DRAFT

ENVIRONMENTAL ASSESSMENT

for

Munitions Storage Igloos

at

Andersen Air Force Base, Guam



This page intentionally left blank.

ABSTRACT

Designation:	Environmental Assessment
Title of Proposed Action:	Munitions Storage Igloos
Project Location:	Andersen Air Force Base (AFB), Guam
Lead Agency for the EA:	Headquarters Pacific Air Forces
Affected Region:	Guam
Action Proponent:	The 36th Wing, Andersen AFB, Guam
Point of Contact:	Jeffrey Laitila, United States Air Force (USAF) 36 CES/CEV Environmental Flight Chief NAVFAC IEPD Andersen AFB, Guam Email address: jeffrey.laitila@us.af.mil
Date:	December 2019

On behalf of the Headquarters Pacific Air Forces, a Major Command of the USAF, Naval Facilities Engineering Command Pacific has prepared this Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA), as implemented by the Council on Environmental Quality Regulations. Per the Joint Region Marianas (JRM) Memorandum of Agreement (2009) implementing the 2005 Base Realignment and Closure Commission's (BRAC) decisions and the 2011 JRM Memorandum of Agreement, Navy NEPA regulations are implemented at Andersen AFB. The Proposed Action is to construct an additional 48 Hayman style munitions storage igloos in Munitions Storage Area I at Andersen AFB in Joint Region Marianas, Guam to reduce the current existing munitions storage capacity shortfall and to enable 36th Wing's mission requirements under Title 10 U.S Code Section 8062. The new igloos would require lighting and electrical support, an intrusion detection system, ventilation, reinforced concrete foundations, rated 7-bar construction, floor slabs, columns, beams, and a lightning protection system. Supporting facilities would include site development, utilities and connections, road improvements, and loading aprons. Project construction would occur between approximately 2020 and 2022. This EA evaluates the potential environmental impacts associated with the two action alternatives, Alternative 1 (Preferred Alternative), Alternative 2, and the No Action Alternative. The environmental resource areas analyzed in this EA include: air quality, water resources, geological resources, cultural resources, biological resources, noise, infrastructure, transportation, public health and safety, and hazardous materials and wastes.

Written comments may be provided by email to NFPAC-Receive@navy.mil or by mail to: Naval Facilities Engineering Command Pacific, Building 258 Makalapa Drive, Suite 100, Joint Base Pearl Harbor-Hickam, HI 96860-3134, Attn: EV21 Andersen AFB Munitions Storage Igloos EA Project Manager; Telephone (808) 472-1450.

This page intentionally left blank.

Draft Environmental Assessment
Munitions Storage Igloos
Andersen Air Force Base, Guam

TABLE OF CONTENTS

ABBREVIATIONS AND ACRONYMS vi
1 INTRODUCTION 1-1
1.1 Background 1-1
1.2 Location 1-2
1.3 Purpose of and Need for the Proposed Action 1-4
1.4 Scope of Environmental Analysis 1-4
1.5 Key Documents 1-4
1.6 Relevant Laws and Regulations 1-5
1.7 Public and Agency Participation and Intergovernmental Coordination 1-6
1.8 Organization of this Document 1-6
2 PROPOSED ACTION AND ALTERNATIVES 2-1
2.1 Proposed Action 2-1
2.1.1 Baseline Conditions 2-1
2.1.2 Site Development Considerations 2-1
2.1.3 Explosives Safety 2-5
2.1.4 Design Standards 2-5
2.1.5 Description of Proposed Action 2-6
2.1.6 Timeline 2-6
2.2 Screening Factors 2-9
2.3 Alternatives Carried Forward for Analysis 2-9
2.3.1 No Action Alternative 2-9
2.3.2 Alternative 1 (Preferred Alternative) 2-9
2.3.3 Alternative 2 2-12
2.3.4 Alternatives Comparison 2-14
2.4 Alternatives Considered but not Carried Forward for Effects Evaluation 2-15
2.4.1 Alternative Locations on Base for Munitions Storage Facilities 2-15
2.4.2 Alternative Designs for Munitions Storage Facilities 2-16
2.4.3 Renovate, Upgrade, or Replace Existing Munitions Storage Igloos 2-16
2.5 Best Management Practices Included in Proposed Action 2-18
2.6 Decision to be Made and Identification of the Preferred Alternative 2-19

3 AFFECTED ENVIRONMENT AND ENVIRONMENTAL CONSEQUENCES 3-1

3.1 Air Quality 3-2
3.1.1 Regulatory Setting 3-2
3.1.2 Affected Environment 3-4
3.1.3 Environmental Consequences 3-5
3.2 Water Resources 3-7
3.2.1 Regulatory Setting 3-8
3.2.2 Affected Environment 3-9
3.2.3 Environmental Consequences 3-10
3.3 Geological Resources 3-12
3.3.1 Regulatory Setting 3-12
3.3.2 Affected Environment 3-13
3.3.3 Environmental Consequences 3-13
3.4 Cultural Resources 3-16
3.4.1 Regulatory Setting 3-16
3.4.2 Affected Environment 3-17
3.4.3 Environmental Consequences 3-19
3.5 Biological Resources 3-23
3.5.1 Regulatory Setting 3-23
3.5.2 Affected Environment 3-25
3.5.3 Environmental Consequences 3-38
3.6 Noise 3-46
3.6.1 Basics of Sound and A-Weighted Sound Level 3-46
3.6.2 Noise Metrics 3-47
3.6.3 Noise Effects 3-50
3.6.4 Regulatory Setting 3-52
3.6.5 Affected Environment 3-52
3.6.6 Environmental Consequences 3-53
3.7 Infrastructure 3-54
3.7.1 Regulatory Setting 3-54
3.7.2 Affected Environment 3-54
3.7.3 Environmental Consequences 3-55
3.8 Transportation 3-57
3.8.1 Regulatory Setting 3-57
3.8.2 Affected Environment 3-57
3.8.3 Environmental Consequences 3-58
3.9 Public Health and Safety 3-59
3.9.1 Regulatory Setting 3-59

3.9.2 Affected Environment 3-60
3.9.3 Environmental Consequences 3-61
3.10 Hazardous Materials and Wastes 3-63
3.10.1 Regulatory Setting 3-63
3.10.2 Affected Environment 3-64
3.10.3 Environmental Consequences 3-65
3.11 Summary of Potential Impacts to Resources and Impact Avoidance and Minimization 3-68
4 CUMULATIVE IMPACTS 4-1
4.1 Definition of Cumulative Impacts 4-1
4.2 Scope of Cumulative Impacts Analysis 4-2
4.3 Past, Present, and Reasonably Foreseeable Actions 4-2
4.3.2 Past Actions 4-3
4.3.3 Present and Reasonably Foreseeable Actions 4-3
4.4 Cumulative Impact Analysis 4-4
4.4.1 Air Quality 4-4
4.4.2 Water Resources 4-5
4.4.3 Geological Resources 4-5
4.4.4 Cultural Resources 4-5
4.4.5 Biological Resources 4-5
4.4.6 Noise 4-6
4.4.7 Infrastructure 4-6
4.4.8 Transportation 4-7
4.4.9 Public Health and Safety 4-7
4.4.10 Hazardous Materials and Wastes 4-7
5 OTHER CONSIDERATIONS REQUIRED BY NEPA 5-1
5.1 Consistency with Other Federal, State, and Local Laws, Plans, Policies, and Regulations 5-1
5.2 Irreversible or Irretrievable Commitments of Resources 5-1
5.3 Unavoidable Adverse Impacts 5-1
5.4 Relationship between Short-Term Use of the Environment and Long-Term Productivity 5-1
6 REFERENCES 6-1
7 LIST OF PREPARERS 7-1
8 DISTRIBUTION LIST 8-1
8.1 Department of Defense 8-1
8.2 Government Agencies 8-1
8.3 Libraries 8-1

List of Figures

Figure 1-1 Project Location, Andersen AFB, Guam 1-3
Figure 2-1 Existing Conditions (MSA I and Project Location) 2-2
Figure 2-2 Topography and Drainage 2-3
Figure 2-3 Development Considerations 2-4
Figure 2-4 Typical Hayman Style ECM Design 2-7
Figure 2-5 Photographs of Existing Munitions Storage Igloos, Andersen AFB 2-8
Figure 2-6 Alternative 1 Site Plan 2-11
Figure 2-7 Alternative 2 Site Plan 2-13
Figure 3-1 Overlay Refuge Lands and Critical Habitat – Northern Guam 3-24
Figure 3-2 Vegetation Communities within the Project Area 3-27
Figure 3-3 Population Counts of Federally Threatened Plant Species Found in the Project Area 3-29
Figure 3-4 Population Counts of *Maytenus thompsonii* Found in the Project Area 3-30
Figure 3-5 A-Weighted Sound Levels from Typical Sources 3-48
Figure 3-6 IRP Sites 3-66

List of Tables

Table 2-1 Alternative 1 Areas of Proposed Action 2-10
Table 2-2 Alternative 2 Areas of Proposed Action 2-14
Table 2-3 Alternatives Comparison 2-15
Table 2-4 Munitions Storage Facility Alternatives 2-17
Table 2-5 Best Management Practices 2-18
Table 3-1 General Conformity *de minimis* levels 3-4
Table 3-2 Alternative 1 – Construction Emissions at Andersen AFB with Evaluation of Conformity 3-6
Table 3-3 Alternative 2 – Construction Emissions at Andersen AFB with Evaluation of Conformity 3-7
Table 3-4 Archaeological Resources Located in MSA 1 3-18
Table 3-5 Architectural Resources in the Area of Potential Effects 3-20
Table 3-6 Federally and Guam ESA-listed Species Potentially Occurring within the MSA 3-31
Table 3-7 Reptiles and Amphibians at Andersen AFB 3-34
Table 3-8 Bird Species Recorded on Andersen AFB 3-35
Table 3-8 Subjective Responses to Changes in A-Weighted Decibels 3-47
Table 3-9 Predicted Noise Levels for Construction Equipment 3-49

Table 3-10 Summary of Potential Impacts to Resource Areas 3-69
Table 4-1 Cumulative Action Evaluation 4-2
Table 5-1 Principal Federal Laws Applicable to the Proposed Action 5-2

Appendices

Appendix A Public and Agency Participation A-1
Appendix B Air Quality Methodology and Calculations B-1
Appendix C Endangered Species Act Documentation.....C-1
Appendix D National Historic Preservation Act Section 106 Documentation..... D-1
Appendix E Coastal Zone Management Act Correspondence E-1
Appendix F Munitions Storage Area Plant Survey Report F-1

This page intentionally left blank.

Abbreviations and Acronyms

Abbreviation/Acronym	Definition
36 WG	36th Wing
ACM	asbestos-containing material
AFB	Air Force Base
AFI	Air Force Instruction
AFMAN	Air Force Manual
APE	Area of Potential Effect
ATFP	Antiterrorism Force Protection
BMP	best management practice
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CES	Civil Engineer Squadron
CFR	Code of Federal Regulations
CHH	cable handhole
CNEL	Community Noise Equivalent Level
CNMI	Commonwealth of the Northern Mariana Islands
CO	carbon monoxide
CO_2	carbon dioxide
CWA	Clean Water Act
DAWR	Division of Aquatic and Wildlife Resources
dB	decibel
dBA	A-weighted sound level
DNL	day-night average sound level
DOD	Department of Defense
DON	Department of the Navy
EA	Environmental Assessment
ECM	earth-covered magazine
EIS	Environmental Impact Statement
EO	Executive Order
EPP	Environmental Protection Plan
ESA	Endangered Species Act
ESS	Explosives Safety Submission
ESZ	explosive safety zone
ft^2	square feet
FY	Fiscal Year
GAR	Guam Administrative Rules and Regulations
GEPA	Guam Environmental Protection Agency
GHG	greenhouse gas
GovGuam	Government of Guam
HAP	hazardous air pollutant
IMD	inter-magazine distance
IRAA	Indoor Radon Abatement Act
IRP	Installation Restoration Program
ISR	Intelligence, Surveillance, and Reconnaissance
JRM	Joint Region Marianas
kV	kilovolt
LBP	lead based paint
LED	light-emitting diode
L_{eq}	equivalent sound level
LFTRC	live-fire training range complex
L_{max}	maximum A-weighted sound level
LOS	level of service
MBTA	Migratory Bird Treaty Act
MEC	Munitions and Explosives of Concern
MSA	Munitions Storage Area
NAAQS	National Ambient Air Quality Standards
NAVFAC	Naval Facilities Engineering Command
NAVFAC Pacific	Naval Facilities Engineering Command Pacific
NAVRAMP	Navy Radon Assessment and Mitigation Program
Navy	U.S. Navy
NBG	Naval Base Guam
NEPA	National Environmental Policy Act
NEW	Net Explosive Weight
NHPA	National Historic Preservation Act
NIOSH	National Institute for Occupational Safety and Health
NIPTS	Noise Induced Permanent Threshold Shift
NO_2	nitrogen dioxide
NO_x	nitrogen oxide
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NRHP	National Register of Historic Places
NWF	Northwest Field
NWR	National Wildlife Refuge
O_3	ozone
OSHA	Occupational Safety and Health Administration
PACAF	Pacific Air Forces
Pb	lead
PCB	polychlorinated biphenyl
$PM_{2.5}$	particulate matter less than or equal to 2.5 microns in diameter

Abbreviation/Acronym	Definition	Abbreviation/Acronym	Definition
PM_{10}	particulate matter less than or equal to 10 microns in diameter	THAAD	Terminal High-Altitude Area Defense
QD	quantity-distance	tpy	tons per year
ROD	Record of Decision	U.S.	United States
ROI	region of influence	U.S.C.	U.S. Code
SEIS	Supplemental Environmental Impact Statement	UFC	Unified Facilities Criteria
		USACE	U.S. Army Corps of Engineers
SEL	sound exposure level	USAF	U.S. Air Force
SHPO	State Historic Preservation Officer	USEPA	U.S. Environmental Protection Agency
SO_2	sulfur dioxide	USFWS	U.S. Fish and Wildlife Service
SWPPP	Stormwater Pollution Prevention Plan	USINDOPACOM	United States Indo-Pacific Command
TARRP	tactical air-munitions rapid response package	UXO	unexploded ordnance
		VOC	volatile organic compound
TCP	traditional cultural property	WW II	World War II

1 Introduction

The United States (U.S.) Air Force (USAF), Headquarters Pacific Air Forces (PACAF), 36th Wing (36 WG), Andersen Air Force Base (AFB), Guam proposes to construct an additional 48 Hayman style munitions storage igloos in Munitions Storage Area (MSA) I at Andersen AFB in Joint Region Marianas (JRM), Guam. The new igloos would require lighting and electrical support, an intrusion detection system, ventilation, reinforced concrete foundations, rated 7-bar construction, floor slabs, columns, beams, and a lightning protection system. Supporting facilities would include site development, utilities and connections, road improvements, and loading aprons.

The action would increase munitions storage capacity and provide minor facility modifications to meet operational requirements. Facility construction is projected between approximately 2020 and 2022. An increase in personnel is not anticipated.

The JRM military command on Guam oversees the partnership of Andersen AFB and Naval Base Guam (NBG) in accordance with the Joint Region Marianas Memorandum of Agreement (2009) implementing the 2005 Base Realignment and Closure Commission's (BRAC) decisions and the 2011 JRM Memorandum of Agreement. Per these agreements, Navy NEPA regulations are implemented at Andersen AFB. Under JRM, PACAF and the U.S. Navy (Navy) utilize shared resources and support services, including Navy support of environmental compliance documentation.

On behalf of the Headquarters Pacific Air Forces, a Major Command of the USAF, Naval Facilities Engineering Command Pacific (NAVFAC Pacific) has prepared this Environmental Assessment (EA) in accordance with the National Environmental Policy Act (NEPA), as implemented by the Council on Environmental Quality (CEQ) Regulations (40 Code of Federal Regulations [CFR] parts 1500–1508) and Navy procedures for implementing NEPA (32 CFR part 775), in accordance with the 2009 MOA. This EA evaluates the environmental consequences associated with the Proposed Action (Alternatives 1 and 2) and the No Action Alternative.

1.1 Background

Andersen AFB is a strategically located forward main operating base. The 36 WG is host unit to USAF Active, Reserve, National Guard, and U.S. Naval forces and its mission is to provide the highest quality peacetime and wartime support from its strategic Pacific location. Guam serves as a stopping point for numerous aircraft enroute to Japan, Korea, and other Indo-Asia Pacific locations. Andersen AFB is positioned to support operations across the spectrum of conflict to include sustained combat operations.

Andersen AFB has an existing total of 144 munitions storage igloos (126 igloos in MSA I and 18 igloos in MSA II). Within MSA I there are: 114 traditional earth-covered magazines (ECMs) that have been downgraded for nonstandard munitions storage; 12 Hayman style ECMs that were constructed in Fiscal Year (FY) 2008; numerous exterior storage pads and designated open storage areas; 10 aboveground magazines; and several maintenance, operations, and storage facilities.

In April 2002, the USAF Safety Center evaluated existing munitions magazines from the 1950s (USAF 2002, USAF 2005). A total of 132 igloos were improperly sited and had substandard storage capability, providing a total of 263,000 ft^2 of storage capacity. The magazines failed to meet the standard rating due to faulty door design. Additionally, the earth coverings on the magazines have deteriorated from age, typhoon winds, and rain. With this loss of storage capability, the 36 WG was challenged to meet the

operational requirement. As a result of failing the safety rating, these munitions magazines were downgraded from storing 500,000 pounds of net explosive weight (NEW) to 250,000 pounds of NEW. The age and wear of these facilities have caused a shortfall in munitions storage that is needed to support the current mission.

Every functional munitions storage unit at Andersen AFB is currently in use and essential to meet the minimum storage capacity. The loss or temporary loss of a magazine will negatively impact the mission of Andersen AFB. A total of 60 additional munitions storage igloos were determined to be needed to provide adequate munitions storage (USAF 2005). A portion of that total amount (12 igloos) was completed as Phase I in FY08, with the remaining 48 igloos to be constructed in subsequent phases, subject to funding.

The 36 WG initially proposed to construct 60 munitions storage igloos in two phases: Phase 1 (12 munitions storage igloos) and Phase 2 (48 munitions storage igloos). In October 2005, the *Environmental Assessment of Proposed Munitions Storage Igloo Construction at Andersen Air Force Base, Guam* was prepared to analyze the effects of siting all 60 munitions storage igloos within MSA I (USAF 2005). Phase 1 was constructed in FY 2008, with the remaining 48 igloos planned to be constructed in Phase 2, subject to funding. However, Phase 2 was not implemented due to constraints identified during agency review of the 2005 Draft EA. The U.S. Fish and Wildlife Service (USFWS) and Guam Department of Agriculture, Division of Aquatic and Wildlife Resources (Guam DAWR) indicated that Phase 2 (the proposed construction of the 48 igloos) would encroach on biologically sensitive habitat. Areas north and west of Phase 1 possess limestone forest components that serve as important habitat to several endangered species on Guam. The 36 WG subsequently revised alternatives for the remaining 48 igloos to avoid and minimize potential effects on biologically sensitive habitat. These revised alternatives are analyzed in this EA.

The current munitions storage capability at Andersen AFB is 384,000 square feet (ft^2). The future operational floor space requirement is 664,000 ft^2, leaving the base with a storage capacity shortfall of 280,000 ft^2. There are no other anticipated storage capacity shortfalls currently identified for munitions storage at Andersen AFB.

1.2 Location

Guam is located approximately 3,700 miles west of Hawaii, 1,500 miles east of the Republic of the Philippines, and 1,550 miles south of Japan. The island of Guam is the westernmost territory of the U.S. and is the southernmost island of the Marianas chain. NBG is the primary military presence on Guam, occupying over 18,000 acres of land on seven noncontiguous sites located throughout the 212 square mile island. These sites include the main base, NBG Barrigada, NBG North Finegayan, NBG Munitions Site, Polaris Point, Tenjo Valley, and Sasa Valley.

Andersen AFB is located on the northern tip of the island and covers over 14,000 acres. The base hosts the largest MSA in the USAF and is a key base in the U.S. Indo-Pacific Command (USINDOPACOM) Area of Responsibility. The proposed munitions storage facilities would be constructed within MSA I, which is located northwest of Andersen AFB's airfield and southeast of the Northwest Field Training Area. MSA I is used exclusively for the receiving, storage, and maintenance of munitions. Figure 1-1 shows the location of the project within Andersen AFB.

1

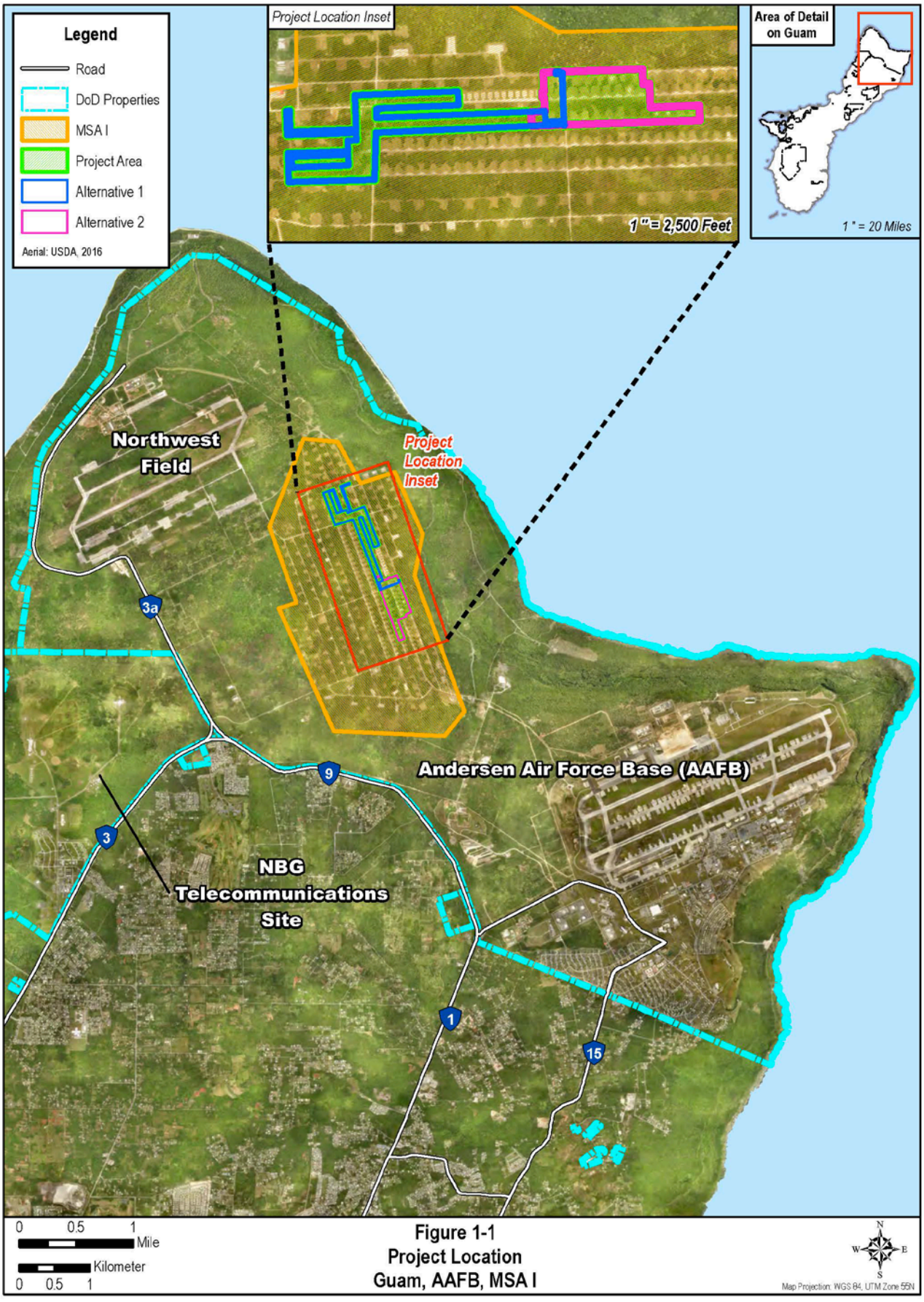


Figure 1-1
Project Location
Guam, AAFB, MSA I

The majority of Andersen AFB is within the Refuge Overlay Unit of the Guam National Wildlife Refuge (NWR). The Guam NWR was established in 1993 through a Memorandum of Understanding between the U.S. Fish and Wildlife Service (USFWS), Department of the Navy (DON), USAF, and the Government of Guam (GovGuam) (GovGuam et al., 1993). By way of cooperative agreements signed in 1994, the USAF, DON, USFWS, and the Guam Department of Agriculture, Division of Aquatic and Wildlife Resources established the Refuge Overlay Units to provide a coordinated program for protecting threatened and endangered species and native flora and fauna, maintaining native ecosystems, and conserving biological diversity on Department of Defense lands on Guam. Further detail on Overlay Refuge lands can be found in Section 3.5.1.

1.3 Purpose of and Need for the Proposed Action

The purpose of and need for the Proposed Action is to enable Andersen AFB to fulfill its mission of providing a sufficient supply of new, highly sophisticated munitions deemed critical in the initial stages of any armed conflict in the region. To fully achieve this mission, 280,000 ft^2 of additional munitions storage capacity and associated infrastructure upgrades are needed. The Proposed Action is needed to enable the 36 WG, a PACAF wing at Andersen AFB, to perform its existing mission and ongoing military operations by providing adequate munitions storage.

The USAF has congressionally mandated roles and responsibilities under Title 10 U.S. Code (U.S.C.) section 8062, which specifies that the USAF, "shall be organized, trained, and equipped primarily for prompt and sustained offensive and defensive air operations." By addressing the NEW storage shortfall, the Proposed Action supports the USAF's Title 10 U.S.C. section 8062 directive to "form the basis for a complete and immediate mobilization for the national defense in the event of a national emergency."

1.4 Scope of Environmental Analysis

This EA includes an analysis of potential environmental impacts associated with the action alternatives and the No Action Alternative. The environmental resource areas analyzed in this EA include: air quality, water resources, geological resources, cultural resources, biological resources, noise, infrastructure, transportation, public health and safety, and hazardous materials and waste. The study area for each resource analyzed may differ due to how the Proposed Action and alternative actions interact with or impact the resource.

1.5 Key Documents

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

- *Environmental Assessment of Proposed Munitions Storage Igloo Construction at Andersen Air Force Base, Guam*, October 2005 (USAF 2005). The EA analyzed the effects of siting 60 munitions storage igloos within MSA I (USAF 2005). A portion of that total amount (12 igloos) was completed as Phase I in FY 2008.
- *Joint Region Marianas Andersen Air Force Base Area Development Plan, MSA 1 Earth Covered Magazines Final Report, April 2017*. Report assessed existing facilities and infrastructure, developed and evaluated concepts for safely increasing munitions storage at Andersen AFB.

- *Final Supplemental Environmental Impact Statement (SEIS) Guam and Commonwealth of the Northern Marianas Islands (CNMI) Military Relocation (2012 Roadmap Adjustments), February 2015*. In September 2010, the DON signed a Record of Decision regarding the 2010 Final Environmental Impact Statement (EIS) for the Guam and CNMI Military Relocation. The Final SEIS analyzes the potential environmental impacts of a materially smaller and reconfigured Marine Corps force on Guam than was evaluated in the 2010 Final EIS.

1.6 Relevant Laws and Regulations

The USAF has prepared this EA based upon federal and state laws, statutes, regulations, and policies pertinent to the implementation of the Proposed Action, including the following:

- NEPA (42 U.S.C. sections 4321–4370h), which requires an environmental analysis for major federal actions that have the potential to significantly impact the quality of the human environment
- CEQ Regulations for Implementing the Procedural Provisions of NEPA (40 CFR parts 1500–1508)
- Navy regulations for implementing NEPA (32 CFR part 775), which provides Navy policy for implementing CEQ regulations and NEPA
- Clean Air Act (42 U.S.C. section 7401 et seq.)
- Clean Water Act (33 U.S.C. section 1251 et seq.)
- Coastal Zone Management Act (16 U.S.C. section 1451 et seq.)
- National Historic Preservation Act (NHPA) (54 U.S.C. section 300101 et seq.)
- Archaeological and Historic Preservation Act (1974) (54 U.S.C. section 312102 et seq.)
- Archaeological Resources Protection Act (1979) (16 U.S.C. section 470aa et seq.)
- Endangered Species Act (16 U.S.C. section 1531 et seq.)
- Migratory Bird Treaty Act (16 U.S.C. section 703–712)
- Comprehensive Environmental Response and Liability Act (42 U.S.C. section 9601 et seq.)
- Emergency Planning and Community Right-to-Know Act (42 U.S.C. sections 11001–11050)
- Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. section 136 et seq.)
- Resource Conservation and Recovery Act (42 U.S.C. section 6901 et seq.)
- Toxic Substances Control Act (15 U.S.C. sections 2601–2629)
- Executive Order (EO) 11988, Floodplain Management
- EO 12088, Federal Compliance with Pollution Control Standards
- EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations
- EO 13045, Protection of Children from Environmental Health Risks and Safety Risks
- EO 13186, Responsibilities of Federal Agencies to Protect Migratory Birds
- EO 13834, Efficient Federal Operations
- Indoor Radon Abatement Act (IRAA) of 1988 (15 U.S.C. section 53 et seq.)
- Defense Base Closure and Realignment Act of 1990 (Part A of Title XXIX of Public Law 101-510; 10 U.S.C. 2687 Note

- Department of Defense Initial Guidance for BRAC 2005 Joint Base Implementation, 22 January 2008
- Department of Defense Supplemental Guidance for Operating a Joint Base, April 15, 2008

A description of the Proposed Action's consistency with these laws, policies, and regulations, as well as the names of regulatory agencies responsible for their implementation, is presented in Chapter 5 (Table 5-1).

1.7 Public and Agency Participation and Intergovernmental Coordination

CEQ Regulations for Implementing the Procedural Provisions of the NEPA (40 CFR 1500-1508) require agencies to encourage and facilitate public involvement in decisions which affect the quality of the human environment (1500.2(d).

The USAF published a Notice of Availability of the Draft EA for three consecutive days in the Pacific Daily News and Guam Post (Appendix A). The notice described the Proposed Action, solicited public and agency comments on the Draft EA, provided dates of the open comment period, and announced that a copy of the EA would be available for review (explain how or where). The Draft EA was made available for review by interested parties at the Nieves M. Flores Memorial Library, 254 Martyr Street Hagatna, Guam; and the Dededo Public Library, West Santa Barbara Avenue, Dededo, Guam. The Draft EA was also made available on the following website: https://www.navfac.navy.mil/navfac_worldwide/pacific/about_us/national-environmental-policy-act--nepa--information/environmental-assessments-availble-for-public-review.html.

The USAF initiated formal consultation with the USFWS under Section 7 of the Endangered Species Act regarding the Preferred Alternative (Appendix C). The USAF also consulted with the Guam State Historic Preservation Officer regarding the Preferred Alternative (Appendix D). The USAF will coordinate with the Guam Bureau of Statistics and Plans to ensure the proposed action is consistent with the Guam Coastal Management Program and is in compliance with the Coastal Zone Management Act to the maximum extent practicable. Appendix E will include the coastal consistency analysis for the proposed action (coordinated with Guam Bureau of Statistics and Plans).

1.8 Organization of this Document

This EA is organized into eight sections, not including the executive summary or appendices. Section 1 contains background information, a description of the purpose of and need for the Proposed Action, a description of the applicable regulatory requirements, and an introduction to the organization of the EA. Section 2 provides a detailed description of the Proposed Action, the action alternatives, the No Action Alternative, the alternatives not carried forward for analysis, and best management practices (BMPs) included in the project. Section 3 contains a general description of the baseline conditions that could potentially be affected by the Proposed Action or the No Action Alternative, and it presents an analysis of the environmental consequences. Section 4 includes an analysis of the potential cumulative impacts. Section 5 looks at other special considerations under NEPA. Section 6 lists the sources of information used in the preparation of the document. Section 7 lists the preparers of the document. Section 8 lists the federal, territorial, and other organizations to which the Draft EA was distributed.

Appendix A includes distribution letters sent during the public review period. Appendix B includes air emission calculations to support the Air Quality section. Appendix C includes information from the natural resource surveys and consultation documentation for the project (coordinated with USFWS).

Appendix D includes information from the cultural resource surveys and consultation documentation for the project (coordinated with Guam State Historic Preservation Officer). Appendix E will include the coastal consistency analysis for the proposed action (coordinated with Guam Bureau of Statistics and Plans). Appendix F contains the Munitions Storage Area Plant Survey Report.

This page intentionally left blank.

2 Proposed Action and Alternatives

2.1 Proposed Action

2.1.1 Baseline Conditions

MSA I contains facilities for the storage, receiving, and maintenance of munitions. The area is heavily vegetated and surrounding development includes Northwest Field to the north and west, undeveloped jungle to the west and south, and a cliffline to the east. The area is moderately sloped with an average slope of approximately 2.5 percent. Drainage within MSA I is mostly via surface runoff to the west.

The project area under consideration in this EA is located within MSA I and includes the footprints of Alternative 1 and Alternative 2. The project area is generally located between E Avenue and D Avenue on the north and south sides, respectively, and between 4th Street and 8th Street on the east and west sides, respectively. Figure 2-1 shows an aerial look at existing conditions within MSA I and the project area. Figure 2-2 illustrates topography and drainage in the project area.

The transportation system within MSA I consists of a grid of paved and unpaved roads that provide access to the various munitions storage facilities. The primary entrance to MSA I is through a controlled gate near the intersection of B Avenue and 5th Street.

Utilities in the project area include electrical service and fiber optic communications cabling. Under existing conditions, the primary voltage at Andersen Air Force Base (AFB) is 13,800Y/7,970 volts. In 2008, an underground primary electrical feeder was installed to serve the first 12 ECMs in Phase I as well as the future ECMs. This feeder extends from the east on the north side of 4th Street to a 4-way, pad-mounted 15-kilovolt (kV) switch near the intersection of 4th Street and C Avenue. From this switch, a radial feeder is extended to a new pad-mounted transformer located on the east side of ECM 8418. This transformer has a 13.8-kV primary and 480Y/277 volts secondary. A standby generator is located in a building near the transformer.

Communications infrastructure was also expanded in the project area in 2008. An underground communications ductbank with 100-pair copper and 48-strand fiber optic cabling was installed to serve the first 12 ECMs in Phase I as well as the future ECMs. The fiber optic cable originates in Building 23028 and the copper cable originates in Building 25008. This cable is extended to MSA I where the copper cable is terminated in a splice case in cable handhole (CHH) 123 and the fiber optic cable is terminated in a splice case in CHH 124. From these handholes, the cable is extended to the ECMs. Figure 2-3 shows existing facilities and utilities within the project area. This figure also shows explosives safety arcs within and adjacent to the study area that constrain development potential.

2.1.2 Site Development Considerations

The site planning process must consider factors that may have the potential to or will affect the planned laydown of program requirements.

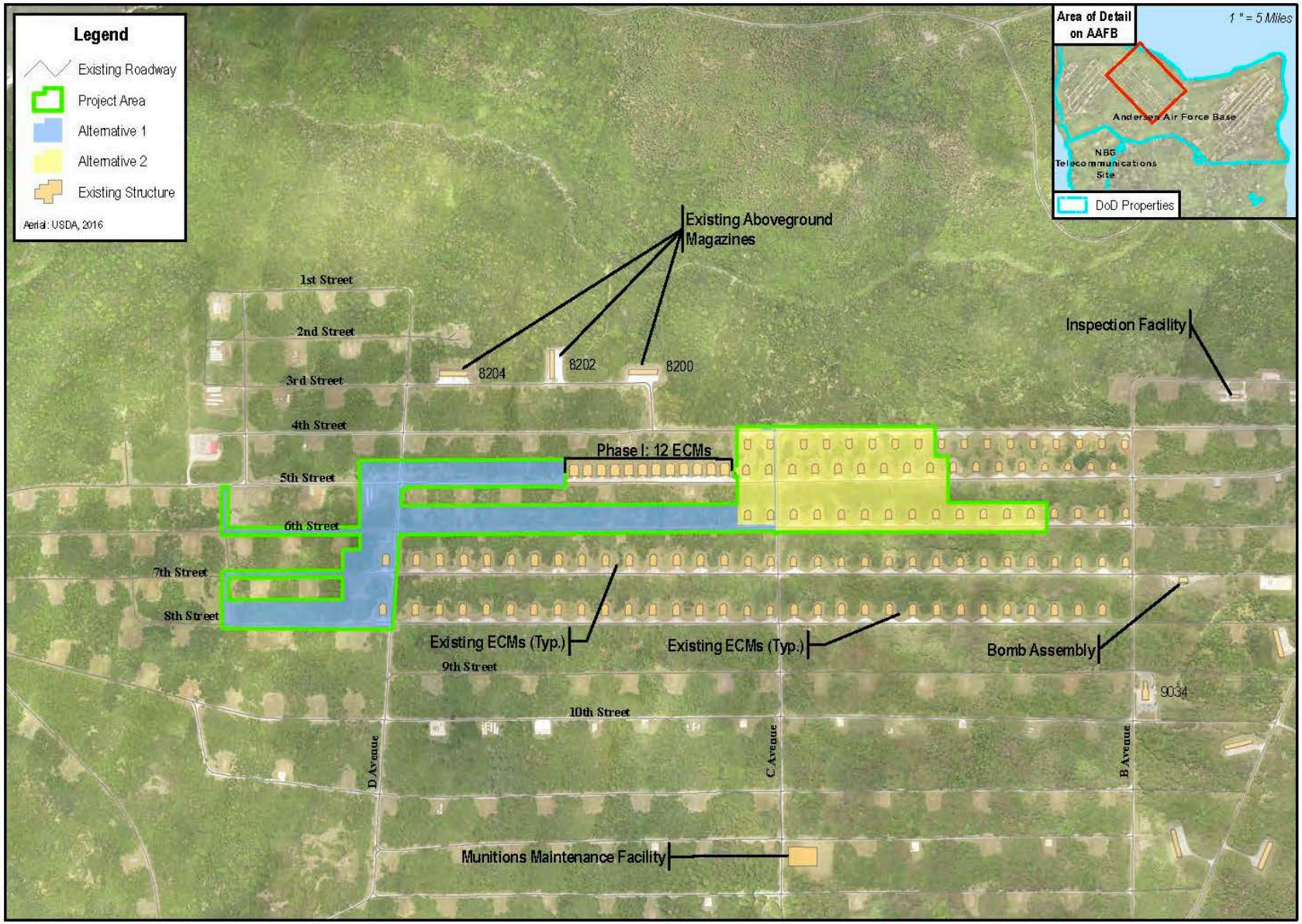


Figure 2-1
Existing Conditions (MSA I and Project Location)

1

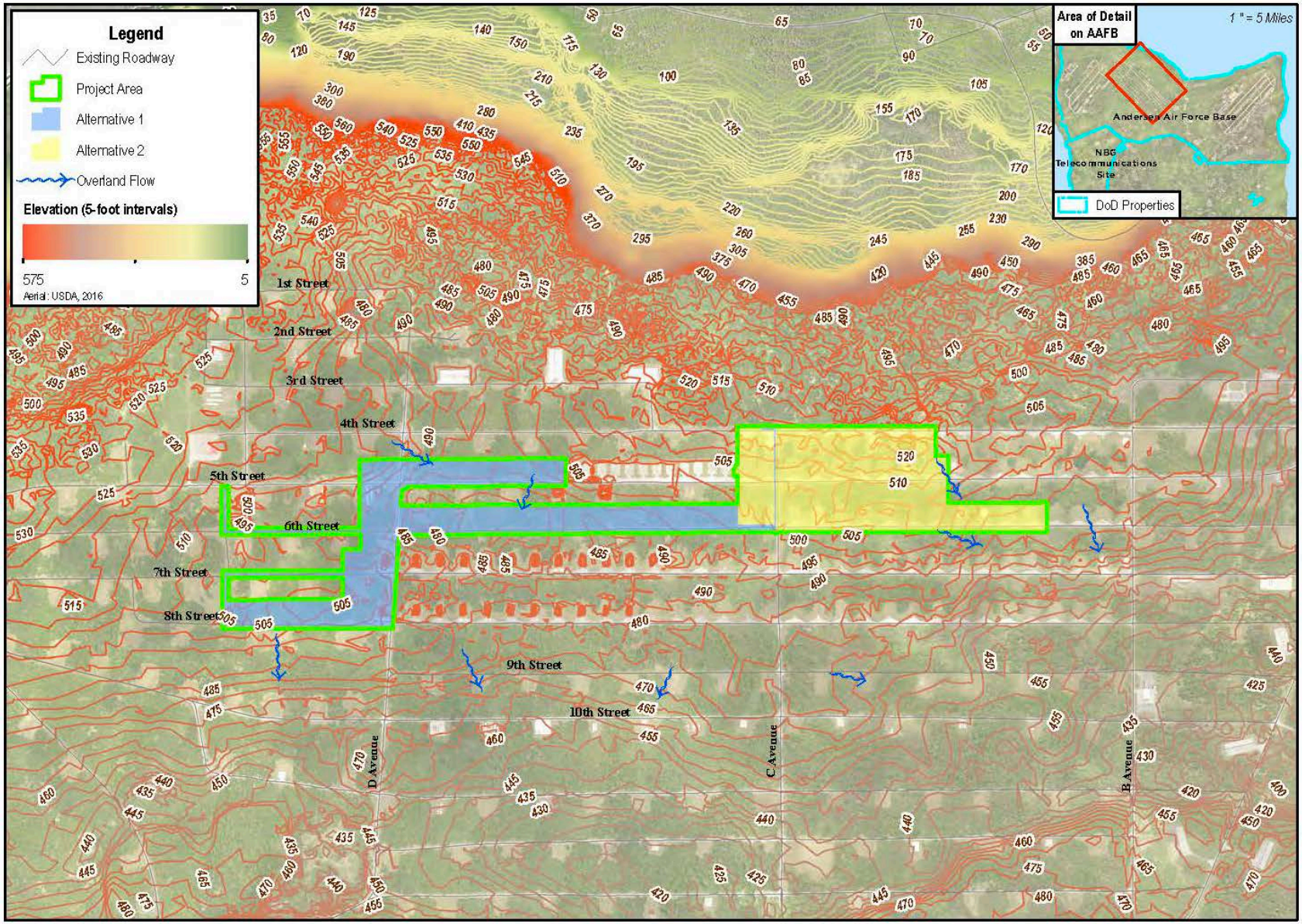


Figure 2-2
Topography and Drainage

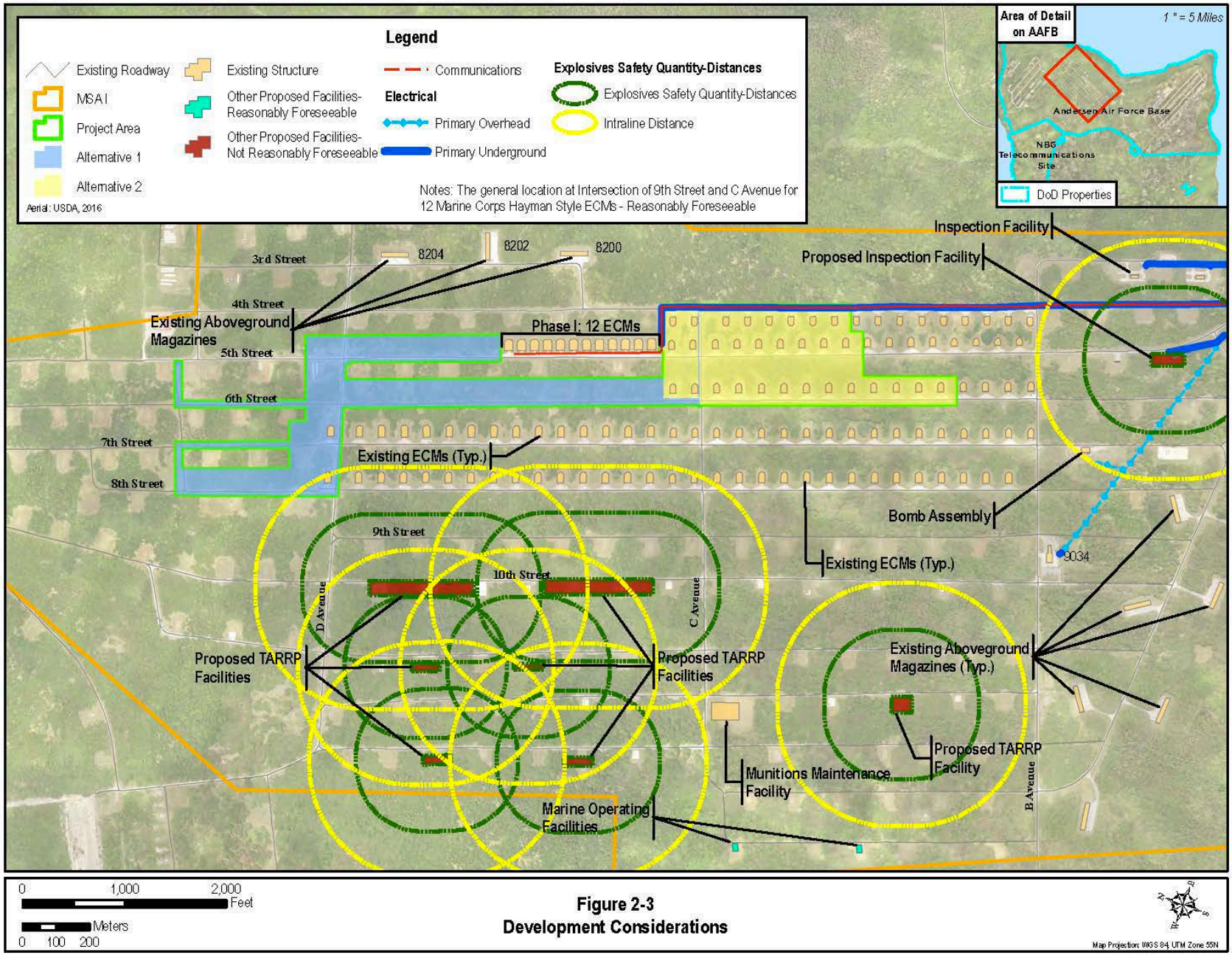


Figure 2-3
Development Considerations

2.1.2.1 Existing Facilities

Most existing facilities within MSA I must remain and will limit the areas where new facilities could be constructed. The primary existing facilities in the project vicinity are ECMs. There are two existing ECMs within the Alternative 1 footprint that would be retained. Alternative 2 would provide the option to demolish 30 existing ECMs to construct the proposed 48 new Hayman ECMs. Other existing facilities include: access roads, aboveground magazines, inspection facility, bomb assembly area, plus electrical and communications connections.

