
Ground Beetle [unnamed]	*Rhadine ivyi*	-	-
Ground Beetle [unnamed]	*Rhadine sprousei*	-	-
Millipede [unnamed]	*Speodesmus ivyi*	-	-
Millipede [unnamed]	*Speodesmus falcatus*	-	-
Cave meshweaver [unnamed]	*Cicurina brunsi*	-	-
Cave meshweaver [unnamed]	*Cicurina bullis*	-	-
Cave meshweaver [unnamed]	*Cicurina platypus*	-	-
Armored harvestmen [unnamed]	*Texalla elliotti*	-	-
Armored harvestmen [unnamed]	*Texalla hilgerensis*	-	-
Dipluran [undescribed]	*Myxojapyx sp.*	-	-
Pseudoscorpion [unnamed]	*Tarttartogreagis reyesi*	-	-

E – Endangered species

T – Threatened species

C – Candidate species

Cascade Caverns Salamander

The Cascade Caverns salamander (*Eurycea latitans*) is listed as endangered by the state. This species is entirely aquatic and depend upon water from the Edwards and associated aquifers in sufficient quantity and quality to meet their requirements for survival, growth and reproduction. This species has been recorded at JBSA-BUL from nine locations (caves and springs).

Golden-cheeked Warbler

GCWA are a federally and state listed migratory song bird. GCWAs nest in central Texas areas with mixed Ashe juniper and hardwood woodlands. The species was recorded at JBSA-BUL as early as 1887 (Pulich, 1976). GCWA arrive in Texas in early March from wintering grounds in Mexico and northern Central America and return there in mid-summer. At JBSA-BUL approximately 8,824 ac is suitable for GCWA nesting. GCWA point counts and territory monitoring occur each year. A report and data collected is submitted to USFWS after the survey season has ended.

White-faced Ibis

The white-faced ibis is a state threatened species that frequents marshes, swamps, ponds and rivers. It nests in isolated colonies from Oregon to Kansas to the Gulf Coast in Texas and Louisiana. JBSA is in the migration corridor for this species and has been recorded one time at JBSA-BUL in 1999.

Zone-tailed Hawk

The zone-tailed hawk is a state threatened species often found in river woodlands, desert mountains, and canyons. This species nest in large trees along streams in Arizona, southwestern New Mexico and west Texas. One observation of a zone-tailed hawk occurred at JBSA-BUL in 2007.

Rhadine exilis

R. exilis is a federally listed endangered species. It is a troglobitic (lives entire life underground) ground beetle restricted to caves and mesocaverns (humanly impassable voids in karst limestone) in Bexar County, TX. The species has been recorded at 51 caves (USFWS 2011). *R. exilis* has been recorded in 25 caves on JBSA-BUL. Critical habitat has been designated for this species off of the installation.

Rhadine infernalis

R. infernalis is a federally listed endangered species. It is a troglobitic ground beetle restricted to caves and mesocaverns in Bexar County, TX. The species has been recorded at 39 caves, 7 of those occurring at JBSA-BUL (USFWS 2011). Critical habitat has been designated for this species off of the installation.

Madla's Cave Meshweaver

Madla's Cave meshweaver is a federally listed endangered species. It is a troglobitic spider restricted to caves and mesocaverns in Bexar County, TX. The species has been recorded at 22 caves (USFWS 2011). This species has been recorded in 3 caves at JBSA-BUL. Critical habitat has been designated for this species off of the installation.

Texas Tortoise

The Texas tortoise is a state threatened species that lives in southern Texas and in northeastern Mexico. In Southern Texas it lives in scrub forests in humid, subtropical areas, preferring open scrub woods and well-drained, sandy soils. There has been four observations, one being photographed, on JBSA-BUL by biologists. Surveys are required to determine the extent of its presence at JBSA-BUL and the other JBSA locations.

Texas Horned Lizard

The Texas horned lizard is a state threatened species found in arid and semiarid habitats in open areas with sparse plant cover. This species has been documented one time at JBSA-CTA in 1992 (LAFB 2007). Due to vegetation management practices or lack thereof potential habitat is limited across JBSA.

Bracted Twistflower

The bracted twistflower is a federally listed candidate species and is endemic to the Edwards Plateau region of Texas. The species is often found on rocky hillsides, usually found growing under shrubs. The species was recorded in 2006 in the southwestern portion of JBSA-BUL near Eisenhower Park. Botanists have searched for the species several times, the most recent effort was in 2018 when USFWS botanists searched the area it was previously recorded and other potential areas but were unable to document it.

Edwards Aquifer Dependent Species Affected by JBSA Withdrawal

These federally and state listed species either live in the Edwards Aquifer or are dependent on spring flow from the aquifer in sufficient quantity and quality to meet their requirements for survival, growth and reproduction. Over pumping from the Edwards Aquifer is a main threat to these species. Over pumping effects are exacerbated by increased human recreation, which is more concentrated when river levels are lower.

Texas wild-rice, Comal Springs riffle beetle, fountain darter, San Marcos gambusia and the San Marcos salamander are all aquatic species found in the San Marcos River and associated spring system. This area is located in San Marcos, TX approximately 32 miles northeast of JBSA-RND.

The Comal Springs dryopid beetle, Comal Springs riffle beetle, and Peck's Cave amphipod are aquatic invertebrate species found in Comal Springs in New Braunfels, TX approximately 16 miles northeast of JBSA-RND. Peck's Cave amphipod is also found in Hueco Springs, about three miles north of Comal Springs. The Comal Springs dryopid beetle is also found in Fern Bank Springs located eight miles northwest of San Marcos Springs.

The Texas blind salamander is federally and state listed. It inhabits water-filled subterranean caverns of the Edwards Aquifer in the San Marco area. It has been collected at several locations within Hays County, TX.

The Guadalupe darter is a state listed species confined to the Guadalupe River and its tributaries, the San Marcos and Blanco Rivers.

The widemouth blindcat and toothless blindcat are both state listed catfish species that inhabit the Edwards Aquifer. It has been recorded from five artesian wells that obtain water at depths between 305-582 meters below ground level.

Forecast climate change may affect these species habitat and cause disruption to food availability for species at JBSA. Habitat requirements, such as need for refugia, for some species may change as they employ behavioral adaptations. Prey populations or forage abundance may also be affected by changes in temperature and precipitation. Seasonal cues for prey or forage emergence may change resulting in a mismatch between food availability and food needs of threatened and endangered species. Populations of some threatened and endangered species are further imperiled by life stages that are sensitive to temperature and precipitation changes projected in climate scenarios.

Figure 2-19. State Listed Salamander Locations

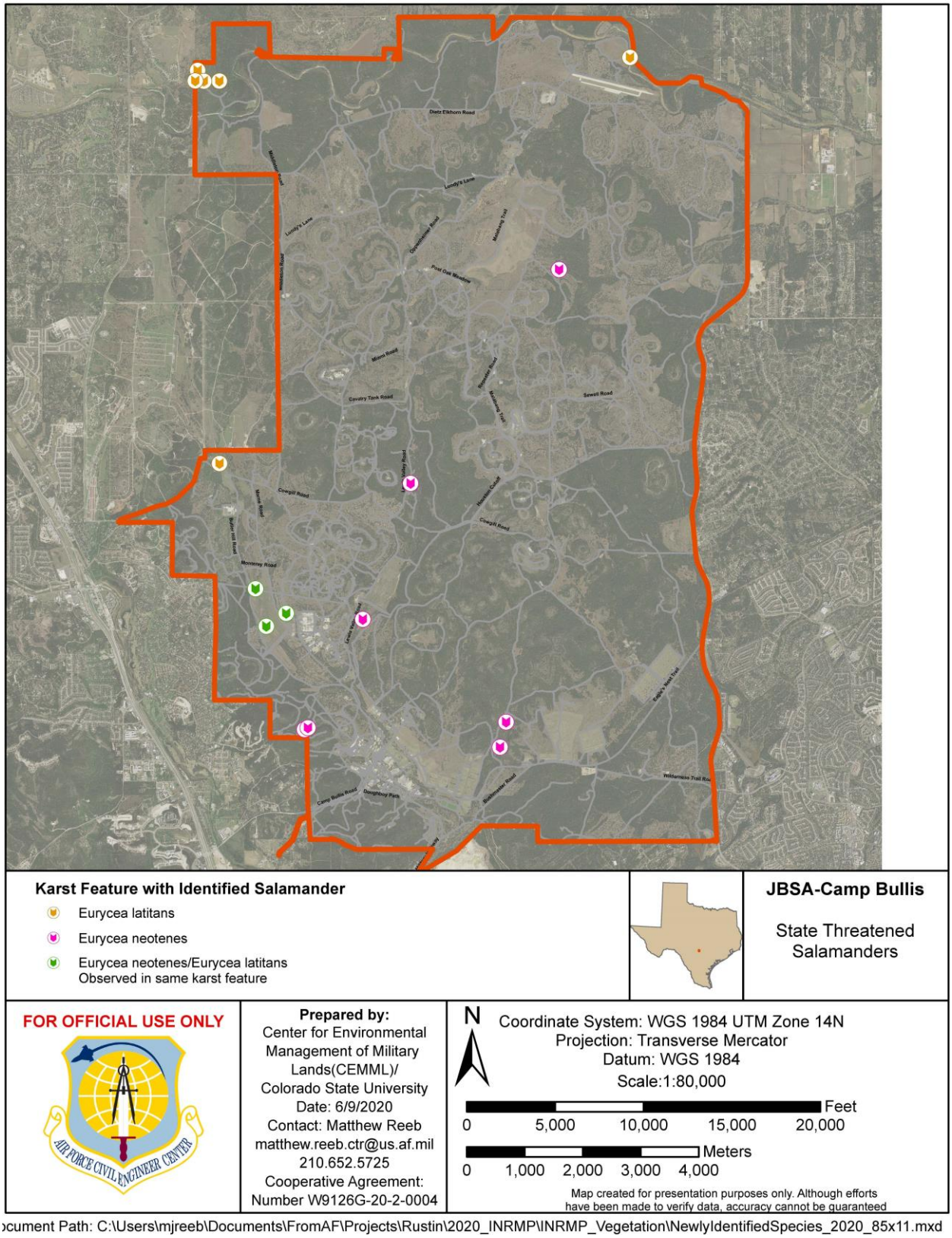


Figure 2-20. GCWA Habitat Map 2019

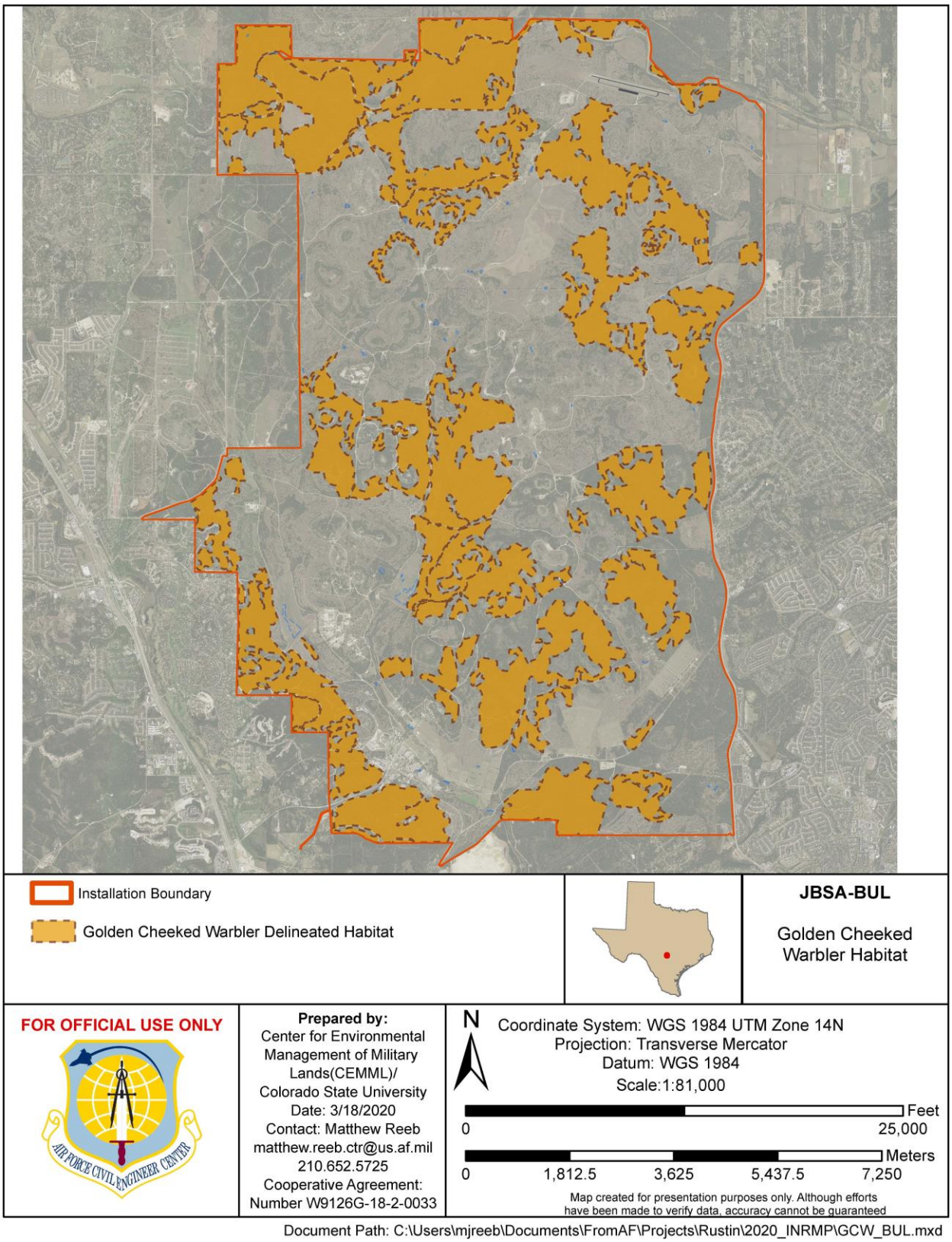


Figure 2-21. Federally Listed Karst Invertebrate Habitat

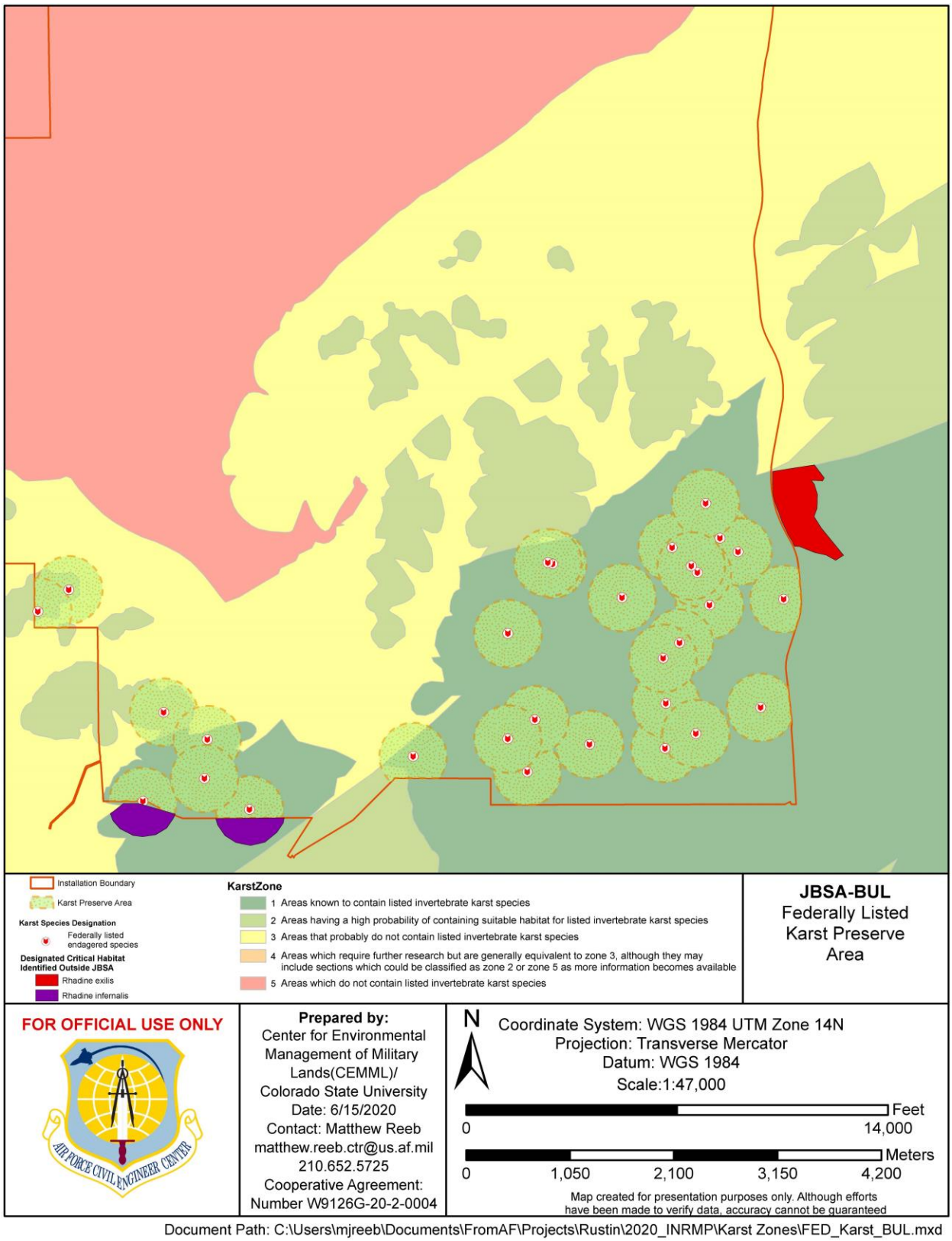
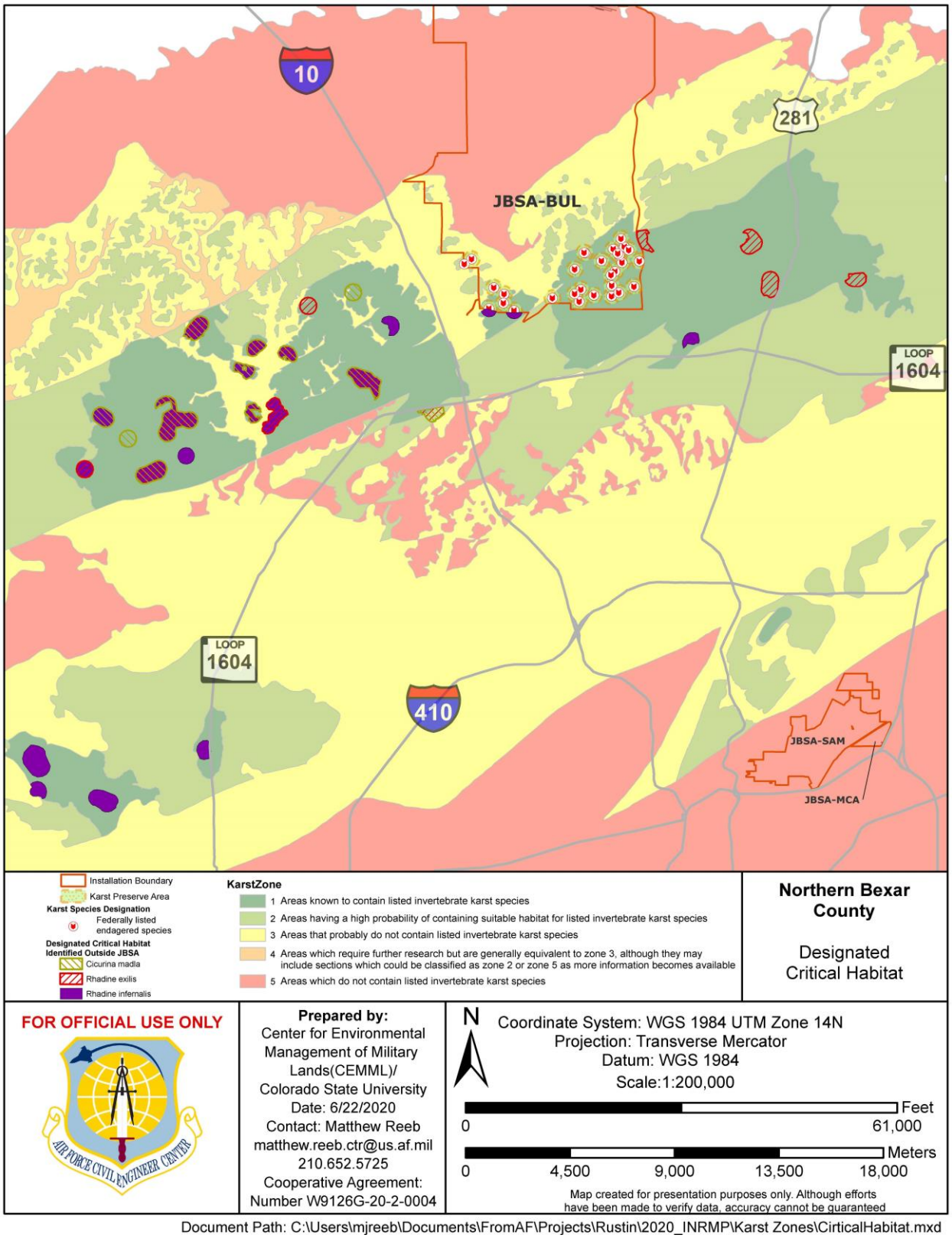


Figure 2-22. Designated Critical Habitat for Federally Listed Karst Invertebrates



2.3.5 Wetlands and Floodplains

A few wetland inventories and delineations have been completed for various JBSA locations. A wetland survey completed for all JBSA locations found 144 ac. of wetlands across the entire installation (Tetra Tech 2016). A wetland delineation was completed for JBSA-KFA (USACE 1994) found 22.26 ac of wetlands and waters of the U.S. Another delineation completed for JBSA-LAK and JBSA-CTA determined there were 26.58 ac of wetlands, 18.09 ac of those being delineated as jurisdictional wetlands (USACE 2012). There are discrepancies in size and number of wetlands between the delineations and the survey conducted in 2016. Mapped wetlands from both reports will be used to ensure potential wetlands are protected and further delineations will be requested if a wetland is to be impacted.