2.1.3 Explosives Safety

For existing storage facilities, the controlling constraint to siting new explosives storage facilities is the minimum inter-magazine distance that is based on the amount of munitions to be stored and the construction type of each storage facility. The inter-magazine distance (IMD), the distance from one magazine to another, for the existing ECMs and proposed Hayman style ECMs is approximately 100 feet for up to 500,000 pounds of hazard class/division (HC/D) 1.1 munitions. IMD arcs for existing ECMs are not depicted as a constraint in the summary constraints drawing that follows, but each alternative for new munitions storage facilities considered the minimum IMD from existing storage facilities. In addition to the IMD, each proposed facility must consider other explosives safety siting criteria including the minimum intra-line distance (the distance to related personnel or facilities), minimum public traffic route distance (the distance to unrelated public traffic routes), and the minimum inhabited building distance (the distance to unrelated facilities or personnel).

In addition to existing facilities, proposed facilities also impose siting constraints due to their explosives safety spacing requirements. See Section 4.3.3 for a list of Present and Reasonably Foreseeable Actions. Based on preliminary explosives site plans approved by the Department of Defense (DOD) Explosives Safety Board, proposed projects near the study area have the following explosives safety spacing requirements (USAF 2017):

- The proposed Marine Operation Locations have an approximate IMD of 680 feet
- Proposed tactical air-munitions rapid response package (TARRP) facilities have the following IMD:
  - Aboveground magazines have an approximate IMD of 680 feet
  - Operations pads have an approximate IMD of 694 feet
  - The T-2 pad has an approximate IMD of 694 feet
- The proposed Munitions Inspection Facility has an approximate IMD of 337 feet

2.1.4 Design Standards

Basic design standards for construction in northern Guam, munitions storage facilities in general, and munitions storage igloos specifically would be followed. Geotechnical conditions would be investigated and integrated into project design. Design standards specific to munitions storage facilities include the following:

- Air Force Handbook 32-1084, Facility Requirements
- Air Force Instruction 32-1021, Planning and Programming Military Construction Projects
- Air Force Manual (AFMAN) 91-201, Explosives Safety Standards

- Technical Manual 5-1300, Structures to Resist the Effects of Accidental Explosives
- DOD Manual 5100.76-M, Physical Security of Sensitive Conventional Arms, Ammunition, and Explosives
- DOD Standard 6055.9-STD, DOD Ammunition and Explosives Safety Standards

2.1.5 Description of Proposed Action

The USAF 36WG proposes to construct new munitions storage facilities and infrastructure upgrades in MSA I on Andersen AFB, Guam. The Proposed Action would help the 36 WG reduce its munitions storage capacity deficit.

The Proposed Action would include two action alternatives and one No Action alternative. Each action alternative proposes construction of 48 new Hayman style ECMs, based on the DOD Explosives Safety Board-approved Hayman ECM for Guam. The program requirement for munitions storage is guided by AFMAN 32-1084 *Earth Covered Magazines* (CC 422-264), AFMAN 91-201, Unified Facilities Criteria (UFC) 4-420-01. Figure 2-4 depicts a standard Hayman style ECM design. Figure 2-5 shows photographs of existing munitions storage igloos on Andersen AFB.

The igloos would be constructed with reinforced concrete floor and roof slabs, approximately 25 feet wide and 80 feet long interior dimension. Excavation depth would vary from at least 2 feet below the planned igloo footings to a depth of at least 5 feet beyond footing limits (DON, 2018a). Wing walls would be cast in place. Rear and side walls would be cast in place. The walls and roof are designed to be covered in a minimum of 24 inches (61 centimeters) of fill with a topping of shotcrete to prevent plant growth and erosion. Each new ECM would have approximately 2,000 square feet (ft^2) of floor space for munitions storage. Access to the storage area would be provided through a pair of blast resistant structural steel access doors of 7-bar construction that provides an 11-foot clear height and a 24-foot clear width opening. The doors are required to be secured with high security hasps and an intrusion detection system. Each igloo would have a concrete apron at the igloo door.

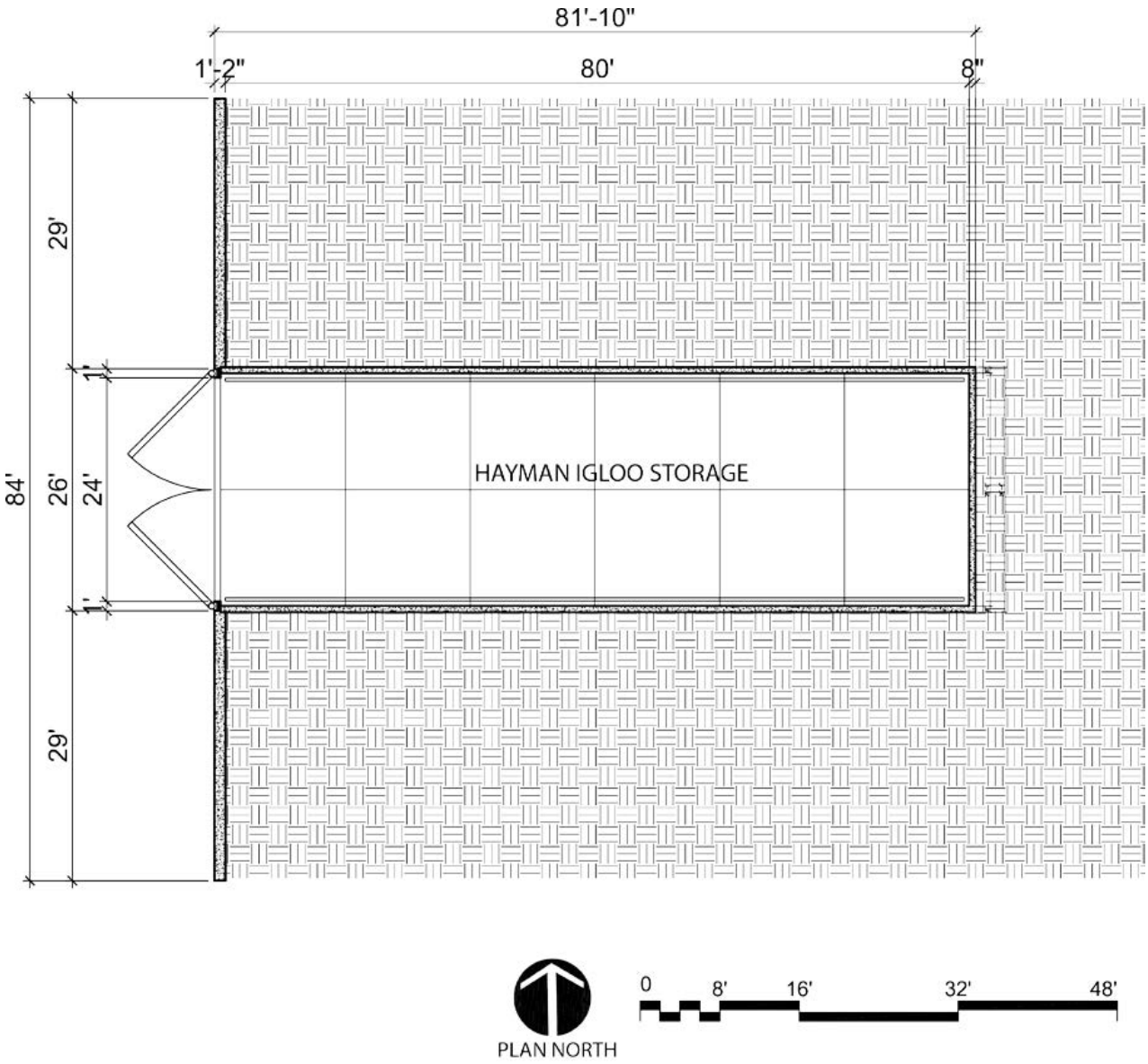
Each igloo would include electrical outlets, standard fluorescent lighting, and exterior lighting. Flood lights over the igloo doors would be hooded to avoid disturbing bats. Primary power would require 13.8 kV, and secondary power would require 480 volts and 120/208 volts. Each storage ECM would be lightning and surge protected and would have a grounding system.

No water or sewer infrastructure would be included for the igloos. Shotcrete erosion control of the exterior and waterproofing of the interior would also be included. For moisture drainage, the interior floor slab would be ridged in the center, parallel with the long direction, and sloped down 1 inch (2.5 centimeters) to a gutter. The space requires mechanical ventilation in two places, one in the side wall near the front entry, and one in the rear wall.

Construction fill material would be obtained from an established borrow location on Andersen AFB.

2.1.6 Timeline

The Proposed Action would occur in multiple phases based on the availability of funds. The anticipated timeline for construction, design and acquisition of the 48 igloos is approximately 3 years, anticipated between approximately 2020 and 2022. The 3-year timeline includes: 1 year for design, six months for acquisition, and 18 months for actual construction.



Source: DON, 2018a.

Figure 2-4 Typical Hayman Style ECM Design





Figure 2-5 Photographs of Existing Munitions Storage Igloos, Andersen AFB

2.2 Screening Factors

NEPA's implementing regulations provide guidance on the consideration of alternatives to a federally proposed action and require rigorous exploration and objective evaluation of reasonable alternatives. Only those alternatives determined to be reasonable and to meet the purpose and need require detailed analysis.

Potential alternatives that meet the purpose and need were evaluated against the following screening factors:

- Operational Readiness: Operational readiness must be preserved so the 36 WG is able to meet their USAF-assigned missions. Operational readiness is the capability of a unit/formation, aircraft, weapon system, or equipment to perform the missions or functions for which it is organized or designed.
- DOD Explosives Safety Board Approval: Proposed improvements must satisfy NEW square footage requirements and receive DOD Explosives Safety Board approval.
- Safety Requirements: The individual igloos must be sited in accordance with all regulatory guidance to ensure the safe working environment for munitions and other installation personnel. The igloo configurations are as close together as safety setback distances allow. This (1) helps maintain quantity-distance (QD) setback arcs within MSA 1 and prevent unnecessary exposure to habitable spaces outside the MSA; and (2) minimizes logistical and maintenance requirements due to a more compact project area footprint.

2.3 Alternatives Carried Forward for Analysis

Based on the reasonable alternative screening factors and meeting the purpose and need for the Proposed Action, two action alternatives were identified and will be analyzed within this EA. The No Action Alternative is also described below.

2.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur. Construction of new munitions storage facilities and infrastructure upgrades would not occur, and no additional storage capacity would be gained. There would be no site disturbance due to construction activities and utilities would not be extended or upgraded. The No Action Alternative would not meet the purpose and need for the Proposed Action; however, as required by NEPA, the No Action Alternative is carried forward for analysis in this EA. The No Action Alternative will be used to analyze the consequences of not undertaking the Proposed Action, not simply conclude no impact, and will serve to establish a comparative baseline for analysis and a determination of the significance of any effect.

2.3.2 Alternative 1 (Preferred Alternative)

Alternative 1 (the Preferred Alternative) proposes construction of 48 new Hayman style ECMs directly north and west of the existing 12 ECMs that were completed under Phase 1 in FY2008. Alternative 1 would be constructed in Phases 2 through 4. The number of igloos constructed in each phase may be adjusted, but the total number of new igloos remains at 48. Initial plans call for the following number of igloos in each phase:

- Phase 2: Construction of up to 16 Hayman style storage ECMs generally south of D Avenue on 6th Street.
- Phase 3: Construction of up to 20 Hayman style storage ECMs along 5th, 6th, 7th and 8th Street west of the Phase 1 ECMs.
- Phase 4: Construction of the remaining balance of Hayman-style storage ECMs to meet a total of 48, along 5th, and 6th Street, north of the Phase 1 ECMs.

Figure 2-6 depicts the proposed site plan for Alternative 1. Constructing 48 new Hayman style ECMs would result in a net increase of approximately 97,392 ft^2 of munitions storage capacity, reducing the operational storage capacity deficit at Andersen AFB from 280,000 ft^2 to approximately 182,600 ft^2. The Preferred Alternative would have the least amount of operational impact to existing ECMs, and the 48 new ECMs would be constructed without the need to demolish existing storage facilities, resulting in immediate storage capacity increase.

2.3.2.1 Existing Conditions

The site selected for Alternative 1 is currently undeveloped space and demolition of existing facilities would not be required. The site is heavily overgrown and would require vegetation clearance.

2.3.2.2 Site Disturbance

Construction and implementation of Alternative 1 would involve disturbance of 51 acres, 19 acres of which would be new impervious surface. Areas of the Proposed Action are detailed in Table 2-1.

Table 2-1 Alternative 1 Areas of Proposed Action

Alternative 1	***Acres***
Impervious Surface (Igloos, Pavement)	19.3
Pervious Construction Area (Grading, LID)	21.6
Pervious Utility Corridor	3.5
Construction Staging Area	1.6
Existing Igloo Site	1.25
Non-Impacted Pervious Surface	3.8
TOTAL	51.05

Key: LID = Low Impact Development.

2.3.2.3 Access

Existing access roads within the Alternative 1 footprint are in poor condition and improvements would be needed. New roads would be 24 feet wide with 2-foot wide shoulders and constructed of asphaltic concrete. Roads would be crowned to drain.

A paved apron between an adjacent road and the access doors would be required for each ECM. Each apron would consist of two separate elements: an asphaltic concrete transition approximately 26.5 feet long and 127 feet wide, and a Portland cement concrete apron centered on the ECM doors and approximately 24 feet long and 26 feet wide. It is assumed that excavation depths would be similar those described earlier for construction of the igloos (2-5 feet).

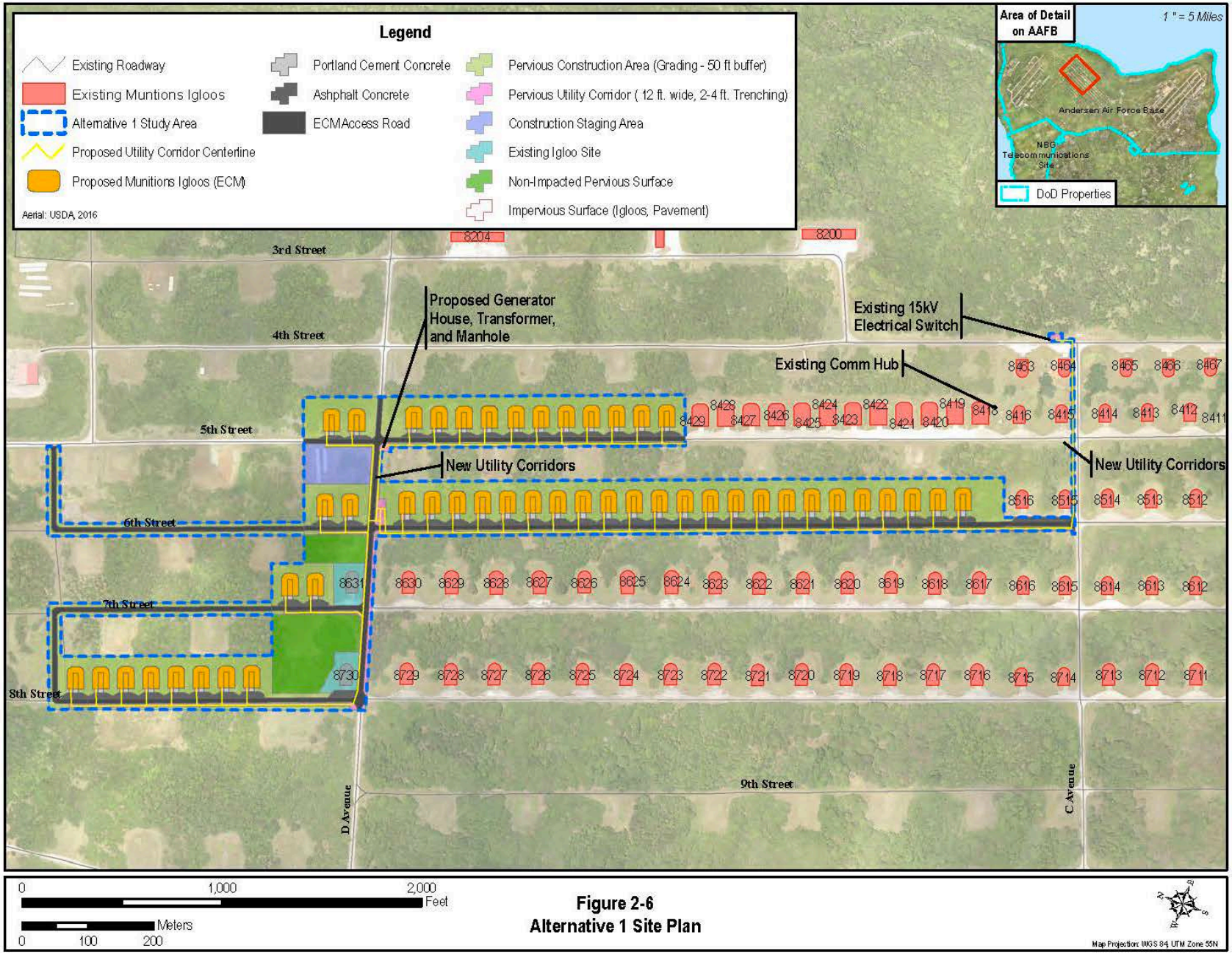


Figure 2-6
Alternative 1 Site Plan

2.3.2.4 Utilities

New electrical and communications services would be provided for Alternative 1. New electrical facilities would consist of a new radial feeder extended from the pad-mounted switch installed in Phase 1, to a new pad-mounted transformer and enclosure located near the intersection of 6th Street and D Avenue. A new building would be constructed adjacent to the transformer enclosure to house a new standby generator, which would serve the additional 48 ECMs. An automatic transfer switch would be provided from the new pad-mounted transformer and the standby generator to provide redundant electrical sources for the new ECMs. A distribution panel supplied from the automatic transfer switch would provide secondary service to the ECMs. Primary and secondary electrical service would be distributed to the ECMs via new utility corridors with ductbanks with intermediate handholes.

A new air-conditioned communications equipment building would be provided as well as a new standby generator building. Existing fiber optics would be extended from the communications equipment room and connected to serve the ECMs. New communications infrastructure housing would be located in the new utility corridors.

Storm drainage would be managed with percolation basins and meet the requirements of UFC 3-210-10, *Low Impact Development*. Potable water and sewer services are not required to serve the project area.

2.3.2.5 Antiterrorism Force Protection

In October 2006, the DOD issued Instruction Number 2000.16, *DOD Antiterrorism Standards*, requiring all DOD Components to adopt and adhere to common criteria and minimum construction standards to mitigate antiterrorism vulnerabilities and terrorist threats. The intent of these building standards is to integrate greater resistance to a terrorist attack into all inhabited buildings. That philosophy affects the general practice of designing inhabited buildings. Antiterrorism Force Protection (ATFP) standards consist of restrictions for onsite planning, including standoff distances, building separation, unobstructed space, drive-up and drop-off areas, access roads, and parking; structural design; structural isolation; and electrical and mechanical design. The igloos, Generator Building, and Telecom Building are considered low occupancy per UFC 4-010-01 as they are not routinely inhabited by 11 or more DoD personnel; therefore, they are exempt from the minimum ATFP standards. ATFP standards would be incorporated into the design of the project, where applicable.

2.3.3 Alternative 2

Alternative 2 proposes demolishing 30 existing substandard ECMs and constructing 48 new Hayman style ECMs in their place. The Alternative 2 project area is located directly south of the Phase I ECMs between 4th Street and 6th Street. Facilities that could be demolished include:

- ECMs 8463 through 8470 (8 total)
- ECMs 8408 through 8416 (9 total)
- ECMs 8504 through 8516 (13 total)

Demolishing the existing 30 ECMs would result in a loss of approximately 50,000 ft^2 of storage capacity. The proposed 48 ECMs would add approximately 47,392 ft^2 of munitions storage capacity. Alternative 2 would reduce the operational storage capacity deficit at Andersen AFB from 280,000 ft^2 to approximately 232,600 ft^2.

Figure 2-7 depicts the proposed Alternative 2 site plan.

1

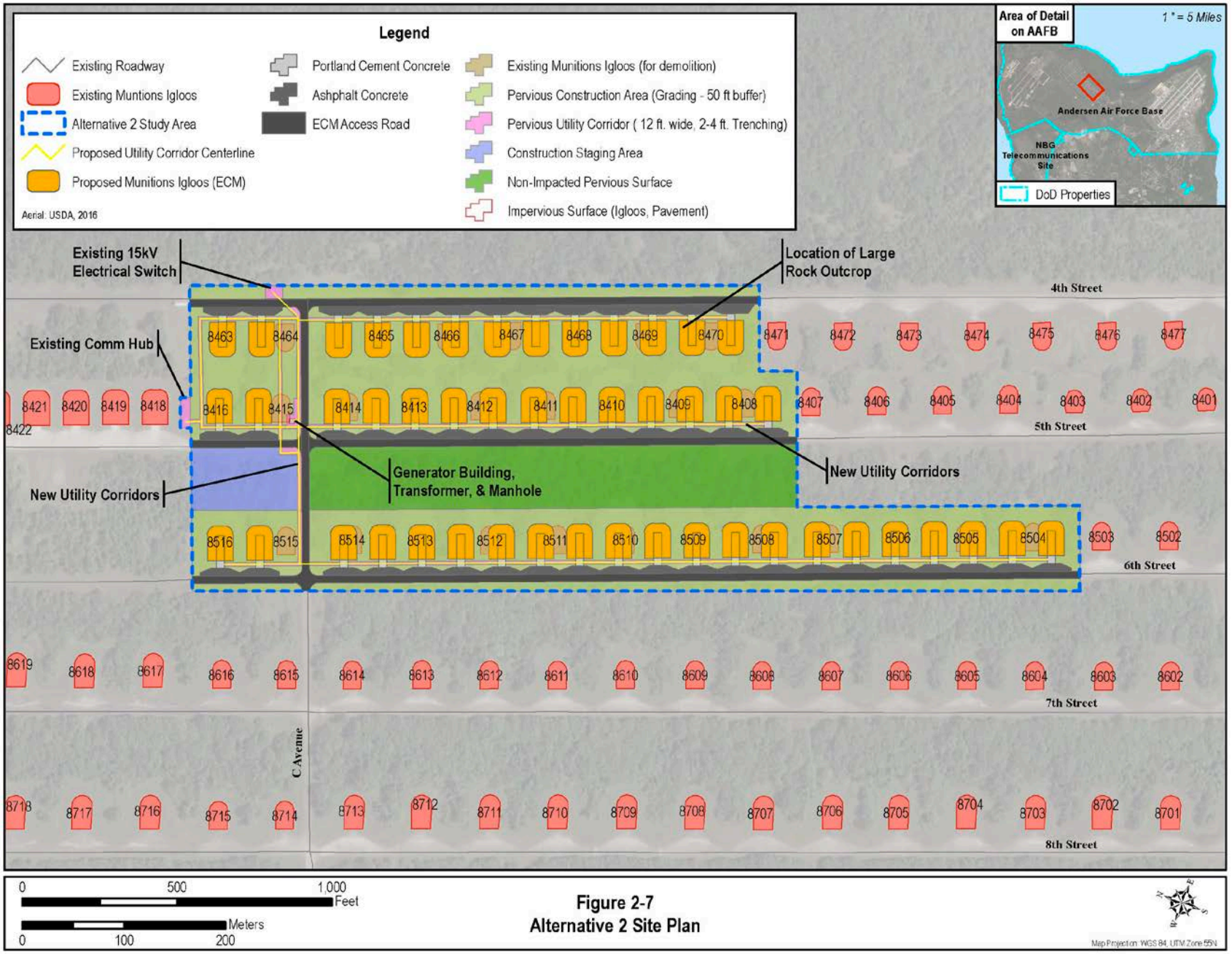


Figure 2-7
Alternative 2 Site Plan

2.3.3.1 Existing Conditions

There are 30 existing ECMs located within the Alternative 2 project area. The magazines were constructed in the 1950s and have since been rated as substandard due to their limited capacity for ordnance storage. The area proposed for construction has been previously disturbed so less existing vegetation would be cleared.

2.3.3.2 Site Disturbance

Construction and implementation of Alternative 2 would involve disturbance of 50 acres, 18 acres of which would be impervious surface. Areas of the Proposed Action are detailed in Table 2-2.

Table 2-2 Alternative 2 Areas of Proposed Action

Alternative 1	*Acres*
Impervious Surface (Igloos, Pavement)	18.2
Pervious Construction Area (Grading, LID)	20.3
Pervious Utility Corridor	2
Construction Staging Area	1.6
Non-Impacted Pervious Surface	7.4
TOTAL	49.5

Key: LID = Low Impact Development.

2.3.3.3 Access

Existing access roads are already improved and would only require minor patching to repair construction damage under Alternative 2.

2.3.3.4 Utilities

The electrical distribution for Alternative 2 would be the same as that described for Alternative 1 with the exception that the pad-mounted transformer and generator building would be located at the intersection of 5th Street and C Avenue. The electrical distribution plans and stormwater management for Alternative 2 would also be the same as Alternative 1.

2.3.3.5 Antiterrorism Force Protection

The same ATFP requirements listed under Alternative 1 would also apply to Alternative 2.

2.3.4 Alternatives Comparison

A comparison of alternatives is presented in Table 2-3.

Table 2-3 Alternatives Comparison

Metric	*Alternative 1*	*Alternative 2*
Total Acres	51.05 acres	49.5 acres
Total Impervious Surface	19.3 acres	18.2 acres
Total Pervious Surface	21.6 acres	20.3 acres
Demolition	No demolition	Demolition of 30 existing ECMs
Safety	Constrained by ESQD arcs	Constrained by ESQD arcs
Operational	None	Mission-critical short-term operational impacts to remove 30 ECMS from use during construction
Net Increase in Munitions Storage Capacity	97,392 ft^2	47,392 ft^2
Residual Storage Capacity Deficit	182,608 ft^2	232,608 ft^2
Biological	More vegetation removal than Alternative 2; potentially sensitive habitat	Majority of site was previously disturbed; less potentially sensitive habitat compared with Alternative 1
ROM Cost	No demolition costs; may include mitigation costs	Includes demolition costs

Key: ESQD = Explosive Safety Quantity Distance; ROM = Rough Order Magnitude.

2.4 Alternatives Considered but not Carried Forward for Effects Evaluation

The following alternatives were considered, but not carried forward for evaluation of potential effects to resources in this EA as they did not meet the purpose and need for the project and satisfy the reasonable alternative screening factors presented in Section 2.2.

2.4.1 Alternative Locations on Base for Munitions Storage Facilities

According to munitions siting criteria in AFMAN 91-201, *Explosives Safety Standards*, munitions storage facilities can only be constructed within an MSA. There are two MSAs on Andersen AFB: MSA I and MSA II (refer to Figure 1-2). MSA I is the primary MSA and is used to store large quantities of munitions (114 igloos), whereas MSA II, just north of the airfield, is much smaller (18 igloos) and cannot be adequately expanded to accommodate 48 additional munitions storage igloos. In addition, MSA II cannot be expanded to accommodate additional munitions storage igloos because it is constrained by topography and the airfield; safety setbacks and munitions siting criteria prohibit an increase in storage capacity. Furthermore, it is not operationally feasible or safe to store only a portion of the munitions shortfall in MSA II. It would not be safe or practical to transport munitions between MSA I and MSA II, or between the MSAs and other more distant locations, with the frequency needed to support the existing mission. Only MSA I would have adequate space for the proposed munitions storage igloos. Therefore, locations outside of MSA I on Andersen AFB were eliminated from detailed evaluation. Alternative configurations within MSA I were considered but are not being carried forward for detailed analysis in the EA because they do not meet operational or safety requirements.

2.4.2 Alternative Designs for Munitions Storage Facilities

Munitions storage facilities are used to store munitions explosives materiel, inert components, and equipment used for the operating requirements of the USAF. Table 2-4 presents a description of various types of munitions storage facilities and the basis for analysis or elimination. As indicated in Table 2-4, storage igloos were found to be the only reasonable munitions storage facility for the Proposed Action.

As defined in Air Force Handbook 32-1084, *Facility Requirements*, storage igloos are used to store all types of explosives and are the preferred facility where moisture condensation is not a factor. They would be either concrete or steel arch-type construction (see Figure 2-4). The typical munitions storage module is 24 feet by 80 feet long and no wider than 30 feet; however, length can vary in 66-foot increments to provide greater mission-specific flexibility. Of the various types of munitions storage facilities, the storage igloo was found to be the only reasonable alternative. Alternative designs for munitions storage facilities were considered but eliminated from detailed analysis in this EA because they did not meet operational or safety requirements.

2.4.3 Renovate, Upgrade, or Replace Existing Munitions Storage Igloos

The existing munitions storage igloos are rated to store only nonstandard-type munitions (i.e., limited to 250,000 pounds NEW capacity). The 36 WG could theoretically meet the storage shortfall by replacing the nonstandard doors and eroded earthen covering, or demolishing all 114 existing nonstandard storage igloos in MSA I and constructing enough 7-bar-rated replacement storage igloos to meet the shortfall (i.e., 117 storage igloos).

These alternatives were eliminated from detailed evaluation due to the current 36 WG munitions storage capacity deficit. In order to upgrade or replace any of the existing storage igloos, the munitions in that existing igloo (and possibly surrounding igloos) would have to be temporarily relocated for safety purposes. There is no other location on Andersen AFB that could safely accommodate a temporary relocation of munitions from the existing igloos. The only safe option would be to temporarily store munitions at an installation other than Andersen AFB during renovation or construction periods. The 36 WG would not be able to meet their current mission requirements if their existing capabilities were further reduced by temporarily storing munitions at other installations. Therefore, this alternative was eliminated from detailed evaluation. This alternative was considered but is not being carried forward for detailed analysis in the EA because it does not meet operational requirements.

Table 2-4 Munitions Storage Facility Alternatives

Type of Munitions Storage Facility	*Description and Most Appropriate Use*	*Basis for Analysis or Elimination*
Storage Igloo	Aboveground, covered with a minimum of 24 inches of earth. Preferred storage facility type for all explosives.	The storage igloo is the preferred storage facility type and meets the 36 WG's munitions storage needs. This alternative is analyzed in this EA.
Aboveground Magazine Storage	Aboveground, similar to storage igloo but not earth-covered. Requires large QD setbacks to ensure proper protection.	While similar in size and function to igloos, the QD arc for the aboveground magazines would encroach on habitable buildings outside MSA I. This is not a safe alternative. Therefore, this alternative was eliminated.
Multi-cubicle Magazine Storage	Aboveground, used to store small quantities of explosives. Ideal for segregating incompatible explosive groups.	The 36 WG needs to increase munitions storage space. Multi-cubicle magazines are designed for storing small quantities of munitions. Therefore, this alternative was eliminated.
Segregated Magazine Storage	Aboveground, similar to multi-cubicle magazine storage. Ideal for segregating incompatible explosive groups. Each cubicle is akin to a small locker with a door width of 36 inches.	The 36 WG needs to increase munitions storage space. Segregated magazines are designed for storing small quantities of munitions. Therefore, this alternative was eliminated.
Rocket Check Out and Assembly Storage	Serves as an operating location to accommodate the assembly, disassembly, and electrical checkout and provides a site to store built-up rockets.	Rocket checkout and assembly facilities are designed for the assembly and storage of rockets. This capability is beyond the scope of the 36 WG's needs. Therefore, this alternative was eliminated.
Module Barricaded Storage	Provides field storage for large quantities of explosives in constrained land uses. Maximum NEW permitted is 250,000 pounds. Locations for use must be specifically approved under AFMAN 91-201.	Module barricaded storage supports less NEW than storage igloos. Furthermore, this would be an expensive venture to accommodate the munitions storage required. Therefore, this alternative was eliminated.
Inert Spares Storage	Stores inert munitions components, materials, and support equipment.	The 36 WG needs to store live munitions. Therefore, this alternative was eliminated.
Ancillary Explosives Facility	Used in pads, locations, revetments, and facilities primarily for munitions holding, inspection, loading, and unloading.	The 36 WG needs permanent munitions storage. This alternative is for the temporary storage of munitions. Therefore, this alternative was eliminated.

Source: Based on munitions facilities identified in the *Air Force Munitions Facilities Standards Guide Volume I* (Air Force Center for Engineering and the Environment, 2004).

2.5 Best Management Practices Included in Proposed Action

This section presents an overview of the BMPs that are incorporated into the Proposed Action in this document. BMPs are existing policies, practices, and measures that the Air Force would adopt to reduce the environmental impacts of designated activities, functions, or processes. Although BMPs mitigate potential impacts by avoiding, minimizing, or reducing/eliminating impacts, BMPs are distinguished from potential mitigation measures because BMPs are (1) existing requirements for the Proposed Action, (2) ongoing, regularly occurring practices, or (3) not unique to the Proposed Action. In other words, the BMPs identified in this document are inherently part of the Proposed Action and are not potential mitigation measures proposed as a function of the NEPA environmental review process for the Proposed Action. Table 2-5 includes a list of BMPs. Mitigation measures are discussed separately in Chapter 3.

Table 2-5 Best Management Practices

BMP	*Description*	*Impacts Reduced/Avoided*
Air Quality	Properly maintain vehicles and construction equipment.	Reduce/minimize gaseous and particulate pollutant emissions during construction.
Air Quality	Water exposed soil for dust suppression.	Minimize fugitive dust associated with soil disturbance during construction.
Water Quality	Comply with Program and Site-Specific Stormwater Pollution Prevention Plans and use measures such as diversion dikes and swales, gravel/sand bag berms, and fiber rolls.	Reduce/minimize off-site transport of stormwater runoff and sediment.
Water Quality	Comply with Clean Water Act Section 401 Water Quality Certification: prepare and implement Environmental Protection Plan and use measures such as diversion dikes and swales, gravel/sand bag berms, and fiber rolls.	Reduce/minimize off-site transport of stormwater runoff and sediment during construction.
Water Quality	Equip all vehicles with on-board spill containment kits, park on paved surfaces where possible, and place drip pans beneath parked vehicles.	Prevent/minimize potential for construction vehicle fuel to enter surface and groundwater.
Water Quality	In the event of an accidental release of fuel, follow the Andersen AFB *Oil and Hazardous Substance Contingency Plan*, and implement the Guam Environmental Protection Agency *Spill Prevention Control Countermeasure Program.*	Prevent/minimize potential for construction vehicle fuel to enter surface and groundwater.
Water Quality	Construct percolation basins between the new ECMs according to the requirements of Unified Facilities Criteria (UFC) 3-210-10, *Low Impact Development*.	Prevent erosion and sediment mobilization into stormwater drainage resulting from the increased impervious surfaces created by construction of the ECMs.
Water Quality	Following completion of construction and utility line trenching replant exposed soil with native vegetation.	Prevent long-term soil erosion in the areas disturbed during construction.
Geological Resources	Use drainage diversion and control to divert stormwater away from the construction area.	Prevent increased erosion, compaction, and soil loss from physical disturbance during construction activity.
Geological Resources	Limit the size of the unstabilized disturbed areas for each project phase to less than 20 acres during construction.	Prevent increased erosion, compaction, and soil loss from physical disturbance during construction activity.

Table 2-5 Best Management Practices

BMP	*Description*	*Impacts Reduced/Avoided*
Geological Resources	Implement standard soil erosion control practice construction practices.	Minimize soil erosion during clearing, grubbing, grading, embankment or filling, excavation, stockpiling, or other earthmoving operations.
Geological Resources	Construct percolation basins between the new ECMs according to the requirements of UFC 3-210-10, *Low Impact Development*.	Prevent erosion and sediment mobilization into stormwater drainage resulting from the increased impervious surfaces created by construction of the ECMs.
Geological Resources	Construct ECMs in accordance with UFC 3-310-04, *Seismic Design of Buildings* dated June 1, 2013 (U.S. Army Corps of Engineers [USACE], 2013).	Minimize potential for seismic safety hazards at the new ECMs.
Infrastructure	Locate and mark existing underground fire suppression, electrical, and communications lines and avoid them during construction activities.	Prevent damage to existing utility infrastructure in the project area.
Infrastructure	Recycle all project municipal solid waste, including concrete demolition debris, to the maximum extent possible. Mulch cleared vegetation for landscaping.	Divert project-related solid waste from the Andersen AFB to minimize impacts to the landfill capacity.
Public Health and Safety	Comply with DOD Directive 6055.9-STD (DOD Ammunition and Explosive Safety Submission [ESS]) and prepare ESS documentation.	Outline specific measures that would be implemented to ensure the safety of workers and the public.
Public Health and Safety	Have qualified unexploded ordnance (UXO) personnel perform surveys to identify and remove potential UXO and munitions and explosives of concern (MEC) items prior to the initiation of ground-disturbing activities.	Prevent/minimize potential UXO and MEC hazards before construction begins.
Public Health and Safety	Have the Andersen AFB Explosive Ordnance Disposal Unit present at the work site during all active groundbreaking and clearing activities.	Prevent/minimize potential UXO and MEC hazards during construction.
Public Health and Safety	Provide UXO awareness training to construction personnel involved in grading and excavations prior to and during ground-disturbing activities that would occur in previously disturbed areas that have a high probability of UXO.	Prevent/minimize potential UXO and MEC hazards to workers during construction.
Hazardous Materials and Waste	Conduct ongoing radon gas monitoring in the new ECMs and maintain the ventilations following construction (U.S. Navy 2017).	Minimize potential impacts of radon gas accumulation inside the ECMs.