Floodplains occur at every location except JBSA-PRT. According to the Federal Emergency Management Agency's (FEMA) National Flood Insurance Program (NFIP) maps, JBSA has approximately 5,040 ac of 100 year floodplain total.

Table 2-2. Wetland and Floodplain Acreage by JBSA Location

Location	Number of Wetlands	Acreage (ac)	Percent of Location Acreage	100-yr Floodplain (ac)	Percent of Location Acreage
JBSA-CTA	37	17.4	0.4	777.6	19.6
JBSA-LAK[1]	19	7.3	0.2	469.4	9.9
JBSA-BUL	84	82.8	0.3	3310.8	11.8
JBSA-SAM[1]	13	7.8	0.3	316.6	10.9
JBSA-RND	18	25.5	0.9	53.7	1.9
JBSA-SAF	10	3.4	0.4	2.5	0.3
JBSA-CAN	0	0	0	109.4	28.7

[1]Includes adjacent locations

Wetlands could be particularly vulnerable to forecasted increases in temperature leading to increased evaporation rates. Wetland systems are vulnerable to changes in quantity and quality of their water supply, and it is expected that, in general, climate change will have a pronounced effect on wetlands through alterations in hydrological regimes (Erwin, 2009).

Figure 2-23. Floodplain/Wetland Map for JBSA-CTA

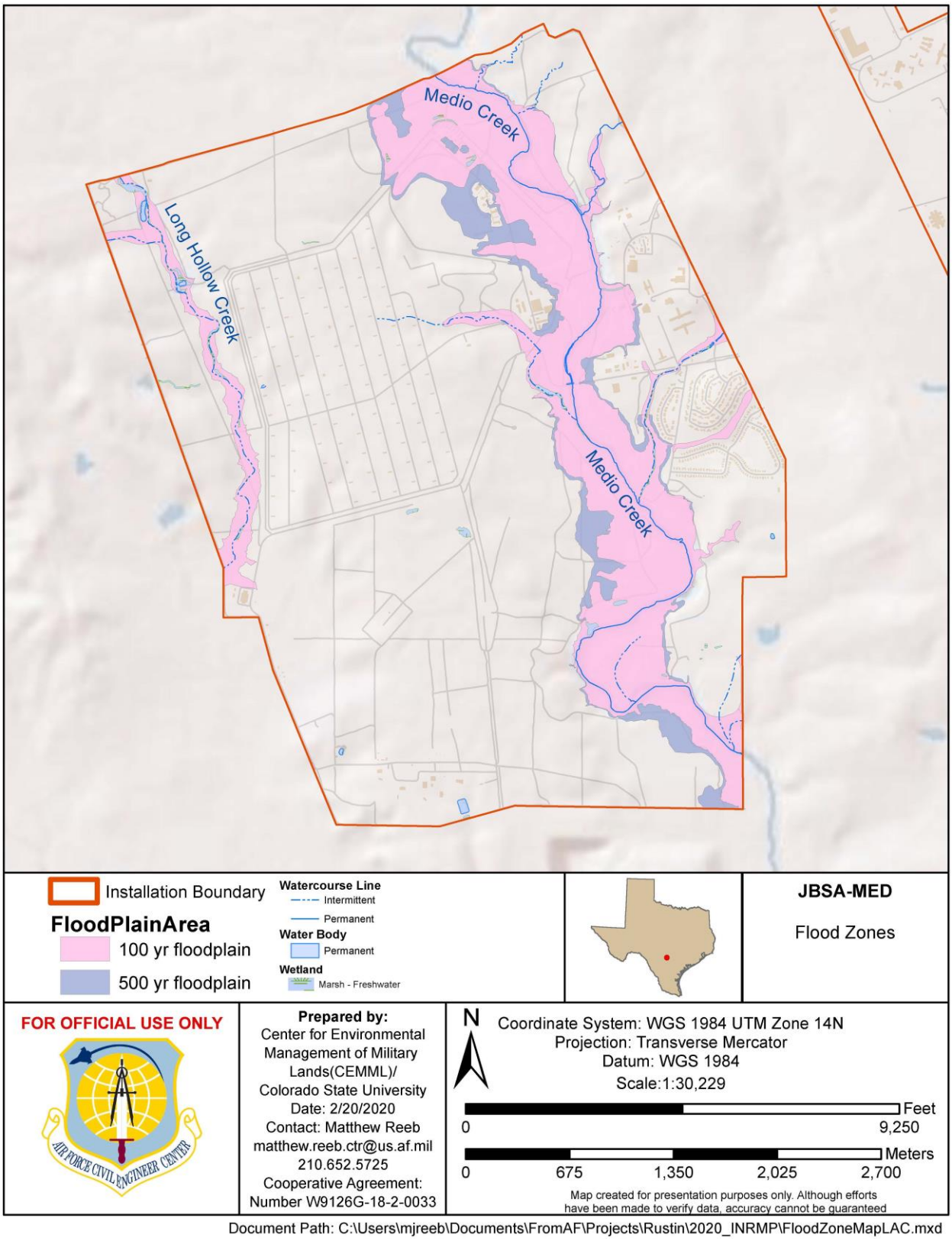


Figure 2-24. Floodplain/Wetland Map for JBSA-LAK, JBSA-KFA and JBSA-PRT

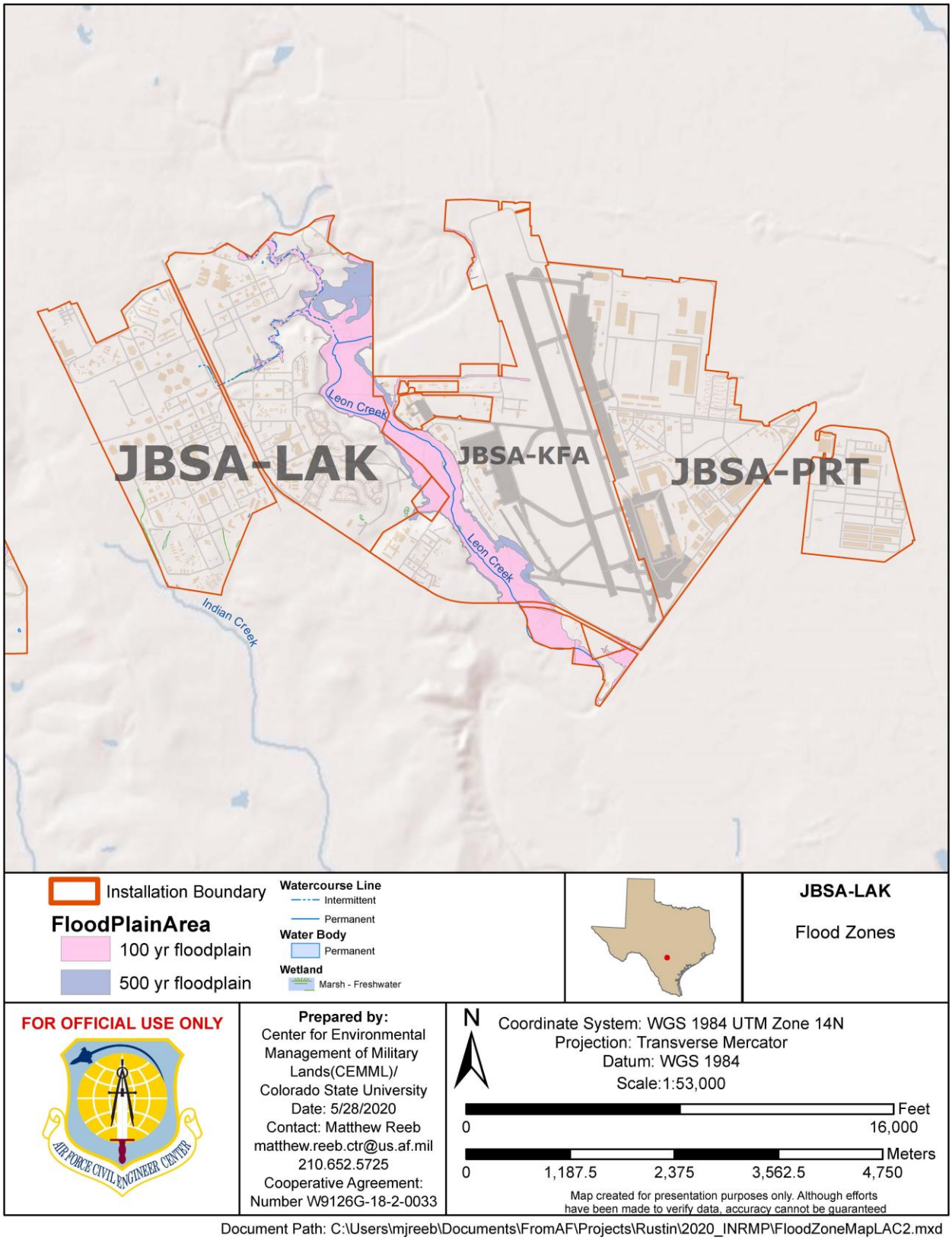


Figure 2-25. Floodplain/Wetland Map for JBSA-BUL

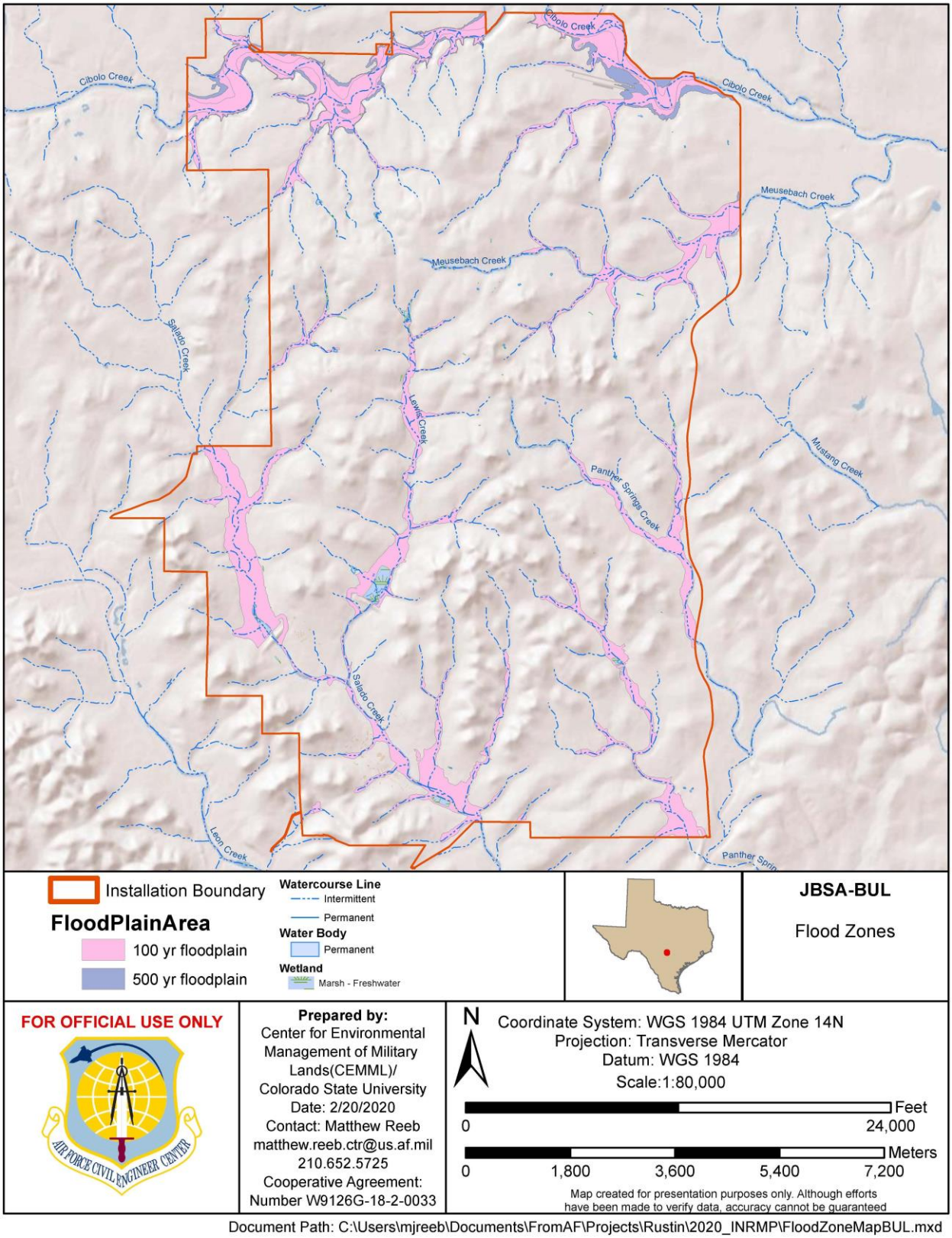


Figure 2-26. Floodplain/Wetland Map for JBSA-SAM, JBSA-GSA, and JBSA-MCA

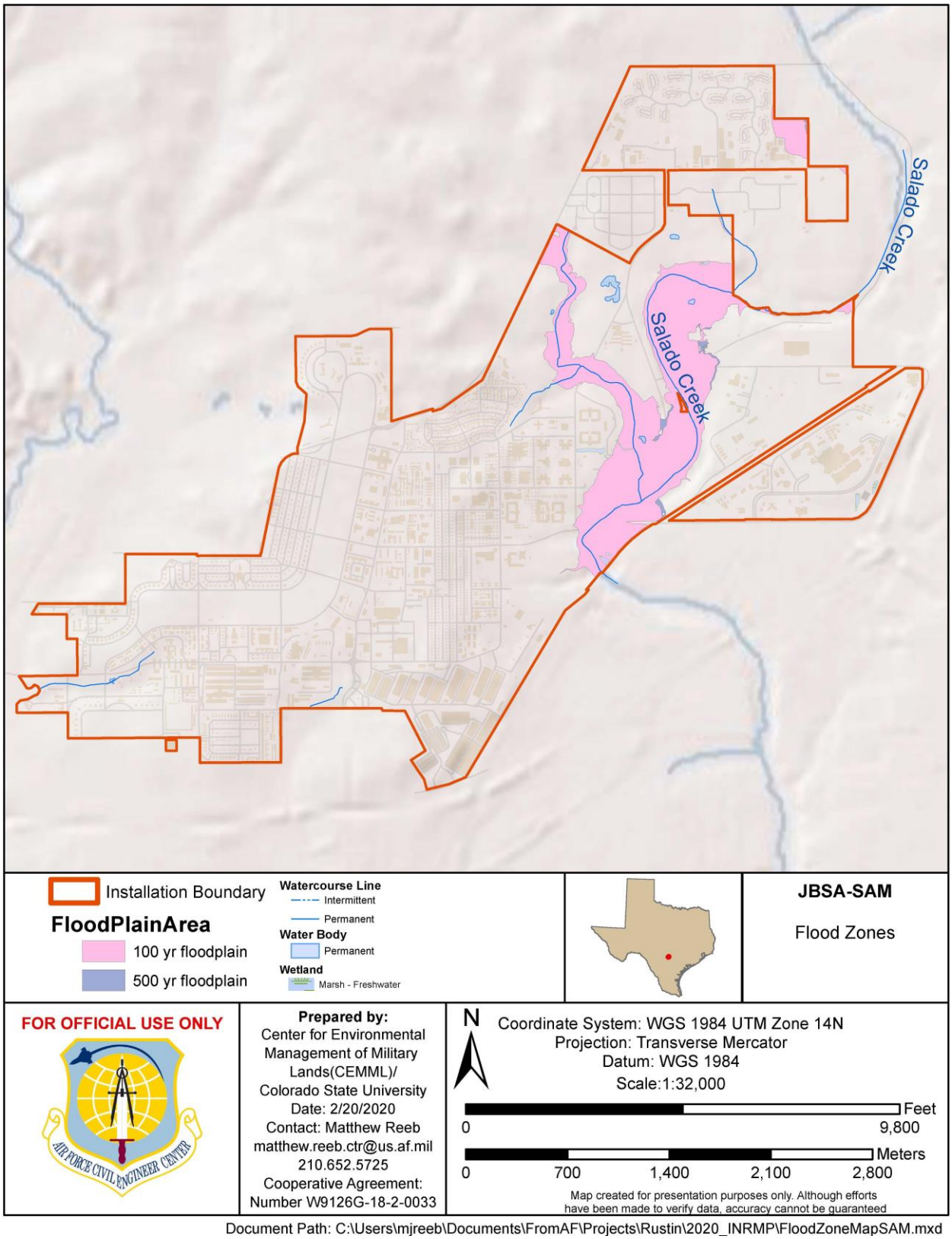


Figure 2-27. Floodplain/Wetland Map for JBSA-RND

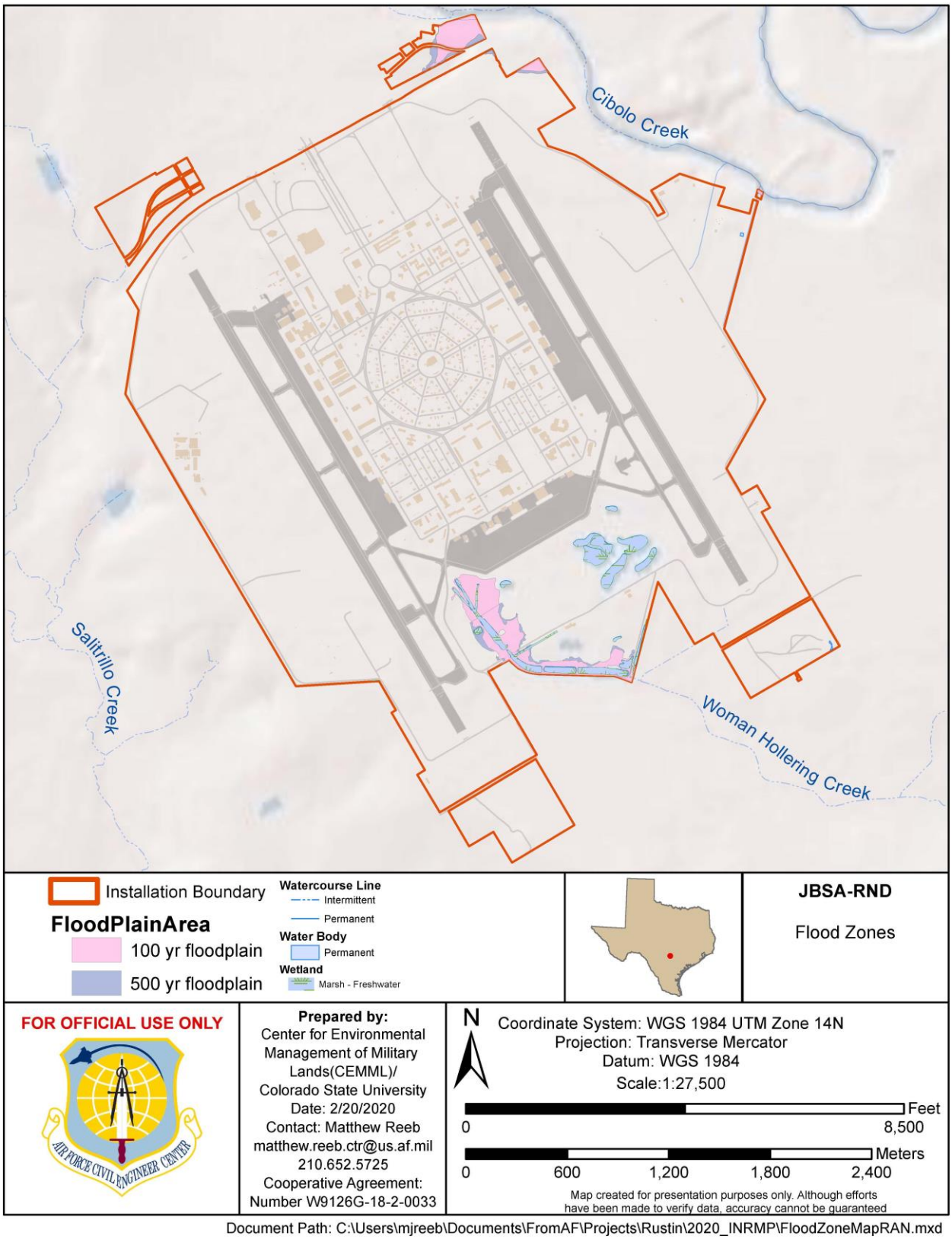


Figure 2-28. Floodplain/Wetland Map for JBSA-SAF

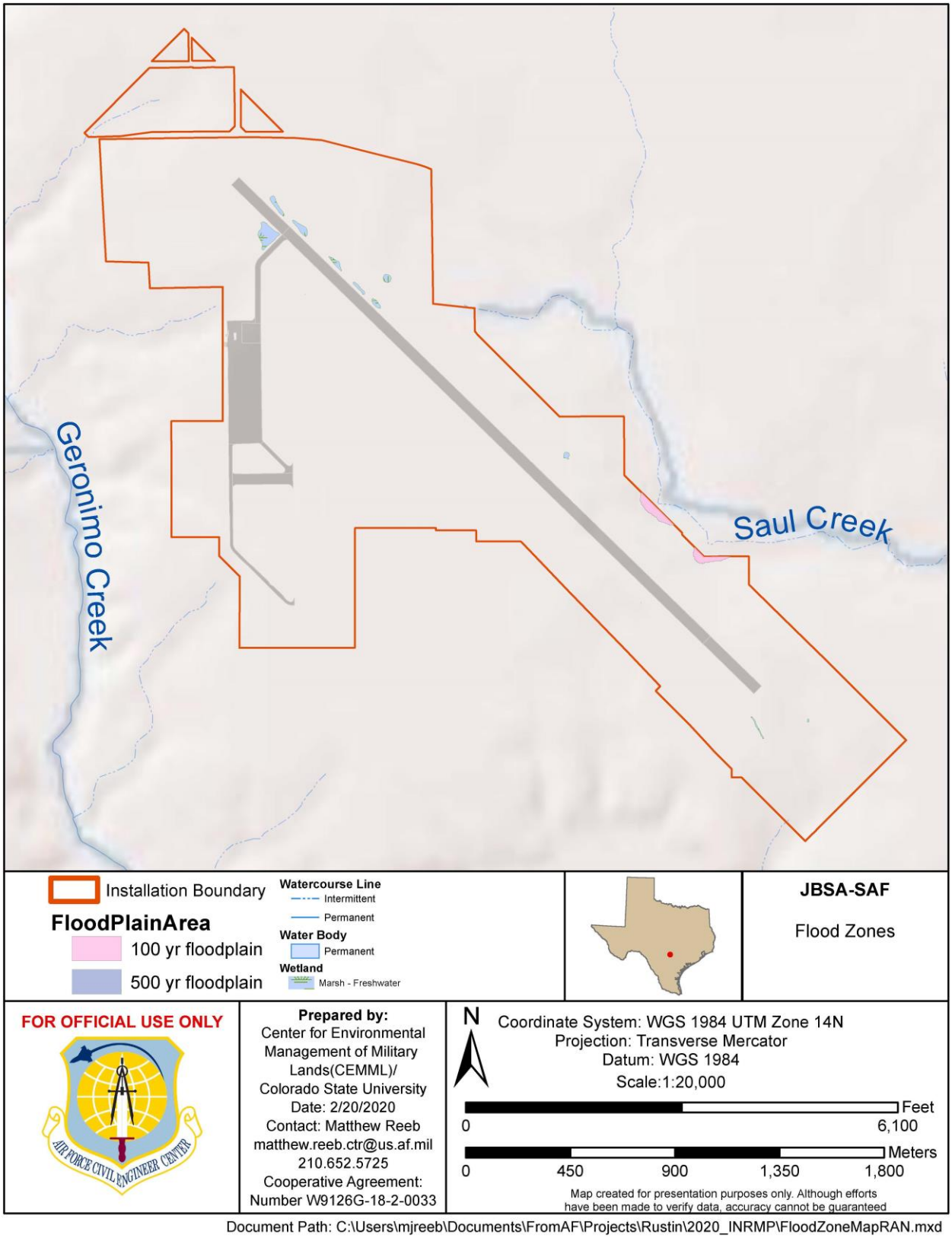
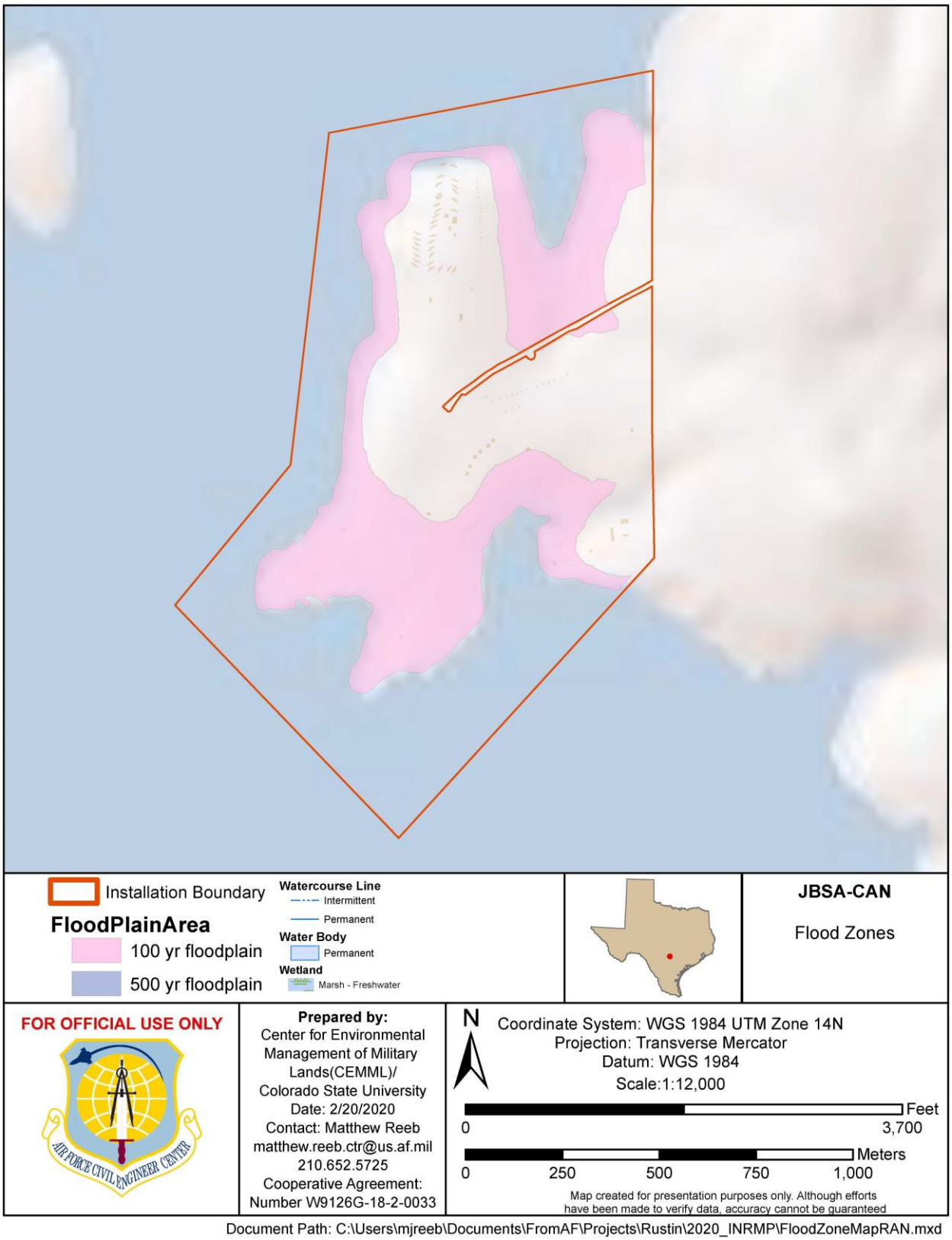


Figure 2-29. Floodplain/Wetland Map for JBSA-CAN



2.3.6 Other Natural Resources Information

Routine wildlife surveys are conducted at JBSA-BUL for birds (wintering and spring bird species inventories), Northern bobwhite (*Colinus virginianus*) and white-tailed deer (*Odocoileus virginianus*). Other projects at JBSA-BUL include two GCWA habitat mapping studies that both use remotely sensed data to map potential habitat. One of the studies is designed to assess the feasibility of using drones to collect data and machine learning algorithm to accurately identify habitat.

Previous studies are kept on file at the NRO at JBSA-BUL. Studies include Edwards Aquifer Authority die tracing, recharge and infiltration studies; Texas A&M University Kingsville turkey nest predation study; USDA feral hog bait delivery study; NRI woody cover, cave utilization by mesomammals, brush management and white-tailed deer browsing studies.

2.4 Mission and Natural Resources

2.4.1 Natural Resources Constraints to Mission and Mission Planning

Constraints are considered to be anything that causes restrictions on the mission. In some cases, the presence of T&E species, water resources, or sensitive habitats may limit the types or degree of activities in an area, but rarely are mission activities completely restricted due to natural resource issues. Early consideration of these issues in planning typically results in solutions where the mission can proceed unimpeded, either through slight modifications in location or timing, by implementing requirements from an existing consultation, or by obtaining permits through the appropriate regulatory channels that allow the potential for negative impacts to the resource (i.e., ESA Section 7 consultation). However, for some quick-response tasks, early planning is not an option; in these situations, efforts are made to accommodate the mission while minimizing environmental impacts. Missions may also experience shut downs or delays due to smoke or fire suppression activities.

The NRO and AFCEC maintain geospatial data for resources such as floodplains, T&E species habitat, wetlands or the Edwards Aquifer recharge zone to aid in project or training requirements reviews. Through the planning or NEPA process NRO staff relay maps with list of requirements associated with resources in the action area in order to plan the best way forward in accommodating the request.

JBSA completed an informal consultation in 2016, Informal Consultation for the Continuation of the Military Mission and Mission Sustainment Activities on Joint Base San Antonio – Camp Bullis in Relation to Five Listed Species (Consultation No. 02ETAU00-2015-I-0216). It was determined that military mission and mission sustainment activities had the potential to affect but were not likely to adversely affect the endangered species found on JBSA-BUL with the implementation of avoidance and conservation measures. Avoidance measures specified in the consultation are below.

Military training restrictions within GCWA core habitat and 300 ft buffer of core habitat during GCWA breeding season (1 March to 15 August) are as follows:

- No vegetation removal or disturbance, including brush removal without the prior approval of the NRM.
- Units in vehicles may pass through habitat only using existing roads & trails or for emergency stops.
- Equipment must only be parked in open areas (e.g. roads, fields), for no more than two hours if running.
- No establishment of new bivouacs or other static positions, including temporary fueling areas, decontamination areas and field medical operations.

- Off road use is prohibited without prior approval of the NRM.
- No use of pyrotechnics, obscurant smoke, any chemical agents, or lighted nighttime activities.
- No long-term (longer than 2 hours in a static location) use of any noise-producing equipment (e.g. generators).
- Military training restrictions within all GCWA habitat during non-breeding season (16 August to 28 February) are as follows:
- No vegetation removal or disturbance, including brush removal without prior NRM approval.
- Units may occupy and utilize habitat but all vehicles must stay on existing roads and trails unless approved in advance by the NRM.

Military Training Restrictions within Karst Preserve Areas (KPA)

- No vegetation removal or disturbance, including brush removal except normal maintenance activities without prior approval of the NRM.
- No entry into any cave is allowed without prior approval of the NRM.
- Units may pass through KPAs only using existing roads and trails and where land navigation courses intersect the KPA.
- No establishment of bivouacs or other static positions, including temporary fueling areas, decontamination areas and field medical operations within 105 m of cave locations.
- No use of any bait or attractant within 150 m of cave locations unless approved by the NRM.

Development in the Edwards Aquifer recharge zone is possible, however, as most of JBSA relies on the water from the Edwards Aquifer it would not be conducive to the long term viability of JBSA. Mission activities such as fueling points or bivouac sites that may adversely impact the recharge zone and are not allowed in the recharge zone.

In addition to natural resources located on JBSA, encroachment of development in surrounding areas can also impact the management of natural resources and installation missions. As development outside of JBSA continues, wildlife may relocate to natural resources found on JBSA, potentially increasing the need for management of wildlife. As San Antonio continues to grow, increased water use restrictions may be likely. JBSA receives runoff from upstream properties, as these upstream properties continue to develop, the quantity and the quality of this runoff may affect each JBSA location in perpetuity.

2.4.2 Land Use

Land use on JBSA is generally defined by ground maintenance land use categories to indicate scope and intensity of land management. The three land use categories include Improved, Semi-improved, and Unimproved.

Improved lands are areas occupied by buildings, permanent structures, and lawns or landscape plantings that are regularly maintained, such as cantonment areas, parade grounds, drill fields, cemeteries, and housing areas.

Semi-improved are areas where periodic maintenance is performed primarily for operation reasons and includes areas adjacent to runways, taxiways, and aprons; clear zones, lateral safety zones, small arms ranges and antenna facilities.

Unimproved areas are all other areas where natural vegetation is not intensively managed or not managed at all. These areas may be managed on a longer term rotational basis with prescribed fire or brush removal.

Table 2-3. Acres of Land Use Categories per JBSA Locations

	JBSA-CTA	JBSA-LAK[1]	JBSA-BUL	JBSA-SAM[1]	JBSA-RND	JBSA-SAF	JBSA-CAN
Unimproved	2,599	438	24,979	314	35	72	139
Semi-improved	198	1,523	1,750	297	1,659	794	36
Improved	1,171	4,677	1,239	2,303	1,187	92	53