2.6 Decision to be Made and Identification of the Preferred Alternative

The 36 WG will make one of the following decisions:

- Take no action as described in Section 2.3.1
- Implement Alternative 1 as the Preferred Alternative as described in Section 2.3.2
- Implement Alternative 2 as described in Section 2.3.3

This page intentionally left blank.

3 Affected Environment and Environmental Consequences

This chapter presents a description of the environmental resources and baseline conditions that could be affected from implementing any of the alternatives and an analysis of the potential direct and indirect effects of each alternative.

All potentially relevant environmental resource areas were initially considered for analysis in this Environmental Assessment (EA). In compliance with the National Environmental Policy Act (NEPA), the Council on Environmental Quality (CEQ), and the Department of the Navy's "Procedures for Implementing NEPA (32 CFR Part 775), Secretary of the Navy Instruction (SECNAVINST) 50906.A, *Environmental Planning for Department on the Navy Actions,* and Office of the Chief of Naval Operations Instruction (OPNAVINST) M-5090.1 Chapter 10 , the discussion of the affected environment (i.e., existing conditions) focuses only on those resource areas potentially subject to impacts. Additionally, the level of detail used in describing a resource is commensurate with the anticipated level of potential environmental impact.

"Significantly," as used in NEPA, requires considerations of both context and intensity. Context means that the significance of an action must be analyzed in several contexts such as society as a whole (e.g., human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of a proposed action. For instance, in the case of a site-specific action, significance would usually depend on the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant. Intensity refers to the severity or extent of the potential environmental impact, which can be thought of in terms of the potential amount of the likely change. In general, the more sensitive the context, the less intense a potential impact needs to be in order to be considered significant. Likewise, the less sensitive the context, the more intense a potential impact would be expected to be significant.

This section includes air quality, water resources, geological resources, cultural resources, biological resources, noise, infrastructure, transportation, public health and safety, and hazardous materials and wastes.

The potential impacts to the following resource areas are considered to be negligible or non-existent so they were not analyzed in detail in this EA:

Land Use: Both alternatives are located on Andersen Air Force Base (AFB) within Munitions Storage Area (MSA) 1 (land already designated for munitions storage). The entire territory of Guam lies within the Coastal Zone. Neither Alternative 1 nor Alternative 2 would alter or modify the existing land use designations; therefore, this resource has been excluded from further detailed analysis. The USAF will coordinate with the Guam Bureau of Statistics and Plans to ensure the proposed action is consistent with the Guam Coastal Management Program and is in compliance with the Coastal Zone Management Act to the maximum extent practicable. Appendix E will include the coastal consistency analysis for the proposed action (coordinated with Guam Bureau of Statistics and Plans).

Visual Resources: Both alternatives would be located on Andersen AFB within MSA 1 (land already designated for munitions storage). This area cannot be accessed or seen by anyone other than Andersen AFB personnel. Multiple earth-covered magazines (ECMs) resembling those that would be constructed with either Alternative 1 or Alternative 2 are already present in MSA 1. Neither Alternative 1 nor Alternative 2 would change the visual characteristics of MSA 1; therefore, this resource has been excluded from further detailed analysis.

Airspace: Both alternatives are located on Andersen AFB, within MSA 1 (land already designated for munitions storage). With either alternative, there would be no changes to airspace. Therefore, this resource has been excluded from further detailed analysis.

Socioeconomics: Neither Alternative 1 nor Alternative 2 would involve any activities that would contribute to changes in socioeconomic conditions at Andersen AFB or on the island of Guam. There would be no change in the number of personnel assigned to Andersen AFB, and, therefore, there would be no changes in area population or associated demands for housing and support services. There would be short-term minor beneficial economic impacts from the local purchase of goods and services during construction of either alternative. Neither alternative would pose any adverse or disproportionate environmental health or safety risks to children living on or in the vicinity of Andersen AFB. Therefore, this resource has been excluded from further detailed analysis.

Environmental Justice: Consideration of environmental justice concerns includes race, ethnicity, and the poverty status of populations in the vicinity of a proposed action. Short-term direct minor beneficial impacts on the local economy through increased employment and purchase of goods and services would be expected as a result of construction activities. Both alternatives are located entirely within MSA 1, an area designated for munitions storage that is only accessible to Andersen AFB munitions personnel. Neither Alternative 1 nor Alternative 2 would pose any adverse or disproportionate environmental health or safety risks to the population living on or in the vicinity of Andersen AFB. Therefore, this resource has been excluded from further detailed analysis.

3.1 Air Quality

Air quality in a given location is defined by the concentration of various pollutants in the atmosphere. A region's air quality is influenced by many factors, including the type and amount of pollutants emitted into the atmosphere, the size and topography of the air basin, and the prevailing meteorological conditions.

Most air pollutants originate from human-made sources, including mobile sources (e.g., cars, trucks, buses) and stationary sources (e.g., factories, refineries, power plants), as well as indoor sources (e.g., some building materials and cleaning solvents). Air pollutants are also released from natural sources such as volcanic eruptions and forest fires.

3.1.1 Regulatory Setting

3.1.1.1 Criteria Pollutants and National Ambient Air Quality Standards

The principal pollutants defining the air quality, called "criteria pollutants," include carbon monoxide (CO), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), ozone (O_3), suspended particulate matter less than or equal to 10 microns in diameter (PM_{10}), fine particulate matter less than or equal to 2.5 microns in diameter ($PM_{2.5}$), and lead (Pb). CO, SO_2, Pb, and some particulates are emitted directly into the atmosphere from emissions sources. O_3, NO_2, and some particulates are formed through atmospheric chemical reactions that are influenced by weather, ultraviolet light, and other atmospheric processes.

Under the Clean Air Act (CAA), the U.S. Environmental Protection Agency (USEPA) has established National Ambient Air Quality Standards (NAAQS) (40 Code of Federal Regulations [CFR] part 50) for these pollutants. NAAQS are classified as primary or secondary. Primary standards protect against adverse health effects; secondary standards protect against welfare effects, such as damage to farm crops and vegetation and damage to buildings. Some pollutants have long-term and short-term

standards. Short-term standards are designed to protect against acute, or short-term, health effects, while long-term standards were established to protect against chronic health effects.

Areas that are and have historically been in compliance with the NAAQS are designated as attainment areas. Areas that violate a federal air quality standard are designated as nonattainment areas. Areas that have transitioned from nonattainment to attainment are designated as maintenance areas and are required to adhere to maintenance plans to ensure continued attainment.

The CAA requires local air quality management agencies to develop a general plan to attain and maintain the NAAQS in all areas of the country and a specific plan to attain the standards for each area designated nonattainment for a NAAQS. These implementation plans are developed by local air quality management agencies and submitted to USEPA for approval.

In addition to the NAAQS for criteria pollutants, national standards exist for hazardous air pollutants (HAPs), which are regulated under Section 112(b) of the 1990 CAA Amendments. The *National Emission Standards for Hazardous Air Pollutants* regulate HAP emissions from stationary sources (40 CFR part 61). Because the Proposed Action does not involve any new stationary sources of emissions, HAPs are not discussed further in this section.

3.1.1.2 General Conformity

The USEPA General Conformity Rule applies to federal actions occurring in nonattainment or maintenance areas when the total direct and indirect emissions of nonattainment pollutants (or their precursors) exceed specified thresholds. The emissions thresholds that trigger requirements for a conformity analysis are called *de minimis* levels. *De minimis* levels (in tons per year [tpy]) vary by pollutant and also depend on the severity of the nonattainment status for the air quality management area in question.

A conformity applicability analysis is the first step of a conformity evaluation and assesses if a federal action must be supported by a conformity determination. This is typically done by quantifying applicable direct and indirect emissions that are projected to result due to implementation of the federal action. Indirect emissions are those emissions caused by the federal action and originating in the region of interest, but which can occur at a later time or in a different location from the action itself and are reasonably foreseeable. The federal agency can control and will maintain control over the indirect action due to a continuing program responsibility of the federal agency. Reasonably foreseeable emissions are projected future direct and indirect emissions that are identified at the time the conformity evaluation is performed. The location of such emissions is known and the emissions are quantifiable, as described and documented by the federal agency based on its own information and after reviewing any information presented to the federal agency. If the results of the applicability analysis indicate that the total emissions would not exceed the *de minimis* emissions thresholds, then the conformity evaluation process is completed. *De minimis* threshold emissions are presented in Table 3-1.

Table 3-1 General Conformity *de minimis* levels

Pollutant	*Area Type*	*tpy*
Ozone (VOC or NO_x)	Serious nonattainment	50
	Severe nonattainment	25
	Extreme nonattainment	10
	Other areas outside an ozone transport region	100
Ozone (NO_x)	Marginal and moderate nonattainment inside an ozone transport region	100
	Maintenance	100
Ozone (VOC)	Marginal and moderate nonattainment inside an ozone transport region	50
	Maintenance within an ozone transport region	50
	Maintenance outside an ozone transport region	100
Carbon monoxide, SO_2 and NO_2	All nonattainment and maintenance	100
PM_{10}	Serious nonattainment	70
	Moderate nonattainment and maintenance	100
$PM_{2.5}$ Direct emissions, SO_2, NO_x (unless determined not to be a significant precursor), VOC or ammonia (if determined to be significant precursors)	All nonattainment and maintenance	100
Lead (Pb)	All nonattainment and maintenance	25

Key: NO_x = nitrogen oxide; VOC = volatile organic compound.

3.1.1.3 Greenhouse Gases

Greenhouse Gases (GHGs) are gas emissions that trap heat in the atmosphere. These emissions occur from natural processes and human activities. Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in GHG emissions from human activities. The climate change associated with this global warming is predicted to produce negative economic and social consequences across the globe.

USEPA issued the Final *Mandatory Reporting of Greenhouse Gases Rule* on September 22, 2009. GHGs covered under the Final *Mandatory Reporting of Greenhouse Gases Rule* are carbon dioxide (CO_2), methane, nitrogen oxide (NO_x), hydrofluorocarbons, perfluorocarbons, sulfur hexafluoride, and other fluorinated gases including nitrogen trifluoride and hydrofluorinated ethers. Each GHG is assigned a global warming potential. The global warming potential is the ability of a gas or aerosol to trap heat in the atmosphere. The global warming potential rating system is standardized to CO_2, which has a value of one. The equivalent CO_2 rate is calculated by multiplying the emissions of each GHG by its global warming potential and adding the results together to produce a single, combined emissions rate representing all GHGs. Under the rule, suppliers of fossil fuels or industrial GHGs, manufacturers of mobile sources and engines, and facilities that emit 25,000 metric tons or more per year of GHG emissions as CO_2e are required to submit annual reports to USEPA.

3.1.2 Affected Environment

Guam has been designated as Air Quality Control Region No. 246. Guam is in attainment of the NAAQS for all criteria pollutants, with the exception of the areas within a 3.5-mile radius of the Piti and Tanguisson Power Plants. These areas are in nonattainment of the NAAQS for SO_2, however, Andersen

AFB is outside of these nonattainment areas (USEPA, 2017). Because the project area is in attainment of the NAAQS, Conformity Applicability Requirements do not apply to the Proposed Action; however, as explained in Section 3.1.3 below, estimates of potential air quality emissions have been provided for planning purposes.

3.1.3 Environmental Consequences

Effects on air quality are based on estimated direct and indirect emissions associated with the action alternatives. The region of influence (ROI) for assessing air quality impacts is the air basin in which the project is located. Guam has been designated as Air Quality Control Region No. 246.

Estimated emissions from a proposed federal action are typically compared with the relevant national and state standards to assess the potential for increases in pollutant concentrations. Although the ROI is in attainment of the NAAQS for all criteria pollutants and no *de minimis* thresholds apply, emissions estimates are provided and are compared with *de minimis* thresholds of 100 tpy for criteria pollutants (i.e., *de minimis* threshold for a basic nonattainment area), for planning purposes only.

3.1.3.1 Approach to Analysis

The air quality analysis estimated the magnitude of emissions that would occur from proposed construction activities. Construction-related activities would include clearing vegetation and grading to prepare the site, paving the igloo pads, constructing the additional 48 Hayman style munitions storage igloos and infrastructure upgrades, and architectural coating.

Operational emissions from maintenance and repair activities would be minor and infrequent and are, therefore, evaluated only briefly and qualitatively.

3.1.3.2 Emissions Evaluation Methodology

Air quality impacts from construction activities proposed under each action alternative would primarily occur from combustive emissions due to the use of fossil fuel-powered equipment and fugitive dust emissions (PM_{10} and $PM_{2.5}$) from the operation of equipment on exposed soil. Construction emissions were estimated using CalEEMod (Version 2016.3.1), which is an industry accepted comprehensive air quality modeling tool for quantifying air quality emissions from land use projects. Assumptions were made regarding the total number of days each piece of equipment would be used, and the number of hours per day each type of equipment would be used. Assumptions and model inputs are located within the modeling calculations presented in Appendix B.

3.1.3.3 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline air quality. Therefore, no significant impacts to air quality or air resources would occur with implementation of the No Action Alternative.

3.1.3.4 Alternative 1

Impacts

Construction of 48 new Hayman style ECMs under Alternative 1 would be divided over the three-year construction period and would include clearing vegetation, grading to prepare the site, paving the ECM pads, construction of the ECMs and supporting structures (standby generator building, telecommunications building, and transformer enclosure), and architectural coating. Since phasing of

the projects could potentially change, it is assumed for the air quality analysis that the amount of construction would be roughly equal for each of the three years. These activities would generate minor amounts of air emissions and dust, which would have the potential to migrate off-site, depending on wind and soil conditions and the intensity of surface disturbance on any given day. Construction activities would be temporary.

Table 3-2 presents a summary of the annual estimated air quality emissions associated with construction activities at Andersen AFB under Alternative 1. Because the potential emissions from construction activities would occur over the course of three years, they are not additive. As shown in Table 3-2, construction emissions would be below the *de minimis* thresholds of a basic nonattainment area. As previously discussed, the ROI is in attainment of the NAAQS for all criteria pollutants and even if the ROI was located in a basic nonattainment area, the estimated emission would not trigger a formal Conformity Determination under the CAA General Conformity Rule.

Table 3-2 Alternative 1 – Construction Emissions at Andersen AFB with Evaluation of Conformity

Approximate Calendar Year	*Emissions (tons/year)*					
	VOCs	*NO_x*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*
Year 1 – Phase 2	9.06	4.37	3.25	0.01	0.77	0.42
Year 2 – Phase 3	9.09	4.53	3.48	0.01	0.84	0.45
Year 3 – Phase 4	8.93	3.15	2.54	0.01	0.56	0.27
Conformity *de minimis* Limits *(for a basic nonattainment area)*[1]	100	100	100	100	100	100
Exceeds Conformity *de minimis* Limits?[1]	No	No	No	No	No	No

Note: [1] The ROI is in attainment of the NAAQS for all criteria pollutants and no *de minimis* thresholds apply; however, emission estimates have been provided and are compared with the *de minimis* thresholds of a basic nonattainment area, for planning purposes only.

The estimated emissions presented in Table 3-2 would be negligible and would not trigger a formal Conformity Determination under the CAA General Conformity Rule. Standard BMPs such as proper maintenance of vehicles and construction equipment and dust suppression methods (watering of exposed soil) would be implemented by the construction contractor as needed to minimize and further reduce air quality impacts.

General Conformity

The General Conformity rule applies to federal actions proposed within areas designated as either nonattainment or maintenance areas for a NAAQS for any of the criteria pollutants. Emissions of pollutants for which an area is in attainment are exempt from conformity analyses. As such, a Record of Non-Applicability for CAA conformity is not required for this project.

Because the ROI is in attainment of all criteria pollutants, the *de minimis* thresholds for General Conformity Applicability analysis do not apply. The temporary and minor increases in construction and operation emissions would be negligible (as shown in Table 3-2), would not trigger a formal Conformity Determination under the CAA General Conformity Rule, and would be not be considered significant.

Greenhouse Gases

Implementation of Alternative 1 would contribute a nominal amount of emissions of GHGs from the combustion of fossil fuels from construction and operational activities. Total emissions for all constituents in the maximum construction year for Alternative 1 is 18 tons (see Table 3-2), and only a

subset of these are considered GHG emissions. Therefore, due to the relatively small project scale, the annual GHG emissions would fall well below the CEQ threshold of 25,000 metric tons. The limited amount of emissions would not likely contribute to global warming to any discernible extent. Therefore, implementation of Alternative 1 would not result in significant impacts to air quality.

3.1.3.5 Alternative 2

Impacts

Air quality impacts under Alternative 2 would be similar as described for Alternative 1, except that emissions associated with construction activities would be slightly higher during Phase 2 (approximately 2019) when compared to Alternative 1. This is because the proposed demolition of 30 existing ECMs is assumed to occur in Phase 2, before construction of the new ECMs. Emission estimates would be slightly lower for Phase 3 and Phase 4 when compared to Alternative 1, due to a slightly smaller construction footprint proposed under Alternative 2. However, since phasing of the projects could potentially change, it is assumed for the air quality analysis that the amount of construction would be roughly equal for each of the three years. Table 3-3 presents a summary of the estimated annual emissions associated with construction activities at Andersen AFB under Alternative 2.

Table 3-3 Alternative 2 – Construction Emissions at Andersen AFB with Evaluation of Conformity

Approximate Calendar Year	*Emissions (tons/year)*					
	VOCs	*NO_x*	*CO*	*SO_2*	*PM_{10}*	*$PM_{2.5}$*
Year 1 – Phase 2	9.12	6.44	4.32	0.01	1.14	0.67
Year 2 – Phase 3	8.98	4.86	3.86	0.01	0.81	0.44
Year 3 – Phase 4	8.80	3.42	2.82	0.01	0.57	0.28
Conformity *de minimis* Limits *(for a basic nonattainment area)*[1]	100	100	100	100	100	100
Exceeds Conformity *de minimis* Limits?[1]	No	No	No	No	No	No

Note: [1] The ROI is in attainment of the NAAQS for all criteria pollutants and no *de minimis* thresholds apply; however, emission estimates have been provided and are compared with the *de minimis* thresholds of a basic nonattainment area, for planning purposes only.

Total emissions for all constituents in the maximum construction year for Alternative 2 is less than 22 tons (see Table 3-3), and only a subset of these are considered GHG emissions. Therefore, due to the relatively small project scale, the annual GHG emissions would fall well below the CEQ threshold of 25,000 metric tons. Similar to Alternative 1, the estimated emissions in Table 3-3 for Alternative 2 would be temporary and minor and would not trigger a formal Conformity Determination under the CAA General Conformity Rule. As stated for Alternative 1, a Record of Non-Applicability for CAA conformity is not required for this project. The temporary and minor increases in construction and operation emissions would be negligible (as shown in Table 3-3), would not trigger a formal Conformity Determination under the CAA General Conformity Rule, and would be not be considered significant. The annual GHG emissions would fall well below the CEQ threshold of 25,000 metric tons, so the limited amount of emissions would not likely contribute to global warming to any discernible extent. Therefore, implementation of Alternative 2 would not result in significant impacts to air quality.

3.2 Water Resources

This discussion of water resources includes groundwater, surface water, wetlands, and floodplains. This section only discusses the physical characteristics of wetlands. Related wildlife and vegetation are

addressed in Section 3.5, Biological Resources. The project location is inland. No runoff from construction or operational activities will reach cliff edges and flow offshore, thereby ensuring that coral reefs will not be affected. Measures to avoid and minimize runoff at the project site are discussed in Section 3.2.3, Environmental Consequences.

Groundwater is water that flows or seeps downward and saturates soil or rock, supplying springs and wells. Groundwater is used for water consumption, agricultural irrigation, and industrial applications. Groundwater properties are often described in terms of depth to aquifer, aquifer or well capacity, water quality, and surrounding geologic composition. Sole source aquifer designation provides limited protection of groundwater resources that are used as drinking water supplies.

Surface water resources generally consist of wetlands, lakes, rivers, and streams. Surface water is important for its contributions to the economic, ecological, recreational, and human health of a community or locale. A Total Maximum Daily Load is the maximum amount of a substance that can be assimilated by a water body without causing impairment. A water body can be deemed impaired if water quality analyses conclude that exceedances of water quality standards occur.

Wetlands are jointly defined by USEPA and U.S. Army Corps of Engineers (USACE) at 40 CFR 232.2 as those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include “swamps, marshes, bogs, and similar areas.”

Floodplains are areas of low-level ground present along rivers, stream channels, large wetlands, or coastal waters. Floodplain ecosystem functions include natural moderation of floods, flood storage and conveyance, groundwater recharge, and nutrient cycling. Floodplains also help to maintain water quality and are often home to a diverse array of plants and animals. In their natural vegetated state, floodplains slow the rate at which the incoming overland flow reaches the main water body. Floodplain boundaries are most often defined in terms of frequency of inundation, that is, the 100-year and 500-year flood. Floodplain delineation maps are produced by the Federal Emergency Management Agency, and provide a basis for comparing the locale of the Proposed Action to the floodplains.

3.2.1 Regulatory Setting

The Safe Drinking Water Act is the federal law that protects public drinking water supplies throughout the U.S. and Guam. Under the Safe Drinking Water Act, the USEPA sets standards for drinking water quality. Groundwater quality and quantity are regulated under several statutes and regulations, including the Safe Drinking Water Act.

The Clean Water Act (CWA) establishes federal limits, through the National Pollutant Discharge Elimination System (NPDES) program, on the amounts of specific pollutants that can be discharged into surface waters to restore and maintain the chemical, physical, and biological integrity of the water. The NPDES program regulates the discharge of point (i.e., end of pipe) and nonpoint sources (i.e., stormwater) of water pollution.

The Guam Coastal Management Program requires consistency with its Erosion and Siltation development policy for applicable federal activities on Guam. The policy states that “development shall be limited in areas of 15 percent or greater slope by requiring strict compliance with erosion, sedimentation, and land use regulations, as well as other related land use guidelines for such areas.” The laws and regulations that follow describe the networked management framework that all non-

exempted federal actions, including the proposed action, must be consistent with to the maximum extent practicable as required by the Coastal Zone Management Act, administered by the Guam Bureau of Statistics and Plans. The Guam Environmental Protection Agency (GEPA) administers portions of federal statutes via a Memorandum of Agreement with the USEPA Region 9. In addition to compliance with the USEPA NPDES program, federal projects must also comply with local requirements (e.g., "respecting the control and abatement of water pollution") per Section 313(a) of the CWA.

Construction or demolition that necessitates an individual permit also requires preparation of a Notice of Intent to discharge stormwater and a Stormwater Pollution Prevention Plan (SWPPP) that is implemented during construction. As part of the 2010 Final Rule for the CWA, titled *Effluent Limitations Guidelines and Standards for the Construction and Development Point Source Category*, activities covered by this permit must implement non-numeric erosion and sediment controls and pollution prevention measures.

CWA Section 401 Water Quality Certification issuance identifies that construction or operation of a proposed project or facility would be conducted in a manner consistent with Guam Water Quality Standards. As part of a Water Quality Certification, an Environmental Protection Plan (EPP) is required. EPPs describe the methods, practices, and equipment to be used on site; expected or anticipated environmental problems during and after construction; and the methods, practices, and equipment that may be used to avoid, mitigate, or control potential adverse effects on the environment. EPPs are specifically identified in 22 Guam Administrative Rules and Regulations (GAR), Division II, Chapter 10, § 10103.C.5 (d). For work occurring within or affecting surface waters, a USACE permit applicant must prepare a Water Quality Monitoring Plan that describes measures to maintain Guam Water Quality Standards. These measures typically include procedures for monitoring, corrective actions, reporting, and recordkeeping. The local requirement for a Water Quality Monitoring Plan is usually incorporated by the USACE or GEPA in their permit programs regulating activities affecting surface water or wetlands.

Section 438 of the Energy Independence and Security Act establishes stormwater design requirements for development and redevelopment projects. Under these requirements, federal facility projects larger than 5,000 square feet (ft^2) must "maintain or restore, to the maximum extent technically feasible, the predevelopment hydrology of the property with regard to the temperature, rate, volume, and duration of flow."

3.2.2 Affected Environment

The following discussions provide a description of the existing conditions for each of the categories under water quality resources at MSA 1 on Andersen AFB.

3.2.2.1 Surface Water

There are no surface water resources in the Andersen AFB area. Sinkholes and depressions in the porous limestone bedrock (karst) covering the northern portion of Guam, including Andersen AFB channel surface runoff downward into the bedrock. The direction of overland surface water runoff in MSA 1 is generally westward to several sinkholes and depressions.

3.2.2.2 Groundwater

Andersen AFB overlies the northern portion of three groundwater basins: the Finegayan Basin under the western third of the base, the Agafa-Gumas Basin under the central portion of the base, and the Andersen Basin under the eastern portion of the base. The Andersen AFB SWPPP protects against

groundwater contamination from recharge of stormwater runoff via approximately 100 dry wells that were drilled to facilitate the flow of stormwater into the underlying groundwater.

3.2.2.3 Wetlands

As described above in Section 3.2.2.1, surface water percolates downward into the bedrock in the Andersen AFB area. In addition, Andersen AFB and MSA 1 are located on an elevated bedrock platform with a very gentle slope. The physical setting at MSA 1 does not support the formation of wetlands, thus, none are found at MSA 1.

3.2.2.4 Floodplains

Andersen AFB and MSA 1 are not located within either the 100-year or the 500-year flood zones (Department of the Navy [DON], 2015).

3.2.3 Environmental Consequences

In this EA, the analysis of water resources looks at the potential impacts on groundwater, surface water wetlands, and floodplains. Groundwater analysis focuses on the potential for impacts to the quality, quantity, and accessibility of the water. The analysis of surface water quality considers the potential for impacts that may change the water quality, including both improvements and degradation of current water quality. The impact assessment of wetlands considers the potential for impacts that may change the local hydrology, soils, or vegetation that support a wetland. The analysis of floodplains considers if any new construction is proposed within a floodplain or may impede the functions of floodplains in conveying floodwaters.

3.2.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline water resources. Therefore, no significant impacts to water resources would occur with implementation of the No Action Alternative.

3.2.3.2 Alternative 1

The study area for the analysis of effects to water resources associated with Alternative 1 includes Andersen AFB MSA 1.

Construction activities under Alternative 1 would result in the removal of vegetation and soil disturbance, which could increase potential for short-term increases in stormwater runoff and erosion.

No surface waters are located within or near the Alternative 1 construction area. The Program SWPPP, a site-specific SWPPP, and EPP would require the use of potential construction BMPs such as diversion dikes and swales, gravel/sand bag berms, and fiber rolls to control erosion and reduce runoff. Through implementation of the BMPs required in the SWPPPs and the EPP, off-site transport of stormwater runoff, sediment, or other pollutants would be unlikely. Project design would include components to withstand and minimize potential effects of typhoon-level events. No construction activities would occur in the 100-year or 500-year flood zones. Therefore, construction activities associated with Alternative 1 would have minimal effect on surface waters, and no construction-associated runoff would reach cliff edges and flow offshore.

Stormwater percolates rapidly in the Andersen AFB limestone karst bedrock. Construction vehicles and equipment have the potential to leak fuel or other hazardous materials, which could have adverse

effects on the aquifer due to rapid infiltration. The construction contractor would be responsible for ensuring that their equipment is in good operating condition, and following BMPs to prevent/minimize accidental releases of fuels and hazardous materials, such as equipping all vehicles with on-board spill containment kits, parking on paved surfaces where possible, and placing drip pans beneath parked vehicles. Should a spill occur, the contractor would follow the Andersen AFB *Oil and Hazardous Substance Contingency Plan*, and implement the GEPA *Spill Prevention Control Countermeasure Program.*

The Alternative 1 construction stormwater runoff protection measures would also serve to protect groundwater quality. The Proposed Action would be implemented in compliance with the Program SWPPP, a site-specific SWPPP, EPP, and BMPs associated with addressing site- and activity-specific water resource protection requirements. Therefore, there would be a reduction in stormwater pollutant loading potential, and thus a reduction in pollution loading potential to the groundwater basins underlying Andersen AFB.

Percolation basins would be constructed between the new ECMs to manage stormwater drainage resulting from the increased impervious surfaces created by construction of the ECMs. The percolation basins would meet the requirements of Unified Facilities Criteria (UFC) 3-210-10, *Low Impact Development*. Following completion of construction and utility line trenching, exposed soil would be replanted with native vegetation to avoid long-term soil erosion.

Following construction, operations would consist of vehicles transporting ordnance primarily on paved surfaces to and from the ECMs. The percolation basins and replanted vegetation would avoid mobilization of soil in runoff into surface and groundwater. Andersen AFB personnel operating the vehicles would comply with the Andersen AFB Spill Prevention, Control, and Countermeasure Plan to avoid and minimize the impacts of accidental releases of fuel from the transport vehicles.

Given the use of stormwater protection measures and BMPs to minimize soil transport and accidental release of hazardous materials during construction, the incorporation of stormwater management in project design and construction, and compliance with the Andersen AFB Spill Prevention, Control, and Countermeasure Plan during operations, Alternative 1 would not result in significant impacts to water resources.

3.2.3.3 Alternative 2

The study area for the analysis of effects to water resources associated with this alternative includes Andersen AFB MSA 1.

Construction activities under Alternative 2 would result in the removal of vegetation and soil disturbance, which could increase potential for short-term increases in stormwater runoff and erosion. However, vegetation removal would be less than under Alternative 1 since 30 existing ECMs would be demolished before construction of the 48 new ECMs.

No surface waters are located within or near the Alternative 2 construction area. Through implementation and compliance with the Program SWPPP, a site-specific SWPPP, and EPP, off-site transport of stormwater runoff, sediment, or other pollutants would be unlikely. Project design would include components to withstand and minimize potential effects of typhoon-level events. No construction activities would occur in the 100-year or 500-year flood zones. Therefore, construction activities associated with Alternative 2 would have minimal effect on surface waters, and no construction-associated runoff would reach cliff edges and flow offshore.

Similar to Alternative 1, under Alternative 2 the construction contractor would be responsible for ensuring that their equipment is in good operating condition, and following BMPs to prevent/minimize accidental releases of fuels and hazardous materials, such as equipping all vehicles with on-board spill containment kits, parking on paved surfaces where possible, and placing drip pans beneath parked vehicles. Should a spill occur, the contractor would follow the Andersen AFB *Oil and Hazardous Substance Contingency Plan*, and implement the GEPA *Spill Prevention Control Countermeasure Program.*

Compliance with the same plans described for Alternative 1 would be required for Alternative 2. Similar to Alternative 1, implementation of stormwater runoff protection measures during construction would also serve to protect groundwater quality under Alternative 2. Thus under Alternative 2, the effect on groundwater would be similar to that of Alternative 1, i.e., there would be a reduction in pollution loading potential to the groundwater basins underlying Andersen AFB.

Under Alternative 2, the same percolation basins would be constructed between the new ECMs to manage stormwater drainage resulting from the increased impervious surfaces created by the ECMs as for Alternative 1. Following completion of construction and utility line trenching, exposed soil would be replanted with native vegetation to avoid long-term soil erosion. Operations following construction of Alternative 2 would be the same as described for Alternative 1.

Given the use of stormwater protection measures and BMPs to minimize soil transport and accidental release of hazardous materials during construction, the incorporation of stormwater management in project design and construction, and compliance with the Andersen AFB Spill Prevention, Control, and Countermeasure Plan during operations, implementation of Alternative 2 would not result in significant impacts to water resources.

3.3 Geological Resources

This discussion of geological resources includes topography, geology, and soils of a given area. Topography is typically described with respect to the elevation, slope, and surface features found within a given area. The geology of an area may include bedrock materials, mineral deposits, and fossil remains. The principal geological factors influencing the stability of structures are soil stability and seismic properties. Soil refers to unconsolidated earthen materials overlying bedrock or other parent material. Soil structure, elasticity, strength, shrink-swell potential, and erodibility determine the ability for the ground to support structures and facilities. Soils are typically described in terms of their type, slope, physical characteristics, and relative compatibility or limitations with regard to particular construction activities and types of land use.

3.3.1 Regulatory Setting

Consideration of geologic resources extends to prime or unique farmlands. The Farmland Protection Policy Act was enacted in 1981 in order to minimize the loss of prime farmland and unique farmlands as a result of federal actions. The implementing procedures of the Farmland Protection Policy Act require federal agencies to evaluate the adverse effects of their activities on farmland, which includes prime and unique farmland and farmland of statewide and local importance, and to consider alternative actions that could avoid adverse effects.

3.3.2 Affected Environment

The following discussions provide a description of the existing conditions for each of the categories under geological resources at MSA 1 at Andersen AFB, Guam.

3.3.2.1 Topography

MSA 1 is located at the top of a broad, near-level plateau that slopes gently downward towards the west. Surface elevations in the proposed project area range from approximately 505 to 480 feet above mean sea level.

3.3.2.2 Geology

The island of Guam is located on a volcanic arc adjacent to the Mariana subduction boundary and comprises a volcanic core partially overlain with limestone (karst). The entire island is a potentially active seismic area. Geologic hazards on Guam include the potential for earthquakes that can cause liquefaction (loss of soil cohesiveness and stability in response to earthquake ground motion) and tsunamis, steep slopes where landslides can occur due to earthquakes or heavy rainfall, and sinkholes associated with the limestone karst.

Andersen AFB is located on the northeastern portion of Guam's uplifted limestone (karst) plateau. There are no earthquake fault zones within Andersen AFB. However, there is a minor earthquake fault zone approximately 1 mile west of the proposed project area in MSA 1 (DON, 2015a). MSA 1 is located in an area with low landslide potential, and is not located in an area subject to tsunamis (DON, 2015a). Basic design standards for construction in northern Guam, munitions storage facilities in general, and munitions storage igloos specifically would be followed. Geotechnical conditions would be investigated and integrated into project design (see Section 2.1.4, *Design Standards*).

3.3.2.3 Soils

The soil in MSA 1 is classified by the U.S. Department of Agriculture as "Urban Land Complex" due to previous disturbance for military purposes. Prime farmland soils, as defined by the U.S. Department of Agriculture, are soils best suited to producing food, seed, forage, fiber and oilseed crops, are favorable for economic production and sustained high yield, and require minimal inputs of energy and result in the least damage to the environment (DON, 2015a). The soil underlying MSA 1 is not identified as prime farmland by the U.S. Department of Agriculture (DON, 2015a).

3.3.3 Environmental Consequences

Geological resources are analyzed in terms of drainage, erosion, prime farmland, land subsidence, and seismic activity. The analysis of topography and soils focuses on the area of soils that would be disturbed, the potential for erosion of soils from construction areas, and the potential for eroded soils to become pollutants in downstream surface water during storm events. The analysis also examines potential impacts related to seismic events. BMPs are identified to minimize soil impacts and prevent or control pollutant releases into stormwater. The potentially affected environment for geological resources is limited to lands that would be disturbed by any proposed facility development or demolition.

3.3.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline geology, topography, or soils. Therefore, no significant impacts to geological resources would occur with implementation of the No Action Alternative.

3.3.3.2 Alternative 1

The study area encompasses the proposed construction and ground disturbance areas related to Alternative 1.

As listed in Table 2-1, Alternative 1 would involve disturbance of 51 acres. Under existing conditions, there are 19.3 acres of impervious surfaces in the Alternative 1 Project area. Upon completion, there would be 38.6 acres of impervious surface in the project area. With Alternative 1, construction of the new Hayman style ECMs and associated support facilities would include clearing and grubbing, grading, roadway improvements, excavation, utility line trenching, and landscaping. Construction fill material would be obtained from an established borrow location on Andersen AFB.

The near-level limestone plateau where the work would occur does not have substantial grade changes such as steep hills or canyons that would be leveled or filled. In addition, cut and fill volumes generated during construction would be relatively balanced. For these reasons, only relatively minor changes in grade are anticipated to provide a buildable surface to construct the ECMs and improve the roadways associated with Alternative 1. The limestone karst underlying Andersen AFB is subject to the formation of sinkholes. Known sinkholes in the project area would be avoided. Construction of Alternative 1 would not involve major elevation changes, substantially alter the surrounding landscape, affect important geologic features, or diminish slope stability.

The potential geologic hazards associated with slope instability and liquefaction are minimal at Andersen AFB MSA 1. Potential structural damage or injuries during operations from seismic ground-shaking and fault rupture during an earthquake would be minimized by adherence to UFC 3-310-04, *Seismic Design of Buildings*, Change 1 dated June 20, 2016 (USACE, 2016). Therefore, impacts with respect to seismic hazards would be less than significant.

There is a potential for increased erosion, compaction, and soil loss from physical disturbance during construction activity. However, project design and construction would incorporate engineering controls as BMPs to minimize erosion. Examples of such engineering controls include:

- Use of drainage diversion and control to direct stormwater flow away from construction sites
- Limiting the size of the unstabilized disturbed areas for each project phase to less than 20 acres during construction

Percolation basins would be constructed between the new ECMs to manage stormwater drainage resulting from the increased impervious surfaces created by the ECMs. The percolation basins would meet the requirements of UFC 3-210-10, *Low Impact Development*. Following completion of construction and utility line trenching, exposed soil would be replanted with native vegetation to avoid long-term soil erosion.

There is no prime farmland in the Alternative 1 project area, so implementation of Alternative 1 would have no impact on prime farmland.

Following construction, operations would consist of vehicles transporting ordnance primarily on paved surfaces to and from the ECMs. There would be no further soil disturbance or other effects on geological resources.

Given the minimal changes to topography, the use of engineering controls and BMPs to minimize erosion during construction, the incorporation of stormwater management in project design and construction, implementation of the Alternative 1 would not result in significant impacts with respect to seismic hazards and geological resources.

3.3.3.3 Alternative 2

The study area encompasses the proposed construction and ground disturbance areas related to the Alternative 2.

As listed in Table 2-2, Alternative 2 would involve disturbance of 50 acres, 18 acres of which would be existing impervious surface. Under existing conditions, there are 17.9 acres of impervious surfaces in the Alternative 2 Project area. Upon completion, there would be 36.1 acres of impervious surface in the project area.

Similar to Alternative 1, only relatively minor changes in grade are anticipated to provide a buildable surface for construction of the ECMs and roadway improvements with Alternative 2. Construction fill material would be obtained from an established borrow location on Andersen AFB. In addition, cut and fill volumes generated during construction would be relatively balanced. Localized high karst outcrops would be avoided in the project design phase. Because construction activities under Alternative 2 would not involve major elevation changes, Alternative 2 would not substantially alter the surrounding landscape, affect important geologic features, or diminish slope stability. Under Alternative 2, similar construction activities would take place as under Alternative 1, in similar geologic, soil, and seismic conditions. However, new ground disturbance would be less than under Alternative 2 since 30 existing ECMs would be demolished before construction of the 48 new ECMs. No prime farmland is identified within the Alternative 2 project footprint, thus there would be no impact to prime farmland soil.

As described for Alternative 1, project design and construction for Alternative 2 would incorporate engineering controls as BMPs to minimize erosion. The same construction BMPs described for Alternative 1 would be implemented for Alternative 2.

As with Alternative 1, percolation basins would be constructed between the new ECMS to manage stormwater drainage resulting from the increased impervious surfaces created by the ECMs. The percolation basins would meet the requirements of UFC 3-210-10, *Low Impact Development*. Following completion of construction and utility line trenching, exposed soil would be replanted with native vegetation to avoid long-term soil erosion.

Potential structural damage or injuries during operations from seismic ground-shaking and fault rupture during an earthquake would be minimized by adherence to UFC 3-310-04, *Seismic Design of Buildings*, with Change 1, dated June 2016 (USACE 2016). Therefore, impacts with respect to seismic hazards would be less than significant.

Following construction, operations would consist of vehicles transporting ordnance primarily on paved surfaces to and from the ECMs. There would be no further soil disturbance or other effects on geological resources.

Given the minimal changes to topography, the use of engineering controls and BMPs to minimize erosion during construction, the incorporation of stormwater management in project design and construction, implementation of Alternative 2 would not result in significant impacts with respect to seismic hazards and geological resources.

3.4 Cultural Resources

Cultural resources include prehistoric or historic archaeological sites, buildings, structures, districts, or other places or objects considered important to a culture, a subculture, or a community for traditional, religious, or other reasons. Cultural resources can be divided into three major categories:

- Archaeological sites are locations where past human activity measurably altered the earth, left deposits of physical remains, or created measurably modified landscapes.
- Architectural resources include standing buildings, structures, l, and other built-environment resources of historic significance.
- Traditional cultural properties may include archaeological resources, structures, neighborhoods, prominent topographic features, habitat, plants, animals, and minerals that traditional Chamorro or other groups consider essential for the preservation of traditional culture.

3.4.1 Regulatory Setting

Cultural resources are protected and identified under several federal laws and executive orders. Federal laws include the NHPA (1966), the Archaeological and Historic Preservation Act (1974), and the Archaeological Resources Protection Act (1979). Cultural resources may also be covered by state, local, and territorial laws.

Federal agencies' responsibility for protecting significant cultural resources is defined primarily by sections 106 and 110 of the NHPA. Section 106 requires federal agencies to take into account the effects of their undertakings on historic properties. Historic properties are defined by 36 CFR § 800.16 as any prehistoric or historic district, site, building, structure, or object (per Part 800) included in, or eligible for inclusion in, the National Register of Historic Places (NRHP). Section 110 of the NHPA requires federal agencies to establish—in conjunction with the Secretary of the Interior—historic preservation programs for the identification, evaluation, and protection of historic properties.

Program comments are an alternate method for federal agencies to meet their Section 106 obligations. The *Program Comment for World War II and Cold War Era (1939-1974) Ammunitions Storage Facilities* (Advisory Council on Historic Preservation, 2006:1) "provides the Department of Defense (DoD) and its Military Departments with an alternative way to comply with their responsibilities under Section 106 of the National Historic Preservation Act with regard to the effect of the following management actions on World War II and Cold War Era ammunition storage facilities that may be eligible for listing on the National Register of Historic Properties ongoing operations, maintenance and repair, rehabilitation, renovation, mothballing, cessation of maintenance, new construction, demolition, deconstruction and salvage, remediation activities, and transfer, sale, lease, and closure of such facilities." Under the Program Comment, Section 106 review is considered to be complete for ammunition storage facilities built from 1939-1974 that are identified by a DoD Category Group (2 digit) code of 42, Ammunition Storage. The Program Comment does not apply to ammunition storage facilities in historic districts "where the ammunition storage facility is a contributing element of the district and the proposed undertaking has the potential to adversely affect such historic district. This third exclusion does not

apply to historic districts that are made up solely of ammunition storage facility properties" (Advisory Council on Historic Preservation, 2006:4).

3.4.2 Affected Environment

The area of potential effect (APE) for cultural resources is the geographic area or areas within which an undertaking (project, activity, program, or practice) may directly or indirectly cause alterations in the character or use of historic properties (§800.16(d). The APE is influenced by the scale and nature of the undertaking and may be different for various kinds of effects caused by the undertaking. For the Proposed Action, the APE is the potential Munitions Storage Area historic district that includes the footprint of the project area on Andersen AFB. The potential Munitions Storage Area historic district is made up of MSA 1 and MSA 2, totaling approximately 1,372 acres. MSA 1 contains the footprints for Alternative 1 and Alternative 2.

The Navy has conducted nine cultural resource inventories within MSA 1 (Davis, 1983; Dixon and Walker, 2011; Dixon et al., 2017; Hokanson et al., 2008; Hunter-Anderson and Moore, 2003; Defant and Leon Guerrero, 2006; Mason Architects, Inc., 2004; Yee et al., 2004). One archaeological survey (Defant and Leon Guerrero, 2006) partially overlapped the Alternative 1 footprint. Dixon et al. (2017) conducted an intensive archaeological survey of the remaining portions of the Alternative 1 footprint and all of the Alternative 2 footprint. The other previous surveys covered areas adjacent to but not within the footprints of Alternative 1 and 2. A 2004 architectural survey (Mason Architects, Inc., 2004) covered most of MSA 1 and 2, but focused on architectural resources only. In 2017, a survey of architectural resources within MSA 1 and MSA 2 (Dixon et al., 2017) was conducted in order to provide data for this analysis.

3.4.2.1 Archaeological Resources

NRHP criteria to categorize sites are listed below:

- A = eligible because they are associated with events that have made a significant contribution to the broad pattern of history
- B = eligible because they are associated with the lives of significant persons
- C = eligible because they embody the distinctive characteristics of a type, period, or method of construction
- D = eligible for potential to yield information important in prehistory or history

Sixteen archaeological sites are located within MSA 1 (Table 3-4). These sites include Latte Period ceramic scatters, Latte Period artifact scatters, Post World War II (WW II)/Second American Territorial artifact scatters, Post WW II/Second American Territorial Period concrete curbs and slabs, and a Spanish Colonial Period oven. Of these 16 sites, 11 are eligible for listing in the NRHP under Criterion D (have yielded or may be likely to yield, information important in history or prehistory) (Aguon, 2005; Defant and Leon Guerrero, 2006; Dixon and Walker, 2011; Hokanson et al., 2008; Dixon et al., 2017). One (Site 66-08-2728) is eligible for listing in the NRHP under Criteria A, C, and D (Yee et al., 2004).

Of the sites within MSA 1, three are located within the project footprints. Three eligible sites (66-08-2101, 66-08-2102, 66-08-2922) are located within the Alternative 1 footprint. No eligible sites are located within the Alternative 2 footprint. One eligible archaeological site (66-08-2921) is located adjacent to Alternative 2 but outside the construction footprint.

Table 3-4 Archaeological Resources Located in MSA 1

Site Number	*Site Age*	*Description*	*Reference*	*NRHP Eligibility Determination**	*Located within the Area of Potential Effects*
66-08-2096	Post WW II/Second American Territorial	Concrete Slab	Defant and Leon Guerrero, 2006	Not Eligible (Aguon, 2005)	No
66-08-2097	Latte	Ceramic Scatter	Defant and Leon Guerrero, 2006	Eligible under D (Aguon, 2005)	No
66-08-2098	Post WW II/Second American Territorial	Concrete curb	Defant and Leon Guerrero, 2006	Not Eligible (Aguon, 2005)	No
66-08-2099	Latte	Ceramic Scatter	Defant and Leon Guerrero, 2006	Eligible under D (Aguon, 2005)	No
66-08-2100[2]	Latte	Ceramic Scatter	Defant and Leon Guerrero, 2006	Not Eligible (Aguon, 2005)	Alternative 1
66-08-2101[2]	Latte	Ceramic Scatter	Defant and Leon Guerrero, 2006	Eligible under D (Aguon, 2005)	Alternative 1
66-08-2102[2]	Latte	Ceramic Scatter	Defant and Leon Guerrero, 2006	Eligible under D (Aguon, 2005)	Alternative 1
66-08-2103[2]	Latte	Ceramic Scatter	Defant and Leon Guerrero, 2006	Not Eligible (Aguon, 2005)	Alternative 1
66-08-2155	Latte	Artifact Scatter	Hokanson et al., 2008	Eligible under D	No
66-08-2156	Latte	Artifact Scatter	Hokanson et al., 2008	Eligible under D	No
66-08-2728	Spanish Colonial	Spanish Oven	Yee et al., 2004	Eligible under A,C,D	No
66-08-2913	Latte	Ceramic Scatter	Dixon and Walker, 2011	Eligible under D	No
66-08-2914	Latte, Post WW II/Second American Territorial	Artifact Scatters	Dixon and Walker, 2011	Eligible under D	No
66-08-2915	Latte	Ceramic Scatter	Dixon and Walker, 2011	Eligible under D	No
66-08-2921	Latte	Ceramic Scatter	Dixon et al., 2017	Eligible under D	No
66-08-2922	Latte	Ceramic Scatter	Dixon et al., 2017	Eligible under D	Alternative 1

Notes: * NRHP criteria for significance contained in Federal Regulation 36 CFR 60.4: A = eligible because they are associated with events that have made a significant contribution to the broad pattern of history; B = eligible because they are associated with the lives of significant persons; C = eligible because they embody the distinctive characteristics of a type, period, or method of construction; D = eligible for potential to yield information important in prehistory or history.

3.4.2.2 Architectural Resources

The APE for architectural properties includes the entire potential MSA Historic District (MSA 1 and MSA 2). This potential historic district was first identified by Mason Architects, Inc. (2004) and recommended eligible for listing in the NRHP under Criterion A and C. The 2004 study defined the district as including "the various types of storage igloos" on MSA 1 and MSA 2. Because this project has the potential to impact buildings that are part of this district, the entire proposed district was considered in this analysis. A 2017 architectural history study of MSA 1 and MSA 2 (Dixon et al., 2017) assessed the conditions and significance of 174 architectural resources located within MSA 1 and MSA 2, including all architectural resources in Alternative 1 and Alternative 2 (Table 3-5). All of the architectural resources in Alternatives 1 and 2 were evaluated as not eligible for listing in the NRHP. The study also found that none of the facilities in MSA 1 met any NRHP criteria and were not individually eligible for the NRHP. MSA 1 was analyzed as a historic district, and the study found that a district comprising MSA 1 facilities did not meet any NRHP criteria, and was not eligible for the NRHP. In accordance with the *Program Comment for World War II and Cold War Era (1939 – 1974) Ammunition Storage Facilities* (Advisory Council on Historic Preservation, 2006), the Air Force/Navy has no further obligations under Section 106 regarding the igloos in Alternatives 1 and 2.

In MSA 2, the same study found the igloos (Types 4 and 5) and Facility 51150 to be eligible for the NRHP under Criterion A for their associations with Strategic Air Command's Cold War era nuclear program. Type 4 igloos and Facility 51150 are also eligible under NRHP Criterion C for their specialized designs that were specific to their direct roles in supporting Strategic Air Command's program. Furthermore, a historic district comprising the individually eligible structures and secondary supporting structures is eligible under NRHP Criterion A. The boundary of the district encompasses the fenced area of MSA 2, which historically encompassed the Ordnance Storage Area.

3.4.2.3 Traditional Cultural Properties

No traditional cultural properties (TCPs) are found within the project area (Welch and Prasad, 2006).

3.4.3 Environmental Consequences

Analysis of potential impacts to cultural resources considers both direct and indirect impacts. Impacts may be the result of physically altering, damaging, or destroying all or part of a resource, altering characteristics of the surrounding environment that contribute to the importance of the resource, introducing visual, atmospheric, or audible elements that are out of character for the period the resource represents (thereby altering the setting), or neglecting the resource to the extent that it deteriorates or is destroyed.

3.4.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to cultural resources. Therefore, no significant impacts to cultural resources would occur with implementation of the No Action Alternative.

Table 3-5 Architectural Resources in the Area of Potential Effects

Facility Number	*Type*	*Date*	*NRHP Eligibility Determination**	*Located within the Area of Potential Effects*
8200, 8202, 8204	Storage Magazine	1955	Not eligible	Yes
8400-8403	Storage Igloo 87.6 square meters (943 square feet) (TYPE 1)	1953	Not eligible	Yes
8404, 8405, 8406, 8407, 8408-8416[2]	Storage Igloo 161.3 square meters (1,736 square feet) (TYPE 2)	1953	Not eligible	Yes
8463-8470[2], 8471-8479	Storage Igloo 161.3 square meters (1,736 square feet) (TYPE 2)	1953	Not eligible	Yes
8500-8503 8504-8516[2]	Storage Igloo 161.3 square meters (1,736 square feet) (TYPE 2)	1954	Not eligible	Yes
8600-8616	Storage Igloo 161.3 square meters (1,736 square feet) (TYPE 2)	1954	Not eligible	Yes
8617-8630, 8631[1]	Storage Igloo 215.9 square meters (2,324 square feet) (TYPE 3)	1954	Not eligible	Yes
8700-8713	Storage Igloo 215.9 square meters (2,324 square feet) (TYPE 3)	1954	Not eligible	Yes
8714-8715	Storage Igloo 161.3 square meters (1,736 square feet) (TYPE 2)	1954	Not eligible	Yes
8716-8729 8730[1]	Storage Igloo 215.9 square meters (2,324 square feet) (TYPE 3)	1955	Not eligible	Yes
9000	Munitions Maintenance Administration Building	1952	Not eligible	Yes
9001/66-08-2923	Munitions Production Mobility and Training	1955	Not eligible	Yes
9002	36th Munitions Squadron Building	1955	Not eligible	Yes
9020, 9022, 9024, 9026, 9028, 9030, 9032	Storage Magazine	1954	Not eligible	Yes
9034/66-08-2924	Storage Building (Surveillance and inspection Building)	1953	Not eligible	Yes
9040	Fabrication Shop (Renovation Shop Building)	1953	Not eligible	Yes
9041/66-08-2925	Inert Storage (Renovation Shop Building)	1953	Not eligible	Yes
51000/66-08-2926	Sentry House	1953	Contributor to MSA 2 Historic District	Yes
51104	WRM Storage Facility	1953	Not eligible	Yes
51110	Spare Inert Storage	1952	Contributor to MSA 2 Historic District	Yes
51112	Spare Inert Storage	1952	Contributor to MSA 2 Historic District	Yes

Table 3-5 Architectural Resources in the Area of Potential Effects

Facility Number	*Type*	*Date*	*NRHP Eligibility Determination**	*Located within the Area of Potential Effects*
51114	Spare Inert Storage	1952	Contributor to MSA 2 Historic District	Yes
51150	Munitions Support Equipment Maintenance	1953	Eligible (A and C); Contributor to MSA 2 Historic District	Yes
51175/66-08-2927	Station 7	1948	Not eligible; Noncontributing to MSA 2 Historic District	Yes
51250, 51254, 51265	Storage Igloo 70.6 square meters (760 square feet) (TYPE 4)	1953	Eligible under A and C; Contributor to MSA 2 Historic District	Yes
51253, 51255, 51257, 51259, 51261	Storage Igloo 200.2 square meters (2,155 square feet) (TYPE 5)	1956	Eligible under A; Contributor to MSA 2 Historic District	Yes
51256, 51258, 51260, 51262, 51264	Storage Igloo 200.2 square meters (2,155 square feet) (TYPE 5)	1953	Eligible under A; Contributor to MSA 2 Historic District	Yes

Notes: Structures less than 50 years old are not eligible except under specific circumstances.
* NRHP criteria for significance contained in Federal Regulation 36 CFR 60.4: A = eligible because they are associated with events that have made a significant contribution to the broad pattern of history; B = eligible because they are associated with the lives of significant persons; C = eligible because they embody the distinctive characteristics of a type, period, or method of construction; D = eligible for potential to yield information important in prehistory or history.
[1] Within Alternative 1.
[2] Within Alternative 2.

3.4.3.2 Alternative 1

Alternative 1 would involve the disturbance of 51 acres, 19 of which would be impervious surface, for the construction of 48 new Hayman style ECMs. Depth of construction is anticipated to vary between 2 to 5 feet below ground surface for road and facility construction. Vegetation is dense in the undeveloped space and would require clearance. Existing access roads within Alternative 1 would be removed and replaced, and new utilities would be constructed. No demolition of existing facilities would be required.

Analyses from the architectural survey in 2017 (Dixon et al., 2017) do not support a historic district made up of structures within MSA 1. In accordance with the *Program Comment for World War II and Cold War Era (1939 – 1974) Ammunition Storage Facilities* (Advisory Council on Historic Preservation,

2006), the Air Force/Navy has no further obligations under Section 106 regarding the igloos in Alternatives 1 and 2. In addition, only two architectural resources (Facilities 8631 and 8730) are located within Alternative 1. Both are ineligible, for listing in the NRHP, and these two facilities would not be demolished or modified. Therefore, no impacts would occur either to eligible architectural resources or to historic properties made up of either individual structures or a historic district.

Three archaeological sites found within the footprint of Alternative 1 (66-08-2101, 66-08-2102, 66-08-2922) are Latte Period ceramic scatters eligible for listing in the NRHP, and one (66-08-2103) is a Latte Period ceramic scatter ineligible for listing in the NRHP. These sites would be disturbed by vegetation clearance and the construction of the munitions storage facilities. Though Site 66-08-2103 is ineligible for listing in the NRHP, the provision of the Final Integrated Cultural Resource Management Plan (ICRMP) for Andersen AFB would be followed (Andersen AFB, 2003) in the event that inadvertent discoveries occur during construction. Sites 66-08-2100 (ineligible), 66-08-2101, and 66-08-2922 would have adverse effects mitigated through avoidance by altering plans to omit the igloo that coincides with that location and by altering the path of proposed utility lines. Site 66-08-2102, which falls under the footprint of three igloos, would have adverse effects mitigated through archaeological data recovery. A data recovery plan shall be submitted to the Guam State Historic Preservation Officer (SHPO) for approval and the work executed prior to the onset of construction. Human remains encountered during these excavations or in association with any of the project's construction activities would trigger ICRMP Standard Operating Procedures and would require further consultation with the Guam SHPO. If archaeological resources are inadvertently discovered during ground-disturbing activities, then the ICRMP Standard Operating Procedures would be followed, as well as the provisions of the 36 CFR 800.13 Post Review Discovery.

The Air Force initiated consultation under Section 106 of NHPA in April 2018 (Andersen AFB, 2018). This consultation indicated that Guam Historic Properties Inventory sites 66-08-2101, 66-08-2102, and 66-08-2922 are eligible for the NRHP and that there would be no adverse effect to these sites if proposed mitigation measures are followed. The Guam SHPO concurred with the Section 106 request, with the provision that an approved archaeological data recovery plan be put in place (see Appendix D). Implementation of Alternative 1 would result in no adverse effect to historic properties, so impacts would be less than significant.

3.4.3.3 Alternative 2

Alternative 2 would involve the disturbance of 50 acres, 18 of which would be impervious surface, for the construction of 48 new Hayman style ECMs. Thirty existing ECMs would be demolished as part of this action. The 30 existing ECMs were constructed in the 1950s and are not considered to be eligible for listing in the NRHP. These structures are also covered under the *Program Comment for World War II and Cold War Era Ammunitions Storage Facilities* (Advisory Council on Historic Preservation, 2006). Analyses from the architectural survey in 2017 (Dixon et al., 2017) do not support a historic district made up of structures within MSA 1. Therefore, no impacts would occur to historic properties made up of either individual structures or a historic district.

No eligible archaeological sites are located within the Alternative 2 footprint. One eligible archaeological site (66-08-2921) is located adjacent to Alternative 2, but outside of the construction footprint, and would be avoided. Implementation of Alternative 2 would result in no adverse effects to archaeological sites.

Therefore, implementation of Alternative 2 would not result in a significant direct impact to historic properties consisting of archaeological resources, architectural properties, or TCPs.

3.5 Biological Resources

Biological resources include native and naturalized plant and animal species and the habitats in which they occur. Plant associations are referred to generally as vegetation, and animal species are referred to generally as wildlife. Habitat can be defined as the resources and conditions present in an area that support a plant or animal.

Within this EA, biological resources are divided into two major categories: (1) terrestrial vegetation and (2) terrestrial wildlife. Special-status species, including threatened and endangered species, are discussed within the corresponding sections.

3.5.1 Regulatory Setting

Special-status species, for the purposes of this assessment, are those species listed as threatened or endangered under the Federal ESA and Guam ESA, and species afforded federal protection under the Migratory Bird Treaty Act (MBTA) (Title 16 U.S.C. section 703).

The purpose of the federal ESA is to conserve the ecosystems on which threatened and endangered species depend and to conserve and recover listed species. Section 7 of the federal ESA requires action proponents to consult with the U.S. Fish and Wildlife Service (USFWS) or National Oceanic and Atmospheric Administration (NOAA) Fisheries to ensure that their actions do not jeopardize the continued existence of federally listed threatened and endangered species, or result in the destruction or adverse modification of designated critical habitat. Andersen AFB has prepared a Biological Assessment (BA) as part of a request for formal consultation under Section 7 of the ESA (Appendix C). This document also supports Department of Defense's compliance with section 102 of NEPA mandating that appropriate consideration be given to environmental resources impacted by the preferred alternative presented in this EA.

The Guam National Wildlife Refuge (NWR) was established in 1993 by a Memorandum of Understanding between the USFWS, Navy, USAF, and GovGuam (GovGuam et al., 1993). Cooperative Agreements were signed in 1994 to establish the Overlay Refuge and define the management, administrative roles, and responsibilities (DON and USFWS, 1994; Air Force and USFWS, 1994). The 1994 Cooperative Agreements provide a commitment by the Navy, Air Force, and USFWS for a coordinated program centered on the protection of threatened and endangered species and other native flora and fauna, maintenance of native ecosystems, and the conservation of native biological diversity in cooperation with Guam Department of Agriculture, Division of Aquatic and Wildlife Resources (DAWR), recognizing that the primary purpose of lands within the Overlay Refuge is to support the national defense missions of the Navy and Air Force. Excess military land at Ritidian Point was then transferred to USFWS under the federal excess property regulations for inclusion in the Guam NWR as the Ritidian Unit.

The Guam NWR is comprised of three units: the Ritidian Unit, the Andersen AFB Overlay Unit, and the Navy Overlay Unit. The Ritidian Unit is located on the northern tip of Guam and encompasses 1,217 acres, including 385 acres of terrestrial lands and 832 acres of submerged lands (USFWS, 2009). The Andersen AFB and Navy overlay units are collectively referred to as Overlay Refuge lands and total 21,693 acres. The Andersen AFB Overlay Unit covers approximately 10,159 acres and the Navy Overlay Unit covers approximately 11,534 acres (see Figure 3-1).

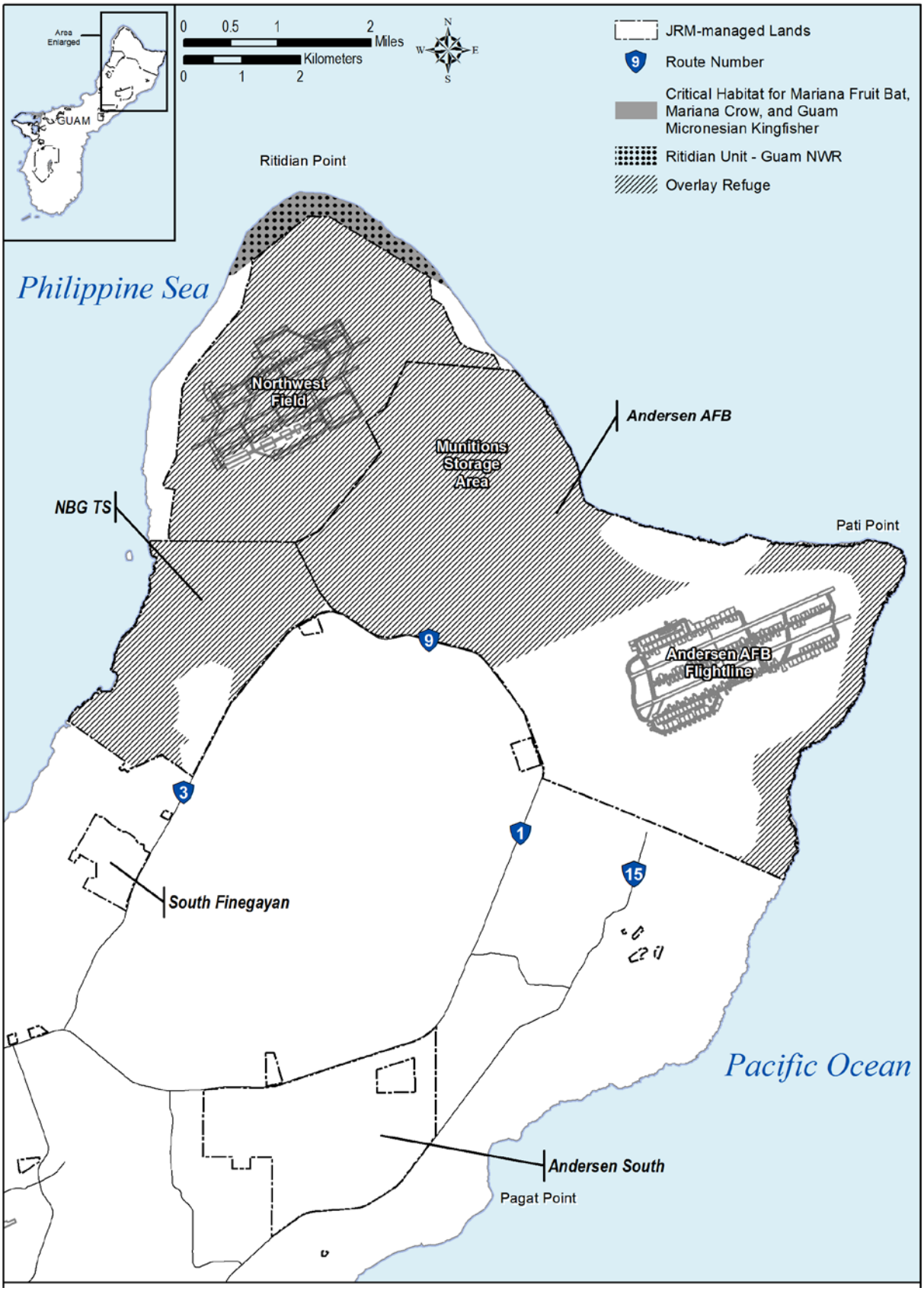


Figure 3-1 Overlay Refuge Lands and Critical Habitat – Northern Guam

In 2004, the USFWS designated 376 acres of land as critical habitat under the ESA for the Guam Micronesian kingfisher (*Todiramphus cinnamominus*), Mariana crow (*Corvus kubaryi*), and Mariana fruit bat (*Pteropus mariannus mariannus*) on the Ritidian Unit of the Guam NWR (USFWS, 2004). Overlay Refuge lands were excluded from this designation in northern and southern Guam. Air Force lands were excluded under section 4(a)(3) of the ESA based on the Air Force's 2003 INRMP for Andersen AFB. The DON lands were excluded under section 4(b)(2) of the ESA based on a determination by the Secretary of the Interior that the benefits of excluding these lands, including benefits to national security and existing management plans and conservation efforts, outweighed the benefits of designating them as critical habitat. The 376 terrestrial acres of the Guam NWR (Ritidian Unit) is the only designated critical habitat on Guam.

Birds, both migratory and most native resident species, are protected under the MBTA, and their conservation by federal agencies is mandated by EO 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*. Under the MBTA (Title 16 U.S.C. section 703), it is unlawful by any means or in any manner, to pursue, hunt, take, capture, kill, attempt to take, capture, or kill, [or] possess migratory birds or their nests or eggs at any time, unless permitted by regulation.

The 2003 National Defense Authorization Act (50 CFR 21) gave the Secretary of the Interior authority to prescribe regulations to exempt the Armed Forces from incidentally taking migratory birds during authorized military readiness activities. In this Act, congress defined military readiness activities as all training and operations of the armed forces that relate to combat and the adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use. Military readiness activities do not include: (a) routine operation of installation support functions such as administrative offices, military exchanges, water treatment facilities, schools, housing, storage facilities, and morale, welfare, and recreation activities; (b) the operation of industrial activities; and (c) the construction or demolition of facilities used for a purpose described in a or b (50 CFR 21). The 2003 National Defense Authorization Act includes a requirement that the DOD must confer with the USFWS while developing and implementing appropriate conservation measures to minimize or mitigate the adverse effects of a military readiness activity, if the activity is predicted to have a significant adverse effect on a population of migratory birds. The proposed action addressed in this EA, however, is not a military readiness activity. Migratory bird conservation relative to military activities not necessary for military readiness is addressed separately in a 2006 Memorandum of Understanding developed in accordance with EO 13186.

3.5.2 Affected Environment

The following paragraphs provide a description of the existing conditions for each of the categories under biological resources at Andersen AFB MSA I. Threatened and endangered species are discussed within the corresponding sections. The action area is defined as all areas that may be affected directly or indirectly and not merely the immediate area involved in the action. It encompasses the geographic extent of environmental changes (i.e., the physical, chemical and biotic effects) that may result directly and indirectly from the Proposed Action. The action area is the area within which the action is likely to produce stressors that have direct or indirect effects to ESA-listed species.

Navy-funded endangered plant surveys were conducted from November 2016 to January 2017 in the entire MSA with focus on the action area. The plant survey targeted ESA-listed plants as well as *Maytenus thompsonii*, the host plant for the endangered and extirpated Mariana wandering butterfly (*Vagrans egistina*), and *Procris pedunculata* and *Elatostema calcareum*, the host plants for the Mariana

eight-spot butterfly (*Hypolimnas octocula marianensis*). ESA-listed plants and *Maytenus thompsonii* were flagged and GPS points of their locations were collected. Health of plants was documented and plant life stage (adult or seedling) was noted. Neither *Procris pedunculata* nor *Elatostema calcareum* were observed.

Biologists conducted fauna surveys for species listed under federal ESA, the Guam ESA, and MBTA in the Alternative 2 action area in December 2016 (DON, 2017b). Target species included federal and Guam ESA-listed reptiles and tree snails, federal ESA-listed butterflies, associated tree snail and butterfly host plants, and birds listed under the MBTA. Observations during the November 2016 to January 2017 plant survey in the Alternative 1 action area and other existing data were used to characterize wildlife in that location. Although fauna surveys were not conducted in the Alternative 1 action area, this action area is similar in habitat and adjacent to the Alternative 2 action area and have the same forest composition. These two locations are also contiguous; the Alternative 1 action area, however, contains native limestone forest while the Alternative 2 action area does not and is much more fragmented than habitat in the Alternative 1 action area.

3.5.2.1 Terrestrial Vegetation

Overview

The action area on Andersen AFB consists of old Hayman style munition storage bunkers surrounded by maintained grassy fields and other forested vegetation. The Alternative 1 action area consists of Limestone Degraded Forest, *Vitex* Forest, Developed land, and a very small portion of Coconut Forest, and the Alternative 2 action area consists of *Vitex* Forest and Developed Land (Figure 3-2). However, surveys conducted within the action areas found that the forested vegetation consists of fragmented, degraded limestone forest, with small patches of native limestone forest restricted to areas of tower karst. These two dominant forest types found within the action area are described below. Feral pigs (*Sus scrofa*) and Philippine deer (*Rusa marianna*) have highly impacted the forest understory, leaving little to no vegetation, and rooting by pigs has further produced large areas of rutted topsoil.

MSA I is located at the edge of the northern Guam limestone plateau. The original native limestone vegetation was largely composed of *Artocarpus mariannensis*, *Pandanus tectorius*, and *Ficus* spp., among others. The plateau has historically been impacted by extensive agricultural and military use, which began in the early 1800s, continued during WW II, and continues today (Mueller-Dombois and Fosberg, 1998). Vegetation mapping was conducted on Andersen AFB lands in 2015, which relied on a combination of desktop mapping, aerial imagery, and ground-truthing (DON, 2016). Based on the results of this recent vegetation mapping, the project area is composed of 10.4 acres of *Vitex* forest and 38.9 acres of developed land (Figure 3-2).

Plants common to limestone degraded forests include *Artocarpus mariannensis*, *Artocarpus altilis*, ironwood (*Casuarina equisetifolia*), *Pandanus tectorius*, *Ochrosia oppositifolia*, *Scaevola sericea*, *Morinda citrifolia*, *Hibiscus tiliaceus*, *Elaeocarpus joga*, *Ficus prolixa*, *Aglaia mariannensis*, *Guamia mariannae*, and *Cycas micronesica*. Native terrestrial ferns are present in the forest understory and include tongue fern (*Pyrrosia lanceolata*), shoestring fern (*Vittaria incurvata*), galak (*Pteris tripartita*), scaly sword fern (*Nephrolepis hirsutula*), and crested elk horn fern (*Polypodium punctatum*) (36 CES/CEVN, 2003). The canopy found in the limestone degraded forests within the two alternative action areas varies from full closure to intermediate with some rock outcrops.

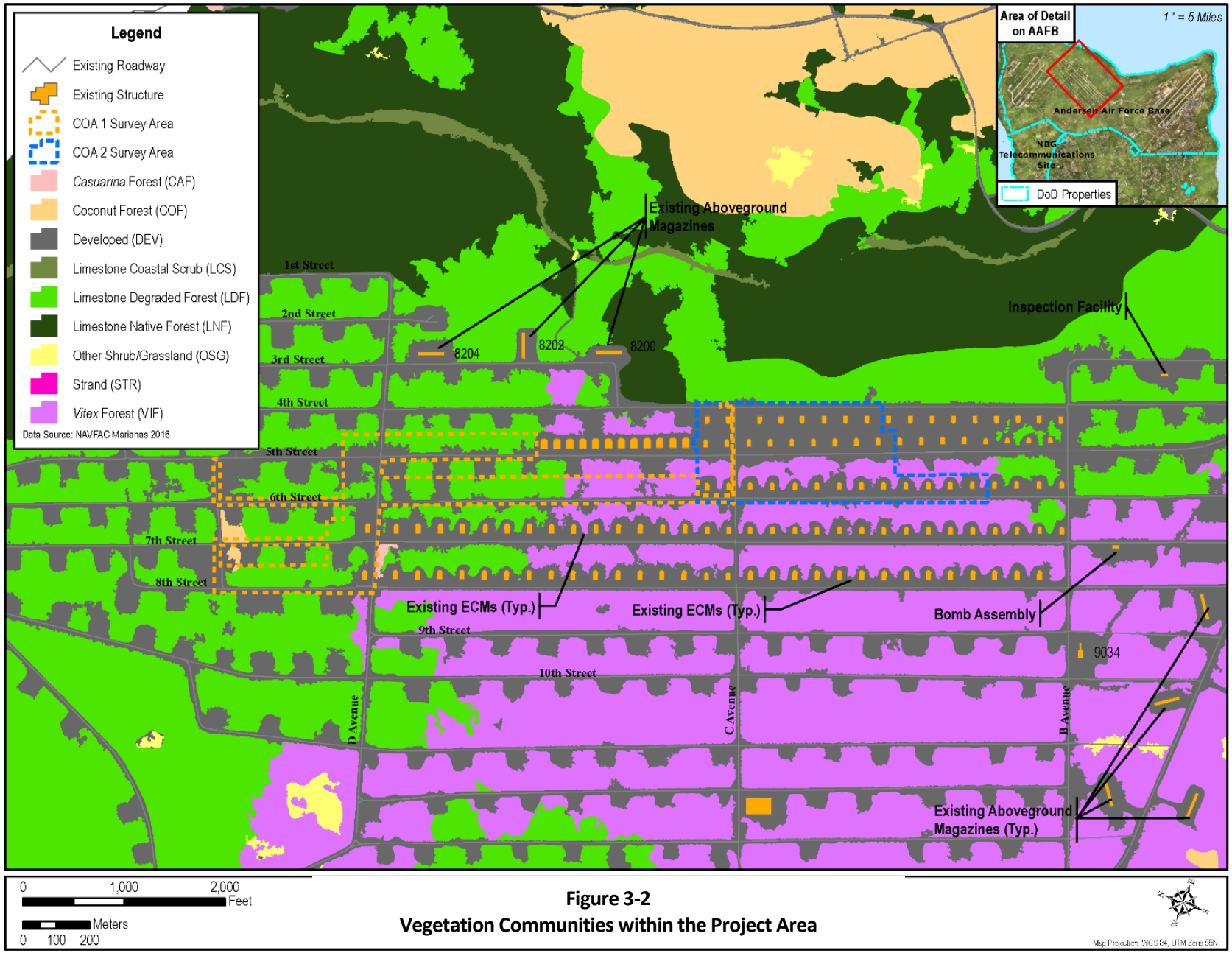


Figure 3-2
Vegetation Communities within the Project Area

Numerous non-native plant species have become established throughout Guam, including Andersen AFB, and are displacing native plant species. Invasive non-native species are characterized by rapid growth and rapid seed production. Disturbed areas in MSA I are colonized by introduced species such as bittervine (*Mikania micrantha*), *Momordica charantia*, and wild passion flower (*Passiflora suberosa*). Introduced weedy herbs such as *Chromolaena odorata*, comb bushmint (*Hyptis pectinata*), light blue snakeweed (*Stachytarpheta jamaicensis*), tropical whiteweed (*Ageratum conyzoides*), and romerillo (*Bidens alba*) are frequent as well (36 CES/CEVN, 2003). *Vitex parviflora* is a large, non-native tree that dominates much of the canopy in the project area, displacing native species that normally colonize limestone soils.

The plant surveys conducted in MSA I found native and degraded limestone forest vegetation types within the Alternative 1 project area (shown in Figure 2 of Appendix F [DON, 2017a]). The native limestone forest was described as generally dense forest dominated by *Guamia mariannae*, *Aglaia mariannensis*, *Eugenia reinwardtiana*, *Eugenia thompsonii*, and *Macaranga thompsonii*. The upper canopy occasionally consisted of natives such as *Ficus prolixa*, *Artocarpus mariannensis*, *Intsia bijuga*, *Elaeocarpus joga* and *Tristiropsis obtusangula*, while the mid-canopy often consisted of natives such as *Premna serratifolia*, *Cynometra ramiflora*, and *Psychotria mariana*. Other native trees occasionally encountered within the Alternative 1 project area included *Guettarda speciosa*, *Dendrocnide latifolia*, *Polyscias grandifolia*, *Drypetes dolichocarpa* and *Maytenus thompsonii*. The degraded limestone forest contained many of the same species as found in native limestone forest, but was described as having a slightly more open canopy cover and was dominated by native trees that are commonly found in disturbed areas (*Guamia mariannae*, *Hibiscus tiliaceus*, and *Ochrosia oppositifolia*). Seven federally and Guam-listed plant species have the potential to occur within the MSA and project area (Table 3-6), but only *Cycas micronesica* and *Tabernaemontana rotensis* were observed within the Alternative 1 project area (Appendix C) (Figure 3-3) (DON, 2017a).

Degraded limestone forest and mixed scrub community were the two vegetation types found within the Alternative 2 project area (DON, 2017a, see Appendix F). Mixed scrub community was described as open and disturbed habitat dominated by the shrubs *Cestrum diurnum* and *Wikstroemia elliptica*. No native limestone forest was found within this area. Seven federally and Guam-listed plant species have the potential to occur within the MSA and the Alternative 2 project area (see Table 3-6), but only *Cycas micronesica* was observed within the project area (Appendix C) (Figure 3-3). Unlike the Alternative 1 project area, *Tabernaemontana rotensis* was not found in the Alternative 2 project area (DON, 2017a, b). Many *Cycus micronesica* found in the Alternative 2 project area were in poor condition, either ravaged by scale and / or found dead (DON, 2017b). While the ESA-listed butterfly host plants *Procris pedunculata* and *Elatostema calcareum* were not seen in the project area, several *Maytenus thompsonii,* the host for the Mariana wandering butterfly, were found to occur within the project area (Figure 3-4).