[1] Includes adjacent locations

Figure 2-30. Land Use Map for JBSA-CTA, JBSA-LAK, JBSA-KFA and JBSA-PRT

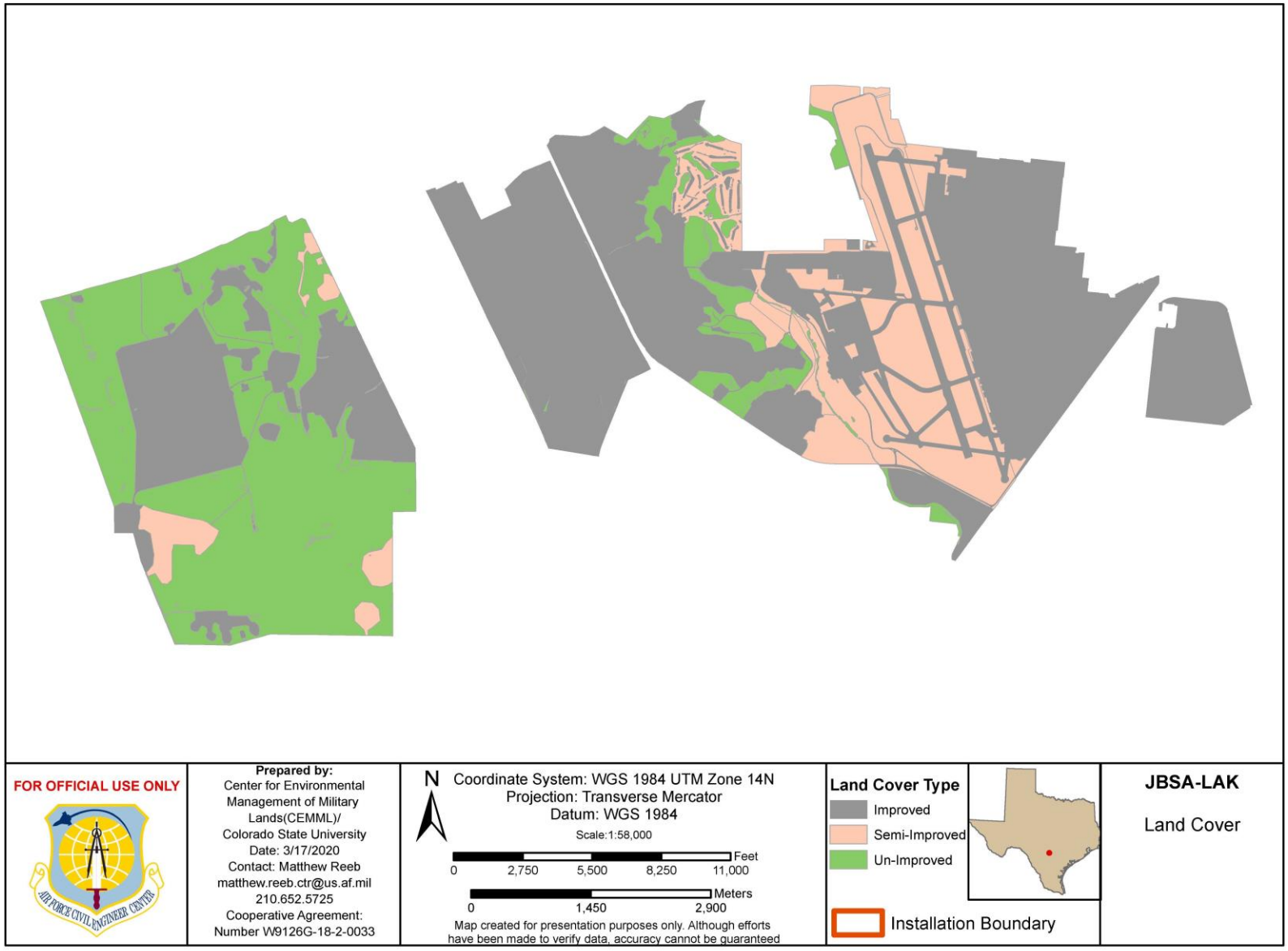


Figure 2-31. Land Use Map for JBSA-BUL

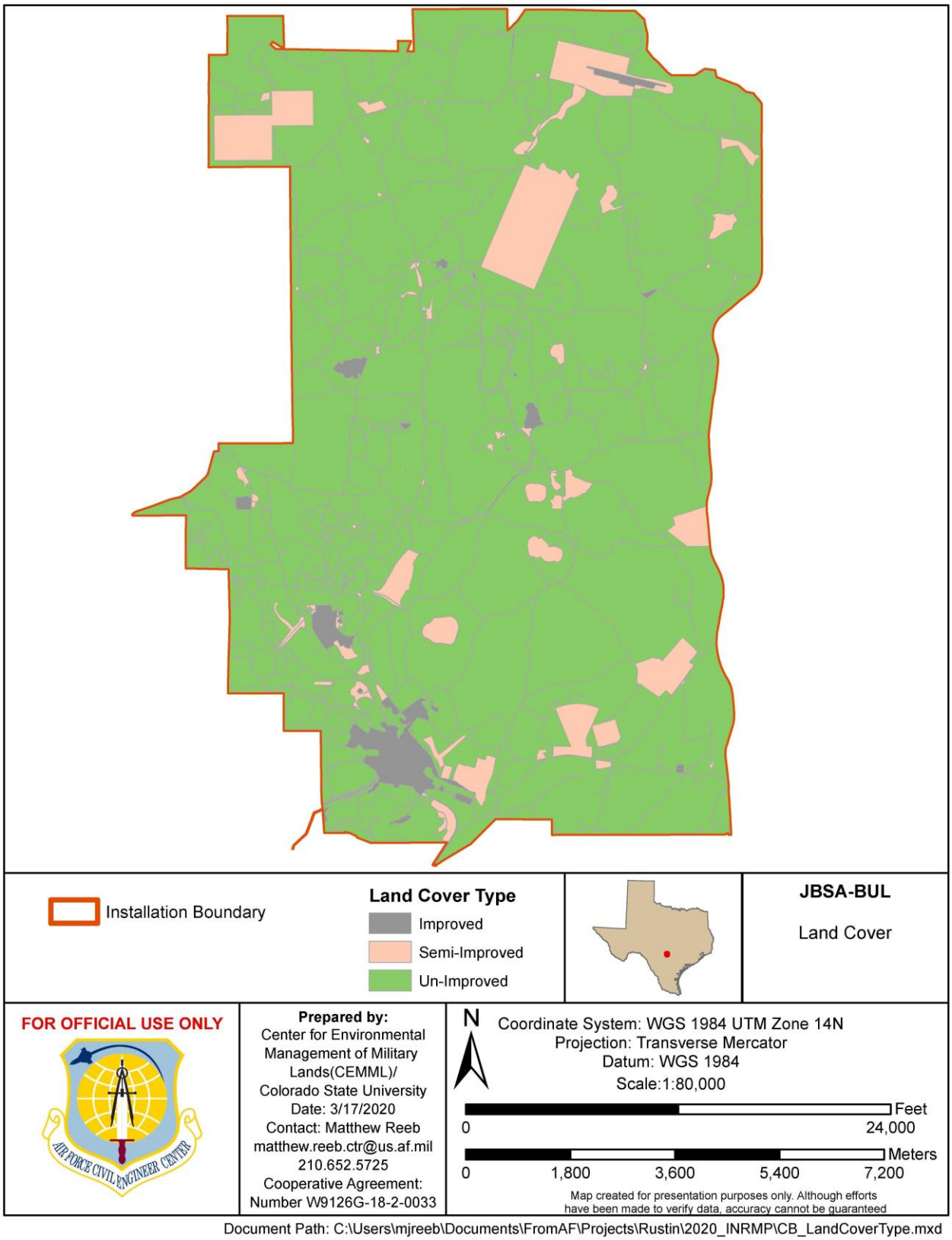


Figure 2-32. Land Use Map for JBSA-SAM

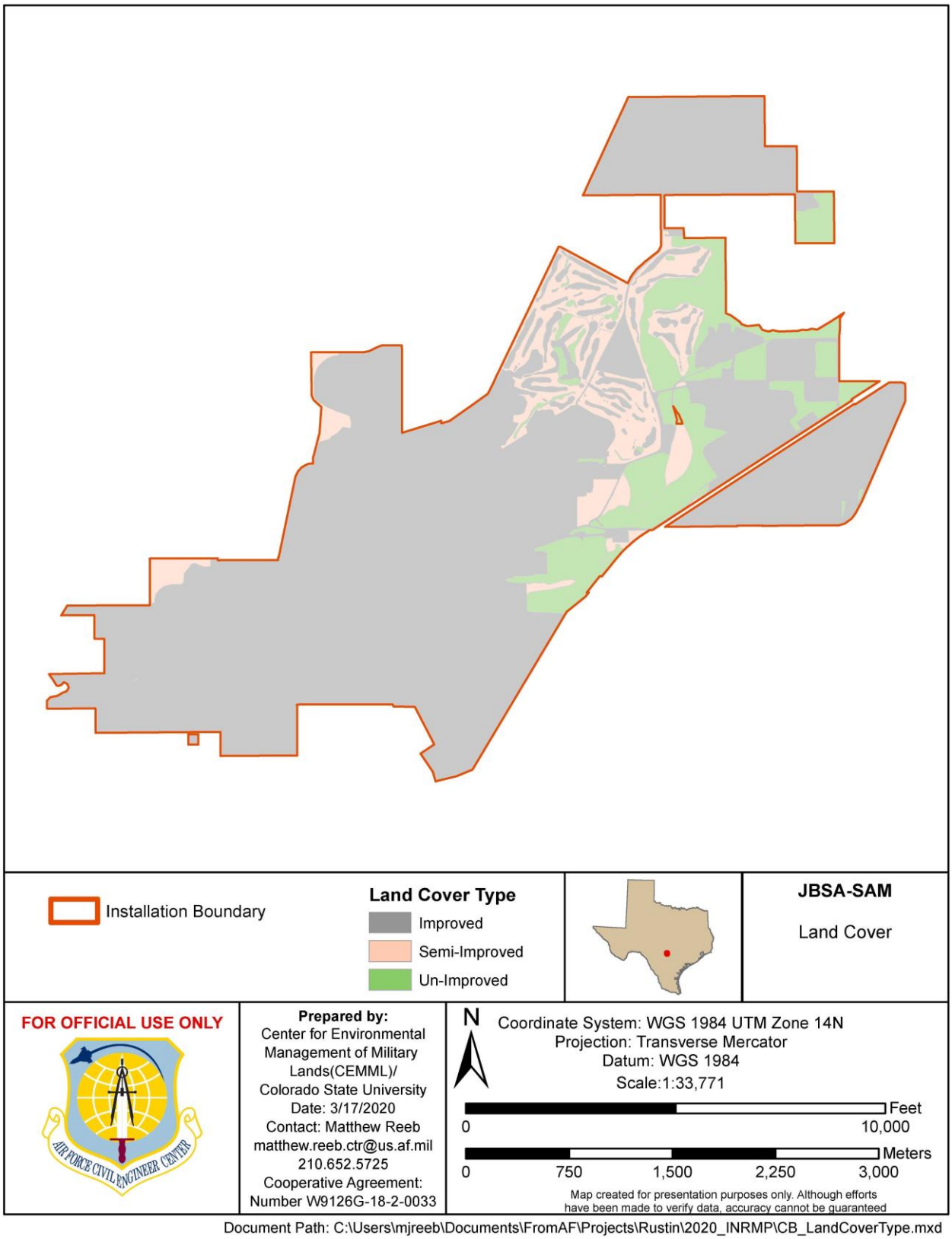


Figure 2-33. Land Use Map for JBSA-RND

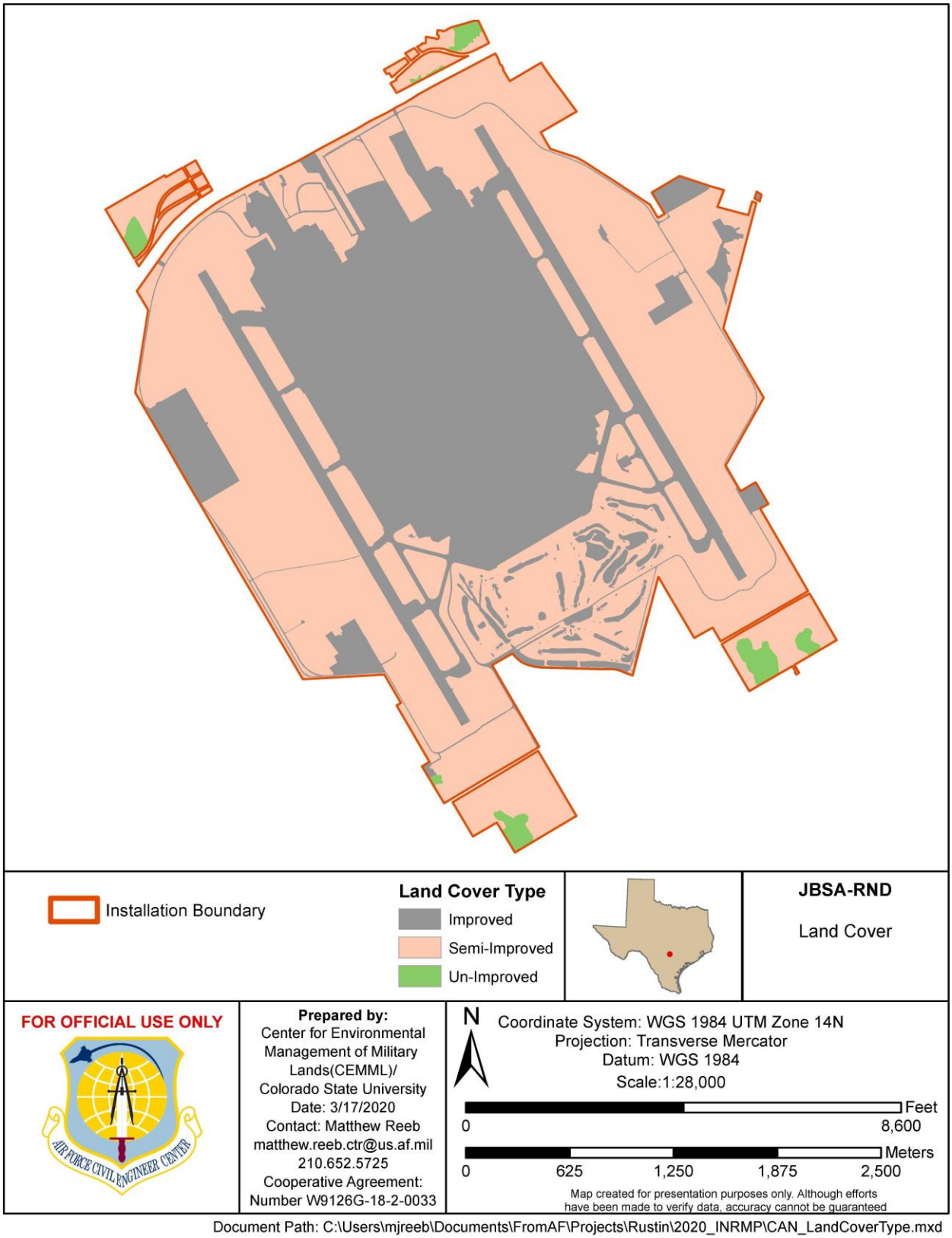


Figure 2-34. Land Use Map for JBSA-SAF

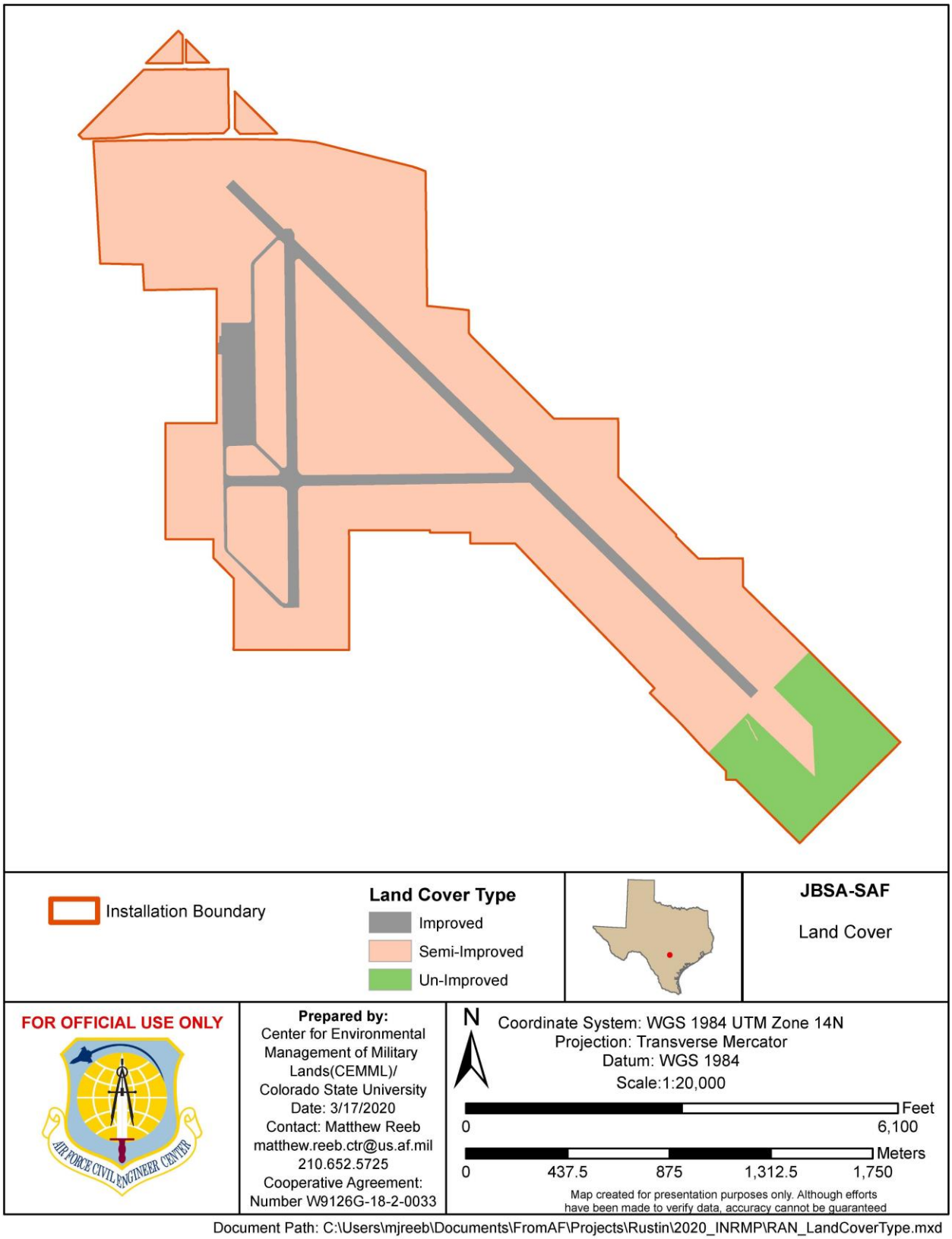
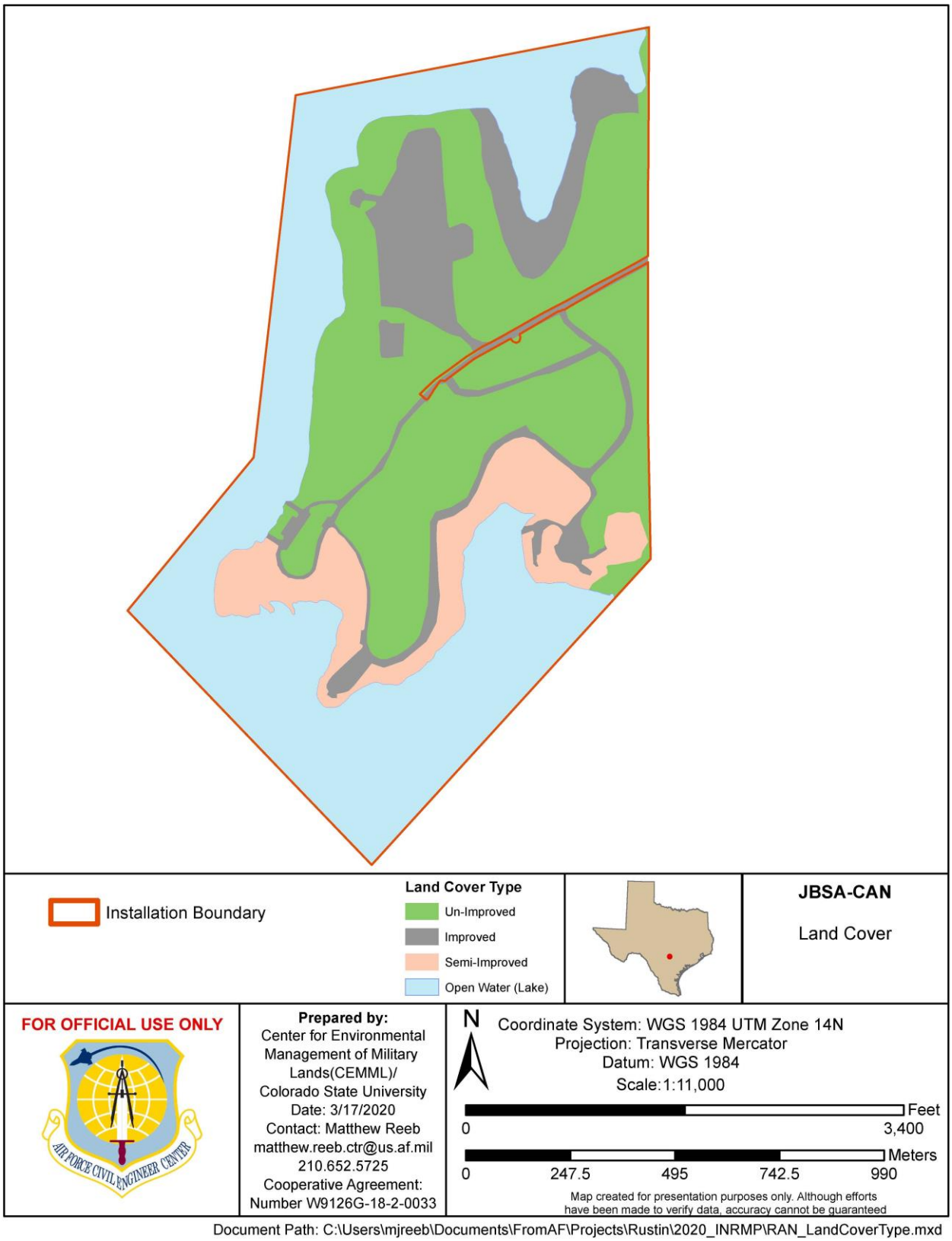


Figure 2-35. Land Use Maps for JBSA-CAN



2.4.3 Current Major Mission Impacts on Natural Resources

On September 24, 2018 Bexar County was designated as nonattainment for ozone, under the National Ambient Air Quality Standards (NAAQS) set for by the Clean Air Act. The NAAQS represents the maximum levels of background pollution that are considered safe, with an adequate margin of safety to protect public health and welfare. Air quality management is conducted by JBSA in compliance with applicable laws and regulations. Currently JBSA maintains one Title V Permit for operation of an energy plant and boilers associated with Woolford Hall and other emission sources at JBSA-LAK. JBSA has implemented best management practices at power production sites and has invested in solar power generation. The JBSA Installation Commander has also implemented an anti-idling policy and has promoted the use of alternative modes of transportation including carpooling and public transit. JBSA has steadily reduced volatile organic compounds (VOC) by reducing paint and solvent use and by buying low VOC chemical when possible.

Activities which affect the vegetative cover and soil can also affect the quality and quantity of surface water runoff into streams and their associated drainages. Such actions include military construction projects (which may expose the soil to erosion and compaction, as well as convert permeable surfaces to impermeable surfaces); training area land management (including vegetation management, prescribed burning, trail maintenance, training site maintenance); grounds and landscape maintenance (including pesticide and fertilizer application, turf improvement); and pest management (pesticide application). Many of these activities are considered non-point sources of pollution, which are difficult to regulate centrally. JBSA maintains four Texas Pollutant Discharge Elimination permits which address permit requirements, designates responsibilities, and recommends best management practices for mitigating stormwater pollution.

Tetrachloroethylene (TCE) has been identified as a pollutant that has migrated into groundwater in the vicinity of Landfill 8 at JBSA-BUL. The ground water at the location has been treated as recently as March 2020 with an injection of emulsified vegetable oil mixed with Dechlorinating Culture to replenish the carbon source and augment bacterial populations at the site, to reduce concentrations of TCE.

Vegetation at several areas of JBSA are maintained for operational capabilities and safety. Areas adjacent to AMA at JBSA-KFA and JBSA-RND should be maintained according to AFI 91-212, *Bird/wildlife Aircraft Strike Hazard (BASH) Management Program* and the JBSA BASH Plan. Impacts to natural resources in these areas are negligible as they have been managed similarly to how they are managed now since their inception. New management activities using herbicides and insecticides to manage broadleaf weeds and localized insect infestations in these area could impact natural resources, especially if not applied appropriately in accordance with the product label.

Vegetation management practices at JBSA-BUL may also have an adverse impact to natural resources if not adequately planned, coordinated and carried out. Mechanical and prescribed fire activities carried out by the WSM and ITAM program have been and will continue to be coordinated with the NRO to ensure sensitive natural resources are not adversely impacted by the work.

2.4.4 Potential Future Mission Impacts on Natural Resources

The JBSA IDP and ADPs propose future development activities needed to support current and future military missions. Current and proposed construction projects may impact sensitive natural resources, either directly through destruction or indirectly (e.g. erosion, sedimentation).

Two mission changes are in the planning and environmental assessment phases. Since these changes are in the early stages of being planned, it is currently unknown how they might impact natural resources. The first is to replace the aging T-38C with a newer, more capable aircraft to prepare pilots for technological advancement found in modern aircraft and to cut down on increasing maintenance requirements. The T-38C is used primarily at JBSA-RND and JBSA-SAF for pilot instructor training. The second change is the reintroduction of tracked vehicles at JBSA-BUL by the U.S. Army in the form of a new Armored Multi-Purposed Vehicle (AMPV). Bradley fighting vehicles and M113 tracked support vehicles were utilized at JBSA-BUL as recently as 2012.

3.0 ENVIRONMENTAL MANAGEMENT SYSTEM

The USAF environmental program adheres to the Environmental Management System (EMS) framework and it's Plan, Do, Check, Act cycle for ensuring mission success. Executive Order (EO) 13834: Efficient Federal Operations, Planning for Federal Sustainability in the Next Decade; DoDI 4715.17, Environmental Management Systems; AFI 32-7001, Environmental Management; and International Organization for Standardization (ISO) 14001 standard, Environmental Management Systems – Requirements with guidance for use, provide guidance on how environmental programs should be 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

Table 4-1. Organizational Roles and Responsibilities

Office/Organization/Job Title (Listing is not in order of hierarchical responsibility)	**Installation Role/Responsibility Description**
Installation Commander	• Approves or delegates approval of the INRMP • Endorses or delegates endorsement of the annual review of the INRMP as valid and current • Enters into cooperative agreements for Sikes Act related activities as needed • Provides for appropriate staffing of professionally trained natural resource management personnel • Approves or delegates approval of the Wildland Fire Management Plan (WFMP) • Designate the Wildland Fire Program Coordinator (WFPC) in coordination with the installation Fire Chief
AFCEC Natural Resources Media Manager/SME/Subject Matter Specialist (SMS)	• Provides technical assistance and guidance to AF on natural resources issues • Advocates for resources required to implement approved INRMPs
AFCEC Wildland Fire Branch AFCEC/CZOF	• Maintains Wildland Support Modules (WSM)and associated agreements needed to support WSM • Issues, certifies, maintains and tracks National Wildfire Coordinating Group certifications and qualifications for JBSA personnel