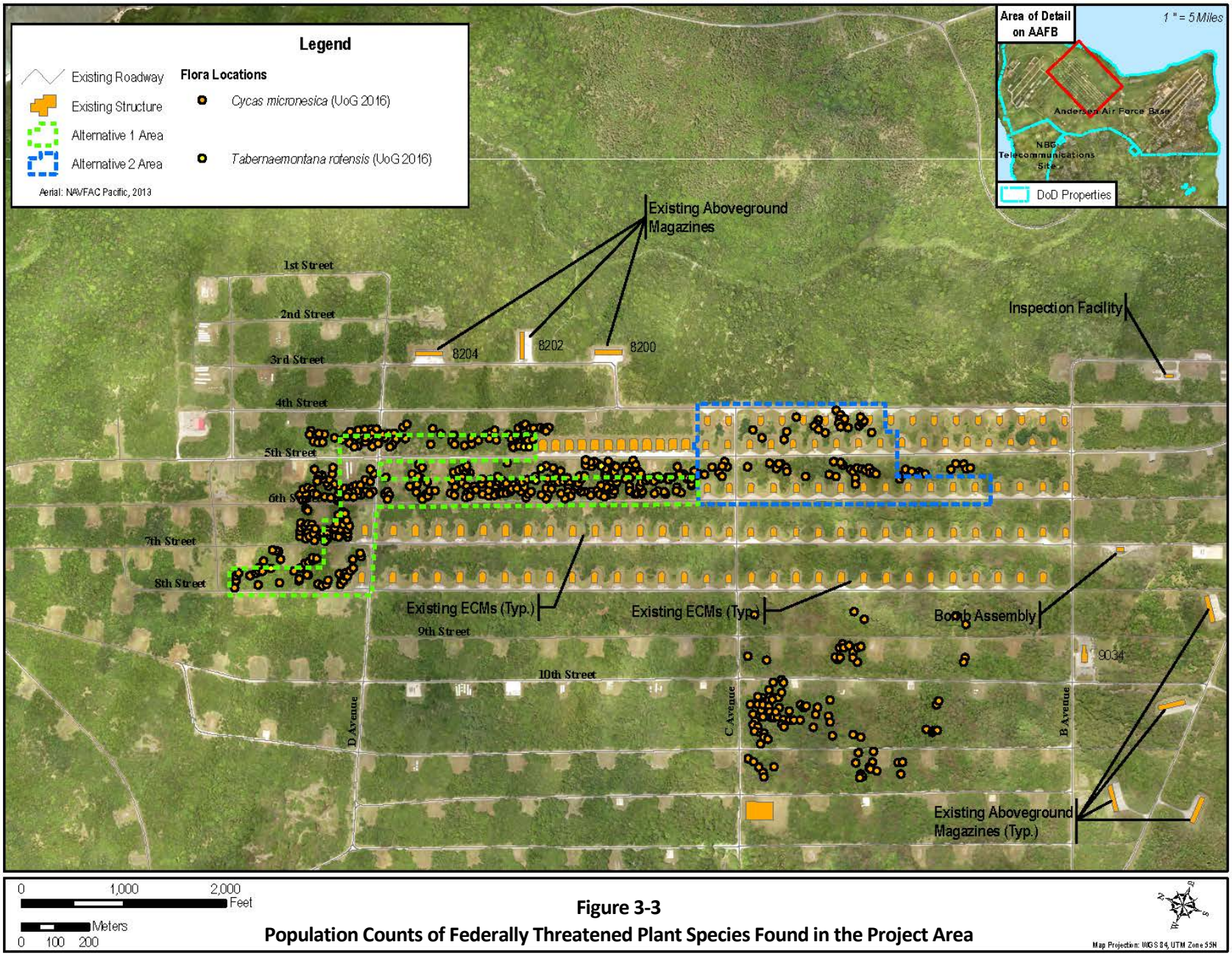


Figure 3-3
Population Counts of Federally Threatened Plant Species Found in the Project Area

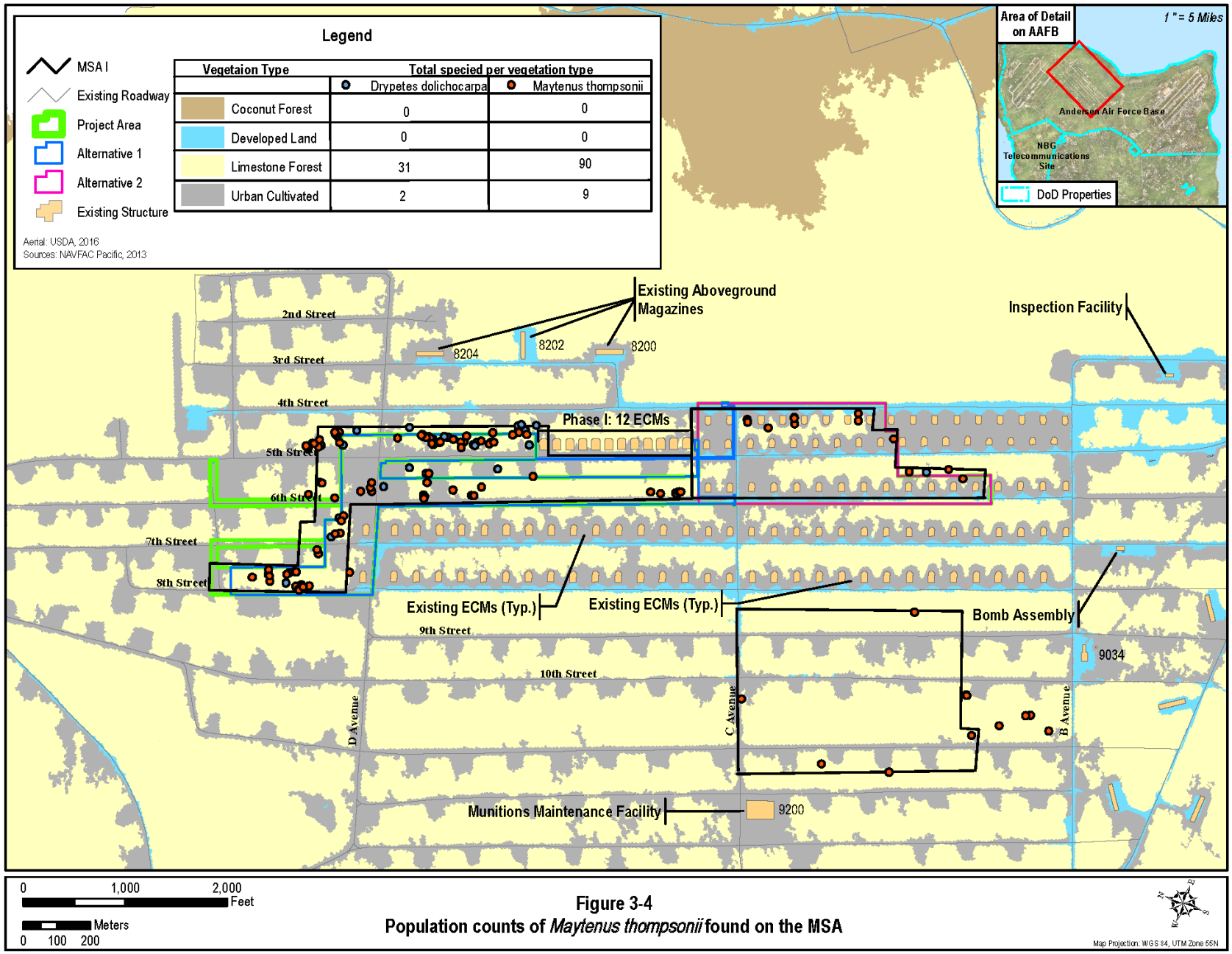


Figure 3-4
Population counts of *Maytenus thompsonii* found on the MSA

Table 3-6 Federally and Guam ESA-listed Species Potentially Occurring within the MSA

Common Name/ Chamorro Name[1]	*Scientific Name*	*Federal Status[2]*	*GovGuam Status[3]*	*Status of Project Area Population[2, 4, 5]*	*Habitat[2, 4, 6, 7]*
Plants					
Fire tree/hayun lago	*Serianthes nelsonii*	E	E	Not present.	Native limestone and ravine forest; edge species.
None/siboyas halumtanu	*Bulbophyllum guamense*	T	--	Not present.	Native forests, especially along clifflines and slopes. Epiphytic.
None/none	*Tuberolabium guamense*	T	--	Not present.	Native forests. Epiphytic.
None/none	*Dendrobium guamense*	T	--	Not present.	Native forests. Epiphytic and lythohytic.
None/Ufa halumtano	*Heritiera longipetiolata*	E	E	Not present.	Limestone cliffs and plateaus.
Cycad/fadang	*Cycas micronesica*	T	T	7,863 individuals occur throughout the entire MSA[8] (724 in Alternative 1, 55 in Alternative 2).	Clay, sand, and limestone soils.
None/none	*Tabernaemontana rotensis*	T	T	542 individuals occur throughout the entire MSA[8] (83 in Alternative 1, 0 in Alternative 2).	Limestone forests.
Mammals					
Mariana fruit bat/fanihi	*Pteropus mariannus mariannus*	T	E	Few individuals known to transit over project area.	Limestone forest, coastal forest, and coconut plantations. Critical habitat on the Ritidian Unit of the Guam NWR. No critical habitat has been designated on DoD lands.
Birds					
Guam rail/ko'ko'	*Gallirallus owstoni*	E	--	Not observed during fauna survey, no longer known to exist in the wild in Guam.	In captivity on Guam, small introduced population on Cocos, introduced population on Rota.
Mariana crow/aga	*Corvus kubaryi*	E	--	Not observed during fauna survey, no longer known to exist in the wild in Guam.	Critical habitat on the Ritidian Unit of the Guam NWR. No critical habitat has been designated on DoD lands.

Common Name/ Chamorro Name[1]	*Scientific Name*	*Federal Status[2]*	*GovGuam Status[3]*	*Status of Project Area Population[2, 4, 5]*	*Habitat[2, 4, 6, 7]*
Micronesian starling/såli	*Aplonis opaca*	--	E	Primarily occurs in urban areas, Andersen AFB, and Cocos Island.	Cavity nester; all habitats but prefers forest.
Reptiles					
Moth skink/ guali'ek kanton tåsi	*Lipinia noctua*	--	E	Very rare.	Native limestone forest.
Pacific slender-toed gecko/guali'ek	*Nactus pelagicus*	--	E	Very rare.	Forest edge.
Invertebrates					
Humped tree snail/akaleha	*Partula gibba*	E	E	Very rare.	Coastal backstrand limestone forest.
Guam tree snail/akaleha	*Partula radiolata*	E	E	Very rare.	Coastal backstrand limestone forest.
Fragile tree snail/akaleha	*Samoana fragilis*	E	E	Very rare.	Coastal backstrand limestone forest.
Mariana eight-spot butterfly/ababbang	*Hypolimnas octocula marianensis*	E	--	Very rare.	Coastal backstrand limestone forest.

Sources: [1]Chamorro names are from USFWS, 2015a and GovGuam, 2009; [2]USFWS, 2015a; [3]Government of Guam, 2009; [4]Guam Department of Agriculture DAWR, 2015; [5]JRM, 2013; [6]DON, 2015b; [7]Raulerson and Rinehart, 1991; [8]DON, 2017a.

Summary of Occurrence of ESA-Listed Plant Species

The occurrence of ESA-listed plant species within the MSA is summarized below (DON, 2018b):

- *Cycas micronesica* (threatened). On Guam, there are approximately 516,000 individuals that occur from the shoreline to limestone cliffs (USFWS, 2015b). Vegetation surveys in support of this project identified 7,863 *Cycas micronesica* within the MSA. Approximately 724 *Cycas micronesica* are located within the Alternative 1 action area (UOG, 2017), and 55 *Cycas micronesica* are located within the Alternative 2 action area. Locations of the trees are identified in Figure 3.1. Trees varied in heath with some having damage to the crown and others being healthy.
- *Tabernaemontana rotensis* (threatened). There are seven known locations of this species on Guam and Rota, totaling 22,375 individuals. There are 9 known individuals in one location on Rota, and 6 locations on Guam where the species occur, equaling a range-wide total of 22,384 individuals (DON, 2017a). Vegetation surveys in support of this project identified 542 *Tabernaemontana rotensis* within the MSA, including 83 plants in the Alternative 1 action area (0 individuals were identified in the Alternative 2 action area). Both seedlings (44 plants) and mature plants (39 plants) were found in the Alternative 1 action area (UOG, 2017).

3.5.2.2 Terrestrial Wildlife

Wildlife includes all animal species (i.e., mammals, reptiles, birds, and invertebrates) focusing on the species and habitat features of greatest importance or interest.

Mammals

Mariana fruit bat or fanihi (*Pteropus mariannus mariannus*) is the only native mammal species that occurs on Andersen AFB (DON, 2015b; DON, 2017d). As a result of overhunting, habitat loss, and predation by the brown treesnake (*Boiga irregularis*), fruit bat population numbers have significantly decreased since the 1930s (DON, 2017c).

Introduced feral ungulates, such as the Philippine deer and feral pig, have altered the island's natural ecosystems. Feral ungulates impact native vegetation by grazing and rooting, which (1) kills or clears vegetation, (2) prevents native vegetation recolonization, (3) spreads the seeds of introduced plant species, and (4) disturbs soils. A small herd of deer was seen moving through the forest during surveys conducted in the action area. Three introduced rat species (*Rattus norvegicus*, *Rattus rattus*, and *Rattus exulans*) inhabit the base. The introduced and native skinks and geckos, as well as the potentially recent introduction of frog species, sustain the high brown treesnake population levels. Rodents also have a very detrimental effect on island birds and affect native ecosystems in their consumption of native tree seeds, thus reducing native plant recruitment.

While only a few small mammal surveys have been conducted on Andersen AFB, it is likely that the musk shrew (*Suncus murinus*) occurs within the MSA (Wiles 2005; Wiewel et al. 2009). Feral populations of domesticated animals such as dogs (*Canis lupus familiaris*) and cats (*Felis catus*) occur on Andersen AFB and have the potential to occur within the MSA. (NAVFAC Marianas 2017a). Dogs are opportunistic feeders and feral cats destroyed an experimental population of Guam rail within the MSA (NAVFAC 15 Marianas 2013).

Reptiles and Amphibians

Table 3-7 summarizes reptiles and amphibians at Andersen AFB. The brown treesnake was inadvertently introduced to Guam shortly after WW II, probably in ship cargo. They are a major nocturnal predator of native birds and reptiles on Guam and are thought to be responsible for the near total extinction of the island's forest-dwelling avifauna, as well as severe reductions or extirpation of native reptile species (USFWS, 1990a; Wiles et al., 2003).

Wildlife surveys conducted in the project area for Alternative 2 at Andersen AFB in December 2016 did not detect any listed wildlife species (DON, 2017b). Two species of skinks and three species of gecko were observed:

- non-native curious skink (*Carlia fusca*)
- native Pacific blue-tailed skink (*Emoia caeruleocauda*)
- native mutilating gecko *(Gehyra mutilata*)
- native mourning gecko (*Lepidodactylus lugubrus*)
- non-native house gecko (*Hemidactylus frenatus*)

The non-native Brahminy blind snake (*Indotyphlops braminus*) (DON, 2017b) and the naturalized Pacific monitor lizard (*Varanus indicus*) were also observed.

Birds

Table 3-8 shows bird species recorded at Andersen AFB. Although the forests of Andersen AFB once supported the federally and Guam-listed endangered Mariana crow, Guam Micronesian kingfisher, and Guam rail (*Gallirallus owstoni*), avian populations on Guam were significantly affected by the introduction of the brown treesnake. While the Mariana crow was extirpated from Guam, the Guam rail

and the Guam Micronesian kingfisher were extirpated from the wild (DON, 2015b). Captive-bred Guam rail have been introduced to Cocos Island, immediately southwest of Guam, and the CNMI island of Rota (JRM, 2013).

Table 3-7 Reptiles and Amphibians at Andersen AFB

Common Name/Chamorro Name[1]	*Scientific Name*	*Residence Status*
Brown treesnake/Kolepbla	*Boiga irregularis*	Non-native
Marine toad or Cane toad/Kairo	*Rhinella* (=*Bufo*) *marina*	Non-native
Curious skink/Gualiek halumtano	*Carlia ailanpalai*	Non-native
Green turtle/Haggan	*Chelonia mydas*	Native
Greenhouse frog/Kairo	*Eleutherodactylus planirostris*	Non-native
Pacific blue-tailed skink/Gualiek halumtano	*Emoia caeruleocauda*	Native
Hawksbill turtle/Haggan karai	*Eretmochelys imbricata*	Native
Mutilating gecko/Achiak	*Gehyra mutilata*	Native
House gecko/Achiak	*Hemidactylus frenatus*	Non-native
Mourning gecko/Achiak	*Lepidodactylus lugubris*	Native
Moth skink/Gualiek halumtano	*Lipinia noctua*	Native
Brahminy blind snake/Ulo attilong	*Ramphotyphlops braminus*	Non-native
Monitor lizard/Hilitai	*Varanus indicus*	Naturalized

Notes: [1] Common and scientific names based on Gill and Donsker (2017). Chamorro names from GovGuam (2009), Liske-Clark (2015), Topping et al. (1975), and USFWS (2015a).
Source: DON (2010).

No federal or Guam ESA-listed birds were observed during recent surveys of the Alternative 2 project area (DON, 2017b). Three non-native resident bird species (black drongo [*Dicrurus macrocerus*], island collared dove [*Streptopelia bitorquata*] and black francolin [*Francolinus francolinus*]) and three MBTA-listed species (Pacific golden plover [*Pluvialis fulva*], Pacific reef heron [*Egretta sacra*], and yellow bittern [*Ixobrychus sinensis*]) were recorded (DON, 2017b). White-throated ground dove (*Gallicolumba xanthonura*) have also been sighted occasionally in the project areas (DON, 2017e).

Invertebrates

Despite the presence of several native tree snail host plants, no native tree snails were observed in the project area. Non-native tree snails observed included the Asian land snail (*Satsuma* sp.) and tropical American lined tree snail (*Drymaeus multilineatus*), as well as weathered white shells of the giant African snail (*Achatina fulica*) and the invasive predator rosy wolf snail (*Euglandina rosea*). Also seen was the invasive flatworm *Platydemus manokwari*, a known predator of native tree snails on Guam (DON, 2017b).

Table 3-8 Bird Species Recorded on Andersen AFB

Common Name/Chamorro Name[1]	*Species*	*Residence Status*	*Listed under MBTA?*
Micronesian starling/Sali	*Aplonis opaca*	Uncommon native breeding resident	N
Yellow bittern/Kakkak	*Ixobrychus sinesis*	Common native breeding resident	Y
Ruddy turnstone/Dulili	*Arenaria interpres*	Common non-breeding visitor	Y
Tattler spp.[2]	*Tringa spp.*	Common non-breeding visitor	Y
Wood sandpiper/Dulili	*Tringa glareola*	Common non-breeding visitor	Y
Sharp-tailed sandpiper/Dulili	*Calidris acuminata*	Common non-breeding visitor	Y
Pacific golden plover/Dulili	*Pluvialis fulva*	Common non-breeding visitor	Y
White tern/Chunge	*Gygis alba*	Common breeding resident	Y
Eastern cattle heron/Chuchuko	*Bubulcus coromandus*	Common non-breeding visitor	Y
Pacific reef heron, reef egret/Chuchuko atilong[3]	*Egretta sacra*	Uncommon non-breeding resident	Y
Little egret/Chuchuko	*Egretta garzetta*	Uncommon non-breeding visitor	Y
Whimbrel/Kalalang	*Numenius phaeopus*	Uncommon non-breeding visitor	Y
Black-winged stilt/None	*Himantopus himantopus*	Uncommon non-breeding visitor	Y
Ruff/None	*Calidris pugnax*	Uncommon non-breeding visitor	Y
Island collared dove/Palumat	*Streptopelia bitorquata*	Common introduced breeding resident	N
Black drongo/Salin Taiwan	*Dicrurus macrocercus*	Common introduced breeding resident	N
Eurasian tree sparrow/Gagapale	*Passer montanus*	Common introduced breeding resident	N
Great frigate bird/Payaya	*Fregata minor*	Occasional non-breeding resident	Y
Black francolin/None	*Francolinus francolinus*	Common introduced breeding resident	N

Notes: [1] Common and scientific names based on Gill and Donsker (2017). Chamorro names from GovGuam (2009), Liske-Clark (2015), Topping et al. (1975), and USFWS (2015a).
[2] Wandering and grey tattlers were combined into one category since they are undistinguishable from each other in non-breeding plumage.
[3] The Pacific reef egret is uncommon.
Sources: NAVFAC Marianas 2013b; DON 2015a.

The coconut rhinoceros beetle (*Oryctes rhinoceros*) was first detected on Guam in the Tumon Bay area 2007 and spread island-wide by 2010 (DON, 2019). This large scarab beetle is a serious pest to palm trees, including coconut and betelnut, and screwpine trees. The little fire ant was confirmed on Guam in November 2011 (DON, 2019). However, it is not yet known to occur on Andersen AFB.

Although *Maytenus thompsonii*, the host plant for the endangered and extirpated Mariana wandering butterfly (*Vagrans egistina*) was observed during project surveys, no Mariana wandering butterflies, larvae, or pupae were observed during surveys conducted in December 2016 (see Figure 3-4) (DON, 2017b). Neither the Mariana eight-spot butterfly nor its host plants (*Procris pedunculata* and *Elatostema calcareum*) were observed during surveys of the Alternative 2 action area. The non-native black citrus swallowtail (*Papilio polytes*) and common eggfly (*Hypolimnas bolina*) were abundant in the project area (DON, 2017b).

Summary of ESA-listed Wildlife Species

The ESA-listed wildlife species are summarized below from the DON (2018) Biological Assessment:

- Mariana Fruit Bat (*Pteropus mariannus mariannus*) (threatened). The Guam population of the Mariana fruit bat was listed as endangered in August 1984 (USFWS, 1984) and critical habitat was designated. A Revised Recovery Plan was completed for the species bat in 2009 (USFWS, 2009) and in 2005, the USFWS down-listed it from endangered to threatened. This decision was based on research indicating that *Pteropus mariannus* is not a subspecies endemic to Guam but is instead endemic to the Mariana archipelago (USFWS, 2005). The Mariana fruit bat is medium-sized compared to other fruit bats, weighing 11.6-20.3 ounces (330-577 grams) and with a wingspan of 34-42 inches (86-107 centimeters); males are slightly larger than females. The underside is black to brown with interspersed gray hair creating a grizzled appearance. The shoulders and sides of the neck are bright golden brown, but may be paler in some individuals. The head varies from brown to dark brown (DON, 2017c).
- Mariana Crow (*Corvus kubaryi*) (endangered). The Mariana crow was federally listed as endangered on August 27, 1984 and was considered extirpated from Guam in 2011 (USFWS, 2013). Critical Habitat for the species has been designated on Guam and Rota (USFWS, 2004). At the time of listing, only a small remnant population survived at the northern end of Guam. Andersen AFB hosted a translocation, captive recovery, and release program for the Mariana crow in an area of large scale brown treesnake control within the MSA. Thirty-one Mariana crows have been released since 1997 but none have survived. In 2010, 10 crows were released in the forests on the northern cliffs Andersen AFB (JRM, 2013). A single banded male was observed in July 2011 and last heard in August 2011 (SWCA, 2012). The next closest population of crows is approximately 56 miles away on the island of Rota (USFWS, 2015b). Surveys on this island in 2013 counted 46 pairs during the breading season (Kroner, 2014).
- Guam Rail (*Gallirallus owstoni*) (endangered). The Guam rail was believed to have been extirpated from the wild on Guam by 1987 (Wiles et al., 1995). The rail persists in captivity on Guam and in twelve U.S. mainland zoos (USFWS, 2015b). Critical habitat for the species has not been designated. Guam rails were experimentally introduced to Andersen AFB at Northwest Field and Area 50 in 1998 and in 2003, but this population did not survive reintroduction; 80 percent died from feral cat predation and the release area was too small to support the population (DON, 2013). A population of breeding rails has become established on the island of Cocos (off of the southern coast of Guam) under the Safe Harbors Agreement permitted under Section 10(a)(1)(A) of the ESA. The rails are actively monitored to learn more about their survivorship, breeding behavior, habitat preferences and nesting success (USFWS, 2014).
- Humped Tree Snail (*Partula gibba*). The humped tree snail is the least common of the three ESA-listed tree snail species on Guam. At the time of listing in 2015, the population of humped tree snails on Guam was estimated at approximately 100 individuals. The humped tree snail is only found at Haputo Beach (Lindstrom & Benedict, 2014). While population decline of humped tree snails has been reported on most islands of the CNMI, population estimates for the archipelago have not been calculated (CNMI DLNR, 2015). In 2008, no humped tree snails were found on Rota, Tinian, or Aguiguan, potentially due to habitat loss related to extensive deforestation and agriculture (Smith et al., 2008; Hadfield, 2010).

- Guam Tree Snail (*Partula radiolata*). Prior to WW II the Guam tree snail existed everywhere suitable vegetation occurred (USFWS, 2015a). In 1925, Guam tree snails were found at 37 of 39 sites across the island, and 2,278 individuals were collected. In 1989, the Guam population was resurveyed at 34 of the original 39 sites, and only 9 of the sites still supported snails. The surveys found snails at 7 of 13 new sites surveyed (USFWS, 2015a). At the time of listing in 2015, there were no more than 26 colonies of Guam tree snails, with between 10 and 150 individuals per colony (USFWS, 2015a) and it is believed that the population has declined since. Guam tree snails were sighted in November 2016 in Andersen AFB South. Surveys in the same area by USDA Wildlife Services personnel reported three live snails in 2016, and DON personnel returned to the locations where these snails were sighted and confirmed presence of 35 live snails. In February 2017, a total of 38 live snails were documented at Andersen South (Olmsted, 2017, personal communication). Ritidian Point was the site of a targeted search on July 17, 2013, where 20 Guam tree snails were documented (but many more observed). Most of the Guam tree snails on Andersen are found at Tarague basin (DON, 2018b).
- Fragile Tree Snail (*Samoana fragilis*) (endangered). No live native tree snails, bleached or fresh shells or fragments thereof were observed during the surveys in support of this project. Survey protocols used the methodology described in the Federal Candidate Species Surveys on Guam prepared by (NAVFAC Marianas 2013a). The current habitat would not provide recolonization conditions for the fragile tree snail because of the overwhelming presence of Euglandina and carnivorous flatworm (DON, 2017b). Surveys for native tree snails were not done in the Alternative 1 action area, but were conducted in the adjacent Alternative 2 action area. Despite not observing any native tree snails in the Alternative 2 action area, two non-native arboreal tree gastropods were observed: the East Asian bradybaenidae (*Satsuma sp.*) and the tropical American bulimulidae (*Drymaeus multilineatus*). This suggests conditions may be suitable for tree snails in the MSA. However, there were sightings of the predatory flatworm (*Platydemus manokwari*). These flatworms prey on Partulid tree snails and pose a threat to the native Guam tree snails. A continuous swath of dead African giant snail shells suggests that any snail moving along the ground would be at risk of predation by flatworms. The current habitat would not provide recolonization conditions for native Partulid tree snail (DON, 2017b).

3.5.2.3 Recovery Habitat

"Recovery habitat" is a term that was defined in the 2010 Navy Biological Opinion (BO) by the USFWS to mean "habitat that is currently suitable to support the recovery of listed species (USFWS, 2010)." Recovery habitat for species extirpated in the wild is mentioned and is consistent with other consultations with the USFWS. The USFWS has mapped habitat across Guam for species extirpated from the wild and labeled these lands as recovery habitat. Although this term has no legal basis, these habitats could host the reintroduction of extirpated species once threats have been removed or sufficiently managed. Habitat protection for these species is important for their eventual recovery. Andersen AFB acknowledges the need to conserve recovery habitat for listed species and has assessed impacts to identified areas by the amount of suitable habitat available for the species. Suitable habitat comprises areas that could provide foraging, nesting, roosting, or other functions for one or more life stages of a recovered species. Such habitat would include native forest or areas free of predators.

Recovery habitat for the Guam Micronesian kingfisher does not occur within MSA I and is therefore not within the action area. No impact to Guam Micronesian kingfisher recovery habitat is anticipated as a result of the proposed project.

The USFWS estimated approximately 13,962 and 10,957 acres of potential Mariana crow habitat in northern and southern Guam, respectively, or a total of 24,919 acres (USFWS, 2015b). Based on an assessment of habitat on Guam, a minimum of 7,463 acres of appropriate habitat on northern Guam and 7,166 acres in southern Guam would be needed to recover the species on the island. A total of 23.9 acres of recovery habitat for the Mariana crow currently exists within Alternative 1 action area and 10.6 acres within Alternative 2 action area.

The USFWS identified a total of 29,308 acres of Mariana fruit bat recovery habitat on Guam. Although the amount of habitat necessary for recovery of the species has not been determined (USFWS, 2010), there are 28.7 acres of fruit bat recovery habitat in the Alternative 1 action area and 10.6 acres within Alternative 2 action area.

The USFWS identified approximately 24,698 acres and 24,886 acres of Guam rail recovery habitat in northern and southern Guam, respectively, or a total of 49,584 acres. There are 22.6 acres of recovery habitat within the Alternative 1 action area and 25.7 acres within the Alternative 2 action area.

3.5.3 Environmental Consequences

This analysis focuses on wildlife and vegetation types that are important to the function of the ecosystem or are protected under federal or state law or statute. This section presents an analysis of potential direct and indirect effects from implementation of the Proposed Action. Direct effects are the direct or immediate effects on the species or its habitat. Indirect effects are those that are caused by the Proposed Action and would manifest themselves at a later time, but which are still reasonably certain to occur. All direct and indirect project effects have been further classified and evaluated based on their anticipated longevity (i.e., temporary or permanent effects).

As they relate to the federally listed species and suitable habitat considered in this EA, direct and indirect effects from proposed activities within the action area have been evaluated herein based upon: (1) an understanding of the methods and equipment that would be used during construction and operation of facilities, (2) knowledge of the potential for such methods and equipment to disturb the natural resources on which the subject species depend, and (3) awareness of the types of effects that have resulted from similar actions in the past.

3.5.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to biological resources. Therefore, no significant impacts to biological resources would occur with implementation of the No Action Alternative.

3.5.3.2 Alternative 1

Alternative 1 would involve the disturbance of 51 acres, 19 of which would be impervious surface, for the construction of 48 new Hayman style ECMs. During site preparation, surface vegetation would be cleared and grubbed (i.e., roots and stumps extracted), and the ground would be excavated for the storage unit flooring. Ground disturbance during construction would include site grading to establish positive drainage control and a perimeter mound to control runoff. Existing access roads within Alternative 1 would be removed and replaced, and new utilities would be constructed, impacting an additional 3.5 acres of pervious surface. Vegetation in this area and in parts of the degraded limestone forest is dense and would require clearance, with approximately 12 acres of currently undisturbed land listed as native limestone forest.

Vegetation

Short-term adverse effects (during construction) and long-term adverse effects (those lasting into post-construction phase) would be expected. Though parts of Alternative 1 would take place in areas that have been previously modified, the native and degraded limestone forest habitat is considered to be of high habitat value since it contains federally and Guam-listed plant species and provides habitat suitable for listed animal species. Loss of this habitat would result in adverse effects to protected species that are known to inhabit the proposed area of construction.

Alternative 1 would involve the construction of 48 igloos north and west of Phase I along 5th, 6th, 7th, and 8th streets (all north of C Avenue) (Figure 3-2). A maximum of 56.1 acres of vegetation would be removed for Alternative 1 construction (less than 0.5 percent of the total vegetated area of the Guam NWR overlay). Based on data collected during the plant surveys (Appendix F) (DON, 2017a), it is anticipated that up to 83 of the federally threatened *Tabernaemontana rotensis* and 724 of the federally threatened *Cycas micronesica*, as well as 76 *Maytenus thompsonii* trees associated with the federally listed Mariana wandering butterfly, would be removed during construction under Alternative 1 (see Figures 3-3 and 3-4). The removal represents 0.13 percent of the *Cycas micronesica* population on Guam (based on an estimated 516,000 *Cycas micronesica* estimated to occur on Guam) (USFWS, 2015c). Range wide, this loss represents less than one percent (~0.08 percent) of the population (USFWS, 2015c). The removal represents less than one percent (0.36 percent) of the *Tabernaemontana rotensis* population on Guam. Habitat loss, fragmentation, and degradation are of concern to the species, as is the scale infestation that impacts tree health. Past land management practices and the introduction of invasive species has contributed towards forest degradation. This holds true for the Andersen AFB MSA and proposed project site, where historical use of the MSA has significantly lowered the quality of habitat for *Cycas micronesica* and *Tabernaemontana rotensis*.

Trees that are identified in the Native Forest Birds of Guam and Rota Recovery Plan (USFWS, 1990a) and the Guam Mariana Fruit Bat and Little Mariana Fruit Bat Recovery Plan (USFWS, 1990b) as trees associated with protected species that could be removed include *Aglaia mariannensis*, *Ficus microcarpa*, and *Ficus prolixa*. Removal of native vegetation in the area designated for Alternative 1 construction would have a direct adverse effect on the habitat used by Guam's endangered species by reducing forest habitat available for roosting and foraging.

The Alternative 1 action may affect, and is likely to adversely affect, *Cycas micronesica* and *Taberneamontana rotensis*. Incorporation of all BMPs and conservation measures discussed below would reduce the impacts to threatened and endangered species so that significant impacts would not adversely affect the continued existence of the species.

Terrestrial Wildlife

Terrestrial wildlife has not been recently surveyed in the area located within Alternative 1. This site would be disturbed by vegetation clearance and the construction of the munitions storage facilities. Proposed construction activities would remove vegetative habitat, as previously discussed. Wildlife habitat is fragmented due to previous modifications. Construction under Alternative 1 would result in moderate impacts to terrestrial wildlife as a result of the loss of native limestone forest habitat. This native limestone forest makes the Alternative 1 project area better suited to maintaining native wildlife since this native habitat often provides foraging and sheltering conditions important to the survival of native wildlife. Non-native plants may or may not provide this same benefit, and often allow the establishment of non-native wildlife.

Short-term minor adverse effects to wildlife would be expected as a result of construction activity and noise. Ground disturbance and noise from vehicle use or construction is likely to temporarily flush any foraging or resting native birds and fruit bats. As discussed in Section 3.6.2, however, the ambient noise environment is characterized by aircraft overflights, so wildlife are accustomed to noise-generating activities in the Alternative 1 action area. Following construction, no adverse effects as a result of increased noise would be expected.

Management of natural resources on Andersen AFB is covered under the Joint Region Marianas Integrated Natural Resources Management Plan (DON, 2013), which is currently undergoing a revision (DON, 2019). Components of this plan and the updated revised plan include controlling introduced wildlife species on Andersen AFB for the benefit of native species, particularly protected species. Andersen AFB has depredation programs in place within the MSA and will continue to manage feral ungulates in the area.

Although no Mariana fruit bats have been seen roosting within MSA I, they have been known to occur in the Andersen AFB area and to transit over the project area. Adverse effects on this species would be expected primarily as a result of construction activity and noise and secondarily as a result of habitat removal. All of the current *Vitex* and limestone forest within the project footprint is considered fruit bat habitat that is poor quality due to past historical impacts and ongoing operations. The impact to 28.7 acres of suitable habitat represents less than 0.09 percent of suitable habitat lost (USFWS 2010). The overall remaining 29,279 acres of bat suitable habitat is large enough to support the remaining population of Mariana fruit bats on Guam, and would not reduce the likelihood for recovery of the species. To date, the recovery plan for the species has not been updated to reflect the criteria for determining habitat suitability for recovery of the species. However, habitat loss and degradation is considered one of the highest threats to fruit bats on Guam.

Noise levels associated with the construction of the 48 new ECM would cause short-term impacts to the species. Typical construction noise is associated with the construction equipment and increased truck and vehicle access to the location. Construction of the ECMs will be done using concrete casting and heavy construction equipment. Construction noise will impact the action area and be heard in the adjacent forest. It is anticipated that Mariana fruit bats would avoid the action area and adjacent sites during construction because of noise disturbance.

Based on these effects, the action may affect, and is likely to adversely affect, the Mariana fruit bat in the form of disturbing foraging bats according to ESA take definitions. However, a number of BMPs and conservation measures are part of the Proposed Action and are designed to avoid disturbance of bats during construction. Andersen AFB will conduct pre-construction surveys to determine if Mariana fruit bats are present in the project site before construction. If bats are present, construction will be delayed until they have left the site. After construction, noise disturbance will result from ongoing operations at the MSA. As stated above, the impact to suitable habitat represents less than 0.09 percent of suitable habitat lost (USFWS 2010); the overall remaining bat suitable habitat is large enough to support the remaining population of Mariana fruit bats on Guam, and would not reduce the likelihood for recovery of the species. The USAF shared these analyses and conclusions during formal consultation with the USFWS under Section 7 of the Endangered Species Act regarding the Preferred Alternative (Appendix C). The USAF will continue to coordinate with the USFWS during this consultation period.

The Guam rail is now extirpated from Guam, so this species would not be directly impacted by Alternative 1; impacts to their recovery habitat, however, could reduce the likelihood for recovery of the

species. While a total of 22.6 acres of Guam rail habitat would be lost in the Alternative 1 action area, 21.7 acres would be restored through the creation of grassy buffer areas around the ECMs, which would be suitable Guam rail habitat; consequently, only 0.9 of 49,584 acres of recovery habitat available for the Guam Rail on Guam would be lost in the Alternative 1 action area following construction. The overall remaining 49,583 acres of suitable habitat is an area large enough to support a population of Guam rail on Guam. Additionally, there is no projected date for Guam rail reintroduction on Andersen AFB or suppression of the brown treesnake to support reintroduction. Until the Guam rail is successfully reintroduced, no impacts are anticipated from construction and operational activities. Based on these effects, implementation of the Alternative 1 action may affect, but is not likely to adversely affect, the Guam rail.

The Mariana crow is now extirpated from Guam, and this species would not be directly impacted by Alternative 1; impacts to their recovery habitat, however, could reduce the likelihood for recovery of the species. Only 23.9 of 13,962 acres of recovery habitat available for the Mariana crow in Northern Guam occur in the Alternative 1 action area. The overall remaining 13,938 acres of suitable habitat is an area large enough to support a population of Mariana crow on Guam. The opportunity for reintroduction of this extirpated species on Guam is uncertain at this time, and is primarily dependent on the eradication or significant suppression of the brown treesnake. Currently, there is neither a plan nor projected dates for reintroduction of the Mariana crow on Guam. The loss of habitat does not impact the continued survival of the species as it does not currently occur in the wild on the island. Based on the potential effects to the Mariana crow from habitat loss due to construction, implementation of the Alternative 1 action may affect, but is not likely to adversely affect, the Mariana crow.

Native Partulid tree snails have not been found in the adjacent Alternative 2 action area, and none are expected to occur in the 51-acre Alternative 1 action area; favorable vegetation for Partulid tree snails has, however, been identified. Much of this vegetation is common in degraded limestone forest present across Guam. The current forest has gone through significant changes from agriculture and forest destruction from the war and development of the MSA, thus limiting the possibilities for snails to be established in the area. The action area has also been documented to support the predatory flatworm (*Platydemus manokwari*), a significant threat to Partulid tree snails. Deer and pigs also occur in the areas and are known to degrade native forest.

The proposed action is likely to adversely affect habitat for the Partulid tree snails that may occur in the Alternative 1 action area through the construction of the ECMs; however, the proposed action will have no effect on listed Partulid tree snails. Incorporation of all BMPs and conservation measures discussed below would lessen the severity of habitat impacts.

Best Management Practices and Conservation Measures

Best Management Practices

Andersen AFB has identified BMPs and designed conservation measures to avoid or minimize impacts to ESA-listed species. These BMPs are typically process improvement activities and are described below.

1. **Contractor Education Program.** The Contractor Education Program ensures that contracted construction personnel are informed of the biological resources in the project area including invasive species, avoidance measures, and reporting requirements. Information about *Cycas micronesica*, *Tabernaemontana rotensis*, and Mariana fruit bats will be included in the contactor education program to ensure construction personnel are aware of the species and the need to avoid inadvertent impacts.

2. **Mariana Fruit Bat (*Pteropus mariannus mariannus*).** This minimization procedure will reduce the likelihood of Mariana fruit bat disturbance. One week prior to, and again during the first week of forest clearing, a biologist will conduct a survey of the project site to determine if Mariana fruit bats are present. If a fruit bat is present within 492 feet of the project site, the work in that area will be postponed until the bat has left the area of its own volition. Monthly monitoring of Mariana fruit bats will be conducted in the project area to determine site use. If a fruit bat moves into the project footprint while work is ongoing (i.e., the fruit bat selected the site with ongoing noise and activity), work may continue to proceed. Night time construction is not anticipated; however, if necessary, lighting would be hooded and directed away from forested habitat.

3. **Biosecurity.** The little fire ant (LFA) (*Wasmannia auropunctata*) represents a serious threat to native invertebrate and vertebrate species; however, it is not yet known to occur on Andersen AFB. A quarantine regulation for the coconut rhinoceros beetle has been imposed by the Guam Department of Agriculture that prohibits transport of green waste from within a prescribed quarantine zone without inspection or treatment (DON, 2019). These and other biosecurity measures will be implemented to prevent the spread of invasive species. This will be done in accordance with the Regional Biosecurity Plan for Micronesia and Hawaii (DON, 2015c).

Guam rail and Guam Micronesian kingfisher were not observed during the fauna survey (see Appendix C) and are no longer known to exist in MSA I. With the minimization measures described for reducing and compensating for loss of habitat, Alternative 1 could potentially have minor adverse effects on the future plans for releasing captive-bred Guam rail and Guam Micronesian kingfisher in MSA I.

USAF will continue to consult with USFWS to make the final determination of effect.

Conservation Measures

The following conservation measures are specific to the action and promote the continued existence of *Cycas micronesica*, *Tabernaemontana rotensis*, and Partulid tree snails. These conservation measures are meant to off-set the effects of forest clearing and removal of plants in the construction site. A summary of these conservation measures is presented below, and a detailed list is presented in the Biological Assessment submitted to the USFWS (Appendix C):

1. **Reconnaissance Surveys, Salvage, and Translocation.** Andersen AFB will conduct pre-construction surveys for ESA-listed plants and snails prior to habitat disturbance for species that cannot be avoided in the construction footprint. Plants and snails will be translocated to Tarague Basin or other approved restoration site by the USFWS.

    a) **Specific information for *Cycas micronesica*.** All *Cycas micronesica* identified within the project footprint would be impacted by the Proposed Action. Salvaging adult trees or pups will be determined by an authorized biologist. Trees may be evaluated for survivorship, uprooted, treated for Asian cycad scale, and transplanted to a suitable habitat (Marler, 2012). Cycads may also have basal suckers (cycad pups) that can be detached from the parent tree and are considered duplicates of the parent tree. Andersen AFB will collect as many possible cycad pups salvageable for translocation. Maintenance including watering, weeding, pest removal and plant protection will be conducted. Monitoring will be done monthly or more frequently depending on the conditions of the plants to determine growth and status of the plants.

b) **Specific information for *Tabernaemontana rotensis*.** All *Tabernaemontana rotensis* identified within the project footprint will be impacted by the Proposed Action. Viable seeds will be collected by a biologist to propagate new individuals in a USFWS-approved native plant nursery on Guam. Maintenance including watering, weeding, pest removal and plant protection will be conducted. Monitoring will be done monthly or more frequently depending on the conditions of the plants to determine growth and health status.

c) **Specific information for Partulid Tree Snail Species.** Andersen AFB proposes to conduct pre-construction surveys for federally listed snails. If found, a biologist will translocate them to suitable habitat with appropriate native vegetation within the Tarague Basin or other site approved by USFWS. Their protection would be further ensured by translocating them to an ungulate-proofed enclosure at the Conservation Area. Translocation techniques will be used to reduce the likelihood of snail predation. Placing translocated tree snails higher than 3 feet above ground level on trees will reduce the chances of flatworm and *Euglandina rosea* predation.

d) **Specific information for MBTA Species.** One week prior to vegetation removal, the USAF will search the site for nesting MBTA birds. If an active nest is present, vegetation clearing will be kept 100 feet (30 meters) away until birds have fledged or abandoned the nest on their own accord.

2. **Annual Reporting of Propagation/Translocation Activities.** Andersen AFB will submit an annual report to the USFWS one year after the Biological Opinion is issued and each year thereafter until the project and associated conservation measures are complete. The biologists will record observations of each species during the reconnaissance surveys. The report will summarize the type of activities (e.g., health status of plants, propagation, translocation, etc.) conducted on each species and the status of relocation efforts.