Office/Organization/Job Title (Listing is not in order of hierarchical responsibility)	**Installation Role/Responsibility Description**
Installation Natural Resources Manager/POC	• Ensures compliance with all natural resources laws and regulations • Coordinates with installation components to assess the potential impacts of proposed activities on sensitive natural resources, and makes recommendations to reduce, avoid, or mitigate adverse effects to comply with applicable laws and regulations • Prepares, coordinates and implements the JBSA INRMP pursuant to the Sikes Act
Installation Security Forces	• Consults with the Installation Commander to determine the extent of access to the installation as suitable for outdoor recreation
Installation Unit Environmental Coordinators (UECs); see AFI 32-7001 for role description	• Liaison between Environmental Management and their unit • Attend UEC meetings • Inform the work area supervisor of EMS and environmental policies • Manage EMS requirements for the unit • Provide information for installation environmental and sustainability performance measures • Support EMS and compliance assessments, and assist with development of corrective actions for findings
Installation Fire Emergency Services, Fire Chief	• Serves as incident commander during wildfire incidents or delegate incident commander authority to others based on the complexity of incident • Prepares for both initial and extended wildfire suppression operations per National Fire Protection Association (NFPA) standard 1710, and in accordance with DoDI 6055.6, Enclosure 3 paragraph 8.1.2 • Responsible for fire prevention and minimizing adverse consequences within the Wildland Urban Interface per AFI 32-2001 • Initiates request for AFCEC/CZOF assistance during a wildfire • Develop Mutual Assistance Agreements with regional and local fire departments and land management agencies for wildfire suppression assistance, and initiates mutual aid requests • Submits requests to the AFCEC/CZOP training manager for NWCG Incident Qualification Cards for qualified Fire Emergency Services (FES) personnel
Installation Wildland Fire Program Coordinator	• Serves as the primary point of contact between the installation and AFCEC/CZOF for all matters concerning wildland fire

Office/Organization/Job Title (Listing is not in order of hierarchical responsibility)	**Installation Role/Responsibility Description**
	• Initiates and ensures appropriate installation coordination and timely completion of the Wildland Fire Management Plan annual review • Coordinates with the AFCEC/CZOF Wildland Support Module (WSM) Lead to identify NWCG training requirements needed to implement the JBSA WFMP • Submits requests for Incident Qualification Cards to AFCEC/CZOF for installation personnel not employed by FES as specified in the installation WFMP • Coordinates with the installation NRM to assess the need for an Emergency Stabilization Plan and/or Burned Area Emergency Response Plan after a wildfire incident • Responsible for acquiring required approvals of Agency Administrator Ignition Authorization and Prescribed Burn Go/No Go checklist prior to ignition of a prescribed fire • Reports significant wildfire incidents on the installation as soon as practicable to the RFMO
12 Flying Training Wing Flight Safety (12 FTW/SEF) 502 ABW Flight Safety (502ABW/SEF)	• Assign BASH program manager for the applicable location • Responsible for coordinating and implementing BASH Plan
Pest Manager	• Coordinates with NRM to ensure that the IPMP and INRMP are mutually supportive • Conducts and ensures pest management activities on the installation are in compliance with applicable laws and regulations
Army Support Activity	• Responsible for updating and implementing Range Complex Master Plan and Integrated Training Area Management (ITAM) Plan • Ensures compliance with regulations applicable to ranges, training site (TS) and training area (TA) utilization • Coordinates range and TA scheduling • Coordinates ITAM Plan associated work with Environmental Planning Function, NRM, and cultural resources manager to ensure work is completed in accordance with laws and regulations • Implements ITAM Plan in accordance with laws and regulations
Conservation Law Enforcement Officer (CLEO)	• Provides enforcement of hunting, fishing, protected species, and other natural and cultural resources laws and regulations • OPR for maintenance and administration of the Conservation Law Enforcement Plan
502 Force Support Squadron (FSS)	• Aids in registration of hunting program participants

Office/Organization/Job Title (Listing is not in order of hierarchical responsibility)	**Installation Role/Responsibility Description**
	• Schedules training areas for hunting activities • Checks in and out hunting participants
National Environmental Policy Act (NEPA)/Environmental Impact Analysis Process (EIAP) Manager	• Proactively manages all actions to ensure the EIAP is completed • Coordinates NEPA analysis for the INRMP and INRMP activities
WSM	• Assists JBSA in the development of WFMP and Prescribed Fire Plans (PFP) • Aids in the review and revision of WFMP and PFP • Coordinates with NRM to plan fuels management activities • Conducts fuels management activities through prescribed fire and mechanical treatments
USFWS	• Assists JBSA in the conservation and management of federally listed T&E species that occur on or are affected by the installations actions • Reviews, concurs with and signs JBSA INRMP • Provides consultation on actions with the potential to affect federally listed T&E species • Enforces federal fish and wildlife laws • Administers and issues T&E species permits and migratory bird depredation permits
TPWD	• Assists JBSA in the conservation and management of state listed T&E species and game species that occur on or are affected by JBSA actions • Reviews, concurs with, and signs JBSA INRMP • Enforces state fish and wildlife laws • Administers Managed Lands Deer Permit program, reviews survey data and issues harvest tags

5.0 TRAINING

USAF installation NRMs/POCs 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.

Natural resources management personnel are encouraged to attain professional registration, certification, or licensing for their related fields, and may be allowed to attend appropriate national, regional, and state conference and training courses.

Installation Supplement – Training

- NRMs at Category I installations must take the course DoD Natural Resources Compliance, endorsed by the DoD Interservice Environmental Education Review Board and offered for all DoD Components by the Naval Civil Engineer Corps Officers School (CECOS). See

http://www.netc.navy.mil/centers/csfe/cecos/ for CECOS course schedules and registration information.