3.5.3.3 Alternative 2

Alternative 2 would involve the disturbance of 50 acres, 18 of which would be impervious surface, for the construction of 48 new Hayman style ECMs. During site preparation, surface vegetation would be cleared and grubbed (i.e., roots and stumps extracted), and the ground would be excavated for the storage unit flooring. Ground disturbance during construction would include site grading to establish positive drainage control and a perimeter mound to control runoff. Thirty existing ECMs are in a developed area and would be demolished as part of this action. Existing access roads within Alternative 2 would require minor patches, and new utilities would be constructed, impacting an additional 2 acres of pervious surface.

Types of impacts, such as tree trimming and vegetation clearing, would be similar under Alternative 2 as under Alternative 1, but the area impacted under Alternative 2 would be smaller (20.3 acres of pervious surface for Alternative 2 compared to 21.6 acres of pervious surface for Alternative 1). In addition, the impacts to terrestrial biological resources would be reduced since the habitat in Alternative 2 includes no native limestone forest and is much more fragmented than the habitat in Alternative 1.

Vegetation

Short-term adverse effects (during construction) and long-term moderate adverse effects (effects lasting into post-construction phase) would be expected. Though Alternative 2 would take place in areas that have been previously modified, areas of the Mixed Limestone Forest/Secondary habitat is considered to

be of high habitat value. Clearing of this habitat would result in adverse effects on protected species that are known to inhabit the proposed area of construction.

A maximum of 49.5 acres of vegetation would be removed for Alternative 2 construction (less than 0.5 percent of the total vegetated area of the GNWR overlay). Based on data collected during the plant surveys (Appendix F) (DON, 2017a), it is anticipated that none of the federally threatened *Tabernaemontana rotensis* and 55 of the federally threatened *Cycas micronesica*, as well as 12 *Maytenus thompsonii* trees associated with the federally listed Mariana wandering butterfly, would be removed during construction under Alternative 2 (see Figures 3-3 and 3-4). The removal represents 0.13 percent of the *Cycas micronesica* population on Guam (based on an estimated 516,000 *Cycas micronesica* estimated to occur on Guam) (USFWS, 2015c). Range-wide, this loss represents less than one percent (~0.08 percent) of the population (USFWS, 2015c). Habitat loss, fragmentation, and degradation are of concern to the species, as is the scale infestation that impacts tree health. Past land management practices and the introduction of invasive species have contributed towards forest degradation. This holds true for the Andersen AFB MSA and proposed project site, where historical use of the MSA has significantly lowered the quality of habitat for *Cycas micronesica* and *Tabernaemontana rotensis*.

Effects on trees that are federally protected or associated with protected species under Alternative 2 are similar to those described for Alternative 1. The number and density of protected species found within the Alternative 2 project area are fewer, however, and the habitat is much more fragmented. Therefore, the impacts to vegetation would be less than those in Alternative 1. Native trees that could be removed under Alternative 2 include *Aglaia mariannensis*, *Elaeocarpus joga*, and *Ficus prolixa*. Removal of native vegetation in the proposed area for Alternative 2 construction would have a direct adverse effect on the habitat used by Guam's endangered species.

The Alternative 2 action may affect, but is not likely to adversely affect, *Tabernaemontana rotensis* since no individuals are located in the action area. The Alternative 2 action may affect, but is not likely to adversely affect, *Cycas micronesica*, but the impact would be smaller than in Alternative 1 since the habitat is more fragmented and fewer cycads were found in the Alternative 2 action area. Implementation of the proposed BMPs and conservation measures discussed below would lessen the severity of impacts to Alternative 2 action area.

Terrestrial Wildlife

Minor adverse effects to wildlife species would be expected. Proposed construction activities would remove vegetative habitat, as previously discussed; wildlife habitat is fragmented, however, due to previous modifications and fragmentation. Construction under Alternative 2 would result in effects similar to those described under Alternative 1; the effects resulting from loss of habitat, however, would be less adverse because the habitat found in Alternative 1 consists of native and degraded limestone forest, which is of higher quality than the fragmented degraded limestone forest and mixed scrub community found in Alternative 2.

Short-term minor adverse effects on wildlife would be expected as a result of construction activity and noise. Ground disturbance and noise from vehicle use or construction is likely to temporarily flush any foraging or resting native birds and fruit bats. As discussed in Section 3.6.2, however, the ambient noise environment is characterized by aircraft overflights, so wildlife are accustomed to noise-generating activities in the Alternative 2 action area. Following construction, no adverse effects as a result of increased noise would be expected.

Management of natural resources on Andersen AFB is covered under the Joint Region Marianas Integrated Natural Resources Management Plan (DON, 2013), which is currently undergoing a revision (DON, 2019). Components of this plan and the updated revised plan include controlling introduced wildlife species on Andersen AFB for the benefit of native species, particularly protected species. Andersen AFB has depredation programs in place within the MSA and will continue to manage feral ungulates in the area.

Although no Mariana fruit bats have been seen roosting within MSA I, they have been known to occur in the Andersen AFB area and transit over the project area. Adverse effects under Alternative 2 would be similar to Alternative 1; the effects resulting from loss of habitat, however, would be less adverse because the habitat found in Alternative 1 consists of higher quality habitat better suited for the Mariana fruit bat.

Minimization measures associated with protected species habitat would reduce and compensate for adverse effects but not eliminate them altogether. To reduce the potential for adverse effects resulting from construction activity or noise, the following minimization measures described below would be implemented.

The Guam rail is now extirpated from Guam, so this species would not be directly impacted by Alternative 2; however, impacts to recovery habitat could reduce the likelihood for recovery of the species. While a total of 25.7 acres of Guam rail habitat would be lost in the Alternative 2 action area, some acres would be restored through the creation of grassy buffer areas around the ECMs, which would be suitable Guam rail habitat; consequently, less than 25.7 of 49,584 acres of recovery habitat available for the Guam Rail on Guam would be lost in the Alternative 2 action area following construction. The overall minimum remaining 49,568 acres of suitable habitat is an area large enough to support a population of Guam rail on Guam. Additionally, there is no projected date for Guam rail reintroduction on Andersen AFB or suppression of the brown treesnake to support reintroduction. Until the Guam rail is successfully reintroduced, no impacts are anticipated from construction and operational activities. Based on these effects, implementation of the Alternative 2 action may affect, but is not likely to adversely affect, the Guam rail.

The Mariana crow is now extirpated from Guam, so this species would not be directly impacted by Alternative 2; however, impacts to recovery habitat could reduce the likelihood for recovery of the species. Only 10.6 of 13,962 acres of recovery habitat available for the Mariana crow in Northern Guam occur in the Alternative 2 action area. The overall remaining 13,951 acres of suitable habitat is an area large enough to support a population of Mariana crow on Guam. The opportunity for reintroduction of this extirpated species on Guam is uncertain at this time, and is primarily dependent on the eradication or significant suppression of the brown treesnake. There is currently neither a plan nor projected dates for reintroduction of the Mariana crow on Guam. The loss of habitat does not impact the continued survival of the species as it does not currently survive in the wild on Guam. Based on the potential effects to the Mariana crow from habitat loss due to construction, implementation of the Alternative 2 action may affect, but is not likely to adversely affect, the Mariana crow.

Native Partulid tree snails have not been found in the Alternative 2 action area; however, favorable vegetation for Partulid tree snails has been identified. Much of this vegetation is common in degraded limestone forest present across Guam. The current forest has gone through significant changes from agriculture and forest destruction from the war and development of the MSA, thus limiting the possibilities of snails to be established in the area. The action area has also been documented to support

the predatory flatworm (*Platydemus manokwari*), a significant threat to Partulid tree snails. Deer and pigs also occur in the areas and are known to degrade native forest.

Best Management Practices and Conservation Measures

BMPs and conservation measures identified for Alternative 1 also apply for Alternative 2.

3.6 Noise

This discussion of noise includes the types or sources of noise and the associated sensitive receptors in the human environment. Noise in relation to biological resources and wildlife species is discussed in the Biological Resources section.

Sound is a physical phenomenon consisting of minute vibrations that travel through a medium, such as air or water, and are sensed by the human ear. Sound is all around us. The perception and evaluation of sound involves three basic physical characteristics:

- Intensity – the acoustic energy, which is expressed in terms of sound pressure, in decibels (dB)
- Frequency – the number of cycles per second the air vibrates, in Hertz
- Duration – the length of time the sound can be detected

Noise is defined as unwanted or annoying sound that interferes with or disrupts normal human activities. Although continuous and extended exposure to high noise levels (e.g., through occupational exposure) can cause hearing loss, the principal human response to noise is annoyance. The response of different individuals to similar noise events is diverse and is influenced by the type of noise, perceived importance of the noise, its appropriateness in the setting, time of day, type of activity during which the noise occurs, and sensitivity of the individual. While aircraft are not the only sources of noise in an urban or suburban environment, they are readily identified by their noise output and are given special attention in this EA.

3.6.1 Basics of Sound and A-Weighted Sound Level

The loudest sounds that can be detected comfortably by the human ear have intensities that are a trillion times higher than those of sounds that can barely be detected. This vast range means that using a linear scale to represent sound intensity is not feasible. The dB is a logarithmic unit used to represent the intensity of a sound, also referred to as the sound level. All sounds have a spectral content, which means their magnitude or level changes with frequency, where frequency is measured in cycles per second, or Hertz. To mimic the human ear's non-linear sensitivity and perception of different frequencies of sound, the spectral content is weighted. For example, environmental noise measurements are usually on an "A-weighted" scale that filters out very low and very high frequencies in order to replicate human sensitivity. It is common to add the "A" to the measurement unit in order to identify that the measurement has been made with this filtering process (dBA). In this document, the dB unit refers to A-weighted sound levels. Table 3-8 provides a comparison of how the human ear perceives changes in loudness on the logarithmic scale.

Table 3-8 Subjective Responses to Changes in A-Weighted Decibels

Change	*Change in Perceived Loudness*
3 dB	Barely perceptible
5 dB	Quite noticeable
10 dB	Dramatic – twice or half as loud
20 dB	Striking – fourfold change

Key: dB = decibel.

Figure 3-5 (Cowan, 1994) provides a chart of A-weighted sound levels from typical noise sources. Some noise sources (e.g., air conditioner, vacuum cleaner) are continuous sounds that maintain a constant sound level for some period of time. Other sources (e.g., automobile, heavy truck) are the maximum sound produced during an event like a vehicle pass-by. Other sounds (e.g., urban daytime, urban nighttime) are averages taken over extended periods of time. A variety of noise metrics have been developed to describe noise over different time periods, as discussed below.

Noise levels from aircraft operations that exceed background noise levels at an airfield typically occur beneath main approach and departure corridors, in local air traffic patterns around the airfield, and in areas immediately adjacent to parking ramps and aircraft staging areas. As aircraft in flight gain altitude, their noise contributions drop to lower levels, often becoming indistinguishable from the background noise.

3.6.2 Noise Metrics

A metric is a system for measuring or quantifying a particular characteristic of a subject. Since noise is a complex physical phenomenon, different noise metrics help to quantify the noise environment. The noise metrics used in this EA are described in summary format below. While the Day-Night Average Sound Level (DNL) and Community Noise Equivalent Level (CNEL) noise metrics are the most commonly used tools for analyzing noise generated at an airfield, the DOD has been developing additional metrics (and analysis techniques). These supplemental metrics and analysis tools provide more detailed noise exposure information for the decision process and improve the discussion regarding noise exposure. The DOD Noise Working Group product, *Improving Aviation Noise Planning, Analysis and Public Communication with Supplemental Metrics* (DOD Noise Working Group, 2009) was used to determine the appropriate metrics and analysis tools for this EA.

3.6.2.1 Day-Night Average Sound Level

The DNL metric is the energy-averaged sound level measured over a 24-hour period, with a 10-dB penalty assigned to noise events occurring between 10 p.m. and 7 a.m. (acoustic night). DNL values are average quantities, mathematically representing the continuous sound level that would be present if all of the variations in sound level that occur over a 24-hour period were averaged to have the same total sound energy. The DNL metric quantifies the total sound energy received and is therefore a cumulative measure, but it does not provide specific information on the number of noise events or the individual sound levels that occur during the 24-hour day. DNL is the standard noise metric used by the U.S. Department of Housing and Urban Development, Federal Aviation Administration, USEPA, and DOD. Studies of community annoyance in response to numerous types of environmental noise show that DNL correlates well with impact assessments; there is a consistent relationship between DNL and the level of annoyance. Most people are exposed to sound levels of 50 to 55 DNL or higher on a daily basis.

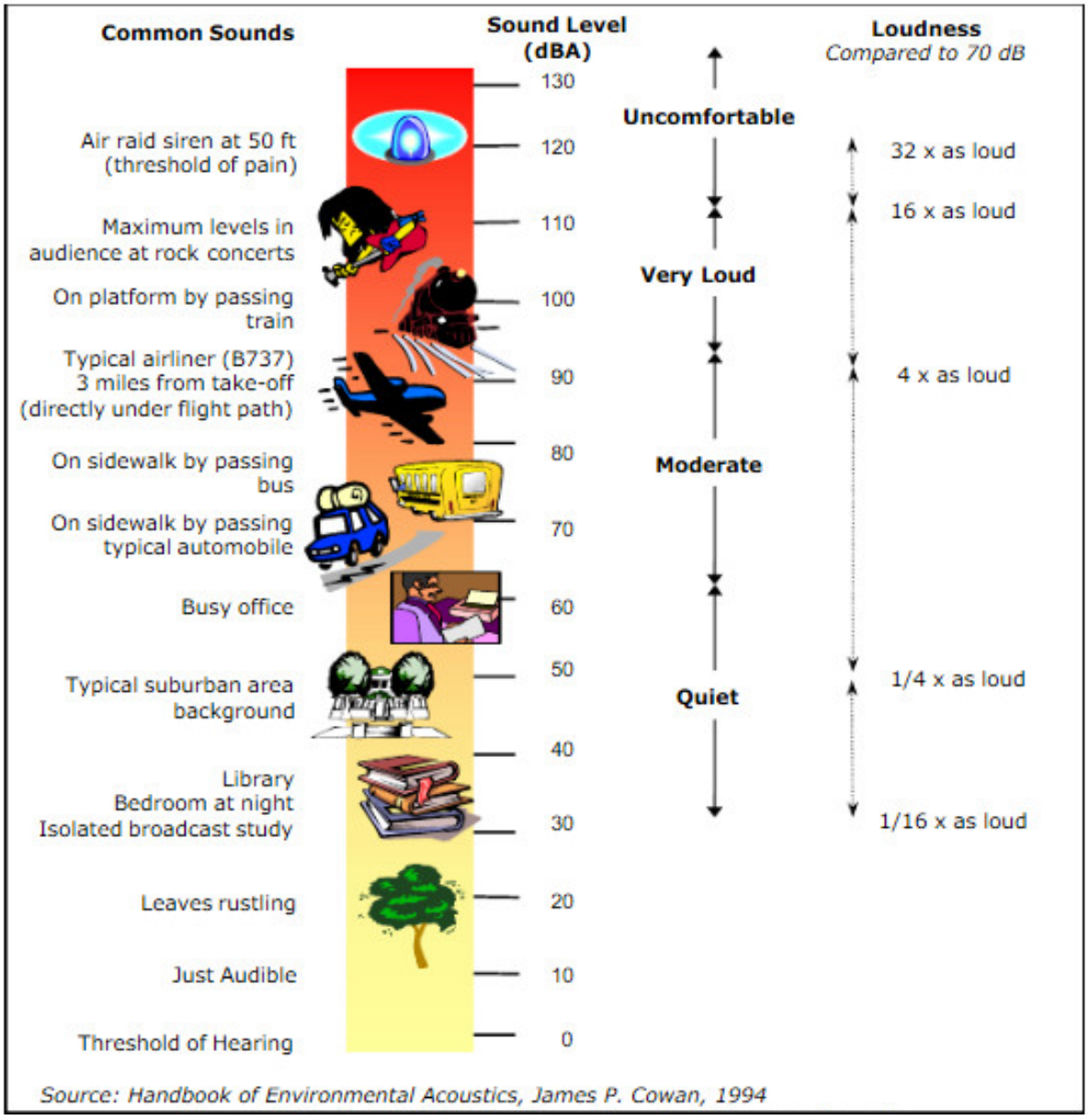


Figure 3-5 A-Weighted Sound Levels from Typical Sources

Research has indicated that about 87 percent of the population is not highly annoyed by outdoor sound levels below 65 dB DNL (Federal Interagency Committee on Urban Noise, 1980). Therefore, the 65 dB DNL noise contour is used to help determine compatibility of military aircraft operations with local land use, particularly for land use associated with airfields.

Building construction, modification, and demolition work can cause noise emissions well above ambient sound levels. A variety of sounds come from cranes, cement mixers, welding, hammering, boring, and other work processes. Table 3-9 lists noise levels associated with common types of construction equipment that might be used to build various buildings and other structures. Construction equipment usually exceeds the ambient sound levels by 20 to 25 dBA in an urban environment and up to 30 to 35 dBA in a quiet suburban neighborhood.

Table 3-9 Predicted Noise Levels for Construction Equipment

Construction Category and Equipment	*Predicted Noise Level at 50 feet (dBA)*
Clearing and Grading	
Bulldozer	80
Grader	80–93
Truck	83–94
Roller	73–75
Excavation	
Backhoe	72–93
Jackhammer	81–98
Building Construction	
Concrete mixer	74–88
Welding generator	71–82
Pile driver	91–105
Crane	75–87
Paver	86–88

Source: USEPA, 1974.

3.6.2.2 Community Noise Equivalent Level

CNEL is a noise metric adopted as a standard by the state of California. The CNEL metric is similar to the DNL metric and is also an energy-averaged sound level measurement. DNL and CNEL provide average noise levels taking into consideration and applying penalties for annoyance from intrusive events that occur during evening and nighttime hours. Both DNL and CNEL are measures of cumulative noise exposure over a 24-hour period, with adjustments to reflect the added intrusiveness of noise during certain times of the day. However, while DNL considers one adjustment period, CNEL reflects two adjustment periods. DNL includes a single adjustment period for night, in which each aircraft noise event at night (defined as 10 p.m. to 7 a.m.) is counted 10 times. CNEL adds a second adjustment period where each aircraft noise event in the evening (defined as 7 p.m. to 10 p.m.) is counted three times. The nighttime adjustment is equivalent to increasing the noise levels during that time interval by 10 dB. Similarly, the evening adjustment increases the noise levels by approximately 5 dB.

3.6.2.3 Equivalent Sound Level

A cumulative noise metric useful in describing noise is the Equivalent Sound Level (L_{eq}). L_{eq} is the continuous sound level that would be present if all of the variations in sound level occurring over a specified time period were smoothed out as to contain the same total sound energy. The same calculation for a daily average time period such as DNL or CNEL but without the penalties is a 24-hour equivalent sound level, abbreviated $L_{eq}(24)$. Other typical time periods for L_{eq} are 1 hour and 8 hours.

3.6.2.4 Sound Exposure Level

The Sound Exposure Level (SEL) metric is a composite metric that represents both the intensity of a sound and its duration. Individual time-varying noise events (e.g., aircraft overflights) have two main characteristics: a sound level that changes throughout the event and a period of time during which the event is heard. SEL provides a measure of total sound energy of the entire acoustic event, but it does not directly represent the sound level heard at any given time. During an aircraft flyover, SEL captures the total sound energy from the beginning of the acoustic event to the point when the receiver no longer hears the sound. It then condenses that energy into a 1-second period of time and the metric

represents the total sound exposure received. The SEL has proven to be a good metric to compare the relative exposure of transient sounds, such as aircraft overflights, and is the recommended metric for sleep disturbance analysis (DOD Noise Working Group, 2009). In this EA, SEL is used in aircraft comparison and sleep disturbance analyses.

3.6.2.5 Maximum Sound Level

The highest A-weighted sound level measured during a single event where the sound level changes value with time (e.g., an aircraft overflight) is called the maximum A-weighted sound level (L_{max}). During an aircraft overflight, the noise level starts at the ambient or background noise level, rises to the maximum level as the aircraft flies closest to the observer, and returns to the background level as the aircraft recedes into the distance. L_{max} defines the maximum sound level occurring for a fraction of a second. For aircraft noise, the "fraction of a second" over which the maximum level is defined is generally 1/8 second (American National Standards Institute, 1988). For sound from aircraft overflights, the SEL is usually greater than the L_{max} because an individual overflight takes seconds and the L_{max} occurs instantaneously. In this EA, L_{max} is used in the analysis of aircraft comparison and speech interference.

3.6.2.6 Number of Events above a Threshold Level

The "Number of Events Above a Threshold Level" metric provides the total number of noise events that exceed a selected noise level threshold during a specified period of time (DOD Noise Working Group, 2009). In this EA, an L_{max} threshold is selected to analyze speech interference and an SEL threshold is selected for analysis of sleep disturbance.

3.6.3 Noise Effects

An extensive amount of research has been conducted regarding noise effects including annoyance, speech interference, sleep disturbance, noise-induced hearing impairment, nonauditory health effects, performance effects, noise effects on children, effects on domestic animals and wildlife, property values, structures, terrain, and archaeological sites. These effects are summarized below.

3.6.3.1 Annoyance

As previously noted, the primary effect of aircraft noise on exposed communities is long-term annoyance, defined by USEPA as any negative subjective reaction on the part of an individual or group. The scientific community has adopted the use of long-term annoyance as a primary indicator of community response and there is a consistent relationship between DNL/CNEL and the level of community annoyance (Federal Interagency Committee on Noise, 1992).

3.6.3.2 Potential Hearing Loss

People living in high noise environments for an extended period of time (40 years) can be at risk for hearing loss called Noise Induced Permanent Threshold Shift (NIPTS). The NIPTS defines a permanent change in hearing level, or threshold, caused by exposure to noise (USEPA, 1982). According to USEPA (1974), changes in hearing level of less than 5 dB are generally not considered noticeable. There is no known evidence that an NIPTS of less than 5 dB is perceptible or has any practical significance for the individual affected. Furthermore, the variability in audiometric testing is generally assumed to be plus or minus 5 dB. The preponderance of available information on hearing loss risk is from the workplace with continuous exposure throughout the day for many years.

Based on a report by Ludlow and Sixsmith (1999), there were no major differences in audiometric test results between military personnel, who as children, had lived in or near installations where fast jet operations were based, and a similar group who had no such exposure as children. Hence, for the purposes of this EA, the limited data are considered applicable to the general population, including children, and are used to provide a conservative estimate of the risk of potential hearing loss.

DOD policy directive requires that hearing loss risk be estimated for the at-risk population, defined as the population exposed to DNL greater than or equal to 80 dB (DOD, 2009). However, it should be recognized that characterizing noise exposure in terms of DNL and CNEL overestimates hearing loss risk but suffices when nighttime operations are 5 percent or less than the total operations. When nighttime operations are greater than 5 percent, $L_{eq}(24)$ is recommended for calculating potential hearing loss since hearing loss is a physical phenomenon due to the sound level and independent of annoyance. Thus, the additional penalties applied by CNEL for evening and nighttime operations do not accurately portray the NIPTS.

3.6.3.3 Speech Interference

Speech interference associated with aircraft noise is a primary cause of annoyance for communities. Speech interference can cause disruption of routine activities, such as enjoyment of radio or television programs, telephone use, or family conversation, giving rise to frustration or irritation. In extreme cases, speech interference may cause fatigue and vocal strain to individuals who try to communicate over the noise. In this EA, speech interference is measured by the number of daily indoor events (from 7 a.m. to 10 p.m.) that exceed 50 dB L_{max} at selected locations. This metric also accounts for noise level reduction provided by buildings with windows open or closed.

3.6.3.4 Classroom Criteria and Noise Effects on Children

Research suggests that environments with sustained high background noise can have variable effects, including effects on learning and cognitive abilities and various noise-related physiological changes. Research on the impacts of aircraft noise, and noise in general, on the cognitive abilities of school-aged children has received more attention in recent years. Several studies suggest that aircraft noise can affect the academic performance of school children. Physiological effects in children exposed to aircraft noise and the potential for health effects have been the focus of limited investigation (DOD Noise Working Group, 2009).

Analyses for school-aged children are similar to speech interference by using the indoor number of events exceeding 50 dB L_{max}, but also has the added restriction of using an outdoor equivalent noise level of 60 dB L_{eq}(9 hour). This represents a level that a person with normal hearing can clearly hear a speaker (teacher) speaking at a level of 50 dB indoors in a classroom setting.

3.6.3.5 Sleep Disturbance

The disturbance of sleep is a major concern for communities exposed to nighttime aircraft noise. In this EA, sleep disturbance uses the SEL noise metric and calculates the probability of awakening from single aircraft overflights. These are based upon the particular type of aircraft, flight profile, power setting, speed, and altitude relative to the receptor. The results are then presented as a percent probability of people awakening (USEPA, 1974).

3.6.3.6 Workplace Noise

In 1972, the National Institute for Occupational Safety and Health (NIOSH) published a criteria document with a recommended exposure limit of 85 dBA as an 8-hour time-weighted average. This exposure limit was reevaluated in 1998 when NIOSH made recommendations that went beyond conserving hearing by focusing on the prevention of occupational hearing loss. Following the reevaluation using a new risk assessment technique, NIOSH published another criteria document in 1998, which reaffirmed the 85 dB recommended exposure limit (National Institute for Occupational Health and Safety, 1998).

3.6.4 Regulatory Setting

Under the Noise Control Act of 1972, the Occupational Safety and Health Administration (OSHA) established workplace standards for noise. The minimum requirement states that constant noise exposure must not exceed 90 dBA over an 8-hour period. The highest allowable sound level to which workers can be constantly exposed is 115 dBA and exposure to this level must not exceed 15 minutes within an 8-hour period. The standards limit instantaneous exposure, such as impact noise, to 140 dBA. If noise levels exceed these standards, employers are required to provide hearing protection equipment that will reduce sound levels to acceptable limits.

3.6.5 Affected Environment

The federal government supports conditions free from noise that threaten human health and welfare and the environment. Response to noise varies, depending on the type and characteristics of the noise, distance between the noise source and whoever hears it (the receptor), receptor sensitivity, and time of day. A noise-sensitive receptor is defined as a land use where people involved in indoor or outdoor activities may be subject to stress or considerable interference from noise. Such locations or facilities often include residential dwellings, hospitals, nursing homes, educational facilities, and libraries. Sensitive receptors may also include noise-sensitive cultural practices, some domestic animals, or certain wildlife species. The nearest sensitive receptors are private residences on Route 9 outside the boundary of Andersen AFB, which are located approximately 1.3 miles from the project site. These private residences are also outside the aircraft operations noise boundaries associated with operations at Andersen AFB (DON, 2015a). Potentially noise-sensitive wildlife species are discussed in Section 3.5.

3.6.5.1 Aircraft Noise

In the vicinity of Andersen AFB, noise contours extend off-base to the south and west, and there are populated areas currently within the noise contours up to 70 dB DNL as described in the 2013 Andersen AFB Air Installation Compatible Use Zone Study (DON, 2015a). Along the Andersen AFB boundary, noise levels range from approximately 65 to 75 dB DNL in line with the end of the runway and dropping back down to below 65 dB DNL near both on- and off-base housing east of the Route 15 family housing gate.

3.6.5.2 Installation Noise Environment

Many components may generate noise and warrant analysis as contributors to the total noise impact. Andersen AFB supports forces deploying throughout the Southwest Pacific and the Indian Ocean. Andersen AFB has two parallel runways, each approximately 2 miles long, as well as fuel and munitions storage facilities. Consequently, the noise environment around Andersen AFB is characterized by military aircraft.

3.6.6 Environmental Consequences

Analysis of potential noise impacts includes estimating likely noise levels from the Proposed Action and determining potential effects to sensitive receptor sites.

3.6.6.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to baseline noise levels. Therefore, no significant impacts due to the noise environment would occur with implementation of the No Action Alternative.

3.6.6.2 Alternative 1

The study area for noise for Alternative 1 includes Andersen AFB MSA 1, Andersen AFB military family housing, and areas within 1 mile from MSA 1.

Short-term direct minor adverse effects would be expected. Construction activities would cause an increase in the surrounding noise levels in the project area. The noise levels from construction equipment would be louder than 50 to 55 dBA. Consequently, short-term direct minor adverse effects on the noise environment near the construction sites could result from the use of heavy equipment. Night time construction is not anticipated; however, construction equipment would be maintained to the manufacturers' specifications to minimize noise impacts.

Since the construction site would be entirely on Andersen AFB property, and the majority of the island's population resides several miles away from the proposed site, construction noise within MSA I would not be audible to residents on base or off base. Construction traffic on off-base roadways would be audible to residents. However, construction traffic would not increase substantially, so construction traffic noise would be similar to typical traffic noise levels. Therefore, the short-term increase in ambient noise levels from Alternative 1 would not cause significant adverse impacts on the surrounding populations. Potential construction noise effects on biological resources are presented as appropriate in Section 3.5.3.

Once the construction of the munitions storage igloos are completed, the ambient noise levels would return to their normal levels. No long-term effects would occur as a result of Alternative 1. Therefore, implementation of Alternative 1 would not result in significant impacts to the noise environment.

3.6.6.3 Alternative 2

Alternative 2 would construct the same 48 new ECMs, but in a different location. The only difference between Alternative 1 and Alternative 2 with respect to noise is the facility demolition activities that would occur prior to construction of new ECMs. Noise associated with facility demolition is consistent with noise associated with new construction, so this difference between alternatives would not result in a significant difference in the surrounding noise environment during construction. There is no operational difference between the alternatives following construction, so operational noise would be the same for each alternative. Therefore, implementation of Alternative 2 would not result in significant impacts to the noise environment.

3.7 Infrastructure

This section discusses infrastructure such as utilities (including potable water service, sanitary sewer service, storm water management, solid waste management, fire suppression, and electrical and communications service). Transportation systems and traffic are addressed separately in Section 3.8.

3.7.1 Regulatory Setting

Resource Conservation and Recovery Act (RCRA) 42 U.S.C. section 6902 et seq., Subtitle C regulates management and disposal of hazardous waste. Federal facilities must have programs in place to reduce the volume or quantity of their hazardous waste to the degree determined by the generator to be economically practicable. Additionally, the proposed method of treatment, storage, or disposal is the practicable method available to the generator that minimizes the present and future threat to human health and the environment. RCRA Subtitle D regulates management and disposal of municipal solid waste. Federal facilities must also comply with the requirements of RCRA Subtitle D, which include proper siting, construction, inspection, and closure of municipal solid waste landfills, as well as restrictions on the type and volume of waste that landfills may accept.

Antiterrorism Force Protection Standards have been adopted by the DOD through DOD Instruction 2000.16 dated October 2006. The standards require all DOD Components to adopt and adhere to common criteria and minimum construction standards to mitigate antiterrorism vulnerabilities and terrorist threats.

3.7.2 Affected Environment

The following discussions provide a description of the existing conditions for each of the categories under infrastructure at Andersen AFB MSA 1.

Potable Water

There is no potable water service within MSA 1.

Fire Suppression

A system of underground water lines provides water for fire suppression in the developed portions of MSA 1. Fire hydrants are positioned on nearly every block of the MSA where there are existing munitions storage facilities and other structures. Andersen AFB firefighters and munitions operations personnel use the underground water supply for fire suppression, in combination with firefighting vehicles and other equipment as needed should a fire occur as a result of an accidental munitions discharge. Immediate containment and suppression of fire is necessary to preclude the possibility of successive explosion.

Wastewater

There is no sanitary sewer service within MSA 1.

Stormwater

Drainage within MSA 1 is typically surface sheet flow. Culverts are minimal and they are normally placed at road intersections to convey runoff from the upslope side of the intersection to the downslope side, preventing erosion of the roadway (DON, 2018a).

Solid Waste Management

The USAF solid waste disposal facility includes a recycling center and a lined solid waste landfill. However, it is under closure and is no longer being used. The main landfill has surrounding areas that are capable of disposing construction and demolition debris, scrap metal, and wood and green waste (Grooms et al., 2008). Solid waste generated on the installation is disposed of in a permitted landfill. The solid waste management plan at Andersen AFB calls for diverting as much waste or refuse from the landfill as possible through recycling, reuse, or recovery.

Electrical Service

Andersen AFB receives electrical power through the Guam Power Authority. Under existing conditions, the primary voltage at Andersen AFB is 13,800Y/7,970 volts. All electrical utility lines in MSA 1 are underground. In 2008, an underground primary electrical feeder was installed to serve the first 12 ECMs in Phase I as well as the future ECMs. This feeder extends from the east on the north side of 4th Street to a 4-way, pad-mounted 15-kilovolt (kV) switch near the intersection of 4th Street and C Avenue. From this switch, a radial feeder is extended to a new pad-mounted transformer located on the east side of ECM 8418. This transformer has a 13.8-kV primary and 480Y/277V secondary. A standby generator is located in a building near the transformer.

Communications

Communications infrastructure was also expanded in the project area in 2008. An underground communications ductbank with 100-pair copper and 48-strand fiber optic cabling was installed to serve the first 12 ECMs in Phase I as well as the future ECMs. The fiber optic cable originates in Building 23028 and the copper cable originates in Building 25008. This cable is extended to MSA I where the copper cable is terminated in a splice case in CHH 123 and the fiber optic cable is terminated in a splice case in CHH 124. From these handholes, the cable is extended to the ECMs (refer to Figure 2-3).

3.7.3 Environmental Consequences

This section analyzes the magnitude of anticipated increases or decreases in public works infrastructure demands considering historic levels, existing management practices, and storage capacity, and evaluates potential impacts to public works infrastructure associated with implementation of the alternatives. Impacts are evaluated by whether they would result in the use of a substantial proportion of the remaining system capacity, reach or exceed the current capacity of the system, or require development of facilities and sources beyond those existing or currently planned.

3.7.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to the existing infrastructure of MSA 1. Therefore, no significant impacts to utilities infrastructure would occur with implementation of the No Action Alternative.

3.7.3.2 Alternative 1

The study area for infrastructure for Alternative 1 is Andersen AFB.

No potable water or sanitary sewer infrastructure would be constructed for Alternative 1, thus there would be no impacts to these two utilities with Alternative 1.

No fire suppression infrastructure would be constructed for Alternative 1. Existing fire suppression water lines would be located, marked, and avoided during construction, so there would be no impacts to fire suppression water supply lines in MSA 1 and the fire suppression system on Andersen AFB.

Stormwater systems would be constructed to manage stormwater drainage resulting from the increased impervious surfaces created by the ECMs. Shallow ground depressions would be constructed at the sides and rear of each ECM for stormwater collection and infiltration. Stormwater run-offs will be directed to a shallow grass swale that would serve as stormwater collection and infiltration area. The depressions and swales would meet the requirements of UFC 3-210-10, *Low Impact Development*. Thus, there would be no significant impact with respect to stormwater infrastructure. New access roads would be crowned to drain, and intersection culverts may be added or improved as needed.

Municipal solid waste resulting from construction activities would consist of a negligible amount of building materials, such as solid pieces of concrete and lumber. Municipal solid waste would be recycled to the maximum extent possible in accordance with Andersen AFB policies to avoid impacting the capacity of the waste disposal facility. Non-recyclable solid waste would disposed of in a permitted landfill. Cleared vegetation would be transferred off base to a certified composter within two weeks of clearing to divert municipal solid waste from landfills. Due to the reduced volume of solid waste, implementation of Alternative 1 at Andersen AFB would have a negligible impact on permitted landfill capacity.

The proposed ECMs would have electrical outlets, light-emitting diode (LED) lighting, and exterior LED lighting. Primary power would require 13.8 kV, and secondary power would require 480 volts and 120/208 volts. The lighting for the ECMs would be hooded and directed not to shine on forest habitat. These additional demands for electricity would be negligible compared with total base usage. Alternative 1 would not significantly increase electricity demand at Andersen AFB.

Communications infrastructure was also expanded in the Alternative 1 project area in 2008. An underground communications ductbank with copper and fiber optic cabling was installed to serve the first 12 ECMs in Phase I as well as the ECMs proposed for Alternative 1. These communications lines would be located, marked, and avoided during construction activities. Sufficient communications infrastructure to support the Alternative 1 ECMs already exists and would not be extended during construction.

During the operational phase, the volume of municipal solid waste (green waste and other types of solid waste) associated with munitions handling and maintaining the Alternative 1 project area would be the same as they are for MSA 1 overall, i.e., no change from existing conditions.

Therefore, implementation of Alternative 1 would not result in significant impacts to infrastructure.

3.7.3.3 Alternative 2

The study area for infrastructure for Alternative 2 is Andersen AFB.

Alternative 2 would construct the same 48 new ECMs, but in a different location. Existing underground utility infrastructure in the Alternative 2 project area would be located, marked, and avoided during construction. As with Alternative 1, LED fixtures would be used to provide interior and exterior lighting. The exterior lighting for the ECMs would be hooded and directed not to shine on forest habitat. Construction and operation of the Alternative 2 ECMs would have the same impacts to potable water,

sanitary sewer, fire suppression, stormwater, electrical, and communications infrastructure as Alternative 1.

The only difference between Alternative 1 and Alternative 2 with respect to infrastructure is the amount and type of municipal solid waste that would result from the demolition activities. With Alternative 1, more vegetation would be removed, so there would be a larger volume of green waste to be mulched than with Alternative 2. Alternative 2 would generate less green waste and more concrete and asphalt debris than Alternative 1. However, with Alternative 2, concrete and asphalt debris would be re-used/recycled for use in other construction projects to the maximum extent possible in accordance with Andersen AFB policies to avoid impacting the capacity of the waste disposal facility. Non-recyclable solid waste would disposed of in a permitted landfill. Given green waste mulching and concrete and asphalt debris reuse and recycling, it is anticipated that implementation of Alternative 2 at Andersen AFB would not have a significant impact on the capacity of the Andersen AFB solid waste landfill.

Therefore, implementation of Alternative 2 would not result in significant impacts to infrastructure.

3.8 Transportation

This discussion of transportation includes land routes with the means of moving passengers and goods.

Traffic is commonly measured through average daily traffic and design capacity. These two measures are used to assign a roadway with a corresponding level of service (LOS). The LOS designation is a professional industry standard used to describe the operating conditions of a roadway segment or intersection. The LOS is defined on a scale of A to F that describes the range of operating conditions on a particular type of roadway facility. LOS A through LOS B indicates free flow travel. LOS C indicates stable traffic flow. LOS D indicates the beginning of traffic congestion. LOS E indicates the nearing of traffic breakdown conditions. LOS F indicates stop-and-go traffic conditions and represents unacceptable congestion and delay.

3.8.1 Regulatory Setting

EO 13834 encourages government agencies to meet energy and environmental performance statutory requirements in a manner that increases efficiency, optimizes performance, eliminates unnecessary use of resources, and protects the environment.

3.8.2 Affected Environment

Primary vehicular access to Andersen AFB is provided by Highway 1 (Marine Drive). The main gate is located at the junction of Highways 1 and 9 and has guarded entry. Traffic volumes entering and exiting the base are relatively low, but short delays are possible at the main gate because USAF personnel screen incoming vehicles. MSA I has serviced a grid of paved and unpaved two-lane roads. The primary entrance to MSA I is through a controlled gate near the intersection of B Avenue and 5th Street. MSA I is a secured area of the base; vehicles entering MSA I are screened at this location.

The Guam climate (typhoons and earthquakes) can degrade pavement rapidly (Andersen AFB, 1998). The majority of the roads on Andersen AFB were constructed following the end of WW II and are generally in good condition.

3.8.3 Environmental Consequences

Impacts to ground traffic and transportation are analyzed by considering the possible changes to existing traffic conditions and the capacity of area roadways from proposed increases in construction traffic and munitions transport operations associated with the new ECMs.

3.8.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to transportation. Therefore, no significant impacts would occur with implementation of the No Action Alternative.

3.8.3.2 Alternative 1

The study area for Alternative 1 is Andersen AFB and Highway 1 (Marine Drive).

The construction phase of Alternative 1 would involve delivery of materials to and removal of debris from construction sites. Potential increases in traffic volume associated with proposed construction activities would be temporary. Construction schedules would be coordinated with MSA operations to avoid impacting MSA activities. All road and lane closures would be coordinated with USAF prior to commencing construction activities and would be temporary; therefore, traffic delays or changes in LOS to roadway segments and intersections within Andersen AFB are anticipated to be minimal.

Outside Andersen AFB, construction equipment and associated trucks transporting material to and from the construction site would be directed to roads and streets that have minimum traffic volume. Construction traffic would compose a small percentage of the total existing traffic and many of the vehicles would be driven to and kept onsite for the duration of construction activities, resulting in relatively few additional trips. Traffic delays or changes in LOS to Highway 1 and its and intersections are also expected to be minimal.

Heavy vehicles frequently use base roads; therefore, the vehicles necessary for construction would not be expected to have an adverse impact on base roads. Roadway improvements in the project area are included as part of Alternative 1 construction.

Construction workers and construction-related vehicle trips would have different trip origins and destinations compared to the Air Force personnel and their dependents. Consequently, short-term and intermittent impacts may occur during construction in locations that would not be impacted after construction, when the new ECMs are in use. No significant increase in ordnance vehicle transport trips is anticipated to result from the increased munitions storage capacity that Alternative 1 would provide during the operational phase.

Therefore, implementation of Alternative 1 would not result in significant impacts to transportation.