- Natural resources 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.
- Natural resources management personnel that are responsible for T&E species management and coordinating activities that may impact T&E species or their habitats must take Interagency Consultation for Endangered Species. See https://training.fws.gov/ for course schedules and registration.
- 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 (http://www.fletc.gov/).
- Individuals participating in the capture and handling of sick, injured, or nuisance wildlife should receive appropriate training, to include training that is mandatory to attain any required permits
- Personnel supporting the BASH program should receive flight line drivers training, training in 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. BASH dispersal and depredation training will be conducted IAW the JBSA BASH Plan.
- Personnel participating in prescribed fire and wildfire activities must complete and maintain training commensurate with their level of involvement in accordance with NWCG PMS 310-1 NWCG Standards for Wildland Fire Position Qualifications.

6.0 RECORDKEEPING AND REPORTING

6.1 Recordkeeping

The installation maintains required records IAW Air Force Manual 33-322, Management of Records, and disposes of records IAW the Air Force Records Management System (AFRIMS) records disposition schedule (RDS). Numerous types of records must be maintained to support implementation of the natural resources program. Specific records are identified in applicable sections of this plan, in the Natural Resources Playbook, and in referenced documents.

Installation Supplement - Recordkeeping

JBSA NRO maintains copies on the JBSA server of all natural resources plans, surveys, consultations, GIS data, studies, permits, reports and other pertinent natural resources materials. Certain materials are also stored on eDASH. Some historical materials are maintained as hard copies and stored at the NRO, JBSA-BUL Building 6201.

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 SMS should refer to the Environmental Reporting Playbook for guidance on execution of data gathering, quality control/quality assurance, and report development.

Installation Supplement -Reporting

JBSA NRO submits annual reports to the USFWS regarding activities conducted during the year to address requirements from ESA Section 7 consultations and MBTA depredation permit.

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 in this outline that do not exist on the installation are identified as not applicable and include a justification, as necessary.

Installation Supplement – Natural Resources Program Management

The 802d CES Natural Resources Office (NRO) is the organization with primary responsibility to implement this INRMP, however, all tenant organization and mission partners are responsible to conduct their missions IAW all applicable federal, state and local laws, regulations and policies.

7.1 Fish and Wildlife Management

Applicability Statement

This section applies to all USAF Installation that maintain an INRMP. The installation is required to implement this element.

Program Overview/Current Management Practices

JBSA contains a wide variety of habitat types that support a large amount of wildlife species diversity. Management of wildlife populations is necessary to sustain and enhance biological diversity and the viability of populations, and to maximize the compatibility of wildlife and human activities. The goal of fish and wildlife management at JBSA is to protect and enhance the habitats of native fish and wildlife species to provide for the long term sustainability of the military missions. The majority of wildlife management occurring at JBSA occurs through management of habitat. Land is managed to encourage conditions favorable for the continued existence and production of fish and wildlife species by natural means whenever possible and consistent with military missions. Direct population management only occurs through hunting and trapping programs administered by the NRO or by NRO management activities. More information on the hunting program is found in Section 7.2 of this document and JBSA Hunting Regulations are found in Appendix B. Wildlife management is conducted under the principles of the Fish and Wildlife Conservation Act (16 U.S.C. 2901 *et seq*.), which encourages federal agencies to balance recreational and consumptive uses of game species with the conservation of non-game fish and wildlife and their habitats.

The NRO conducts annual wildlife surveys for wintering birds, Northern bobwhite, white-tailed deer and the federally listed T&E species that are known to occur on the installation. Additional surveys for red imported fire ants (*Solenopsis invicta*, RIFA) and cave crickets occur on a monthly and biannual basis, respectively.

The JBSA Pest Management shop has primary responsibility for the control of nuisance wildlife species, although the NRO can aid pest management personnel if available. Feral hogs (*Sus scrofa*), white-tailed deer, collared peccary (*Pecari tajacu*), coyotes (*Canis latrans*), and various rodents are the most common nuisance species, creating hazards for aircraft and potentially unwanted encounters with humans. With the exception of emergency situations, lethal control of wildlife is used as a last resort. Initial effort to control nuisance species populations is to modify habitat (food, water, and shelter) in the area where the nuisance wildlife are reported to decrease the attractiveness. Fencing is used for nuisance wildlife exclusions in areas

of the base, specifically airfields, where the presence of wildlife can cause significant risks to safety and operations.

Fish and wildlife management on JBSA is not likely to change greatly in response to climate change. Current fish and wildlife management issues are likely to persist in the future, such as presence of invasive species. Increasing temperature and precipitation are not likely to drive away non-native invasive species such as feral hogs, feral cats (*Felis catus*), feral dogs (*Canis familiaris*), European starlings (*Sturnus vulgaris*), pigeons (*Columba livia*), Eurasian collared-dove (*Streptopelia decaocto*), Egyptian geese (*Alopochen aegyptiaca*), and house sparrows (*Passer domesticus*). Hunting will likely continue to be a management tool for maintaining low populations of invasive species, particularly feral hogs. Fish and wildlife surveys should continue to be conducted on a regular basis. Monitoring of invasive species will continue to be important and management plans should be flexible enough to adapt to changing fish and wildlife concerns (Hellmann et al., 2008).

Increasing temperature under all climate scenarios result in negative impacts for amphibian species inhabiting JBSA due to decreased dissolved oxygen content and impaired water quality. Algal blooms may increase, further depleting dissolved oxygen content and degrading habitat quality (Paerl et al., 2011). Efforts to remove invasive aquatic plants and algae from ponds should be considered and shade trees should be planted around water sources to prevent excessive heating of water (Poff et al., 2002). Rising temperatures are likely to offset positive effects of increased precipitation on recharging of karst systems. (Loáiciga et al., 2000). Karst features are important habitats with respect to biodiversity as a number of endemic species inhabit the caves. Monitoring water levels and restricting pumping from aquifers will be important in maintaining this habitat type.

Projected temperature increases for JBSA could favor vectors for diseases such as mosquitoes and ticks (Sűss et al., 2008) Minimization of stagnant water in and around the cantonment areas will help to reduce mosquito related infections. Tick populations in urban settings can be restricted by keeping lawns mowed to prevent overabundance of hosts such as deer and rodents.

When injured or sick wildlife is found, the natural resources staff should be notified immediately. The natural resources staff will evaluate the situation, and determine the best response for the animal and the rest of the base population. The response to each sick or injured animal will be a judgement call by the natural resources staff present. The JBSA CLEO will be contacted if the animal in question is a game species. Removal of deceased animals is conducted by JBSA Pest Management personnel, natural resources staff may assist in this effort if available. If euthanasia is performed, the American Veterinary Medical Association Guidelines on euthanasia must be followed. When possible euthanized animals will be donated to a 501(c)(3), such as, organizations that rehabilitate wildlife.

7.2 Outdoor Recreation and Public Access to Natural Resources

Applicability Statement

This section applies to all USAF installations that maintain an INRMP. The installation is required to implement this element.

Program Overview/Current Management Practices

Outdoor recreation enhances and supports the military mission by improving the mental, physical, and social well-being of JBSA personnel. JBSA offers excellent although limited opportunities for dispersed consumptive and non-consumptive recreational activities due to the development of most JBSA locations. Outdoor recreational activities are allowed only in areas not scheduled for military training and only when

security, natural resources, and safety conditions allow. Activities available vary by location due to the above conditions, refer to Table 7.1 for outdoor recreation activities available at each location and the JBSA Force Support Squadron website (jbsatoday.com) for more information. JBSA locations not listed do not have the natural infrastructure to support outdoor recreation. Recreational off-roading is not authorized at any JBSA location.

Table 7-1. Outdoor Recreation Activities Available per JBSA Location

Activity	JBSA-CTA	JBSA-LAK[1]	JBSA-BUL	JBSA-SAM[1]	JBSA-RND	JBSA-CAN
Walking/hiking trails	✓	✓	✓		✓	✓
Horse riding facilities/trails		✓		✓		
Camping						✓
Firearm range			✓			
Archery range			✓			
Fishing		✓		✓	✓	✓
Hunting			✓			

All hunting and fishing is IAW federal and state laws.
A Texas license is required for hunting and fishing on JBSA.
A U.S. State issued hunter's education certificate is required for all hunting activities regardless of age.
A JBSA hunting permit is required for hunting on JBSA.

Utilization of outdoor recreation opportunities are based on Participant Categories as defined in AFMAN32-7003. These categories are as follows:

- Active Duty Military (includes Reserve on full-time orders and National Guard on active duty (Title 10 status))
- Department of Defense Civilians
- Active Duty Military Dependents and Family Members
- Disabled Veterans
- Military Retirees
- Department of Defense Civilian Retirees
- Employees of Installation Prime Contractors (defined as a contractor under a 5-year or more term contract)
- Civilians enlisted in the National Guard and Reserve that are not on active duty (Title 10 status)
- General Public

Table 7-2. Outdoor Recreation Access Eligibility on JBSA

Eligibility Category*	Walking/ hiking	Horse riding	Camping	Firearm range	Archery range	Fishing	Hunting
Active Duty Military	✓	✓	✓	✓	✓	✓	✓[2]
DoD Civilians	✓	✓	✓	✓	✓	✓	✓[2]
Active Duty Military Dependents and Family Members	✓	✓	✓	✓[1]	✓[1]	✓	✓[2]
Disabled Veterans	✓[1]	✓[1]	✓[1]	✓[3, 4]	✓[3]	✓[1]	✓[1, 5]
Military Retirees	✓	✓	✓	✓	✓	✓	✓[2]
DoD Civilian Retirees	✓	✓	✓	✓	✓	✓	✓[2]
Employees of Installation Prime Contractor	✓[1]	✓[1]	✓[1]	✓[3,4]	✓[3]	✓[1]	✓[1, 5]
Civilians enlisted in National Guard and Reserve not on active duty	✓	✓	✓	✓	✓	✓	✓[2]
General Public	✓[1]	✓[1]	✓[1]	✓[3, 4]	✓[3]	✓[1]	✓[1, 5]

* Access to the installation for the purposes of outdoor recreation may be suspended at the discretion of the Installation Commander for any or all eligibility categories.

[1] Requires DoD sponsor to access the installation.

[2] Each individual participant must possess their own DoD ID card. (DoD ID not required for dependents less than 10 years old.)

[3] Activity is monitored and supervised by JBSA personnel and are therefore open to the general public.

[4] A valid DoD ID card holder may sponsor up to two non-DoD ID card holding civilians for use of the firearm range.

[5] A valid DoD ID card holder may sponsor one non-DoD ID card holding civilians as non-hunting guests.

Public access is restricted on JBSA for security, antiterrorism, and force protection purposes. The unsupervised possession of a weapon on the installation by members of the public may present a risk to military safety and security. Therefore, outdoor recreational activities involving the unsupervised use of firearms are limited to those identified in Table 7.2.

Hunting and Fishing Programs

The NRM is responsible for the oversight of hunting and fishing programs, and for inclusion of program goals and objectives in the installation INRMP. NRO conducts wildlife surveys, submits survey data to TPWD for issuance of harvest tags and collects data from harvested animals. FSS coordinates with ASA to schedule areas for hunting activities, registers participants, and provides check in and out services during scheduled hunting days. ASA coordinates schedule and hunting equipment allowed to provide for safety of military personnel and hunting participants.

Currently JBSA-BUL is the only location that supports a hunting program. JBSA-CTA is the only other location to have records for a hunting program. That program was shut down in 2008 citing increasing missions at the location and the inability to carry out the program due to safety restrictions. Other JBSA locations either don't have the natural resources to support a hunting program, are too developed to carry out a hunting program safely or both. All hunting and fishing activities shall be IAW all applicable federal and state laws as well as, JBSA specific hunting and/or fishing regulations. The *Joint Base San Antonio* –

Camp Bullis Hunting Regulations 2019-2020 are available in Appendix B and at https://jbsa.isportsman.net/.

Table 7-3. Current Fee Schedule for JBSA Hunting Program.

Permit	Fee
Non-hunting Guest Pass (Annual)	Free
Scouting Permit (Annual)	$15
Exotic Mammals Permit	$20
General Permit (Annual, excludes WTD)	$50
Dog Hunting Endorsement (Annual, Rabies Vaccine Records Required)	$5
White-tailed Deer Lottery Ticket	$10
Early or Late Season White-tailed Deer Permit	$50

Although no formal fishing program exists at JBSA it is allowed at JBSA-KFA, JBSA-SAM, JBSA-RND and JBSA-CAN. Other locations either do not support permanent water suitable for fishing or access is limited due to mission requirements and safety (surface danger zones associated with ranges). The Texas Department of State Health Services (DSHS) issues advisories for the consumption of fish at waterbodies where consumption of fish may pose a threat to human health. Persons participating in fishing are encouraged to visit the DSHS website before consuming any species caught on the installation (https://www.dshs.texas.gov/seafood/TFCAV.aspx).

Few if any changes are expected to occur in outdoor recreation and public access to natural resources on JBSA in response to climate change. Hunting and fishing opportunities will need to be assessed on a regular basis. Opportunities will be based off of the health of fish and wildlife communities. Feral hog hunting is likely to persist as their populations will probably not decline due to climate change.

7.3 Conservation Law Enforcement

Applicability Statement

This section applies to all USAF installations that maintain an INRMP. The installation **IS** required to implement this element.

Program Overview/Current Management Practices

Conservation law enforcement officers (CLEOs) are responsible for enforcing all natural resources management laws pursuant to 16 U.S.C §670e-1 and cultural resources management laws pursuant to 16 U.S.C §470ff on JBSA. CLEOs draw their powers, when delegated, from the installation commander's authority to protect or secure a facility pursuant to 50 U.S.C.§ 797 (Reference (d)). CLEOs on JBSA operate IAW a Conservation Law Enforcement Plan (CLEP) approved by the installation commander per his/her statutory requirement and discretion.

Although various references were found regarding CLEO and enforcement capabilities in INRMPs prior to joint basing (LAFB 2007, Fort Sam Houston 2007) no formal plan was created until 2015. Two JBSA CLEO positions are assigned to the 502d ABW, 502d Civil Engineer Group (CEG), 802d Civil Engineer Squadron, and reports to the NRM. CLEOs are required to complete Land Management Police Training at the Federal Law Enforcement Training Center or, alternatively, have been commissioned as a fish and wildlife conservation office in the state where the installation is located. Additionally CLEOs have a requirement to complete 40 hours of conservation law enforcement specific training annually and must complete all required training and qualification for firearms through 502d Security Forces Squadron.

Conservation law enforcement activities include, but are not limited to, patrols, outreach and education, hunting & fishing compliance checks, investigations, nuisance animal calls, and endangered species, endangered species habitat, and MBTA enforcement.

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

Applicability Statement

This section applies to USAF installations that have threatened and endangered species on USAF property. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

Threatened and endangered species inventories have been completed on all JBSA locations through formal wildlife surveys and natural resources personnel observations. For list of federally and state listed threatened and endangered species recorded on the installation refer to Section 2.3.4. Currently JBSA monitors GCWA populations annually across JBSA-BUL through point count surveys, territory monitoring, nesting searching and banding. The three endangered karst invertebrates are also monitored through annual in cave surveys. Reports are submitted annually to USFWS regarding all T&E species surveys.

Current Biological Opinions

JBSA currently only has one Biological Opinion (BO): The Effects of JBSA Water Draw on Listed Species of the Edwards Aquifer (Consultation No. 02ETAU00-2013-F-0060). The BO addresses effects of JBSA water withdrawal from the Edwards Aquifer on the following species: Texas wild-rice, Peck's cave amphipod, Comal Springs dryopid beetle, Comal Springs riffle beetle, San Marcos gambusia, fountain darter, Texas blind salamander and San Marcos salamander. The following are terms and conditions (non-discretionary) items that JBSA must comply with in order to be exempt from the prohibitions of Section 9 of the ESA:

1. JBSA shall implement all of the conservation measures described in Section 2 of this biological opinion including curtailing groundwater withdrawal according to its critical period management plan.
2. Monitor JBSA pumping and include in the annual report to USFWS. Report shall provide daily withdrawals by water well (in either gallons per day or cubic feet per day) and daily critical period designation.
3. Design and implement a voluntary program or partner with Edwards Aquifer Authority, San Antonio Water Systems, and/or other organization to educate and assist employees in achieving water conservation on base and off base at personal residences. Such program activities could include education and outreach on water conservation practices such as retrofitting with low flow toilets and shower heads or using xeriscaping as an alternative to water intensive landscaping practices.
4. JBSA shall submit annual reports informing USFWS of its progress implementing the Reasonable and Prudent Measures and Terms and Conditions set forth in this BO. The report shall include a description of the activities that have been implemented in the prior calendar year, an evaluation of the effectiveness of those activities, and notify USFWS of any discretionary conservation recommendations which have been implemented. The reports shall include total daily, monthly, and annual (based on calendar year) groundwater withdrawal in kilogallons (kgal) for each JBSA well drawing from the Edwards Aquifer. Annual reports shall be sent to USFWS and are due 1 June of each year (for the previous calendar year) covered by this biological opinion.

Per the BO JBSA follows the Critical Period Management Plan for Edwards Aquifer Water Use at Joint Base San Antonio (hereafter CPMP) to reduce water usage during drought (JBSA 2013). Refer to Appendix B for the CPMP.

A JBSA water conservation brochure was developed in 2017 that details why the Edwards Aquifer is important to the military mission and greater San Antonio area; critical period trigger levels and reduction requirements; stage restrictions; and resources for those who wish to learn more. This brochure has been handed out and discussed with base personnel at annual outreach events such as Earthweek and Basura Bash. Additionally environmental personnel also handed out materials available from the EAA, SARA, and the Texas Water Development Board that cover a range of topics from best management practices for water conservation to riparian area conservation.

Threatened and Endangered Species Management

GCWA

JBSA-BUL has conducted annual surveys for the presence of GCWAs since 1990; conducted point count surveys since 1991; and territory monitoring since 1998. Point count surveys were designed to provide density estimates of singing males per hectare (ha) and show the population trend over time. From 1991-2015, point counts were conducted along transects only through known warbler habitat, which showed an increasing density during that time. The estimates during this time were biased as the protocol did not account for low quality habitat. The protocol was also inconsistent with surveys conducted at other locations (e.g. Fort Hood, Balcones Canyonlands National Wildlife Refuge). In 2016, in an effort to reduce this bias and create comparable data with other locations, the transects were replaced with a grid of points spaced 400 meters apart. In an effort to continue previous density estimates and established trend line, data from points near the old transect lines are used to compare with the previous survey protocols (Figure 7-1). Only grid points are used to determine density estimates in Table 7-4.

During the 2019 GCWA point count surveys there were 215 detections of male GCWAs. Additionally, 123 incidental detections (111 adult males, 6 adult, and 6 fledglings of unknown sex) were made during other monitoring activities (e.g. other individuals detected during territory monitoring, initial searching for GCWAs and color banded bird resighting efforts).

The focal sites shown in the figure and tables below are areas that have long been the best habitat on JBSA-BUL due to the maturity of the vegetation in those areas. The installation density takes into account the focal sites as well as other areas of JBSA-BUL that support GCWAs.

Figure 7-1. Male GCWA Density (males/ha) on JBSA-BUL (1991 to 2019)

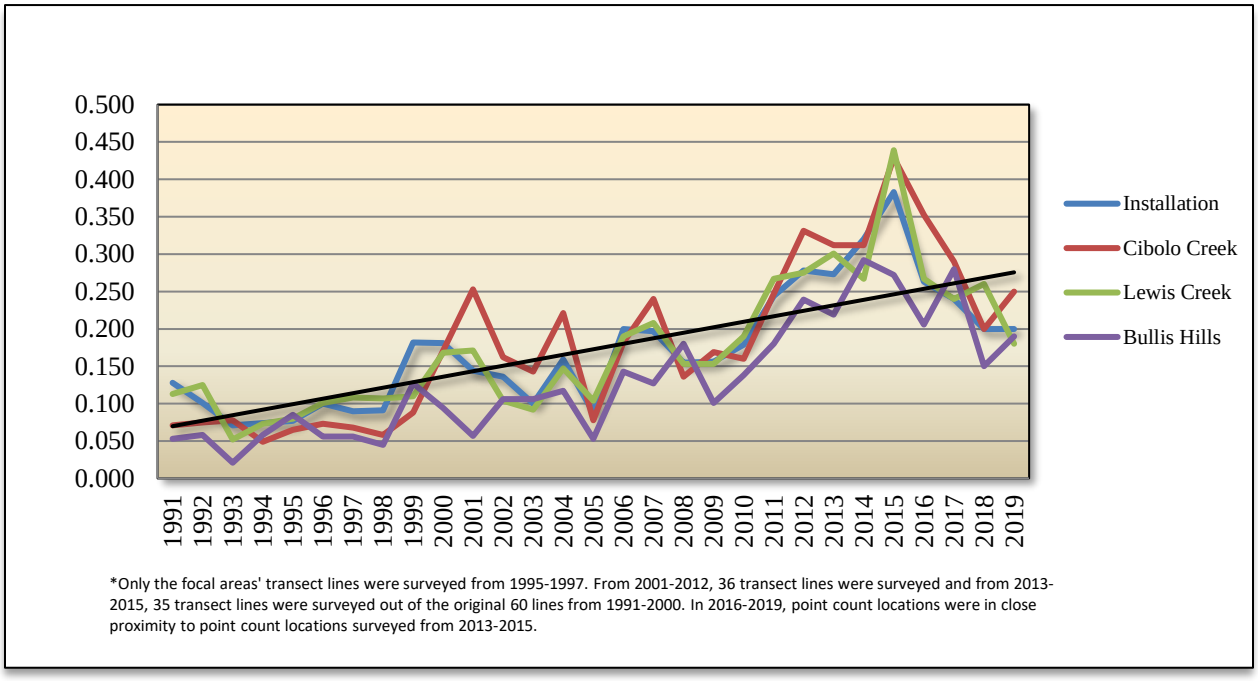


Figure 7-1 only accounts for point count locations in proximity to previous transect lines for comparison with previous data. Table 7-4 is estimated densities based on all surveyed point count locations.