3.8.3.3 Alternative 2

The study area for Alternative 2 is Andersen AFB and Highway 1 (Marine Drive).

Alternative 2 would construct the same 48 new ECMs as Alternative 1, as well as the demolition of 30 ECMs. This would result in higher volumes of construction materials and demolition debris for Alternative 2 and, consequently, a higher number of construction vehicle trips. Despite the higher volume of anticipated construction traffic, the Alternative 2 project area is adjacent to the Alternative 1 project area, so construction vehicles and workers would access the Alternative 2 site using the same Andersen AFB roads and off-base roadways as Alternative 1.

Construction schedules would be coordinated with MSA operations to avoid impacting MSA activities. All road and lane closures would be coordinated with USAF prior to commencing construction activities and would be temporary; therefore, traffic delays or changes in LOS to roadway segments and intersections within Andersen AFB are anticipated to be minimal with Alternative 2.

Alternative 2 would direct construction traffic outside Andersen AFB to roads and streets that carry minimum vehicles. Traffic delays or changes in LOS to Highway 1 and its and intersections are expected to be minimal.

Heavy military vehicles frequently use base roads; therefore, the vehicles necessary for construction would not be expected to have an adverse impact on base roads. Roadway improvements in the project area are included as part of Alternative 2 construction.

Construction workers and construction-related vehicle trips would have different trip origins and destinations compared to the Air Force personnel and their dependents. Consequently, short-term and intermittent impacts may occur during construction in locations that would not be impacted after construction, when the new ECMs are in use. No significant increase in ordnance vehicle transport trips is anticipated to result from the increased munitions storage capacity that Alternative 2 would provide during the operational phase.

Therefore, implementation of Alternative 2 would not result in significant impacts to transportation.

3.9 Public Health and Safety

This discussion of public health and safety includes consideration for any activities, occurrences, or operations that have the potential to affect the safety, well-being, or health of members of the public. A safe environment is one in which there is no, or optimally reduced, potential for death, serious bodily injury or illness, or property damage. The primary goal is to identify and avoid potential accidents or impacts on the general public. Public health and safety within the context of this EA includes information pertaining to community emergency services, construction activities, potential accidental explosives discharge, and operations following construction.

Community emergency services are organizations that ensure public safety and health by addressing different emergencies. The three main emergency service functions include police, fire and rescue service, and emergency medical service.

Public health and safety during construction, demolition, and renovation activities is generally associated with construction traffic, as well as the safety of personnel within or adjacent to the construction zones.

Operational safety may refer to the actual use of the facility or built-out proposed project, or training or testing activities and potential risks to inhabitants or users of adjacent or nearby land and water parcels. Safety measures are often implemented through designated safety zones, warning areas, or other types of designations.

3.9.1 Regulatory Setting

Explosive Safety Zones (ESZs) are required for areas where ordnance is stored or handled. ESZs are typically determined based upon the NEW of the ordnance to be stored or handled and the blast resistance properties of the magazine. Quantity-distance (QD) setback arcs that delineate the extents of each ESZ are determined. In accordance with Air Force Manual (AFMAN) 91-201, Explosives Safety

Standards, munitions storage igloos can only be constructed within a designated MSA that meets all the safety and explosives standards of AFMAN 91-201. Air Force Handbook 32-1081, *Facility Requirements*, defines storage igloos as the preferred facility to store munitions where moisture condensation is not a safety factor. Such facilities can be earth-covered, concrete, or steel-reinforced structures. Additional standards that must be considered for the storage of munitions in igloos are as follows:

- Technical Manual 5-1300, *Structures to Resist the Effects of Accidental Explosives*
- DOD Manual 5100.76-M, *Physical Security of Sensitive Conventional Arms, Ammunition, and Explosives*
- DOD Standard 6055.9-STD, *DOD Ammunitions and Explosives Safety Standards*

In addition, the Air Force follows strict guidance for the transport and handling of ordnance, to minimize the potential for accidental discharge of munitions. All munitions operations personnel are trained and certified in munitions handling. Munitions are transported and stored in a dis-armed state, and without fuses, to preclude inadvertent explosions. Should an accidental explosion occur, munitions operations personnel and Andersen AFB firefighting personnel are trained and have equipment on site to rapidly respond to the incident and immediately contain the explosion, and control and suppress fire that may occur as a result.

Unexploded ordnance (UXO) is any munitions, weapon delivery system, or ordnance item that contains explosives, propellants, and chemical agents. UXO consists of munitions that (1) are armed or otherwise prepared for action; (2) are launched, placed, fired, or released in a way that they cause hazards; or (3) remain unexploded either through malfunction or design. UXO presents both an immediate safety danger (from explosion) and a long-term health threat (from toxic contamination).

Construction site safety is largely a matter of adherence to regulatory requirements imposed for the benefit of employees and implementation of operational practices that reduce risks of illness, injury, death, and property damage. The health and safety of onsite military and civilian workers are safeguarded by numerous DOD and USAF regulations designed to comply with standards issued by OSHA and NIOSH. These standards specify the amount and type of training required for industrial workers, the use of protective equipment and clothing, engineering controls, and maximum exposure limits for workplace stressors.

3.9.2 Affected Environment

Munitions at Andersen AFB are presently being stored in earthen-covered igloos.

Guam's history in WW II increases the potential of finding UXO within areas proposed for development. The project site is located in a moderate probability area for Munitions and Explosives of Concern (MEC). A Munitions and Explosives of Concern (MEC) investigation is required prior to the start of project activities. The MEC investigation must be preceded by an Explosives Safety Submission (ESS). The ESS must also be approved by the appropriate authorities before work begins (see DOD 6055.9 STD, DOD *Ammunition and Explosives Safety Standards*). The ESS is designed to provide an assessment of the explosives hazards likely to be encountered during the implementation of the MEC investigation and any resulting response action. All personnel working on site must complete MEC/UXO Awareness Training before starting work.

3.9.3 Environmental Consequences

The safety and environmental health analysis contained in the respective sections addresses issues related to the health and well-being of military personnel working in MSA 1, as well as military personnel and civilians living on or in the vicinity of Andersen AFB MSA 1. Specifically, this section provides information on potential UXO and MEC in the project area; construction site safety; and operational safety.

3.9.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change to public health and safety. Therefore, no significant impacts would occur with implementation of the No Action Alternative.

3.9.3.2 Alternative 1

The study area for Alternative 1 is Andersen AFB MSA 1. MSA 1 is a secure location within Andersen AFB that is only accessible to Andersen AFB munitions personnel. Construction areas would be fenced and appropriately marked with signs and placards to ensure that construction activities do not interfere or conflict with munitions operations. Outside Andersen AFB, construction equipment and associated trucks transporting material to and from the construction site would be directed to appropriate roads and streets to ensure traffic safety. During all phases of construction, safety standards required by OSHA and NIOSH would be followed. Workers would be required to wear protective gear such as ear protection from sound, steel- toed boots, hard hat, gloves, and other appropriate safety gear for the proposed igloo construction. No adverse safety effects related to traffic and construction site safety would be expected during the construction of the proposed ECMs.

The Alternative 1 construction site lies outside the portion of MSA 1 where munitions operations currently take place. As stated above, Andersen AFB munitions operations personnel would coordinate with the construction contractor to ensure that munitions handling activities do not conflict or take place concurrently (as feasible) with construction activities. In the unlikely event of an accidental explosion in MSA 1, munitions operations personnel and Andersen AFB firefighting personnel are trained and have equipment on site to rapidly respond to the incident and immediately contain the explosion, and control and suppress fire that may occur as a result. Therefore, no adverse safety effects related to explosives handling and fire are anticipated during the construction of the proposed ECMs.

The project site is located in a moderate probability area for MEC, so excavation for building foundations, roads, underground utilities, and other infrastructure could encounter UXO and MEC. Exposure to UXO and MEC could result in death or injury to workers. The general public would be excluded from the construction zones. To reduce the potential hazards related to the exposure to UXO and MEC, in accordance with DOD Directive 6055.9-STD (DOD Ammunition and Explosive Safety Standards), ESS documentation would be prepared that outlines specific measures that would be implemented to ensure the safety of workers and the public. Construction will require MEC screening for all excavation and earthwork. To ensure construction site safety, the Andersen AFB Explosive Ordnance Disposal Unit would be present to conduct MEC screening for all excavation and earthwork during all active groundbreaking and clearing activities. If UXO is found, exclusion zones will be required. UXO identified during construction of facilities that requires open detonation in-place would require an emergency permit from GEPA. UXO that is safe to transport would be taken to the Andersen AFB Hazardous Waste Management Facility - Andersen AFB Explosive Ordnance Disposal Permitted Facility

to be safely detonated. BMPs that would be implemented include having qualified UXO personnel perform surveys to identify and remove potential MEC items prior to the initiation of ground-disturbing activities. Additional safety precautions would include providing UXO awareness training to construction personnel involved in grading and excavations prior to and during ground-disturbing activities that would occur in previously disturbed areas that have a high probability of UXO. Potential safety hazards from encounters with UXO would be minimized because UXO would be identified and removed prior to initiating construction activities and construction personnel would be trained as to the hazards associated with unexploded military munitions.

The construction of new ECMs in MSA I would meet all the safety requirements of the regulations and standards listed in Section 2.1.4. The new ECMs would be constructed in accordance with the highest strength classification for munitions storage igloos, the 7-bar rating. This rating would ensure more than adequate explosion safety for 500,000 pounds of NEW anticipated for each ECM. The 48 new ECMs would have vertical concrete walls, reinforced concrete floor and roof slabs, and blast resistant structural steel access doors. Thus, the design and construction of the new ECMs would minimize potential explosives safety hazards.

The ECMs would be situated in MSA I and would have the appropriate distance between ECMs and the required safety explosive QD of 3,969 feet for ECMs containing 500,000 pounds NEW with respect to the inhabited building distance. The closest inhabited building to the new ECMs would be outside the 3,969 feet QD (AFMAN 91-201). This would not affect any inhabited buildings or pose unacceptable safety risks.

The new ECMs would meet USAF safety standards for 7-bar construction. Following construction of the new ECMs, Andersen AFB munitions operations personnel would continue to transport munitions in MSA 1 according to all applicable DOD requirements. Therefore, implementation of Alternative 1 would not result in significant impacts to public health and safety.

3.9.3.3 Alternative 2

The study area for Alternative 2 is Andersen AFB MSA 1. Under Alternative 2, the same construction safety standards described for Alternative 1 would be followed. The same procedures would be followed to ensure that construction activities would not interfere or conflict with munitions operations. No adverse safety effects related to traffic and construction site safety would be expected during the construction of the proposed ECMs under Alternative 2.

The Alternative 2 construction site lies inside the portion of MSA 1 where munitions operations currently take place. All explosives would be removed and transported elsewhere for proper storage prior to the demolition of ECMs. As described for Alternative 1, Andersen AFB munitions operations personnel would coordinate with the construction contractor to ensure that munitions handling activities do not conflict or take place concurrently (as feasible) elsewhere in MSA 1 with construction activities. In the unlikely event of an accidental explosion in MSA 1, munitions operations personnel and Andersen AFB firefighting personnel are trained and have equipment on site to rapidly respond to the incident and immediately contain the explosion, and control and suppress fire that may occur as a result. Therefore, no adverse safety effects related to explosives handling and fire are anticipated during the construction of the proposed ECMs.

The Alternative 2 project area has the same potential for the presence of UXO and MEC. The same procedures described for Alternative 1 would be required for Alternative 2 to minimize potential safety hazards associated with UXO and MEC.

With Alternative 2, the construction of new ECMs in MSA I would meet all the safety requirements of the regulations and standards listed in Section 2.1.4. The new ECMs would be constructed in accordance with the highest strength classification for munitions storage igloos, the 7-bar rating. This rating would ensure more than adequate explosion safety for 500,000 pounds of NEW anticipated for each ECM. The 48 new ECMs would have vertical concrete walls, reinforced concrete floor and roof slabs, and blast resistant structural steel access doors. Thus, the design and construction of the new ECMs would minimize potential explosives safety hazards.

The ECMs would be situated in MSA I and would have the appropriate distance between ECMs and the required safety explosive QD of 3,969 feet for ECMs containing 500,000 pounds NEW with respect to the inhabited building distance. The closest inhabited building to the new ECMs would be outside the 3,969 feet QD (AFMAN 91-201). This would not affect any inhabited buildings or pose unacceptable safety risks.

The new ECMs would meet USAF safety standards for 7-bar construction. Following construction of the new ECMs, Andersen AFB munitions operations personnel would continue to transport munitions in MSA 1 according to all applicable DOD requirements. Therefore, implementation of Alternative 2 would not result in significant impacts to public health and safety.

3.10 Hazardous Materials and Wastes

This section discusses hazardous materials, hazardous waste, toxic substances, and contaminated sites.

3.10.1 Regulatory Setting

Hazardous materials are defined by 49 CFR section 171.8 as “hazardous substances, hazardous wastes, marine pollutants, elevated temperature materials, materials designated as hazardous in the Hazardous Materials Table, and materials that meet the defining criteria for hazard classes and divisions in 49 CFR part 173.” Transportation of hazardous materials is regulated by the U.S. Department of Transportation regulations.

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

Special hazards are those substances that might pose a risk to human health and are addressed separately from other hazardous substances. Special hazards include asbestos-containing material (ACM), polychlorinated biphenyls (PCBs), lead-based paint (LBP), and radon gas. USEPA is given authority to regulate special hazard substances by the Toxic Substances Control Act. Asbestos is also regulated by USEPA under the CAA, and the Comprehensive Environmental Response, Compensation, and Liability Act.

The DOD established the Defense Environmental Restoration Program to facilitate thorough investigation and cleanup of contaminated sites on military installations (active installations, installations subject to Base Realignment and Closure, and formerly used defense sites). The Installation Restoration Program (IRP) and the Military Munitions Response Program are components of the Defense Environmental Restoration Program. The IRP requires each DOD installation to identify, investigate, and clean up hazardous waste disposal or release sites. The Military Munitions Response Program addresses nonoperational rangelands that are suspected or known to contain UXO, discarded military munitions, or munitions constituent contamination.

3.10.2 Affected Environment

To protect habitats and people from inadvertent and potentially harmful releases of hazardous substances, the DOD has required that all facilities develop and implement Hazardous Material Emergency Planning and Response Plans or Spill Prevention, Control, and Countermeasure Plans. These plans and programs, in addition to established legislation effectively form the "safety net" intended to protect the ecosystems on which most living organisms depend.

Air Force Policy Directive 32-70, *Environmental Quality*, establishes the policy that the USAF is committed to the following environmentally sound practices:

- Cleaning up environmental damage resulting from its past activities
- Meeting all environmental standards applicable to its present operations
- Planning its future activities to minimize environmental impacts
- Responsibly managing the irreplaceable natural and cultural resources it holds in public trust
- Eliminating pollution from its activities wherever possible

Air Force Policy Directive 32-70 and the Air Force Instruction (AFI) 32-7000 series incorporate the requirements of all federal regulations, other AFIs, and DOD Directives for the management of hazardous materials, hazardous wastes, and special hazards.

3.10.2.1 Hazardous Materials and Hazardous Waste

Andersen AFB has enacted programs to ensure adherence to federal environmental regulations regarding hazardous materials and waste management. Standards and procedures for emergency responses for fuel spills are contained in Andersen AFB's Oil and Hazardous Substance Contingency Plan, which conforms to AFI 32-4002, *Facility Hazardous Emergency Planning and Response*; and federal laws and regulations.

3.10.2.2 Special Hazards (Asbestos-Containing Materials, Lead-Based Paint, Polychlorinated Biphenyls and Radon Gas)

Electrical transformers and other exterior electrical equipment in the project area were installed as part of construction and maintenance projects that began in 2006; thus, exterior electrical equipment in the project area is not likely to contain PCBs. There are no structures in the Alternative 1 project area where asbestos-containing materials and lead based paint could be present. However, it is possible that the 30 ECMs in the Alternative 2 project area may have PCBs in interior electrical equipment, as well asbestos-containing materials and lead based paint. Radon gas is a concern on Guam because of its relatively high natural levels. Radon gas originates from the natural decay of uranium and thorium in soil, rock, and

water. MSA I has a porous karst topography, which allows radon gas to easily rise to open air areas, and possibly leak into buildings or other enclosed structures.

3.10.2.3 Installation Restoration Program

On October 14, 1992, USEPA placed Andersen AFB on the National Priorities List. The USAF subsequently entered into a Federal Facility Agreement with USEPA and GEPA to coordinate the IRP effort at Andersen AFB.

There are 4 IRP sites near the Alternative 1 project area in MSA I (Figure 3-6). IRP Site 3, inside MSA I, is near the corner of 2nd Street and E Avenue, approximately 1,000 feet north of the Alternative 1 site boundary, but it is located at a lower elevation than Alternative 1 and thus would not affect surface water, groundwater, or soil conditions at Alternative 1. IRP Site 5, outside MSA 1 is about 1,680 feet northwest of the Alternative 1 site boundary. IRP Site 21, also outside MSA 1 is about 2,120 feet west of the Alternative 1 site boundary. Similar to IRP Site 3, Sites 5 and 21 are at lower elevations than Alternative 1, and would not affect conditions at the Alternative 1 project area.

3.10.3 Environmental Consequences

The hazardous materials and wastes analysis contained in the respective sections addresses issues related to the use and management of hazardous materials and wastes as well as the presence and management of specific cleanup sites at Andersen AFB.

3.10.3.1 No Action Alternative

Under the No Action Alternative, the Proposed Action would not occur and there would be no change associated with hazardous materials and wastes. Therefore, no significant impacts would occur with implementation of the No Action Alternative.

3.10.3.2 Alternative 1

The study area for Alternative 1 is MSA 1. Short-term localized minor adverse effects would be expected. Construction activities associated with Alternative 1 would require the use of certain hazardous materials such as paints, welding gases, solvents, preservatives, and sealants. Construction equipment that would be used contain fuel, lubricating oils, hydraulic fluid, and coolants that could be regulated hazardous substances if spilled or leaked on the construction site. During project activities, contractors would be required to minimize the potential for a release of hazardous substances from all construction equipment, including daily inspection of equipment to ensure that there are no discharges, maintaining appropriate spill containment material onsite, and storage of all fuels and other materials in appropriate containers. Equipment maintenance activities would not be conducted on the construction site.

It is anticipated that the quantity of products containing hazardous materials used during the construction activities would be minimal. Contractors would be responsible for the management of hazardous materials, which would be handled in accordance with federal regulations. Should a spill occur, the contractor would follow the Andersen AFB *Oil and Hazardous Substance Contingency Plan.*

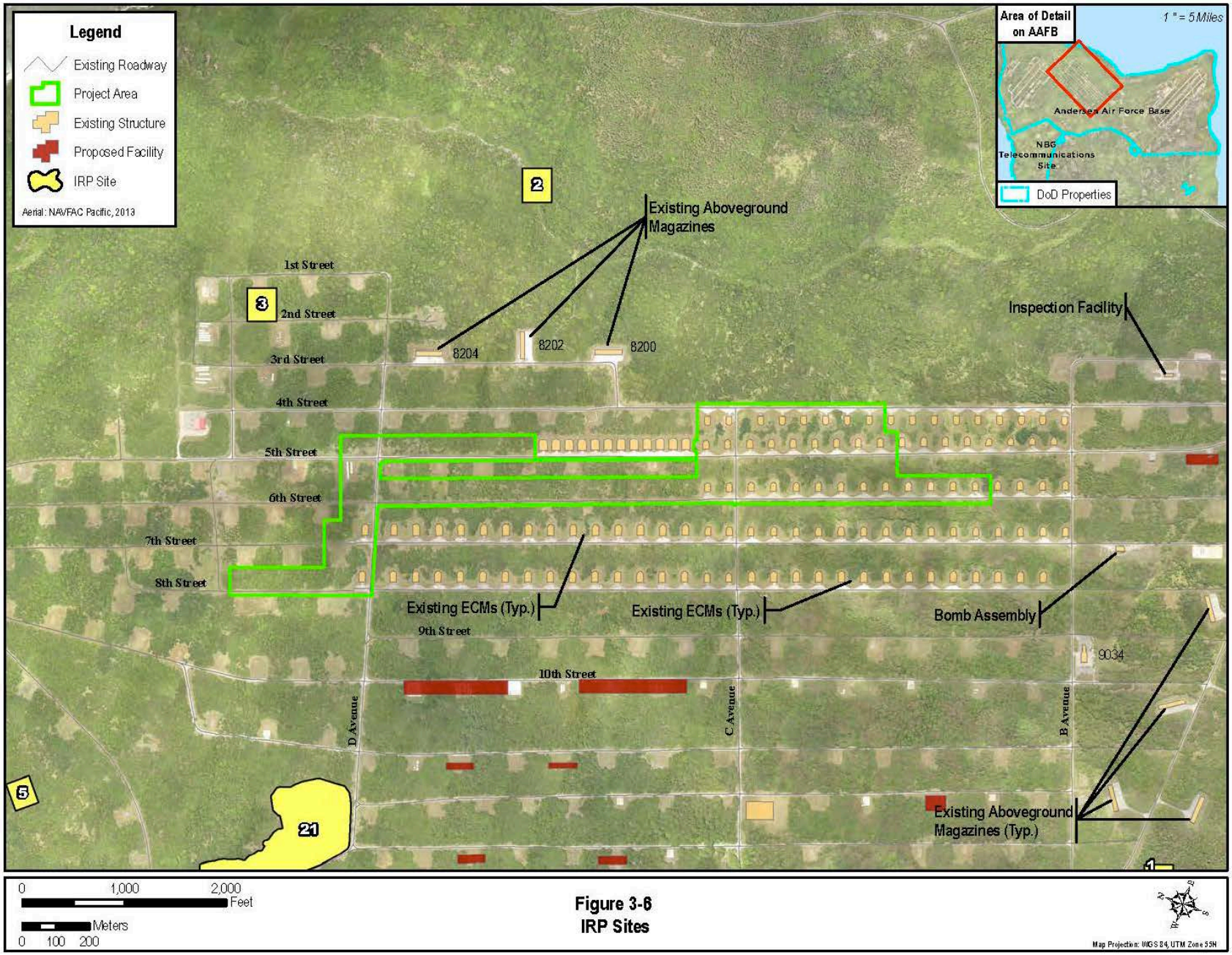


Figure 3-6
IRP Sites

Hazardous wastes resulting from construction activities are expected to be minimal. Construction contractors would be required to manage and dispose all hazardous waste in compliance with all federal regulations and USAF requirements. Hazardous waste collection facilities on Andersen AFB are anticipated to have sufficient capacity to accept the waste resulting from Alternative 1 construction activities.

There are no IRP sites, contaminated soils, or known hazardous materials in or immediately adjacent to the Alternative 1 project area, so construction of Alternative 1 would not disturb contaminated soil or groundwater associated with IRP sites, or interfere with IRP site cleanup and monitoring activities. If contaminated soils were encountered, such material would be managed in accordance with federal guidelines and regulations.

New transformers, electrical switchgear, and lighting equipment installed for Alternative 1 would be specified to be non-PCB (DON, 2018a). No LBP or ACMs would be used in construction of the ECMs. Diesel fuel for the new back-up generator would be stored in a double-walled tank mounted on concrete pad, in accordance with all federal regulations and USAF requirements.

In recognition of the public health hazard presented by indoor radon, the U.S. Congress passed the Indoor Radon Abatement Act (IRAA) of 1988. In response to IRAA, the Navy created the Navy Radon Assessment and Mitigation Program (NAVRAMP) to manage radon at Navy/Marine Corps installations worldwide. Radon is a naturally occurring, odorless, colorless, radioactive gas that is released from rock, soil, and water as part of the natural decay of uranium. According to USEPA, long-term exposure to elevated indoor radon levels is the second leading cause of lung cancer in the U.S. and the number one cause among non-smokers. New Navy/Marine Corps construction projects, as well as certain types of renovation projects (particularly those involving housing and occupied facilities), may be subject to radon abatement measures. With respect to the Proposed Action, the only proposed construction is for munitions storage facilities and supporting infrastructure, which would not require radon abatement measures since the concern is over human health risks. The proposed construction included in the Proposed Action would comply with NAVRAMP as applicable. Potential long-term adverse effects associated with radon gas could occur if radon accumulated in the ECMs. However, radon would be monitored over time to ensure that no adverse effects would occur. The ECMs would be equipped with ventilation systems that would minimize accumulation of radon gas inside the structures.

Following construction, operations would consist of vehicles transporting ordnance primarily on paved surfaces to and from the ECMs. Andersen AFB personnel operating the vehicles would comply with the Andersen AFB Spill Prevention, Control, and Countermeasure Plan to avoid and minimize the impacts of accidental releases of fuel from the transport vehicles.

Given compliance with federal, GEPA and USAF hazardous materials and waste management regulations and requirements during construction, exclusion of LBP, ACMs, and PCBs from new construction, and compliance with the Andersen AFB Spill Prevention, Control, and Countermeasure Plan during operations, implementation of Alternative 1 would not result in significant impacts with respect to hazardous materials and hazardous waste.

3.10.3.3 Alternative 2

The study area for Alternative 2 is MSA 1. The 30 existing ECMs were constructed in the 1950s, thus, it is possible that they may contain LBP, ACMs, and PCBs. Maintenance records for these ECMs would be reviewed, and if necessary, surveys for LBP, ACMs, and PCBs would be conducted prior to demolition. If

any of these hazardous materials are determined to be present in the 30 existing ECMs, prior to demolition they would be removed/abated by licensed technicians according to all applicable federal, GEPA, and USAF requirements, and properly disposed as hazardous waste.

There are no IRP sites or contaminated soils, in or immediately adjacent to the Alternative 2 project area, so construction of Alternative 2 would not disturb contaminated soil or groundwater associated with IRP sites, or interfere with IRP site cleanup and monitoring activities. If contaminated soils were encountered, such material would be managed in accordance with federal guidelines and regulations. The only difference between Alternative 1 and Alternative 2 with regard to hazardous materials and wastes is the potential need to identity, abate/remove, and properly dispose LBP, ACMs, and PCBs in the existing ECMs to be demolished. Otherwise, the same construction activities would take place with Alternative 2 as those described for Alternative 1. Construction contractors would be required to manage and dispose all hazardous waste in compliance with all federal Resource Conservation and Recovery Act regulations and DOD requirements. Hazardous waste collection facilities on Andersen AFB are anticipated to have sufficient capacity to accept the waste resulting from Alternative 2 demolition and construction activities, including any LBP, ACMs, and PCBs that may be removed from the existing ECMs.

New transformers, electrical switchgear, and lighting equipment installed for Alternative 2 would be specified to be non-PCB (DON, 2018a). No LBP or ACMs would be used in construction of the ECMs. Diesel fuel for the new back-up generator would be stored in a double-walled tank mounted on concrete pad, in accordance with all federal regulations and USAF requirements.

If radon is identified as a potential concern during design of the project, suitable measure could be implemented to ensure it is not a safety hazard during construction or during operations. Potential long-term adverse effects associated with radon gas could occur if radon accumulated in the ECMs. However, radon would be monitored over time to ensure that no adverse effects would occur. The ECMs would be equipped with ventilation systems that would minimize accumulation of radon gas inside the structures.

Following construction, operations would consist of vehicles transporting ordnance primarily on paved surfaces to and from the ECMs. Andersen AFB personnel operating the vehicles would comply with the Andersen AFB Spill Prevention, Control, and Countermeasure Plan to avoid and minimize the impacts of accidental releases of fuel from the transport vehicles.

Given compliance with federal and USAF hazardous materials and waste management regulations and requirements during construction, exclusion of LBP, ACMs, and PCBs from new construction, and compliance with the Andersen AFB Spill Prevention, Control, and Countermeasure Plan during operations, implementation of Alternative 2 would not result in significant impacts with respect to hazardous materials and hazardous wastes.

3.11 Summary of Potential Impacts to Resources and Impact Avoidance and Minimization

A summary of the potential impacts associated with each of the action alternatives and the No Action Alternative and impact avoidance and minimization measures are presented in Table 3-10.

Table 3-10 Summary of Potential Impacts to Resource Areas

Resource Area	*No Action Alternative*	*Alternative 1*	*Alternative 2*
Air Quality	No Significant Impacts	No Significant Impacts	No Significant Impacts
Water Resources	No Significant Impacts	No Significant Impacts	No Significant Impacts
Geological Resources	No Significant Impacts	No Significant Impacts	No Significant Impacts
Cultural Resources	No Significant Impacts	No Significant Impacts Guam Historic Properties Inventory sites 66-08-2101, 66-08-2102, and 66-08-2922 are eligible for the NRHP; there would be no adverse effect to these sites if a data recovery plan is implemented.	No Significant Impacts
Biological Resources	No Significant Impacts	Less than Significant Impacts BMPs and conservation measures include Contractor Education Program (*Cycas micronesica*, *Tabernaemontana rotensis*, and Mariana fruit bats), pre-construction surveys and hooded lighting (Mariana fruit bats), biosecurity protocols (invasive species), pre-construction surveys and salvage/translocation for ESA-listed plants and snails (Partulid tree snails), and annual reporting to adaptively manage ESA-listed species. These procedures will be executed to minimize impacts to a level where they are not significant to the environment and species existence.	Less than Significant Impacts BMPs and conservation measures identified for Alternative 1 also apply for Alternative 2. These procedures will be executed to minimize impacts to a level where they are not significant to the environment and species existence.
Noise	No Significant Impacts	No Significant Impacts	No Significant Impacts
Infrastructure	No Significant Impacts	No Significant Impacts	No Significant Impacts
Transportation	No Significant Impacts	No Significant Impacts	No Significant Impacts
Public Health and Safety	No Significant Impacts	No Significant Impacts	No Significant Impacts
Hazardous Materials and Wastes	No Significant Impacts	No Significant Impacts	No Significant Impacts

1

This page intentionally left blank.

4 Cumulative Impacts

This section (1) defines cumulative impacts; (2) describes past, present, and reasonably foreseeable future actions relevant to cumulative impacts; (3) analyzes the incremental interaction the proposed action may have with other actions; and (4) evaluates cumulative impacts potentially resulting from these interactions.

4.1 Definition of Cumulative Impacts

The approach taken in the analysis of cumulative impacts follows the objectives of the National Environmental Policy Act (NEPA), Council on Environmental Quality (CEQ) regulations, and CEQ guidance. Cumulative impacts are defined in 40 Code of Federal Regulations (CFR) section 1508.7 as "the impact on the environment that results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time."

To determine the scope of environmental impact analyses, agencies shall consider cumulative actions, which when viewed with other proposed actions have cumulatively significant impacts and should therefore be discussed in the same impact analysis document.

In addition, CEQ and the U.S. Environmental Protection Agency (USEPA) have published guidance addressing implementation of cumulative impact analyses—Guidance on the Consideration of Past Actions in Cumulative Effects Analysis (CEQ, 2005) and Consideration of Cumulative Impacts in EPA Review of NEPA Documents (USEPA, 1999). CEQ guidance entitled Considering Cumulative Impacts Under NEPA (CEQ, 1997) states that cumulative impact analyses should "…determine the magnitude and significance of the environmental consequences of the proposed action in the context of the cumulative impacts of other past, present, and future actions...identify significant cumulative impacts…[and]…focus on truly meaningful impacts."

Cumulative impacts are most likely to arise when a relationship or synergism exists between a proposed action and other actions expected to occur in the same location or during the time period. Actions overlapping with or nearby the proposed action would be expected to have more potential for a relationship than those more geographically separated. Similarly, relatively concurrent actions would tend to offer a higher potential for cumulative impacts. To identify cumulative impacts, the analysis needs to address the following three fundamental questions.

- Does a relationship exist such that affected resource areas of the proposed action might interact with the affected resource areas of past, present, or reasonably foreseeable actions?
- If one or more of the affected resource areas of the proposed action and another action could be expected to interact, would the proposed action affect or be affected by impacts of the other action?
- If such a relationship exists, then does an assessment reveal any potentially significant impacts not identified when the proposed action is considered alone?

4.2 Scope of Cumulative Impacts Analysis

The scope of the cumulative impacts analysis involves both the geographic extent of the effects and the time frame in which the effects could be expected to occur. For this EA, the study area delimits the geographic extent of the cumulative impacts analysis. In general, the study area will include those areas previously identified in Chapter 3 for the respective resource areas. The time frame for cumulative impacts centers on the timing of the proposed action.

Another factor influencing the scope of cumulative impacts analysis involves identifying other actions to consider. Beyond determining that the geographic scope and time frame for the actions interrelate to the proposed action, the analysis employs the measure of "reasonably foreseeable" to include or exclude other actions. For the purposes of this analysis, public documents prepared by federal, state, and local government agencies form the primary sources of information regarding reasonably foreseeable actions. Documents used to identify other actions include notices of intent for Environmental Impact Statements (EISs) and EAs, management plans, land use plans, and other planning related studies.

4.3 Past, Present, and Reasonably Foreseeable Actions

This section will focus on past, present, and reasonably foreseeable future projects at and near the Proposed Action locale. In determining which projects to include in the cumulative impacts analysis, a preliminary determination was made regarding the past, present, or reasonably foreseeable action. Specifically, using the first fundamental question included in Section 4.1, it was determined if a relationship exists such that the affected resource areas of the Proposed Action might interact with the affected resource area of a past, present, or reasonably foreseeable action. If no such potential relationship exists, the project was not carried forward into the cumulative impacts analysis. In accordance with CEQ guidance (CEQ, 2005), these actions considered but excluded from further cumulative effects analysis are not catalogued here as the intent is to focus the analysis on the meaningful actions relevant to informed decision-making. Projects included in this cumulative impacts analysis are listed in Table 4-1 and briefly described in the following subsections.

Table 4-1 Cumulative Action Evaluation

Action	***Level of NEPA Analysis Completed***
Past Actions	
Establishment and Operation of an Intelligence, Surveillance, Reconnaissance, and Strike (Intelligence, Surveillance, Reconnaissance (ISR)/Strike) Capability (*pending full implementation*)	EIS
Construction of 12 munitions storage igloos in FY2008	EA
Present and Reasonably Foreseeable Future Actions	
Guam and Commonwealth of the Northern Mariana Islands Military Relocation (2012 Roadmap Adjustments)	Supplemental EIS
Two Marine Operation Locations: Sites 15B-4 and 15B-g	Supplemental EIS
Marine Corps Earth-covered Magazines	Supplemental EIS
Terminal High-Altitude Area Defense (THAAD) Permanent Stationing In Guam	EA
Chemical Applications for Control of Brown Treesnakes	EA

4.3.2 Past Actions

The 2005 EA addressed the full proposed action identified at that time (i.e., 60 munitions storage igloos within the MSA), and Phase 1 (12 igloos) was implemented following completion of that EA. However, plans for the remaining 48 igloos were subsequently revised, requiring development of revised alternatives to be addressed in this EA. Therefore, Phase 1 is considered a past action for this cumulative impacts analysis.

Establishment and Operation of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Capability. This project would involve the establishment of ISR/strike; and aerial refueling capabilities at Andersen Air Force Base (AFB), as part of the Pacific Command's Global Strike Task Force Initiative. Specific components of this action include 3 Global Hawk unmanned aerial ISR aircraft, 12 aerial refueling aircraft, 4 Global Hawk RQ-4 unmanned aerial vehicles (Global Hawk), and support personnel at Andersen AFB. Additionally, 48 fighter and 6 bomber aircraft and support personnel would rotate to Andersen AFB from installations in the 50 states. Approximately 3,000 additional military, civilian, and contractor personnel would be required to support this action. Facility construction, addition, and alteration projects would occur to support the establishment and operation of the ISR/Strike capability. The Final EIS was published in November 2006 (71 Federal Register 67864) and a Record of Decision (ROD) was signed on January 12, 2007 (72 Federal Register 2871).

4.3.3 Present and Reasonably Foreseeable Actions

Guam and Commonwealth of the Northern Mariana Islands (CNMI) Military Relocation (2012 Roadmap Adjustments): In September 2010, the Department of the Navy (DON) signed a ROD regarding the 2010 Final EIS for the *Guam and CNMI Military Relocation*. In April 2012, the U.S.-Japan Security Consultative Committee jointly announced an adjustment to the previous plans for the Guam military relocation. In accordance with these "2012 Roadmap Adjustments," the Department of Defense adopted a new force posture in the Pacific providing for a materially smaller and reconfigured Marine Corps force on Guam. The DON prepared a Final Supplemental Environmental Impact Statement (SEIS) for the purpose of supplementing portions of the 2010 Final EIS regarding the establishment on Guam of a live-fire training range complex (LFTRC), a cantonment area, a family housing area, and associated infrastructure to support the relocation of a substantially reduced number of Marines and dependents than was previously analyzed. The Final SEIS analyzes the potential environmental impacts of five action alternatives for the cantonment/family housing component of the proposed action and five action alternatives for the LFTRC component, plus a No Action Alternative. The DON's preferred alternative is to construct and operate the proposed cantonment at the Naval Base Guam (NBG), Telecommunications Site at Finegayan (hereinafter "Finegayan"), the proposed family housing on Andersen AFB, and the proposed LFTRC at Northwest Field (NWF) on Andersen AFB.

Two Marine Operation Locations: Sites 15B-4 and 15B-g in Munitions Storage Area (MSA) 1 have been identified as potential Marine operating locations and are sited for up to 250,000 pounds of hazard class/division (HC/D) 1.1 munitions. The proposed Marine operating locations have an approximate inter-magazine distance (IMD) of 680 feet that would impose siting constraints due to their explosives safety spacing requirements on the Proposed Action.

Marine Corps Earth-covered Magazines (ECMs): Three potential structure designs and location for six new ECMs for Marine Corps hazard class/division 1.1 munitions have been created with a total storage capacity of 110,500 pounds of NEW. Depending on a final decision for the location, number, and structure type, these facilities may have an effect on siting new munitions storage facilities. However, a

preferred site and type of structure for this request has not been determined, and explosives safety distances for these facilities have not been considered a current constraint.

Terminal High-Altitude Area Defense (THAAD) Permanent Stationing in Guam: The U.S. Army proposes to maintain its THAAD ballistic missile defense battery in Guam permanently at its current temporary location on NWF of Andersen AFB near the northern end of the island. As a secondary, connected action to the expeditionary deployment and proposed permanent stationing of the THAAD battery in Guam, the U.S. Army also proposes to expand the NWF cargo drop zone training area that was encumbered by THAAD operations. The THAAD Permanent Stationing in Guam also includes expansion of the Andersen AFB hazardous waste storage area to accommodate new hazardous waste volume associated with the THAAD operations. An EA was completed for this proposed project in March 2017 and the public comment period for the draft Finding of No Significant Impact ended on April 17, 2017.

Chemical Applications for Control of Brown Treesnakes: This project involves use of chemicals to help minimize and control the brown treesnake population on Guam. The method used would be the aerial application of acetaminophen-treated baits.

The following two projects have been proposed for MSA 1, but as of 2017 are not considered reasonably foreseeable.

Multiple Tactical Air-Munitions Rapid Response (TARRP) Facilities: Proposed TARRP facilities have been sited near the study area. Their proposed locations and explosives safety distance requirements limit the potential locations for new Hayman ECMs within the study area. Up to four aboveground magazines, two operations pads, a wood shop, an equipment storage facility, and a T-2 facility are proposed within MSA I. The proposed TARRP facilities have the following IMD:

- Aboveground magazines have an approximate IMD of 680 feet
- Operations pads have an approximate IMD of 694 feet
- The T-2 pad has an approximate IMD of 694 feet

Munitions Inspection Facility: A new munitions inspections and surveillance facility is proposed in the southeast corner of MSA I. The proposed facilities also impose siting constraints due to their explosives safety spacing requirements.

4.4 Cumulative Impact Analysis

Where feasible, the cumulative impacts were assessed using quantifiable data; however, for many of the resources included for analysis, quantifiable data is not available and a qualitative analysis was undertaken. In addition, where an analysis of potential environmental effects for future actions has not been completed, assumptions were made regarding cumulative impacts related to this EA where possible. The analytical methodology presented in Chapter 3, which was used to determine potential impacts to the various resources analyzed in this document, was also used to determine cumulative impacts.

4.4.1 Air Quality

Cumulatively, short-term minor adverse effects on air quality would occur for all projects and the Proposed Action. Air emissions from construction equipment and activities would be short-term and would last only during active construction. Andersen AFB is in attainment for all criteria pollutants.

Overall impacts on air quality during the operational phases of all projects, including the Proposed Action, would be not be significant. Therefore, there would be no significant impacts to air quality.

4.4.2 Water Resources

According to completed NEPA documentation, the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) and the THAAD Permanent Stationing in Guam include requirements to obtain permits and prepare SWPPPs and EPPs to avoid and minimize impacts to water resources during construction and operations. It is assumed that the other two present and reasonably foreseeable projects (Two Marine Operation Locations: Sites 15B-4 and 15B-g Six Marine Corps Earth-covered Magazines) would comply with federal guidance and regulations and include similar water resource protection measures. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would not result in significant impacts to water resources.

4.4.3 Geological Resources

According to completed NEPA documentation, the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) include requirements to obtain permits and prepare SWPPPs and EPPs to avoid and minimize impacts to geological resources during construction and operations. Impacts to geological resources with the proposed THAAD Permanent Stationing in Guam project would be minimal because clearing and construction activities would be limited to surface disturbances and shallow excavations, include implementation of standard erosion control BMPs, and comply with applicable building standards for seismic risks and sinkholes associated with limestone karst. It is assumed that the other two present and reasonably foreseeable projects (Two Marine Operation Locations: Sites 15B-4 and 15B-g Six Marine Corps Earth-covered Magazines) would comply with federal regulations and include similar soil, bedrock, and seismic hazard protection measures. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would not result in significant impacts to geological resources.