Table 7-4. Estimated male GCWA Density (males/ha) on JBSA-BUL (2017-2019)

Study Site	Male GCWA density per year (males/hectare)		
	2017	2018	2019
Cibolo Creek	0.25 (0.16-0.38)	0.25 (0.08-0.83)	0.16 (0.11-0.23)
Lewis Creek	0.23 (0.13-0.40)	0.18 (0.04-0.82)	0.19 (1.03-1.02
Bullis Hills	0.30 (0.14-0.61)	0.09 (0.15-0.39)	0.24 (0.15-0.40)
Installation	0.21 (0.16-0.27)	0.25 (0.15-0.39)	0.24 (0.15-0.40)

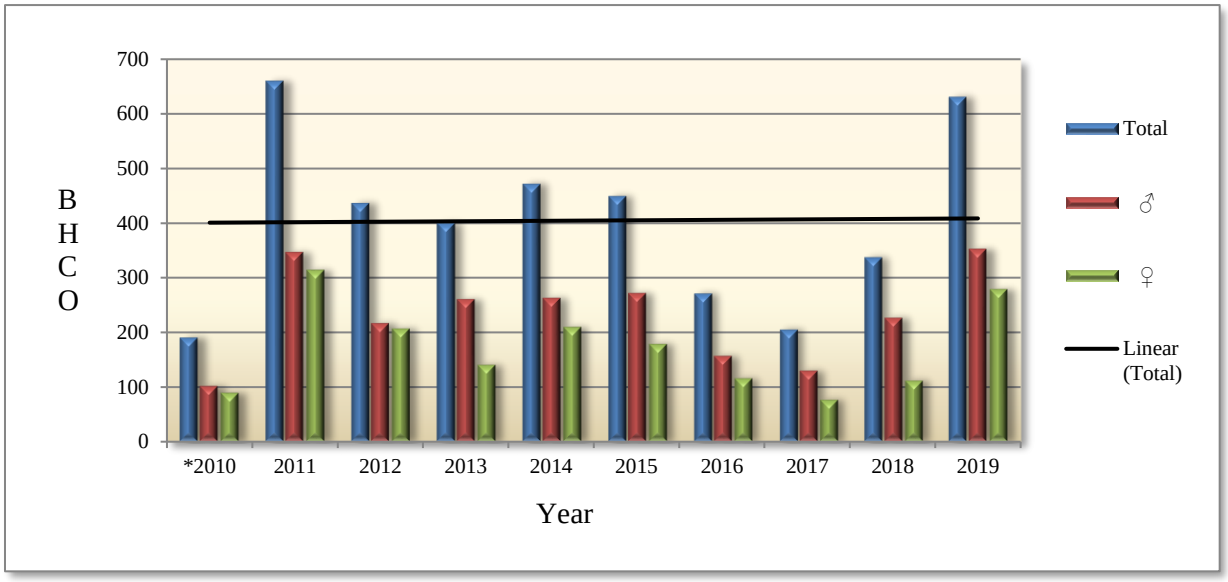
In 2019, 97 territories were monitored, overall pairing success was 79% and territory success was 57%. Pairing success is defined as a female present in a male territory for greater than four weeks. A territory is deemed successful if at least one fledgling was produced from the territory of a paired male.

Table 7-5. GCWA territory success

Study Site	Monitored territories	Territories with females	Pairing success	Territories with young	Territory success
Cibolo Creek	35	29	83%	21	72%
Lewis Creek	30	24	80%	10	42%
Bullis Hills	32	24	75%	13	54%
Total	97	77	79%	44	57%

Brown-headed cowbirds (*Molothrus ater*, BHCO) have been managed near GCWA and black-capped vireo (*Vireo atricapilla*, delisted) habitat for a decade. BHCO are brood parasites of songbirds, including GCWA. BHCO females lay their eggs in GCWA nest and rely on the GCWA adults to raise their offspring at the detriment of the GCWA offspring. BHCO trapping started in 2010 with six traps and was expanded the next year to 10 traps, which is continued today.

Figure 7-2. Number of BHCO Individuals Removed on JBSA-BUL (2010-2019)



* - Only six traps

Karst Invertebrate Management

Initial karst invertebrate surveys were conducted by the U.S. Army in 1988 in response to the listing of several karst invertebrates in Travis and Williamson Counties, TX. At that time five caves were known to exist on JBSA-BUL. The first biological collections of karst invertebrates was initiated in 1994 following the publication by USFWS of the Endangered Karst Invertebrates Recovery Plan (Travis and Williamson Counties Texas). In addition to biological collections work commenced on a karst terrain surveys to identify potential caves or karst features within the boundaries of JBSA-BUL. These surveys and subsequent excavations resulted in the identification of 1494 karst features and 111 caves.

In 2000 USFWS listed nine karst invertebrates that occur in Bexar County, TX as endangered. Three of these species, Madla's Cave meshweaver, *R. exilis*, and *R. infernalis* (hereafter listed karst invertebrates), were recorded from caves and karst features at JBSA-BUL. The first management plan for the conservation and management of karst species was completed in 1999 (Veni and Reddell). The management plan was updated in 2002 and was based on information and recommendations in the designation of critical habitat for the Bexar County karst species (USFWS 2002). KPAs were established at all caves containing listed karst species. The KPAs are 90 ac circles with the cave at the center. NRO staff are currently working with the National Cave and Karst Research Institute to reassess the existing KPAs to take into account current karst preserve design recommendation (USFWS 2012) where consistent with the military mission. All listed karst invertebrate species that occur on JBSA-BUL have critical habitat designated off of the installation. Critical habitat for *R. infernalis* and *R. exilis* occur adjacent to the installation. Current restrictions in KPA is detailed in Section 2.4.

Currently listed karst invertebrates have been recorded at 32 caves and karst features, with a KPA established for each. With the exception of 2018 and 2019, annual surveys have been conducted at each listed karst invertebrate cave at least once per year. Surveys were not complete in 2018 and 2019 due to safety issues related to accessing the caves to conduct the surveys.

RIFA are an invasive species that may directly compete with or directly prey upon karst invertebrates and cave crickets, which are important sources of nutrient input for karst invertebrates (Reddell 1993). JBSA-BUL began monitoring and control of RIFA within a 50 m radius of listed karst species locations in 2003. Inspections are done at each location monthly or bimonthly and control measures are completed using a high pressure hot water treatment and small amounts of soap. Treatments are conducted at least biannually, once in spring and once in fall. Additional treatments are conducted if 80 RIFA mounds are identified during monthly inspections or a mound is identified within 10 m of the cave or karst feature entrance. Current USFWS protocols recommend RIFA inspections and treatments within the 80 m of the cave or karst feature entrance (USFWS 2014), however, per existing consultation we have continued using the 50 m radius for inspections. RIFA inspection and control is carried out at 75 caves and karst features that support federally or state listed species or endemic species. During the monthly or bimonthly surveys NRO personnel also document vegetation condition in the area, to include invasive species identified, and condition of existing cave gates.

The NRO conducts cave cricket exit counts in accordance with USFWS recommendations (USFWS 2014). TAMU Natural Resources Institute began observing cave cricket exits with a modified game camera at listed karst invertebrate caves in the fall of 2019 to determine feasibility using the camera in lieu of in person observation. The camera was deployed two nights at each cave one night without an observer and one night with an observer. The camera was set to take video in one minute increments for two hours beginning at sunset. Videos were then reviewed on a computer and the crickets tallied. Crickets were counted by age class nymph (<5 mm), subadult (5-12 mm), and adult (>12 mm). The initial data and results are promising and the same system is being used for the cricket counts in spring 2020, for further analysis.

The NRO maintains seven cave gates and one fence at listed karst invertebrate caves. These gates and fence prevent unauthorized personnel from entering these caves and were installed due to their location relative to training activities, high traffic areas, roads and perimeter fence or if the entrance is deemed to be a hazard or danger to personnel. Fourteen additional caves are gated for state listed species, endemic species and cultural remains. These gates are inspected on a regular basis and maintenance requirements are accomplished as needed.

Vegetation in the KPAs is preserved through NRO involvement in the project planning process and EIAP reviews. Additionally the NRO works with the WSM lead and ITAM program manager to coordinate management activities that could negatively impact listed karst invertebrates.

Management actions taken to protect threatened and endangered species will be influenced by the speed at which the climate changes, the nature of the climatic changes and the ability of the species to respond to those changes. Our understanding of species' response to changing climate is not yet sufficient to be able to predict how an individual species will respond. In addition, the response of sub-populations of a single species may vary. Species can exhibit behavioral, plastic and genetic response to environmental conditions. Genetic variation within a species has been associated with exposure to environmental conditions, however, populations may not be able to undergo selection for preferred traits if environmental conditions change rapidly (Hoffmann & Sgrò, 2011). Behavioral changes, such as host-plant or food source switching, and plastic responses, such as changes in body size associated with longer growing seasons, have already been observed (Iwamura et al., 2013; Ozgul et al., 2010).

Many current management activities are appropriate for increasing resilience or facilitating adaptation to climate change. An ecosystem approach that prioritizes functional diversity, maintenance of habitat, habitat variability and connectivity can help support genetic diversity that may be important for adaptation, and can help species migrate to more favorable habitats. However, when approaching the uncertainty that is

inherent with managing species under changing environmental conditions, additional analysis and planning is required.

Research into actionable science used for biodiversity conservation in changing conditions has developed several key principles. Historic patterns used for management decisions are likely to be insufficient for future management challenges (Bierbaum et al., 2013). Proactive approaches that anticipate change can help extend the period over which species can adapt to changing climate and avoid catastrophic declines associated with stochastic events that act on an already stressed ecosystem.

7.5 Water Resource Protection

Applicability Statement

This section applies to USAF installations that have water resources. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

Water resources management must consider land and water management actions at JBSA in terms of impacts on the quality and quantity of groundwater and surface water within the watershed. Groundwater and surface waters are discussed in Section 2.2.4 Hydrology.

Groundwater

JBSA's missions and the economic sustainability of the greater San Antonio area are largely dependent on the Edwards Aquifer and as such are dependent upon effective water conservation measures that minimize water withdrawal from the aquifer. JBSA has implemented conservation measures to reduce, recycle, and reuse water resources at all locations. Approximately 4,000 ac of JBSA-BUL are in the Edwards Aquifer Recharge Zone, development in these areas is avoided to ensure protection of that resource.

There are several federally listed species that are dependent on the Edwards Aquifer, either they inhabit the aquifer itself or are dependent on spring flow emanating from it. JBSA completed an Endangered Species Act (ESA) Section 7 Consultation with USFWS that specifies JBSA is restricted to 12,012 ac-ft per year of withdrawal from the Edwards Aquifer. See Section 7.4 Management of Threatened and Endangered Species, Species of Concern, and Habitats for more information.

7.6 Wetland Protection

Applicability Statement

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

Program Overview/Current Management Practices

JBSA, along with the DoD, has a goal of no net loss of wetlands on DoD lands. Wetlands play an important role in the ecosystem as well as improving water quality and flood control. EO 11990 requires all federal agencies to provide leadership in the protection of wetlands in managing federal lands and conducting federal activities and programs affecting land use. The JBSA policy in regards to wetland protection is to avoid undertaking any new construction located in wetlands. Limited variances may be considered if there is no practicable alternative to such construction and the proposed action includes all practicable measures to minimize harm to wetlands which may result from such use.

The approximate location and boundary of wetlands on JBSA have been identified, see Section 2.3.5 for more information. JBSA will maintain and update the wetland boundaries as necessary and will request delineation in the event an activity is proposed in or adjacent to an area previously delineated or surveyed as a wetland. Review of actions will occur during the project planning process, siting process, and the environmental impact analysis process. Existing JBSA GIS database and reports will be used for preliminary planning purposes to determine if a proposed project is in or adjacent to wetlands or floodplains.

Currently there are no existing or pending Section 404 or 401 permits nor any planned wetland restoration or enhancement projects.

Wetland ecosystems at JBSA could be particularly vulnerable to the increase in temperature, which could increase evaporation rates in these areas. Wetland systems are vulnerable to changes in quantity and quality of their water supply, and it is expected that, in general, climate change will have a pronounced effect on wetlands through alterations in hydrological regimes (Erwin, 2009). There should be no development, construction, or disturbance in designated wetlands. Regular mowing and vegetation maintenance should be minimized.

JBSA maintains and updates the wetlands boundaries as necessary, making the protection of wetlands a component of both operations and natural resource management programs at the installation.

7.7 Grounds Maintenance

Applicability Statement

This section applies to USAF installations that perform ground maintenance activities that could impact natural resources. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

Grounds on JBSA are managed in a manner that improves landscape quality, protects cultural resources, and minimizes impacts to training operations. JBSA employs beneficial landscaping practices as specified in the Presidential Memorandum on Environmentally and Economically Beneficial Landscape Practices on Federal Landscaped Grounds (60 FR 40837). This memorandum specifically requires federal facilities, to the extent practicable, to:

- Use regionally native plants;
- Use construction practices that minimize adverse effects on the natural habitat;
- Reduce fertilizer and pesticide use;
- Use water-efficient practices; and
- Create outdoor demonstration areas to promote awareness of the environmental and economic benefits of beneficial landscaping.

Implementation of these requirements, in additional to the JBSA CPMP, support JBSA's continued efforts to reduce water usage on the installation per existing consultation and DoD and AF policy.

The JBSA NRM is responsible for reviewing and approving landscape plans associated with construction through EIAP reviews. The NRO maintains a list of preferred and prohibited species for landscaping that is available upon request. Additionally JBSA has six locations listed on the National Register of Historic Places (NRHP) as National Landmark Districts (NLD). These areas are managed by the Cultural Resources Office (CRO). Installation and maintenance of landscapes in and adjacent to these areas must be approved by the CRO.

A consolidated urban forestry management program currently does not exist for JBSA, however, a vegetation management plan (VMP) is currently being drafted for JBSA-RND to support BASH efforts and maintain the Randolph Field Historic District. The VMP will be expanded to cover the whole of JBSA. It will include needed changes to support military missions and will take into account preservation of cultural and natural resources.

Grounds maintenance may also be affected by climate change. As warmer temperatures increase evaporation and water use by plants, soils are likely to continue to become drier. Average rainfall is likely to decrease during winter, spring, and summer. Increased evaporation and decreased rainfall are both likely to reduce the average flow of rivers and streams. Drier soils will increase the need for irrigation, but sufficient water might not be available (EPA, 2016)

7.8 Forest Management

Applicability Statement

This section applies to USAF installations that maintain forested land on USAF property. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

JBSA-BUL has approximately 16,000 ac classified as forests according to the U.S. National Vegetation Classification system (CSU 2019). However the majority of those forests and adjacent woodlands are breeding habitat for GCWA. About 1,200 ac of the total forested acreage is riparian forests located in floodplains. Due to T&E species habitat, floodplains and unknown economic viability of timber harvest at JBSA no commercial forestry exists on the installation. Other small forested areas associated with riparian areas are found at JBSA-CTA, JBSA-LAK, and JBSA-SAM.

Forests at JBSA, due to the high oak component, are susceptible to oak wilt. Oak wilt is an infectious disease caused by the fungus *Ceratocystis fagacearum* which has been observed in some areas of JBSA and has been successfully treated. The Texas A&M Forest Service suggest the following best management practices (BMP) to prevent the spread of oak wilt include:

- Avoid pruning or wounding oaks between 1 Feb and 1 Jul.
- Sterilize/sanitize all pruning equipment between trees using denature methyl alcohol, isopropyl alcohol, or a general purpose household disinfectant.
- Immediately paint all wounds to prevent contact with beetles that spread oak wilt. Wounds should be painted regardless of the time of year with commercial wound dressing or latex paint.
- Do not transport or buy unseasoned firewood as fungal mats may form on unseasoned red oak firewood infected with the fungus making it possible to spread to uninfected areas.
- Promptly remove and either burn or bury all red oaks that are dying or have been recently killed by oak wilt.

The forested areas of JBSA-BUL are surveyed regularly for the presence of GCWA. The survey crew has instructions to GPS and report several things including oak wilt. If found, oak wilt treatment will follow Texas A&M Forest Service guidance on treating and preventing oak wilt spread. This includes isolation of affected trees from other trees by mechanical means such as trenching and removal of affected trees.

In general, woodland areas are susceptible to climate change. There is a temperature below which the equilibrium state of the ecosystem appears constant, but above which the equilibrium of this vegetation cover declines steadily. The canopy exerts a profound influence on neighboring vegetation, soils,

subcanopy microclimate, wildlife, and insect populations. High densities of woodland species (>25% canopy cover) suppress grass growth and may reduce understory species diversity (Texas Natural Resources Server, n.d.)

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 utilize prescribed burns as a land management tool. This section **IS** applicable to this installation.

Program Overview/Current Management Practices

The first JBSA-wide Wildland Fire Management Plan that address wildland fire at all JBSA locations is expected to be completed by December 2020. Currently only a JBSA-BUL WFMP exists, see Section 15 Associated Plans. The new WFMP will detail roles and responsibilities related to wildland fire activities on the installation. JBSA Fire and Emergency Services (FES) is the OPR for suppression of wildfires on JBSA. FES maintains mutual aid agreements with surrounding fire departments and may request support from the WSM and NRO, as needed. The WSM is the OPR for hazardous fuels management on JBSA. The WSM lead plans and schedules mechanical fuels treatments and prescribed fires with the NRM and mission partners, to ensure treatments meet mission requirements and do not impact training activities. NRO personnel participating in wildland fire activities must meet National Wildfire Coordinating Group (NWCG) qualification and physical fitness standards commensurate with their expected level of involvement.

Many JBSA locations are largely developed and/or are intensively managed for operational purposes with little undeveloped area. With the exception of prescribed fires for airshow pyrotechnic displays the NRO has no records of wildland fires occurring at JBSA-CTA, JBSA-LAK, JBSA-KFA, JBSA-SAM, JBSA-RND, JBSA-SAF and JBSA-CAN. JBSA-BUL is mostly undeveloped land and due to emphasis on field training, it is the location with the most frequent wildfires. Based on the National Fire Incident Reporting System (NFRIS) data, JBSA-BUL experienced on average 4.86 wildfires per year.

Due to the highest incidence of wildfire ignition and the presence of listed and endemic species, wildfires at JBSA-BUL have the highest implications for natural resources across all JBSA locations. There is little developed area at JBSA-BUL outside of the cantonment. Those facilities and training sites that exist in the TAs and the missions that use them are more likely to be threatened or impacted by wildfire due to limited vegetation maintenance around the areas and the prevalence of fuels. JBSA-CTA also has a higher percentage of undeveloped area, however, no records of fire exist for that location.

A PFP has been developed for JBSA-BUL and a PFP for JBSA-CTA will be completed by spring 2021. Both plans will be IAW NWCG PMS-484 Interagency Prescribed Fire Planning and Implementation Procedures Guide. PFPs must be approved by Type 2 Burn Boss IAW NWCG Standards for Wildland Fire Position Qualification. Prescribed burns will only be conducted under conditions needed to meet management objectives as described in the PFP and IAW existing ESA Section 7 Consultation.

Climate change models suggest that wildfire frequency and intensity are likely to increase during most of the fire season throughout JBSA, but to decrease in other parts of the year (CSU 2019). The effect will likely be limited to JBSA-BUL and JBSA-CTA due to unmanaged vegetation and probable ignition sources.

For more specific information regarding wildland fire management refer to the JBSA WFMP and JBSA Prescribed Fire Plans.

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 this installation.

Program Overview/Current Management Practices

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 this installation.

Program Overview/Current Management Practices

Pest management on JBSA is conducted according to the JBSA IPMP. The primary objective of pest management program is to incorporate continuous monitoring, record-keeping, and communication to prevent pests and disease vectors form causing unacceptable damage to operations, people, property, material, or the environment. Primary responsibility for the IPMP is the JBSA Pest Management shop. The NRM works with Pest Management personnel to best meet the needs of the mission, pest management, the protection of natural resources, and to ensure compliance with the INRMP.

Several invasive and/or noxious species are present at one or more JBSA locations. Some of these species have the potential to affect populations of desirable native species or the ecosystem as a whole. Notable non-native or invasive species that occur on JBSA include Chinese tallow (*Triadica sebifera*), Johnson grass (*Sorghum halepense*), King Ranch bluestem (*Bothriochola ischaemum*), Chinaberry *(Melia azedarach*), bamboo (*Bambuseae spp.*), privet (*Ligustrum spp.*), RIFA, feral hogs, feral cats, European starlings, Mediterranean house gecko (*Hemidactylus turcicus*), and armored catfishes (*Hypostomus plecostomus*). For a full list of species recorded on the installation refer to the JBSA species list in Appendix B. These species can out-compete native species and have known negative impacts on native or T&E species. Specific management techniques can be employed to reduce the presence of these invasive species on JBSA including routine surveys of the installation to detect invasive species, landscape management, selective thinning, prescribed burning, trapping and hunting. If management of species is being accomplished by other JBSA organizations, natural resources staff should be consulted for applicable management techniques, as well as, direct and indirect effects to protected species and applicable laws, regulations and permits. Uncoordinated or unapproved treatments may affect protected species and could result in fines and penalties. By decreasing the abundance and impact or invasive species, the habitat available for native and beneficial species is anticipated to increase.

Feral hogs are the most managed invasive species on the installation. They are a combination of domestic stock that have escaped from captivity and Eurasian wild boar originally released for hunting purposes. Feral hogs are resilient and highly adaptable to new habitats. They root up soil and trample vegetation during feeding and wallowing activities, causing habitat destruction and alteration. Feral hogs rooting and wallowing behaviors increase soil erosion, negatively impact water quality and have also been known to prey on small vertebrate animals and the eggs of ground nesting birds. (Sanders et al., 2020). Feral hogs

management is administered by the NRO through a cooperative agreement and the JBSA-BUL hunting program.

JBSA manages feral dog and cat populations following the guidelines provided in the Armed Forces Pest Management Board Technical Guide No. 37 Integrated Management of Stray Animals on Military Installations. Except in extreme or emergency situations, all stray dogs and cats are captured using non-lethal methods. Once caught, the animals are transferred to an offsite animal control center. In addition to capturing feral animals, JBSA works to educate the on base population on animal control and encourages spaying and neutering pets. Additionally, the NRM staff educates base personnel and residents on the importance of reducing attractants for stray animals and wildlife species to limit human/animal interactions. Feeding of wildlife and feral and stray animals is strictly prohibited on JBSA.

Wildlife also can be a significant threat to safety of pilots training at JBSA-KFA, JBSA-RND and JBSA-SAF. Habitat management is the preferred method of reducing bird populations and associated risk at these locations. Harassment, depredation and changes to flight operations can also be implemented to minimize BASH risks. For more detailed information on BASH refer to Section 7.12.

Projected temperature increases for JBSA could favor vectors for diseases such as mosquitoes and ticks (Süss et al., 2008). Minimization of stagnant water in and around the cantonment area will help to reduce mosquito related infections. Tick populations in urban settings can be restricted by keeping lawns mowed to prevent overabundance of hosts such as deer and rodents.

7.12 Bird/Wildlife Aircraft Strike Hazard (BASH)

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 this installation.

Program Overview/Current Management Practices

The JBSA BASH Program uses U.S. Air Force guidance in AFI 91-212 and the JBSA BASH Plan. The JBSA BASH Plan sets forth procedures and responsibilities to be followed to minimize aircraft exposure to wildlife hazards and reduce the number of bird/wildlife strikes at or near JBSA locations. The JBSA BASH Plan supports a common program for two distinctive missions located primarily at JBSA-RND/SAF and at JBSA-KFA. The participation of many organizations is required to implement and support the BASH Program—some organizations support both missions while others support their particular location.

For program development and oversight, two BASH Program Managers are designated to support these missions at their respective locations as well as the overall installation BASH program. Both programs maintain an Interservice Agreement with U.S. Department of Agriculture/Animal and Plant Health Inspection Service-Wildlife Services (USDA/APHIS-WS) Wildlife Biologist trained in airport wildlife hazard mitigation. Two Bird/wildlife Hazard Working Groups are co-chaired by their respective operational Wing Vice Commanders and the Executive Agents. Bird/wildlife Hazard Working Groups meet at least twice annually to prioritize and implement BASH projects and coordinate/evaluate installation improvement projects with respect to wildlife hazard mitigation.

Airfield areas are artificially maintained environments designed to provide for the safe launch and recovery of aircraft by limiting habitat and attractiveness to bird and wildlife species. There are four runways, a Combat Assault Landings Strip, four helipads, and numerous landing zones across JBSA that are considered airfield facilities. Nearly all JBSA air traffic uses the four runways, and only a few missions use other

airfield facilities. Airfield facilities operated and maintained by U.S. Air Force agencies participate in accordance with AFI 91-212 and the JBSA BASH Plan. Airfield facilities operated by non-Air Force agencies are encouraged to participate in the JBSA-KFA (host) program, which offers full installation support for hazard mitigation.

Birds and wildlife have the potential to cause the loss of human life and millions of dollars in damage to aircraft. There has been on average 137 bird/wildlife strikes per year for the last six years, with average annual cost of $1.26 million per year in aircraft damages.

Current issues that affect all airfields are fencing or gate gaps and vegetation management. Larger mammals (e.g. white-tailed deer, coyotes, feral dogs, feral hogs) access the AMA by digging and going under fences or going over fences. Fences should be regularly inspected and maintained to ensure fence and gate gaps are mended or closed off to exclude animals such as canines and feral hogs. Ideally fencing should be eight feet tall and buried at least three feet below ground to deny access to these species per AFI 91-212. Management, or lack thereof, of airfield turf grass has led to broad-leafed weeds encroachment which provides foraging areas for granivorous bird species and insects that attract insectivorous birds. Herbicides and targeted insecticide treatments are occurring at JBSA-RND and are planned for JBSA-KFA to help resolve this issue. Ponding of water in infield areas may also occur after precipitation events.

In addition to the above BASH issues, JBSA-RND has ample roosting and nesting habitat in the base housing and administrative areas between the east and west runways. This area is a NLD that included landscaping features in nomination, as such, the Texas Historical Commission (THC) must be consulted prior to vegetation removal that may have an adverse effect on the district. An inventory completed in this area at JBSA-RND recorded 7,515 individual woody plants (trees & shrubs) consisting of 67 different species between the two runways(NRI 2017) . Breeding bird surveys were completed in the same area resulting in the documentation of 48 species and season densities for each. White-winged dove (*Zenaida asiatica*, WWDO) had the highest densities at 25.0 birds/ha, 55.7 birds/ha, and 31.5 birds/ha for winter, spring and fall, respectively. Models indicated a 4-8% increase in WWDO density for every 10% increase in woody cover (canopy cover) and a 9-20% increase for every 10% increase in tree density (NRI, 2017). JBSA in coordination with the 12 FTW is completing a vegetation management plan and associated environmental assessment that will be the basis of consultation with the THC.

JBSA-KFA is located 4.5 miles from an active landfill (Covel Gardens) located adjacent to the southern fence line of JBSA-CTA. Birds located in San Antonio have been flying over JBSA-KFA to forage at the landfill. 502 ABW/SEF and USDA-WS have coordinated with the City of San Antonio to remove nesting habitat for cattle egrets along Elmendorf Lake Park and harassing individuals still at the location. USDA-WS are also working with landfill personnel on dispersal methods and other mitigation efforts.

The NRM is the principal officer listed on the depredation permit issued to JBSA by the USFWS Migratory Bird Permit Office (MBPO). The NRM is responsible for designating subpermitees in accordance with the permit and contacting the MBPO to update the list as necessary. The NRM is also responsible for reporting strike damage and take of migratory birds to the MBPO annually. The JBSA CLEO is available to conduct mammal depredations when USDA personnel are unavailable and will make appropriate notifications to Texas game wardens before activities commence.

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 this installation.

Program Overview/Current Management Practices

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 this installation.

Program Overview/Current Management Practices

The primary goal of cultural resources management at JBSA is to support mission readiness through compliance. Proper management of these resources is compliant with legislation governing historic properties and cultural sites. JBSA, its mission partners and tenants are required by law to consider the effects of its actions on historic properties. Mandating legislation includes the Antiquities Act of 1906, the Historic Sites Act of 1935, the National Historic Preservation Act (NHPA) of 1966 as amended, 36 CFR Part 800, the Archaeological and Historical Preservation Act of 1974, the Archaeological Resources Protection Act (ARPA) of 1979, the NEPA of 1969, the Native American Graves and Repatriation Act (NAGPRA) of 1990, the American Indian Religious Freedom Act (AIRFA), and AFMAN 32-7003, among others.

JBSA's ICRMP is a guide for cultural resources impact analysis review, cultural resources standard operating procedures and compliance achievement, including scheduling, contracting and funding. This plan is formulated as part of JBSA's compliance with the mandate for consideration of historic properties, outlines goals and objectives of the program, aimed directly at fulfilling JBSA's responsibilities to inventory and evaluate the historic properties under its jurisdiction. Like the INRMP, the ICRMP is updated annually (See Section 15.0 Associated Plans Tab 4).

INRMP activities are subject to Section 106 review and close coordination between the NRO and CRO occurs to avoid impacts to cultural resources, especially for fuel management, erosion control, and invasive species projects. The CRO also reports observations of impacts of plants or wildlife on historic properties, such as invasive plants species contributing to the degradation of a historic property.

The WSM and NRO coordinates with Cultural Resources through the submission of projects through the EIAP, which includes the annual burn map, so that Cultural Resources can identify resources and areas that need to be protected from fire and heavy equipment. Maps showing areas of cultural concern are included in the burn packets that the burn bosses and incident commanders use when a fire occurs in the area. For areas of particular concern, site visits may be coordinated between the WSM and CRO.

7.15 Public Outreach

Applicability Statement

This section applies to all USAF installations that maintain an INRMP. The installation is required to implement this element.

Program Overview/Current Management Practices

Public outreach is a critical component of natural resources management at JBSA due to its size and the various missions' requirements its supports. In support of natural resources management the NRO:

- Participates at in-person public outreach events each year including Basura Bash, Earth Week, and the Rod-N-Gun Recreation Center's Outdoor Expo.
- Submit articles to JBSA Public Affairs Office (PAO) for distribution in the base paper on migratory birds, endangered species, invasive species, water conservation and prescribed fire.
- Contributes to JBSA Environmental Newsletter
- Distributes information to facility managers on urban wildlife management and BASH BMPs

The NRO office has developed the following to support outreach activities:

- Posters (GCWA, Listed Karst Invertebrates, Feral Hog Management, and Environmental Constraints
- Water Conservation at Joint Base San Antonio brochure
- Natural Resources Management retractable banner
- White-tailed deer fawn flyer

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 this installation.

Program Overview/Current Management Practices

Future impacts to the mission at JBSA linked to climate change could include:

- Increases in temperature and wind velocity leading to unsafe environmental conditions for the launch of current and planned weapons and equipment, resulting in increased maintenance requirements, requirements for new equipment, or decreased launch capacity (DoD, 2014);
- Increased dust generation effecting equipment and visibility (DoD, 2014);
- Increased wind velocities damaging vital mission infrastructure (Sydeman et al., 2014);
- Increased drought potential (Glick et al., 2011);
- Potential loss of future training areas that may be needed in light of a changing geopolitical landscape and base realignment.

In addition to these direct effects, climate change has the potential to disrupt the acquisition and transportation of materials required for the maintenance, construction, and storage of the equipment required for the systems (DoD, 2014).

See Section 2.3 *Ecosystems and the Biotic Environment*, for effects of climate changed on ecosystems.

7.17 Geographic Information Systems (GIS)

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. The installation is required to implement this element.

Program Overview/Current Management Practices

Geographic data (GEODATA) used by the installation for natural resources may be acquired by the use of global positioning system (GPS) to identify physical location of resources on the base. The GPS data is gathered often by the NRO, cooperator, research personnel or contractors. This data may be for internal use to identify the location of resources in the field or may transferred to AFCEC to incorporate into GEODATA they maintain per Spatial Data Standards for Facilities, Infrastructure, and Environment (SDSFIE) standards. GEODATA national data sets often retrieved from government organizations, such as, USFWS, FEMA, Natural Resources Conservation Service (NRCS), and USGS.

8.0 MANAGEMENT GOALS AND OBJECTIVES

The installation 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 resources 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

GOAL 1: MAXIMIZE FUNCTIONALITY OF NATIVE ECOSYSTEMS ON JBSA TO PROVIDE SAFE AND REALISTIC TRAINING/MISSION ENVIRONMENTS.

- OBJECTIVE 1.1: Restore fire to unimproved/undeveloped areas of JBSA.
  - PROJECT 1.1.1: Establish long term vegetation monitoring points to measure land management activity effects.
  - PROJECT 1.1.2: Collect base line data on long term vegetation plots. Collect data after planned land management activities and assess successfulness of activities based on objectives.
  - PROJECT 1.1.3: Conduct prescribed burns to meet prescribed burn plan goals and objectives, consistent with military missions and climactic conditions.
- OBJECTIVE 1.2: Assess impacts of land management activities on natural resources through cooperation with other government entities or NGOs.
- OBJECTIVE 1.3: Establish tree planting standards or desired urban forest condition to support training missions and quality of life, while decreasing maintenance requirements.
  - PROJECT 1.3.1: Develop JBSA wide urban forestry management plan to reduce water usage and maintenance requirements to support JBSA BASH Plan and ICRMP.
  - PROJECT 1.3.2: Conduct bird survey and update tree inventory at JBSA-RND to assess changes in breeding bird populations associated with vegetation removal.

GOAL 2: MANAGE FOR THREATENED AND ENDANAGERED SPECIES, OTHER AT RISK SPECIES AND THEIR HABITATS WHILE MAINTAINING MAXIMUM TRAINING CAPABILITY AND FLEXIBILITY.

- OBJECTIVE 2.1: Develop education and outreach materials for Natural Resources.
  - PROJECT 2.1.1: Develop presentation regarding Edwards Aquifer, water conservation and CPMP at JBSA.
  - PROJECT 2.1.2: Post water conservation presentation on AF The Environmental Awareness Course Hub (TEACH) website for wide dissemination to Unit Environmental Coordinators, Facility Managers, and new employees.
  - PROJECT 2.1.3: Work with JBSA public affairs office (PAO) to disseminate Edwards Aquifer conditions, water restrictions and conservation material across all media platforms.
  - PROJECT 2.1.4: Partner with Edwards Aquifer Authority and the Installation Independent School Districts (ISDs) to provide outreach and education to students at JBSA schools.
  - PROJECT 2.1.5: Partner with JBSA housing office and privatized housing to ensure Water Conservation at Joint Base San Antonio brochures are included in welcome packages.
- OBJECTIVE 2.2: Monitoring of GCWA annually to collect and analyze data on density, reproductive success, and habitat utilization.
  - PROJECT 2.2.1: Conduct annual point count surveys, color banding, nest monitoring, and territory monitoring of GCWA.
  - PROJECT 2.2.2: Conduct BHCO trapping program annually (Mar-May) IAW TPWD guidance.
- OBJECTIVE 2.3: Manage and conserve species of concern that includes federally petitioned, workplan, candidate, and threatened and endangered as well as state species of greatest conservation need.
  - PROJECT 2.3.1: Survey and collect RIFA mound density within a 50 m radius of caves known to support endemic and/or federally or state listed species, on a monthly or bimonthly basis.
  - PROJECT 2.3.2: Treat RIFA mounds twice annually in spring and fall. Also mounds will be treated when 80 mounds are detected within the 50 m radius of the caves or when mounds occur within 10m of the cave entrance.
  - PROJECT 2.3.3: Conduct in-cave biomonitoring of listed karst species.
  - PROJECT 2.3.4: Revegetate 50 m RIFA buffer where consistent with the military mission and land use conditions to reduce RIFA density and associated workload.
  - PROJECT 2.3.5: Contingent on ongoing assessment of RIFA bait stations, assess impacts of toxicant bait on cave cricket populations at caves or karst features not known to support endemic or T&E species.
  - PROJECT 2.3.6: Conduct cave cricket exit counts and/or population estimates utilizing trail cameras.
  - PROJECT 2.3.7: Develop salamander management plan.
  - PROJECT 2.3.8: Research and develop protocols to survey for and to treat Tawny Crazy Ants.
- OBJECTIVE 2.4: Partner with stakeholders and other organizations to research TES and/or species of concern associated with Edwards Aquifer BO.
  - PROJECT 2.4.1: Survey groundwater habitats for federally listed, candidate, and USFWS workplan species.
  - PROJECT 2.4.2: Determine BMPs for existing recharge zone area and recharge features at JBSA-BUL.

GOAL 3: SURVEY, MONITOR, AND REMOVE INVASIVE, FERAL, NON-NATIVE, NUISANCE, AND EXOTIC SPECIES ON JBSA.

- OBJECTIVE 3.1: Manage feral animals, nuisance game species, and other species through monitoring and removal, assessing removal efforts and adjusting management as needed.
  - PROJECT 3.1.1: Trap feral hogs at JBSA to reduce negative impacts to the landscape and military missions.
  - PROJECT 3.1.2: Contingent on ongoing project to assess cattle guards for limiting feral hog movement, install cattle guards and exclusion fencing to aid in feral hog management while not impeding vehicle access.
- OBJECTIVE 3.2: Manage invasive plant species throughout the installation through monitoring and removal/eradication.
  - PROJECT 3.2.1: Develop inventory protocols for invasive plant species specifically for JBSA.
  - PROJECT 3.2.2: Develop management plan with recommendations and BMP's for invasive plant species as needed when found during inventories or surveys.
- OBJECTIVE 3.3: Manage invasive aquatic species at JBSA locations, through surveys, outreach and management activities.
  - PROJECT 3.3.1: Develop and install signage at JBSA waterbodies prohibiting the release of organisms.
  - PROJECT 3.3.2: Develop outreach material for measures to prevent the spread of aquatic invasive species.

GOAL 4: SURVEY, MONITOR, AND MANAGE FOR NON-LISTED SPECIES AND THEIR HABITATS.

- OBJECTIVE 4.1: Conduct surveys for non-game species.
  - PROJECT 4.1.1: Conduct surveys and/or monitoring of JBSA locations to determine presence and abundance of terrestrial and aquatic species of all classifications.
- OBJECTIVE 4.2: Manage state regulated game animal populations and habitats through surveys, habitat enhancement, and outdoor recreation programs.
  - PROJECT 4.2.1: Conduct white-tailed deer surveys annually and coordinate with TPWD on harvest recommendations and tag issuance through the MLDP.
  - PROJECT 4.2.2: Annually coordinate and update JBSA Hunting Regulation with internal stakeholders to ensure quality outdoor experiences for participants.
  - PROJECT 4.2.3: Finalize protocols for and implement WTD browse surveys.
  - PROJECT 4.2.4: Conduct annual Northern bobwhite surveys annually to gage trends in population and response to management activities.
  - PROJECT 4.2.5: Conduct turkey surveys to support harvest recommendations.

9.0 INRMP IMPLEMENTATION, UPDATE, AND REVISION PROCESS

9.1 Natural Resources Management Staffing and Implementation

JBSA's goals, objectives, and projects are primarily carried out as duties and responsibilities of the NRO staff. When possible, other organizations, contractors, and volunteer are utilized to supplement Natural Resources staff efforts. Efforts beyond the capabilities on the installation are carried forward as projects to AFCEC for inclusion in the five-year budget review.

Currently JBSA has seven government positions in natural resources management:

- GS-12 Supervisory Wildlife Biologist (NRM)
- GS-12 Biological Scientist (three)
- GS-11 CLEO/Biological Scientist (two)
- GS-9 Biological Scientist (one)

As of 2020, the NRO has seven government positions. The AF transitioned the fuels management program under AFCEC/CZO through standing up and staffing WSM. The WSM personnel are not JBSA employees, however, since they carry out management activities at JBSA towards achieving the goals and objectives of the INRMP their staffing will be identified also. The WSM is currently staffed by three permanent and four seasonal employees.

The 802 CES/CEIE Environmental Flight is responsible for the planning and implementation of the INRMP. The NRM is responsible for coordination and for tracking implementation of the INRMP. This is accomplished through coordination with stakeholders and annual reviews of the INRMP.

- INRMP implementation includes, but is not limited to, the following:
- Execute all "must fund" projects and activities in accordance with specific timeframes identified in the INRMP
- Ensure a sufficient number of professionally trained natural resources management personnel are available to perform the tasks required by the INRMP
- Review the INRMP annually, update goals and objectives, and coordinate changes with regulators, as appropriate
- Document specific INRMP accomplishments each year

Supporting plans and organizations each have their own authority for budgeting and implementation. The NRM has the responsibility to review, provide input, and recommend changes to plans so they further the goals and objectives of the JBSA INRMP. Overall implementation responsibility remains with the Installation Commander.

9.2 Monitoring INRMP Implementation

The Sikes Act requires each installation with significant natural resources to report annually on the status of its INRMP implementation. Natural resources conservation metrics are used to assess the overall health and trends of each installation's natural resources program, as well as, to identify and correct potential funding and other resource shortfalls. The annual review will serve to review completed projects, evaluate effectiveness, determine funding needs, set goals for the future, and demonstrate the importance of JBSA's INRMP activities in supporting the long-term sustainability of JBSA's military mission.

The NRO evaluates progress and determines future direction for various natural resources activities as needed throughout the year, but INRMP implementation primarily is monitored through the annual review of objectives and projects and Annual Work Plans. Throughout the year, multiple coordination meetings are held within and among the NRO and internal stakeholders, with alterations to management activities as needed based on progress towards desired future conditions. Various species and habitat monitoring programs will provide data to evaluate success in meeting INRMP objectives and accomplishing projects.

9.3 Annual INRMP Review and Update Requirements

The INRMP requires annual review, IAW DoDI 4715.03 and AFMAN 32-7003, to ensure the achievement of mission goals, verify the implementation of projects, and establish any necessary new management requirements. This process involves installation natural resources personnel and external agencies working

in coordination to review the INRMP. If the installation mission or any of its natural resources management issues change significantly after the creation of the original INRMP, a major revision to the INRMP is required. The need to accomplish a major revision is normally determined during the annual review with USFWS and TPWD. The NRM documents the findings of the annual review in an Annual INRMP Review Summary and obtains signatures from the coordinating agencies on review findings. By signing the Annual INRMP Review Summary, the collaborating agency representatives assert concurrence with the findings. If any agency declines to participate in an on-site annual review, the NRM submits the INRMP for review along with the Annual INRMP Review Summary document to the agency via official correspondence and request return correspondence with comments/concurrence.

The USFWS, TPWD and the NRM conduct an Annual INRMP Review Meeting. This meeting may take place in person or virtually with respective representatives for each agency. Individuals may telephone or video call if they cannot attend in person. During this meeting the NRM/Section updates the external stakeholders/parties with the end of the year execution report and coordinates future work plans and any necessary changes to management methods, etc. All parties review the INRMP and begin preliminary collaborative work on updating the INRMP (new policies, procedures, impacts, mitigations, etc.) as applicable.

10.0 ANNUAL WORK PLANS

The INRMP Annual Work Plans are included in this section. These projects are listed by fiscal year, including the current year and four succeeding years. For each project and activity, a specific timeframe for implementation is provided (as applicable), as well as the appropriate funding source and priority for implementation. The work plans provide all the necessary information for building a budget within the USAF framework. Priorities are defined as follows:

- High: The INRMP signatories assert that if the project is not funded the INRMP, is not being implemented and the USAF is non-compliant with the Sikes Act; or that it is specifically tied to an INRMP goal and objective and is part of a “Benefit of the Species” determination necessary for Endangered Species Act (ESA) Sec 4(a)(3)(B)(i) critical habitat exemption.
- Medium: 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: 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 is not directly tied to specific compliance within the proposed year of execution.

Table 10-1. JBSA Five Year Work Plan

	Priority Level	FY2022	FY2023	FY2024	FY2025	FY2026
PROJECT 1.1.1: Establish long term vegetation monitoring points to measure land management activity effects.	Medium	✓	✓	✓	✓	✓
PROJECT 1.1.2: Collect base line data on long term vegetation plots. Collect data after planned land management activities and assess successfulness of activities based on objectives.	Medium	✓	✓	✓	✓	✓
PROJECT 1.1.3: Conduct prescribed burns to meet prescribed burn plan goals and objectives, consistent with military missions and climactic conditions.	Medium	✓	✓	✓	✓	✓
PROJECT 1.3.1: Develop JBSA wide urban forestry management plan to support reduce overall costs and water usage and to support JBSA BASH Plan and ICRMP.	Medium		✓			
PROJECT 1.3.2: Conduct breeding bird survey and white-winged dove movement survey and update tree inventory at JBSA-RND to assess changes in breeding bird populations associated with vegetation removal.	Medium		✓			
PROJECT 2.1.1: Develop presentation regarding Edwards Aquifer, water conservation and CPMP at JBSA.	High	✓				
PROJECT 2.1.2: Post water conservation presentation on AF The Environmental Awareness Course Hub (TEACH) website for wide dissemination to Unit Environmental Coordinators, Facility Managers, and new employees.	High	✓				
PROJECT 2.1.3: Work with JBSA public affairs office (PAO) to disseminate Edwards Aquifer conditions, water restrictions and conservation material across all media platforms.	High	✓				
PROJECT 2.1.4: Partner with Edwards Aquifer Authority and the Installation Independent School Districts (ISDs) to provide outreach and education to students at JBSA schools.	High	✓				
PROJECT 2.1.5: Partner with JBSA housing office and privatized housing to ensure Water Conservation at Joint Base San Antonio brochures are included in welcome packages.	High	✓				
PROJECT 2.2.1: Conduct annual point count surveys, color banding, nest monitoring, and territory monitoring of GCWA.	High	✓	✓	✓	✓	✓

	Priority Level	FY2022	FY2023	FY2024	FY2025	FY2026
PROJECT 2.2.2: Conduct BHCO trapping program annually (Mar-May) IAW TPWD guidance.	High	✓	✓	✓	✓	✓
PROJECT 2.3.1: Survey and collect RIFA mound density within a 50 m radius of caves known to support endemic and/or federally or state listed species, on a monthly or bimonthly basis.	High	✓	✓	✓	✓	✓
PROJECT 2.3.2: Treat RIFA mounds twice annually in spring and fall. Also mounds will be treated when 80 mounds are detected within the 50 m radius of the caves or when mounds occur within 10m of the cave entrance.	High	✓	✓	✓	✓	✓
PROJECT 2.3.3: Conduct in-cave biomonitoring of listed karst species.	Medium	✓	✓	✓	✓	✓
PROJECT 2.3.4: Revegetate 50 m RIFA buffer where consistent with the military mission and land use conditions to reduce RIFA density and associated workload.	Medium	✓	✓	✓	✓	✓
PROJECT 2.3.5: Contingent on ongoing assessment of RIFA bait stations, assess impacts of toxicant bait on cave cricket populations at caves or karst features not known to support endemic or T&E species.	Medium	✓				
PROJECT 2.3.6: Conduct cave cricket exit counts and/or population estimates utilizing trail cameras.	High	✓	✓	✓	✓	✓
PROJECT 2.3.7: Develop salamander management plan.	High	✓				
PROJECT 2.3.8: Research and develop protocols to survey for and to treat Tawny Crazy Ants.	High	✓				
PROJECT 2.4.1: Survey groundwater habitats for federally listed, candidate, and USFWS work plan species.	High	✓				
PROJECT 2.4.2: Determine BMPs for existing recharge zone area and recharge features at JBSA-BUL.	Medium			✓		
PROJECT 3.1.1: Trap feral hogs at JBSA to reduce negative impacts to the landscape and military missions.	High	✓	✓	✓	✓	✓
PROJECT 3.1.2: Contingent on ongoing project to assess cattle guards for limiting feral hog movement, install cattle guards and exclusion fencing to aid in feral hog management while not impeding vehicle access.	Medium	✓	✓			
PROJECT 3.2.1: Develop inventory protocols for invasive plant species at JBSA.	High			✓		

	Priority Level	FY2022	FY2023	FY2024	FY2025	FY2026
PROJECT 3.2.2: Develop management for invasive plant species as needed when found during inventories or surveys.	High	✓	✓	✓	✓	✓
PROJECT 3.3.1: Develop and install signage at JBSA waterbodies prohibiting the release of organisms.	High			✓		
PROJECT 3.3.2: Develop outreach material for measures to prevent the spread of aquatic invasive species.	High		✓			
PROJECT 4.1.1: Conduct surveys of JBSA locations to determine presence and abundance of terrestrial and aquatic species of all classifications.	High		✓	✓	✓	✓
PROJECT 4.2.1: Conduct white-tailed deer surveys annually and coordinate with TPWD on harvest recommendations and tag issuance through the MLDP.	Medium	✓	✓	✓	✓	✓
PROJECT 4.2.2: Annually coordinate and update JBSA Hunting Regulation with internal stakeholders to ensure quality outdoor experiences for participants.	High	✓	✓	✓	✓	✓
PROJECT 4.2.3: Finalize protocols for and implement WTD browse surveys.	Low	✓				
PROJECT 4.2.4: Conduct annual Northern bobwhite surveys annually to gage trends in population and response to management activities.	Medium	✓	✓	✓	✓	✓
PROJECT 4.2.5: Conduct turkey surveys to support harvest recommendations.	Medium	✓	✓	✓	✓	✓

11.0 REFERENCES

11.1 Standard References (Applicable to all USAF installations)

- AFMAN 32-7003, Environmental Conservation
- Sikes Act
- eDASH Natural Resources Program Page
- Natural Resources Playbook
- DoDI 4715.03, Natural Resources Conservation Program

11.2 Installation References

Bierbaum, R., Smith, J. B., Lee, A., Blair, M., Carter, L., Chapin, F. S., and Verduzco, L. 2013. A comprehensive review of climate adaptation in the United States: more than before, but less than needed. Mitigation and Adaptation Strategies for Global Change, 18(3), 361–406. https://doi.org/10.1007/s11027-012-9423-1

CEMML (Colorado State University, Center for Environmental Management Military Lands). 2019. Climate Change Summaries for Incorporation into Installation INRMPS, Joint Base San Antonio.

DoD. 1994. Implementation of Ecosystem Management in the DoD. Memorandum from the Office of the Under Secretary of Defense, Environmental Security. Washington, DC.

DoD. 2005. Biological Assessment, The Effects of Water Draw on the Edwards Aquifer by the Department of Defense Installation in the San Antonio Area.

DoD. 2014. Department of Defense Climate Adaptation Roadmap.

EAA (Edwards Aquifer Authority). 2020. The Edwards Aquifer & the EAA. Accessed online at https://www.edwardsaquifer.org/eaa/history/ on 18 March 2020.

EPA (Environmental Protection Agency). 2016. What Climate Change Means for Texas. Accessed online at www.epa.gov/climatechange on 2 March 2020.

Erwin, K. 2009. Wetlands and global climate change: the role of wetland restoration in a changing world. Wetlands Ecology Management, 17, 71-84. https://doi.org/10.1007/s11273-008-9119-1

Fort Sam Houston. 2007. Fort Sam Houston Integrated Natural Resources Management Plan.

Glick, P., Stein, B. A., & Edelson, N. A. 2011. Scanning the Conservation Horizon. National Wildlife Federation. Washington, D.C.

Griffith, G., S. Bryce, J. Omernik, and A. Rogers. 2007. Ecoregions of Texas. Project Report to Texas Commission on Environmental Quality.

Hellmann, J. J., Byers, J.E., Bierwagen, B.G., and Dukes, J.S. 2008. Five potential consequences of climate change for invasive species. Conservation Biology, 22(3), 534-543. https://doi.org/10.1111/j.1523-1739.2008.00951.x

Hoffmann, A. A., & Sgrò, C. M. 2011. Climate change and evolutionary adaptation. Nature, 470(7335), 479–485. https://doi.org/10.1038/nature09670

IPAUS (Invasive Plant Atlas of the United States). 2020. Accessed online at https://www.invasiveplantatlas.org/distribution.cfm on 26 March 2020.

Iwamura, T., Possingham, H. P., Chadès, I., Minton, C., Murray, N. J., Rogers, D. I., and Fuller, R. A. 2013. Migratory connectivity magnifies the consequences of habitat loss from sea-level rise for shorebird populations. Proceedings. Biological Sciences / The Royal Society, 280(1761), 20130325. https://doi.org/10.1098/rspb.2013.0325

JBSA. 2010. JBSA-Randolph History PDF. Accessed online at https://www.jbsa.mil/Portals/102/Documents/JBSA%20History/Randolph.pdf on 10 March 2020.

JBSA. 2013. Critical Period Management Plan for Edwards Aquifer Water Use at Joint Base San Antonio. https://www.jbsa.mil/Portals/102/Documents/Energy%20Awareness/AFD-130809-013.pdf

JBSA. 2014. Joint Base San Antonio History. https://www.jbsa.mil/Information/JBSA-History-Fact-Sheets/Article-View/Article/598508/joint-base-san-antonio/.

JBSA. 2018. Installation Development Plan Joint Base San Antonio, Texas.

LAFB. 2007. Lackland Air Force Base Integrated Natural Resources Management Plan.

Loáiciga, H. A., Maidment, D. R., & Valdes, J. B. 2000. Climate-change impacts in a regional karst aquifer, Texas, USA. Journal of Hydrology, 227(1–4), 173–194. https://doi.org/10.1016/S0022-1694(99)00179-1

NOAA (National Oceanic and Atmospheric Administration).2017. San Antonio Area Climate Table. Data retrieved on 19 Mar 2020 from https://www.weather.gov/media/ewx/climate/ClimateTable-ewx-SanAntonio.pdf.

NOAA. 2020. National Centers for Environmental Information, Climate at a Glance: City Time Series. Data retrieved on March 19, 2020 from https://www.ncdc.noaa.gov/cag./

NRI. 2017. Feasibility of Avian Management Techniques Aimed to Reduce the Risk of Bird-aircraft Collisions on Joint Base San Antonio-Randolph.

NRI (Texas A&M University Natural Resources Institute, NRI). 2012. Joint Base San Antonio – Camp Bullis Historical Woody Vegetation Analysis

Ozgul, A., Childs, D. Z., Oli, M. K., Armitage, K. B., Blumstein, D. T., Olson, L. E., … Coulson, T. (2010). Coupled dynamics of body mass and population growth in response to environmental change. Nature, 466(7305), 482–485. https://doi.org/10.1038/nature09210

Paerl, H. W., Hall, N. S., & Calandrino, E. S. 2011. Controlling harmful cyanobacterial blooms in a world experiencing anthropogenic and climatic-induced change. Science of the Total Environment, 409(10), 1739–1745. https://doi.org/10.1016/j.scitotenv.2011.02.001

Poff, N. L., Brinson, M. M., & Day, J. W. 2002. Aquatic ecosystems & Global climate change: Potential Impacts on Inland Freshwater and Coastal Wetland Ecosystems in the United States. Prepared for the Pew Center on Global Climate Change, (January), 1–56. https://doi.org/10.1039/b211160h

Pulich, W. M. 1976. The Golden-cheeked Warbler: A bioecological study. Texas Parks and Wildlife Department. Austin, Texas.

Reddell, J.R. 1993. The status and range of endemic arthropods from caves in Bexar County, Texas. A report on a study for the U.S. Fish and Wildlife Service and Texas Parks and Wildlife Department.

SARA (San Antonio River Authority). 2017. Creek Book – A Guide to Healthy Creeks and Rivers. Accessed on 10 Jan 2020 at https://www.sara-tx.org/resources/creek-book-guide-healthy-creeks-and-rivers.

Sanders, H. N., Hewitt, D. G., Perotto-Baldivieso, H. L. et al. 2020. Invasive Wild Pigs as Primary Nest Predators for Wild Turkeys. Sci Rep 10, 2625. https://doi.org/10.1038/s41598-020-59543-w

Süss, J., Klaus, C., Gerstengarbe, F. W., & Werner, P. C. 200). What makes ticks tick? Climate change, ticks, and tick-borne diseases. Journal of Travel Medicine, 15(1), 39–45. https://doi.org/10.1111/j.1708-8305.2007.00176.x

Sydeman, W. J., García-Reyes, M., Schoeman, D. S., Rykaczewski, R. R., Thompson, S. A., Black, B. A., & Bograd, S. J. (2014). Climate change and wind intensification in coastal upwelling ecosystems. Science, 345(6192), 77–80. https://doi.org/10.1126/science.1251635

TCEQ (Texas Commission on Environmental Quality. 2020. Texas Integrated Report – Texas 303(d) List (Category 5).

Tetra Tech. 2016. Fence-to-Fence Environmental Services at Joint Base San Antonio, Texas, Wetlands Update.

Texas Natural Resources Server. (n.d.). Mesquite ecology. Retrieved December 9, 2018, from https://texnat.tamu.edu/library/symposia/brush-sculptors-innovations-for-tailoring-brushy-rangelands-to-enhance-wildlife-habitat-and-recreational-value/mesquite-ecology/

TSHA (Texas State Historical Association). 2010. Handbook of Texas Online, Balcones Escarpment. Accessed online at http://www.tshaonline.org/handbook/online/articles/rxb01 on 2 Mar 2020.

US Army. 2012. Camp Bullis – An Emerald City in the rough. Accessed [Online]. http://www.army.mil/article/42652/camp-bullis---an-emerald-city-in-therough/?ref=news-environment-title8 on 15 April 2020.

USACE (U. S. Army Corps of Engineers). 1994. Final Wetland Delineation Report, Kelly Air Force Base, San Antonio, TX.

USACE. 2012. Lackland Air Force Base Jurisdictionl Delination Report.

U. S. Census Bureau. 2020. Data retrieved from https://www.census.gov 28 February 2020.

USDA (U.S. Department of Agriculture) Natural Resources Conservation Service (NRCS). Soil Survey Geographic Database.

USFWS. 2011. Bexar County Karst Invertebrate Recovery Plan.

USFWS. 2012. Karst Preserve Design Recommendations.

USFWS. 2014. Karst Preserve Management and Monitoring Recommendations.

Veni, G. and Reddell, J. 1999. Conservation of Rare Karst Species and Karst Species Proposed for Endanagered Listing, Camp Bullis, Bexar and Comal Counties, Texas.

Zara (Zara Environmental LLC). 2011. Karst Hydrogeology of Camp Bullis, Bexar and Comal Counties, Texas: A Window Into the Edwards – Trinity Aquifer System. Issued by ZARA – July 2011.

12.0 ACRONYMS

12.1 Standard Acronyms (Applicable to all USAF installations)

- eDASH Acronym Library
- Natural Resources Playbook – Acronym Section
- U.S. EPA Terms & Acronyms

12.2 Installation Acronyms

AACOG	Alamo Area Council of Governments
ABW	Air Base
ADP	Area Develop Plan
AETC	Air Education and Training Command
AFB	Air Force Base
AFCEC	Air Force Civil Engineer Center
AMA	Aircraft Movement Area
AMPV	Armored Mult-Purposed Vehicle
ASA	Army Support Activity
BAMC	Brooke Army Medical Center
BMT	Basic Military Training
BO	Biological Opinion
BRAC	Base Realignment and Closure
CDP	Camp Development Plan
CEMML	Center for Environmental Management Military Lands, Colorado State University
CES	Civil Engineer Squadron
CLEO	Conservation Law Enforcement Officer
CLEP	Conservation Law Enforcement Plan
CoSA	City of San Antonio
CPMP	Critical Period Management Plan
CUP	Compatible Use Plan
CZ	Environmental Directorate, AFCEC
DSHS	Department of State Health Services
EIAP	Environmental Impact Analysis Process
FES	Fire and Emergency Services
FSS	Force Support Squadron
FTW	Flying Training Wing
GCWA	Golden-cheeked Warbler
GSU	Geographically Separated Unit
IPAUS	Invasive Plant Atlas of the United States
ITAM	Integrated Training Area Management
JBSA	Joint Base San Antonio
JBSA-BUL	Joint Base San Antonio – Bullis
JBSA-CAN	Joint Base San Antonio – Canyon Lake
JBSA-CTA	Joint Base San Antonio – Chapman Training Annex
JBSA-GSA	Joint Base San Antonio – Grayson Street Annex
JBSA-KFA	Joint Base San Antonio – Kelly Field Annex
JBSA-LAK	Joint Base San Antonio – Lackland
JBSA-MCA	Joint Base San Antonio – Medical Center Annex

JBSA-PRT	Joint Base San Antonio – Port Annex
JBSA-RND	Joint Base San Antonio – Randolph
JBSA-SAF	Joint Base San Antonio – Seguin Auxiliary Field
JBSA-SAM	Joint Base San Antonio – Sam Houston
JLUS	Joint Land Use Study
KPA	Karst Preserve Area
MLDP	Managed Lands Deer Permit
NFPA	National Fire Protection Association
NOAA	National Oceanic and Atmospheric Administration
NR	Natural Resources
NRI	Natural Resources Institute, Texas A&M University
NRO	Natural Resources Office
OCS	Officer Candidate School
PMS	Publication Management System
RIFA	Red Imported Fire Ant
SARA	San Antonio River Authority
SDSFIE	Spatial Data Standards for Facilities, Infrastructure, and Environment
SWPPP	Storm Water Pollution Prevention Plan
TCE	Tetrachloroethylene
TCEQ	Texas Commission on Environmental Quality
TPWD	Texas Parks and Wildlife Department
TW	Training Wing
TWDB	Texas Water Development Board
UEC	Unit Environmental Coordinator
USFWS	United States Fish and Wildlife Service
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

Aircraft Movement Area – Permanent facilities used for the movement of aircraft to include runways, taxiways and aprons.

Cave – A naturally occurring, humanly enterable cavity in the earth, at least 5 meters (15 foot 6 in) in length, and where no dimension of the entrance exceeds the length or depth of the cavity.

Karst Feature – Solutional formation in limestone terrains that does not meet the definition of a cave.

Karst Preserve Area – Areas around recorded locations of listed karst species or endemic species, restricted from certain activities, to preserve the surface area around the location.

Mesocavern – Karst feature that is impassable to humans, does not restrict karst species.

Oak Wilt – Fungus (*Ceratocystis fagacearum*) regarded as most destructive tree disease in Texas.

Pyrotechnic Devices – Training devices, simulators or flares that have the capability to ignite wildfires when employed by training. Mainly used in un-improved areas but are also utilized by air shows.

Training Area – Area of land at JBSA-BUL scheduled and used for training purposes.

Training Site – Area of land at JBSA-BUL scheduled and used for specific training purposes (e.g. land navigation, driver training, shoot house).

14.0 APPENDICES

14.1. Standard Appendices

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 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.
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.

Federal Public Laws and Executive Orders	
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 U.S. Environmental Protection Agency (US EPA) 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	
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.
Bald and Golden Eagle Protection Act of 1940, as amended; 16 U.S.C. 668-668c	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)	This Act, as amended, is known as the Clean Air Act of 1970. 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, 42 USC 9601 et seq.	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.
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

Federal Public Laws and Executive Orders	
	assessment may be required when such species are present in an area affected by government activities.
Federal Aid in Wildlife Restoration Act of 1937 (16 U.S.C. § 669–669i; 50 Stat. 917) (Pittman-Robertson Act)	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 in accordance with 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 Noxious Weed Act of 1974, 7 U.S.C. § 2801–2814	The Act provides for the control and management of non-indigenous weeds that injure or have the potential to injure the interests of agriculture and commerce, wildlife resources, or the public health.
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 US EPA.
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.
Lacey Act (16 U.S.C. § 3371-3378)	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.
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.
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 (CEQ) created Regulations for Implementing the National Environmental Policy Act [40 Code of

Federal Public Laws and Executive Orders	
	Federal Regulations (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.
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.
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 (NPDES) 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.
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. 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). AFMAN 21-7003, Sect 3.11.1. Outsourcing Natural Resources Management. As

Federal Public Laws and Executive Orders	
	stipulated in the Sikes Act, 16 USC § 670 *et seq.*, the Office of Management and Budget Circular No. A-76, *Performance of Commercial Activities,* 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, they may, in accordance with the Sikes Act (16 USC § 670a(d)(2)), obtain inherently governmental services from federal agencies having responsibilities for the conservation and management of natural resources. **(T-0)**.
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 Directive 4715.1E, *Environment, Safety, and Occupational Health (ESOH)*	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 DoDD 4715.1E for the integrated management of natural and cultural resources on property under DoD control.
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 2002 – *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 Amendments. Emphasizes implementing and improving the overall INRMP coordination process and focuses on coordinating with stakeholders, reporting requirements and metrics, budgeting for

Federal Public Laws and Executive Orders	
	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 and Directives	
32 CFR Part 989, as amended, and AFI 32-7061, Environmental Impact Analysis Process (EIAP)	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 32-1015, *Integrated Installation Planning*	Provides guidance and responsibilities related to the USAF comprehensive planning process on all USAF-controlled lands.
AFMAN 32-7003, *Environmental Conservation*	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 and cultural resources on USAF property in compliance with Federal, state, territorial, and local standards.
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.
Policy Memo for Implementation of Sikes Act Improvement Amendments, HQ USAF Environmental Office (USAF/ILEV) on January 29, 1999	Outlines the USAF interpretation and explanation of the Sikes Act and Improvement Act of 1997.

14.2. Installation Appendices

- *Biological Assessment Investigating the Effects of JBSA Water Draw on Listed Species of the Edwards Aquifer (2012)*
- *Critical Period Management Plan for Edwards Aquifer Water Use at Joint Base San Antonio (2013)*
- *Biological Opinion for JBSA Edwards Aquifer Use, Consultation No. 02ETAU00-2013-F-0060 (2013)*
- *JBSA Climate Change Summary Appendix A: Methods (2019)*
- *Migratory Bird Depredation at Airports Permit #MB09077B (2020)*
- *Native Endangered Species Recovery Permit Number: TE082496-0 (2020)*
- *Joint Base San Antonio Species List*
- *Joint Base San Antonio Prohibited Landscape Plant List*
- *Joint Base San Antonio – Camp Bullis Hunting Regulations 2019-2020*

Copies of these appendices are stored on the JBSA natural resources page of the Environmental Dashboard (eDASH) webpage at https://cs2.eis.af.mil/sites/10625/JBSA/WPP/ProgramPage/Natural%20Resources.aspx.

15.0 ASSOCIATED PLANS

JBSA-BUL Wildland Fire Management Plan (2009)

JBSA Bird/Wildlife Aircraft Strike Hazard Plan (2018)

JBSA Golf Courses Environmental Management Plan (2014)

JBSA Integrated Cultural Resources Management Plan (2014)

JBSA Installation Pest Management Plan (2017)

JBSA Conservation Law Enforcement Plan (2015)

Copies of these associated plans are stored on the JBSA natural resources page of eDASH at https://cs2.eis.af.mil/sites/10625/JBSA/WPP/ProgramPage/Natural%20Resources.aspx.