4.4.4 Cultural Resources

Potential impacts to cultural resources could occur for the additional projects and the Proposed Action. Navy will conduct appropriate consultations with Guam SHPO. Additionally, should any cultural resources be uncovered during any construction, all findings would be handled in accordance with the Final ICRMP for Andersen AFB (Andersen AFB, 2003) and consultation with the SHPO.

4.4.5 Biological Resources

Increased air traffic disturbance on Andersen AFB as a result of Intelligence, Surveillance, Reconnaissance, and Strike Capability (ISR/Strike) action is likely to disturb and adversely affect the Mariana fruit bat colony at Pati Point. To mitigate the impacts to fruit bats, an ungulate exclosure and habitat improvements are planned. Construction for the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) LFTRC would be within NWF but away from proposed action area. The USFWS determined that the action is not likely to appreciably reduce the survival and recovery of the Mariana eight-spot butterfly, *Dendrobium guamense*, *Tuberolabium guamense*, *Tabernaemontana rotensis*, *Heritiera longipetiolata*, *Cycas micronesica*, and *Bulbophyllum*. Impacts to biological resources with the proposed THAAD Permanent Stationing in Guam project would be minimal because clearing and construction activities would be limited to surface disturbances and shallow excavations. It is assumed that the other two present and reasonably foreseeable projects (Two Marine Operation Locations: Sites

15B-4 and 15B-g Six Marine Corps Earth-covered Magazines) would comply with federal regulations and include similar soil, bedrock, and seismic hazard protection measures. Aerial application of acetaminophen for Brown treesnake control in the Habitat Management Unit would occur on Andersen AFB. DOD determined that the action may affect, but would not be likely to adversely affect *Cycas micronesica*, *Bulbophyllum guamense*, *Tabernaemontana rotensis*, *Tuberolabium guamense*, *Partula gibba*, *Partula radiolata*, and *Samoana fragilis*. DOD determined that the action is likely to adversely affect the Mariana fruit bat. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects may result in some adverse impacts to biological resources, in particular, to the Mariana fruit bat.

4.4.6 Noise

Construction for the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) LFTRC would be within NWF and away from any sensitive human receptors. Construction areas along the access road to the LFTRC would be approximately 0.25 mile from the nearest receptors, a distance that is far enough from the source of temporary construction noise that there would be minimal noise effects on receptors. The LFTRC would be located at the remote northern tip of the Guam. Noise from LFTRC operations would not be audible in inhabited areas on or off Andersen AFB. Noise from the THAAD Permanent Stationing in Guam construction activities would not be discernable over ambient noise levels. Thus, there would be no significant noise impacts from temporary site preparation and construction activities associated with this project. The THAAD operating location is about two miles from the nearest inhabited areas, so noise associated with THAAD operations would be not perceptible to sensitive receptors. The Proposed Action would have a temporary increase in ambient noise levels during construction that would not cause significant adverse impacts on the surrounding populations. Following construction of the Proposed Action, the ambient noise levels would return to their normal levels. No long-term noise impacts effects would occur as a result of the Proposed Action. The other two present and reasonably foreseeable projects (Two Marine Operation Locations: Sites 15B-4 and 15B-g Six Marine Corps Earth-covered Magazines) are located near the Proposed Action within MSA 1 and would involve similar types of construction activities and construction noise. Thus, it is assumed that these two projects would have noise impacts similar to those described for the Proposed Action, i.e., short-term increases in ambient noise levels that would not cause significant impacts on surrounding populations, followed by a return to normal ambient noise levels. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would not result in significant noise impacts.

4.4.7 Infrastructure

Installation of new or modifications to existing electrical and potable water supply, sanitary sewer/portable latrines, storm drainage, and communications systems are included as part of the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) and the THAAD Permanent Stationing in Guam projects. It is assumed that the other two present and reasonably foreseeable projects (Two Marine Operation Locations: Sites 15B-4 and 15B-g Six Marine Corps Earth-covered Magazines) would include electrical and telecommunications utilities if needed and implement standard construction measures to avoid damage to any existing utilities in their respective project areas. There would be no adverse effects on infrastructure associated with the Proposed Action. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would not result in significant impacts to infrastructure.

4.4.8 Transportation

The Guam and CNMI Military Relocation (2012 Roadmap Adjustments) project would result in potential short-term traffic delays on Andersen AFB roadways during the construction phase. The delays would be minimized with appropriate construction work zone traffic management strategies and BMPs. This project includes a new Andersen AFB main gate and new Commercial Vehicle/Tactical Vehicle Gate on Route 3A to relieve congestion at the existing main gate at the junction of Highways 1 and 9. However, there would still be multiple significant impacts to traffic on off-base roadways and intersections associated with the operational phase of the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) project. The project includes potential mitigation measures to minimize these impacts. The THAAD Permanent Stationing in Guam would have minimal short-term traffic localized traffic delays during construction. Following construction, the THAAD mission would include the existing workforce of 200 military personnel, and an additional small workforce comprising more military personnel and no more than 50 contract workers at any one time. Thus, the increase in vehicle trips that the THAAD Permanent Stationing would add would not cause major increases to on base or off base roadway use. The Proposed Action would cause temporary, minimal traffic delays during the construction phase, which would cease upon completion of construction. The other two present and reasonably foreseeable projects (Two Marine Operation Locations: Sites 15B-4 and 15B-g Six Marine Corps Earth-covered Magazines) are located near the Proposed Action within MSA 1 and would involve similar types of construction activities. Thus, it is assumed that these two projects would have traffic impacts similar to those described for the Proposed Action, i.e., short-term increases traffic delays that would cease upon completion of construction. Impacts to transportation associated with the Proposed Action would be negligible in comparison to those from the Guam and CNMI Military Relocation (2012 Roadmap Adjustments). However, the project includes widening two segments of Route 1, three segments of Route 3, and one segment of Route 28 as mitigation. Additional traffic mitigation for this project includes improvements at two intersections on Route 3 and at nine intersections on Route 1. Therefore, implementation of the Proposed Action, in combination with other present and reasonably foreseeable projects would not result in significant impacts to transportation.

4.4.9 Public Health and Safety

According to completed NEPA documentation, the construction and operational phases of the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) and the THAAD Permanent Stationing in Guam would have no significant impacts to public health and safety. For the reasons described in Section 3.9 of this EA, the Proposed Action is not anticipated to result in significant impacts to public health and safety. It is assumed that the other two present and reasonably foreseeable projects (Two Marine Operation Locations: Sites 15B-4 and 15B-g Six Marine Corps Earth-covered Magazines) would incorporate Occupational Safety and Health Administration worker health and safety protection, and UXO/MEC avoidance measures similar to those included in the Proposed Action. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would not result in significant impacts to public health and safety for all projects and the Proposed Action.

4.4.10 Hazardous Materials and Wastes

According to completed NEPA documentation, the Guam and CNMI Military Relocation (2012 Roadmap Adjustments) and THAAD Permanent Stationing in Guam would not disturb or interfere with investigation/cleanup activities at IRP sites within MSA 1 and NWF. Construction activities for these two

projects would involve the use of fuels, hydraulic fuels, and solvents, similar to the Proposed Action. However, similar to the Proposed Action these two reasonably foreseeably projects are required to comply with federal regulations for the storage, management, and disposal of hazardous materials and waste. The Guam and CNMI Military Relocation (2012 Roadmap Adjustments) and the THAAD Permanent Stationing in Guam include multiple plans, BMPs, and procedures to avoid and minimize potential hazardous materials and hazardous waste impacts during construction and operations. It is assumed that the other two present and reasonably foreseeable projects (Two Marine Operation Locations: Sites 15B-4 and 15B-g Six Marine Corps Earth-covered Magazines) would not disturb IRP sites, and would comply with federal regulations and include hazardous materials and waste impact minimization measures. Therefore, implementation of the Proposed Action in combination with other present and reasonably foreseeable projects would not result in significant impacts with respect to hazardous materials and waste for all projects and the Proposed Action.

5 Other Considerations Required by NEPA

5.1 Consistency with Other Federal, State, and Local Laws, Plans, Policies, and Regulations

In accordance with 40 Code of Federal Regulations (CFR) section 1502.16(c), analysis of environmental consequences shall include discussion of possible conflicts between the Proposed Action and the objectives of federal, regional, state, and local land use plans, policies, and controls. Table 5-1 identifies the principal federal laws and regulations that are applicable to the Proposed Action, and describes briefly how compliance with these laws and regulations would be accomplished.

5.2 Irreversible or Irretrievable Commitments of Resources

Resources that are irreversibly or irretrievably committed to a project are those that are used on a long-term or permanent basis. This includes the use of non-renewable resources such as metal and fuel, and natural or cultural resources. These resources are irretrievable in that they would be used for this project when they could have been used for other purposes. Human labor is also considered an irretrievable resource. Another impact that falls under this category is the unavoidable destruction of natural resources that could limit the range of potential uses of that particular environment.

The irreversible environmental changes that would result from implementation of the Proposed Action involve the consumption of energy resources, biological habitat, and human resources. The use of these resources is considered to be permanent. For the Proposed Action, consumption of energy and human resources are not significant. The potential loss of low-quality non-native biological habitat would be an irreversible and irretrievable commitment of resources. Irreversible and irretrievable resource commitments are related to the use of non-renewable resources and the effects that use of these resources will have on future generations. Irreversible effects primarily result from use or destruction of a specific resource that cannot be replaced within a reasonable timeframe (e.g., energy and minerals).

5.3 Unavoidable Adverse Impacts

While some aspects of the Proposed Action would result in adverse effects, most of the anticipated environmental effects are associated with construction and would be short-term. Construction activities would comply with federal regulations and ordinances, including BMPs, which would reduce the potential for adverse effects. However, this Environmental Assessment (EA) has determined that the alternatives considered may result in significant impacts to natural resources. The loss of high-value native and low-value non-native biological habitat would be considered unavoidable adverse impacts.

5.4 Relationship between Short-Term Use of the Environment and Long-Term Productivity

NEPA requires an analysis of the relationship between a project's short-term impacts on the environment and the effects that these impacts may have on the maintenance and enhancement of the long-term productivity of the affected environment. Impacts that narrow the range of beneficial uses of the environment are of particular concern. This refers to the possibility that choosing one development site reduces future flexibility in pursuing other options, or that using a parcel of land or other resources often eliminates the possibility of other uses at that site.

Table 5-1 Principal Federal Laws Applicable to the Proposed Action

Federal, State, Local, and Regional Land Use Plans, Policies, and Controls	***Status of Compliance***
National Environmental Policy Act (NEPA); Council on Environmental Quality NEPA implementing regulations; Navy procedures for Implementing NEPA	Complies (EA prepared)
Clean Air Act	Complies (does not exceed *de minimis* levels)
Clean Water Act	Complies
Rivers and Harbors Act	Not applicable
Coastal Zone Management Act	Complies (pending Coastal Consistency review)
National Historic Preservation Act	Complies (based on consultation with Guam SHPO, see Section 3.4)
Archaeological and Historic Preservation Act	Complies (based on consultation with Guam SHPO, see Section 3.4)
Archaeological Resources Protection Act	Complies (based on consultation with Guam SHPO, see Section 3.4)
Endangered Species Act	Complies (pending Section 7 ESA consultation, see Section 3.5)
Magnuson-Stevens Fishery Conservation and Management Reauthorization Act	Not applicable
Marine Mammal Protection Act	Not applicable
Migratory Bird Treaty Act	Complies
Bald and Golden Eagle Protection Act	Not applicable
Comprehensive Environmental Response and Liability Act	Complies
Emergency Planning and Community Right-to-Know Act	Complies
Federal Insecticide, Fungicide, and Rodenticide Act	Complies
Resource Conservation and Recovery Act	Complies
Toxic Substances Control Act	Complies
Farmland Protection Policy Act	Not applicable
Executive Order (EO) 11988, Floodplain Management	Complies
EO 12088, Federal Compliance with Pollution Control Standards	Complies
EO 12114, Environmental Effects Abroad of Major Federal Actions (Department of Navy implementing regulation 32 CFR part 287)	Not applicable
EO 12898, Federal Actions to Address Environmental Justice in Minority Populations and Low-income Populations	Complies
EO 13045, Protection of Children from Environmental Health Risks and Safety Risks	Complies
EO 13089, Coral Reef Protection	Not applicable
EO 13175, Consultation and Coordination with Indian Tribal Governments	Not applicable
EO 13834, Efficient Federal Operations	Complies

1

2

For the Proposed Action, construction-related effects are minor and would not result in loss of long-term productivity. The long-term use of MSA I will continue to be for munitions storage and operations. The Proposed Action has the potential to result in long-term adverse effects on sensitive species habitat and potentially to sensitive archaeological and historic resources. However, the mitigation measures identified in this EA would support the long-term use of MSA I military operations and biological habitat. The construction and operation of proposed ECMs would not significantly impact the long-term natural resource productivity of the area. Therefore, the Proposed Action would not result in any impacts that would significantly reduce environmental productivity or permanently narrow the range of beneficial uses of the environment.

This page intentionally left blank.

6 References

36 CES/CEVN. (2003). *Environmental Assessment of a Brown Tree Snake Barrier, Andersen AFB, Guam*. Prepared for AFCEE/ECS by Innovative Technical Solutions, Inc. and LFR Levine Fricke. August 2003.

Andersen AFB. (1998). *Andersen AFB General Plan.*

Andersen AFB. (2003). *Final Integrated Cultural Resource Management Plan for Andersen Air Force Base, Guam, 2003 Update.* Prepared for Earth Tech Global Environmental, AFCEE, and 36 CES/CEVN by M.J. Tomonari-Tuggle and H. D. Tuggle of International Archaeological Research Institute, Inc. November.

Andersen AFB. (2018). Letter to Guam Historic Resources Division, State Historic Preservation Officer (SHPO). Subject: Section 106 Consultation – Construct Fort-Eight Hayman Igloos within MSA-1 at Andersen Air Force Base, Guam, RCS 18-5001. Headquarters 36th Wing (PACAF, Department of the Air Force. 17 April.

Advisory Council on Historic Preservation. (2006). Program Comment for World War II and Cold War Era Ammunitions Storage Facilities. August.

Aguon, L. (2005). Letter from L. Aguon to Lt Col Marvin Smith on Section 106 Consultation for the Environmental Assessment of Proposed Munitions Storage Igloo Construction at Andersen Air Force Base, Guam. October.

Air Force Center for Engineering and the Environment. (2004). *Air Force Munitions Facilities Standards Guide Volume I*.

Air Force and USFWS. (1994). Cooperative Agreement between the U.S. Air Force and the U.S. Fish and Wildlife Service for the Establishment and Management of the Guam National Wildlife Refuge, Guam.

American National Standards Institute. (1988). American National Standard Quantities and Procedures for Description and Measurement of Environmental Sound, ANSI S12-9-1988. New York: Acoustical Society of America.

BMJ. (2013). Residential Exposure to Aircraft Noise and Hospital Admissions for Cardiovascular Diseases; Multi-Airport Retrospective Study. BMJ, Correia, A.W, Peters, J.L., Levy, J.I., Melly, S., Dominici, F., 347:f5561.

Council on Environmental Quality. (1997). Considering Cumulative Effects Under the National Environmental Policy Act. Washington, DC.

Council on Environmental Quality. (2005). Guidance of the Consideration of Past Actions in Cumulative Effects Analysis. Memorandum. Washington, DC.

Cowan, J. P. (1994). *Handbook of Environmental Acoustics.* New York: John Wiley & Sons.

Davis, R. (1983). *Andersen Air Force Base Central Reconnaissance Survey.* Government of Guam Department of Parks and Recreation. MS on file at Andersen AFB, 36CVS/CVN, Guam.

Defant, D.G. and L.R. Leon Guerrero. (2006). Archaeological Survey of Seven Parcels within the Munitions Storage Area, Andersen Air Force Base, Island of Guam. Prepared by PHRI, Hilo, HI.

Dixon, B., T. Meiser, R. Jones, and I. Nelson. (2017). Cultural Resources Survey with the Munitions Storage Area, Andersen Air Force Base, Yigo, Guam.

Dixon, B. and S. Walker. (2011). Cultural Resource Investigations Conducted in the Territory of Guam Supporting the Joint Guam Build-Up Environmental Impact Statement: Final Archaeological Surveys on Guam 2009 at Proposed Utility Sites, Harmon Property, and Andersen AFB. Prepared for Naval Facilities Engineering Command, Pacific Division by TEC Inc., Honolulu, HI.

DOD. (2009). Memorandum from the Under Secretary of Defense. Methodology for Assessing Hearing Loss Risk and Impacts in DoD Environmental Impact Analysis. Washington, DC. June 16.

DOD Noise Working Group. (2009). Improving Aviation Noise Planning, Analysis and Public Communication with Supplemental Metrics - Guide to Using Supplemental Metrics.

Department of the Navy. (DON). (2005). Partnering Agreement for FY06 MILCON AJJY-07-3105P1, Construct Munitions Storage Igloos, Phase I, Andersen Air Force Base, Guam. NAVFAC Pacific and Wilson Okamoto Corporation. April 1.

DON. (2010). Final Environmental Impact Statement for Guam and CNMI Military Relocation: Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force. Volume 2: Marine Corps Relocation – Guam. Prepared for Joint Guam Program Office, Washington, DC by NAVFAC Pacific, Pearl Harbor. HI.

DON. (2013). Final Joint Region Marianas Final Integrated Natural Resources Management Plan. Commander Joint Region Marianas, Guam, December.

DON. (2015a). Final Supplemental Environmental Impact Statement Guam and Commonwealth of the Northern Mariana Islands Military Relocation (2012 Road Map Adjustments). May.

DON. (2015b). Tree snail observations at Sasa Valley Fuel Farm. Personal communication via email to P. Wenninger, NAVFAC Marianas, NBG Main Base, Guam from D. Janeke, Biologist, HDR Inc., San Diego, CA.

DON. (2015c). Regional Biosecurity Plan for Micronesia and Hawaii: 4 Volumes.

DON. (2016). Land Use/Land Cover and Recovery Habitat Analysis for Lands Naval Facilities Engineering Command, Marianas. Managed by Joint Region Marianas on Guam.

DON. (2017a). Plant Surveys, Joint Region Marianas Munition Storage Area Survey Draft Report N-4192-14-2-8002.

DON. (2017b). Final Natural Resources Survey Report in Support of the Environmental Assessment for Proposed Munitions Storage Igloo Construction, Andersen Air Force Base, Guam. Naval Facilities Engineering Command, Pacific. 10 February.

DON. (2017c). *Mariana Fruit Bat Management Plan for Andersen Air Force Base, Guam.* Prepared by Tammy Mildenstein, Nathan Johnson, and University of Guam, Guam, USA. April.

DON. (2017d). *Monitoring Mariana Fruit Bats.* Prepared by Tammy Mildenstein, Ross Miller University of Guam Biology Program. Cooperative Agreement Number N40192-15-2-8001. January.

DON. (2018a). Final Functional Analysis Concept Development Report; FY20 MCAF Project P-3105/AJJY073105P3 APSI - Munitions Storage Igloos (Phase 3) Andersen Air Force Base, Guam. Naval Facilities Engineering Command, Pacific. 17 September.

DON. (2018b). Biological Assessment for the Construction of 48 Munition Storage Igloos at Andersen AFB, Guam. Naval Facilities Engineering Command, Pacific. October.

DON. (2019). Integrated Natural Resources Management Plan for Joint Region Marianas. Prepared for Joint Region Marianas and NAVFAC Marianas, Guam by Cardno, Honolulu, HI. June.

DON and USFWS. (1994). Cooperative agreement between the U.S. Navy and the U.S. Fish and wildlife service for the establishment and management of the Guam National Wildlife Refuge, Guam.

Federal Interagency Committee on Aviation Noise. (1997). *Effects of Aviation Noise on Awakenings from Sleep.*

Federal Interagency Committee on Noise. (1992). Federal Review of Selected Airport Noise Analysis Issues.

Federal Interagency Committee on Urban Noise. (1980). *Guidelines for Considering Noise in Land Use Planning and Control.* Washington, DC.

Gill, F. and Donsker, D. (2017). International Ornithologists' Union (IOC) World Bird List (v 7.3) (No. doi:10.14344/IOC.ML.7.3).

GovGuam. (2009). Endangered Species Regulation No. 9. Department of Agriculture, Mangilau, Guam. November.

GovGuam, U.S. Air Force, U.S. Navy, and USFWS. (1993). Memorandum of Understanding among the Government of Guam and the U.S. Air Force and the U.S. Navy and the U.S. Fish and Wildlife Service for the Establishment and Management of the Guam National Wildlife Refuge, Guam.

Grooms, TSgt Joseph and SSgt John Trembly. (2008). Personal Communication between TSgt Joseph Grooms (36 CEV, Landfill Superintendent), SSgt John Trembly (36 CEV, NCOIC Horizontal Repair) and Ms. Laurie Carter (e^2M) regarding the landfill at Andersen AFB, Guam. October 3, 2008.

Harris, C. (1979). *Handbook of Noise Control.* New York: McGraw-Hill.

Hokanson, J., D. Kilby, M. Church, and R. McCurdy. (2008). *Cultural Resources Survey for a Perimeter Fence and Portions of the Munitions Storage Area, Andersen Air Force Base, Guam.* Engineering-Environmental Management, Inc. Denver. Colorado. June.

Hunter-Anderson, R. and D. Moore. (2003). *Cultural Resources Snake Barrier Concept, Andersen Air Force Base, Guam.* Micronesian Archaeological Research Services, Guam. May.

Lindstrom, D. and J. Benedict. (2014). *Federal Candidate Species Surveys on Guam.* University of Guam (UOG). Cooperative Agreement N40192-12-2-8001.

Lindstrom, D. and J. Benedict. (2014). *Federal Candidate Species Surveys on Guam.* University of Guam (UOG). Cooperative Agreement N40192-12-2-8001.

Liske-Clark, J. (2015). Wildlife Action Plan for the Commonwealth of the Northern Mariana Islands, 2015-2025. CNMI DLNR-Division of Fish and Wildlife, Saipan, MP. 16 December.

Liston, J. (1996). *The Legacy of Tarague Embayment and Its Inhabitants, Andersen AFB, Guam.* Prepared for 36 CES/CEV, Unit 14007, Environmental Flight, Andersen Air Force Base, Guam. International Archaeological Research Institute, Inc., Honolulu.

Ludlow, B., & Sixsmith, K. (1999). Long-term Effects of Military Jet Aircraft Noise Exposure during Childhood on Hearing Threshold Levels. Noise and Health, 33-39.

Mason Architects, Inc. (2004). *Historic Building and Associated Landscape/Viewsheds Inventory and Evaluation for Andersen Air Force Base, Guam, 2004 Update.* Prepared for Naval Facilities Engineering Command Pacific Division, by Mason Architects, Inc., Honolulu, Hawaii.

Mueller-Dombois and Fosberg. (1998). *Vegetation of the Tropical Pacific Islands.* Ecological Studies, Vol 132. Publisher is Springer-Verlag, Inc., New York, NY.

National Institute for Occupational Health and Safety. (1998). *Criteria for a Recommended Standard Occupational Noise Exposure, Revised Criteria.* Cincinnati: U.S. Department of Health and Human Services, Centers for Disease Control and Prevention.

NAVFAC Marianas. (2013a). Federal Candidate Endangered Species Surveys at Andersen Air Force Base. Cooperative Agreement N40192-13-2-8004. Prepared for NAVFAC Marianas by Holland, B. and Rubinoff, D.

NAVFAC Marianas. (2013b). Threatened and Endangered Species and Migratory Birds Monitoring Report, Naval Support Activity Andersen, Guam. Prepared by HDR Inc., San Diego, CA. February.

NAVFAC Pacific. (2010). Final Natural Resource Survey Report in Support of the Environmental Impact Statement for the Marine Corps Relocation Initiative to Various Locations on Guam. Pearl Harbor, HI. 23 December.

Raulerson and Rinehart. (1991). *Trees and Shrubs of the Northern Mariana Islands.* Coastal Resources Management, Office of the Governor.

Smith, B.D., R. Cooper-Nurse, and A. Gawel. (2008). *Survey of Endangered Tree Snails on Navy-Owned Land in Guam.* Prepared for the U.S. Navy by Marine Laboratory, University of Guam, Mangilao. Draft.

Topping, D., Ogo, P., and Dungca, B. (1975). Chamorro-English Dictionary. University of Hawaii Press, Honolulu, HI.

U.S. Air Force (USAF). (2002). Evaluation of existing munitions magazines at Andersen Air Force Base. U.S. Air Force Safety Center. April.

USAF. (2005). Assessment to determine needed munitions storage at Andersen AFB. PACAF and 36th Munitions Squadron.

USAF. (2005). Environmental Assessment of Proposed Munitions Storage Igloo Construction at Andersen Air Force Base, Guam.

USAF. (2017). Area Development Plan, MSA 1 Earth Covered Magazines. Joint Region Marianas, Andersen Air Force Base.

U.S. Army Corps of Engineers (USACE). (2013). Unified Facilities Criteria 3-310-04; Seismic Design of Buildings. June 1.

United States Environmental Protection Agency (USEPA). (1974). *Information on Levels of Environmental Noise Requisite to Protect Public Health and Welfare with and Adequate Margin of Safety.* EPA 550/9-74-004. Washington, DC: Office of Noise Abatement and Control.

USEPA. (1982). *Guidelines for Noise Impact Analysis.* EPA 550/9-82-105. Washington, DC: Office of Noise Abatement and Control.

USEPA. (1999). Consideration of Cumulative Impacts in EPA Review of NEPA Documents.

USEPA. (2017). *Current Nonattainment Counties for All Criteria Pollutants.* Accessed on April 27, 2017 from: https://www3.epa.gov/airquality/greenbook/ancl.html

U.S. Fish and Wildlife Service (USFWS). (1984). *Endangered and Threatened Wildlife and Plants; Determination of Endangered Status for Seven Birds and Two Bats of Guam and the Northern Mariana Islands.* Final Rule.

USFWS. (1990a). Native forest birds of Guam and Rota of the Commonwealth of the Northern Mariana Islands Recovery Plan. Portland, OR: U.S. Fish and Wildlife Service. 86 pp.

USFWS. (1990b). Guam Mariana Fruit Bat and Little Mariana Fruit Bat Recovery Plan. U.S. Fish and

USFWS. (2004). Endangered and Threatened Wildlife and Plants; Designation of Critical Habitat for the Mariana Fruit Bat and Guam Micronesian Kingfisher on Guam and Mariana Crow on Guam and in the Commonwealth of the Northern Mariana Islands; Final Rule. Federal Register 69:62944-62990.

USFWS. (2009). *Draft Revised Recovery Plan for the Mariana Fruit Bat or Fanihi (Pteropus mariannus mariannus).* U.S. Fish and Wildlife Service, Portland, Oregon. xiv + 83 pp.

USFWS. (2009). Guam National Wildlife Refuge Comprehensive Conservation Plan. Guam NWR, Yigo, Guam. September.

USFWS. (2005). *Draft Revised Recovery Plan for the Aga or Mariana Crow (Corvus kubaryi).* Portland, OR.

USFWS. (2009). *Draft Revised Recovery Plan for the Mariana Fruit Bat or Fanihi (Pteropus mariannus mariannus).* U.S. Fish and Wildlife Service, Portland, Oregon. xiv + 83 pp.

USFWS. (2010). Biological Opinion for the Joint Guam Program Office Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam and Tinian. Pacific Islands Fish and Wildlife Office, Honolulu, HI. September 8.

USFWS. (2013). *Endangered and Threatened Wildlife and Plants; Review of Native Species That are Candidates for Listing as Endangered or Threatened; Annual Notice of Findings on Resubmitted Petitions; Annual Description of Progress on Listing Actions; Notice of Review.* Federal Register 78:70104-70162.

USFWS. (2014). *Endangered and Threatened Wildlife and Plants; Proposed Endangered Status for 21 Species and Proposed Threatened Status for 2 Species in Guam and the Commonwealth of the Northern Mariana Islands; Proposed Rule.* Federal Register 79:59364-59413.

USFWS. (2015a). Endangered and Threatened Wildlife and Plants: Endangered Status for 16 Species and Threatened Status for 7 Species in Micronesia. Final Rule. 50 CFR Part 17 Published in Federal Register / Vol. 80, No. 190, Thursday October 1 /Rules and Regulations.

USFWS. (2015b). Biological Opinion for the Implementation of Department of Defense (DOD) Readiness Training under Mariana Island Testing and Training (MITT) Program. Pacific Islands Fish and Wildlife Office, Honolulu, HI. February 20.

USFWS. (2015c). Letter to the Department of the Navy. Endangered and Threatened Wildlife and Plants; Endangered Status for 16 Species and Threatened Status for 7 Species in Micronesia; Final Rule. Federal Register, 80, 190.

U.S. Navy. (2017). *Navy Radon Assessment and Mitigation Program Guidebook for Naval Shore Installations.* Naval Facilities Engineering Command, Pacific. 30 September.

Welch, D. J. and U. K. Prasad. (2006). Investigation of Traditional Cultural Properties at Andersen Air Force Base, Guam. February.

Wiles, G.J., C.F. Aguon, G.W. Davis, D.J. Grout. (1995). The status and distribution of endangered animals and plants in northern Guam. Micronesica 28:31-49.

Wiles, G., J. Bart, R.E. Beck, Jr., and C.F. Aguon. (2003). *Impacts of the brown treesnake: patterns of decline and species persistence in Guam's avifauna.* Conservation Biology 17: 1350–1360.

Yee, S. L., D. J. Welch, and J. Allen. (2004). Archaeological Overview Survey Report for Andersen Air Force Base, Guam.

7 List of Preparers

This EA was prepared collaboratively between the Navy and contractor preparers.

U.S. Department of the Navy

Justin Fujimoto (Naval Facilities Engineering Command [NAVFAC] Pacific)
Responsible for: Biology

Jeffrey Laitila (NAVFAC IEPD)
Responsible for: EA

Paula Hartzell (NAVFAC IEPD)
Responsible for: Natural Resources

Devan Kawakami-Wong (NAVFAC Pacific)
Responsible for: EA

Richard Olmo (NAVFAC IEPD)
Responsible for: Cultural Resources

Mark Petersen (AFIMSC Det 2/CEB [PACDET])
Responsible for: Planning

Coral Rasmussen (NAVFAC Pacific)
Responsible for: Cultural Resources

Jackie Sanehira (NAVFAC Pacific)
Responsible for: Cultural Resources

Thomas A. Spriggs (NAVFAC IEPD)
Responsible for: EA

Alan Suwa (NAVFAC Pacific)
Responsible for: Project Management

Jim Watkins (NAVFAC IEPD)
Responsible for: Biology

Contractors

Cristina Ailes (Cardno)
B.S. Ecology & Environmental Science, B.A. International Studies
Years of Experience: 11
Responsible for: Technical Editing

Peer Amble (Cardno)
B.A., Geography
Years of Experience: 27
Responsible for: Project Management and QA/QC

Margaret Bach (Cardno)
B.A., Geology
Years of Experience: 25
Responsible for: EA Resources

Kevin Butterbaugh (AECOM)
MLA, Landscape Architecture
Years of Experience: 28
Responsible for: Planning

Jackie Clark (Cardno)
B.S. Business Administration
Years of Experience: 8
Responsible for: Technical Editing

Christine Davis (Cardno)
M.S., Environmental Management
Years of Experience: 18
Responsible for: Technical Review and Air Quality

Megan Desillier (Cardno)
M.A., Marine and Environmental Affairs
Years of Experience: 2
Responsible for: Air Quality

Boyd Dixon, PhD, RPA (Cardno)
PhD, Anthropology
Years of Experience: 45
Responsible for: Cultural Resources (Archaeological Resource Survey/Testing)

Jessica Dougherty, RPA (Cardno)
M.S., Anthropology
Years of Experience: 10
Responsible for: Cultural Resources

John Ford (Cardno)
M.S., Zoology
Years of Experience: 36
Responsible for: Biological Resources

Brenden Holland (Cardno)
Ph.D., Oceanography
Years of Experience: 20
Responsible for: Biological Resources

Wes Ishizu (AECOM)
Responsible for: Planning

Robert Jones (Cardno)
M.A., Anthropology
Years of Experience: 12
Responsible for: Cultural Resources

Trina Meiser (AECOM)
M.A., Historic Preservation Planning
Years of Experience: 16
Responsible for: Cultural Resources (Historic Structures/Districts)

Isla Nelson (Cardno)
B.A., Anthropology
Years of Experience: 17
Responsible for: Cultural Resources

Paul Radley (Cardno)
PhD, Wildlife Ecology
Years of Experience: 25
Responsible for: Biological Resources

Teresa Rudolph (Cardno)
M.A., Anthropology
Years of Experience: 40
Responsible for: Cultural Resources

Rachel Shaak, AICP LEED AP (Cardno)
M. Div., M.A., Ancient History and Hebrew
Years of Experience: 16
Responsible for: EA Management, Chapters 1 & 2

Lorraine Shaughnessy (Cardno)
M.S., Biology
Years of Experience: 11
Responsible for: Biological Resources

Chris Stoll (AECOM)
M.A., Urban and Regional Planning
Years of Experience: 15
Responsible for: Planning

Kimberly Wilson (Cardno)
High School Diploma
Years of Experience: 21
Responsible for: Technical Editing

This page intentionally left blank.

8 Distribution List

The Draft EA was distributed to the agencies listed below.

8.1 Department of Defense

Andersen Air Force Base (AFB), Guam

Chief of Naval Operations, N45

Commonwealth of the Northern Mariana Islands Joint Region Marianas (JRM) Coordination Office

Naval Facilities Engineering Command (NAVFAC) Marianas, Guam

NAVFAC Headquarters

NAVFAC Pacific

Pacific Air Forces (PACAF)

8.2 Government Agencies

Guam Bureau of Statistics and Plans

Guam Department of Parks and Recreation, Historic Resources Division

Guam Division of Aquatic and Wildlife Resources (DAWR)

U.S. Fish and Wildlife Service (USFWS)

8.3 Libraries

Dededo Public Library

Nieves M. Flores Memorial Library

This page intentionally left blank.

Appendix A
Public and Agency Participation

[To Be Provided in Final EA]

This page intentionally left blank.

Appendix B
Air Quality Methodology and Calculations

This page intentionally left blank.

Construction of 17 Munitions Storage Igloos for Andersen AFB, Guam

Statewide , Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	0.00	1000sqft	17.00	740,520.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	54
Climate Zone	13			**Operational Year**	2020
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - Assumption: The construction of 48 igloos is expected to occur over three phases and disturb 51 total acres. The total acreage was divided by three to estimate the number of acres disturbed in each phase and allow flexibility.

Construction Phase - Assumption: The number of days needed for each construction phase for Phase 2 will be less than needed for Phase 3, but more than Phase 4.

Grading - Assumption: These numbers were derived from Table 2-1, Alternative 1 Areas of Proposed Action.

Vehicle Emission Factors -

Vehicle Emission Factors -

Vehicle Emission Factors -

Construction Off-road Equipment Mitigation - Assumption: Mitigation measures would take place during construction.

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2018	9.0652	4.3694	3.2548	8.0600e-003	0.5767	0.1886	0.7653	0.2392	0.1763	0.4155	0.0000	739.0186	739.0186	0.0987	0.0000	741.4858
Maximum	**9.0652**	**4.3694**	**3.2548**	**8.0600e-003**	**0.5767**	**0.1886**	**0.7653**	**0.2392**	**0.1763**	**0.4155**	**0.0000**	**739.0186**	**739.0186**	**0.0987**	**0.0000**	**741.4858**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2018	9.0652	4.3694	3.2548	8.0600e-003	0.4073	0.1886	0.5959	0.1478	0.1763	0.3241	0.0000	739.0183	739.0183	0.0987	0.0000	741.4854
Maximum	**9.0652**	**4.3694**	**3.2548**	**8.0600e-003**	**0.4073**	**0.1886**	**0.5959**	**0.1478**	**0.1763**	**0.3241**	**0.0000**	**739.0183**	**739.0183**	**0.0987**	**0.0000**	**741.4854**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**29.37**	**0.00**	**22.14**	**38.23**	**0.00**	**22.01**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Construction of 17 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Architectural Coating	Architectural Coating	1/1/2018	1/2/2018	5	2	
2	Building Construction	Building Construction	1/1/2018	8/14/2018	5	162	
3	Demolition	Demolition	1/1/2018	1/1/2018	5	1	
4	Grading	Grading	1/1/2018	1/12/2018	5	10	
5	Paving	Paving	1/1/2018	1/5/2018	5	5	
6	Site Preparation	Site Preparation	1/1/2018	2/9/2018	5	30	

Acres of Grading (Site Preparation Phase): 6

Acres of Grading (Grading Phase): 7

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 1,110,780; Non-Residential Outdoor: 370,260; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Construction of 17 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Demolition	Excavators	3	8.00	158	0.38
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Grading	Excavators	2	8.00	158	0.38
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Paving	Pavers	2	8.00	130	0.42
Paving	Rollers	2	8.00	80	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Grading	Graders	1	8.00	187	0.41
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Paving	Paving Equipment	2	8.00	132	0.36
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Building Construction	Welders	1	8.00	46	0.45

Trips and VMT

Construction of 20 Munitions Storage Igloos for Andersen AFB, Guam

Statewide , Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	0.00	1000sqft	17.00	740,520.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	54
Climate Zone	13			**Operational Year**	2021
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - Assumption: The construction of 48 igloos is expected to occur over three phases and disturb 51 total acres. The total acreage was divided by three to estimate the number of acres disturbed in each phase and allow flexibility.

Construction Phase - Assumption: The number of days needed for each construction phase for Phase 3 will be more than needed for Phase 2 and Phase 4.

Off-road Equipment - Assumption: Slightly more equipment will be needed for the construction of 20 igloos.

Grading - Assumption: These numbers were derived from Table 2-1, Alternative 1 Areas of Proposed Action.

Vehicle Emission Factors -

Vehicle Emission Factors -

Vehicle Emission Factors -

Construction Off-road Equipment Mitigation - Assumption: Mitigation measures would take place during construction.

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2019	9.0878	4.5316	3.4798	8.7600e-003	0.6450	0.1905	0.8355	0.2728	0.1785	0.4513	0.0000	795.8609	795.8609	0.1088	0.0000	798.5810
Maximum	**9.0878**	**4.5316**	**3.4798**	**8.7600e-003**	**0.6450**	**0.1905**	**0.8355**	**0.2728**	**0.1785**	**0.4513**	**0.0000**	**795.8609**	**795.8609**	**0.1088**	**0.0000**	**798.5810**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2019	9.0878	4.5316	3.4798	8.7600e-003	0.4458	0.1905	0.6363	0.1650	0.1785	0.3435	0.0000	795.8605	795.8605	0.1088	0.0000	798.5806
Maximum	**9.0878**	**4.5316**	**3.4798**	**8.7600e-003**	**0.4458**	**0.1905**	**0.6363**	**0.1650**	**0.1785**	**0.3435**	**0.0000**	**795.8605**	**795.8605**	**0.1088**	**0.0000**	**798.5806**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**30.88**	**0.00**	**23.84**	**39.52**	**0.00**	**23.89**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Construction of 20 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Architectural Coating	Architectural Coating	1/1/2019	1/3/2019	5	3	
2	Building Construction	Building Construction	1/1/2019	8/26/2019	5	170	
3	Demolition	Demolition	1/1/2019	1/1/2019	5	1	
4	Grading	Grading	1/1/2019	1/17/2019	5	13	
5	Paving	Paving	1/1/2019	1/10/2019	5	8	
6	Site Preparation	Site Preparation	1/1/2019	2/18/2019	5	35	

Acres of Grading (Site Preparation Phase): 6

Acres of Grading (Grading Phase): 7

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 1,110,780; Non-Residential Outdoor: 370,260; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Construction of 20 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Demolition	Excavators	3	8.00	158	0.38
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Grading	Excavators	2	8.00	158	0.38
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Paving	Pavers	2	8.00	130	0.42
Paving	Rollers	2	8.00	80	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Grading	Graders	1	8.00	187	0.41
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Paving	Paving Equipment	2	8.00	132	0.36
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Building Construction	Welders	2	8.00	46	0.45

Trips and VMT

Construction of 11 Munitions Storage Igloos for Andersen AFB, Guam

Statewide , Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	0.00	1000sqft	17.00	740,520.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	54
Climate Zone	13			**Operational Year**	2022
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Construction of 11 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Project Characteristics -

Land Use - Assumption: The construction of 48 igloos is expected to occur over three phases and disturb 51 total acres. The total acreage was divided by three to estimate the number of acres disturbed in each phase and allow flexibility.

Construction Phase - Assumption: The number of days needed for each construction phase will be the same for the first two phases of igloo construction, and slightly less for the third phase.

Off-road Equipment - Assumption: Less equipment would be needed for the construction of 11 igloos as compared to the other two phases.

Off-road Equipment -

Off-road Equipment - Assumption: Less equipment would be needed for the construction of 11 igloos, as compared to the other two phases.

Off-road Equipment -

Off-road Equipment -

Off-road Equipment - Assumption: Less equipment would be needed for the construction of 11 igloos as compared to the other two phases.

Grading - Assumption: These numbers were derived from Table 2-1, Alternative 1 Areas of Proposed Action.

Construction Off-road Equipment Mitigation - Assumption: Mitigation measures would take place during construction.

2.0 Emissions Summary

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2020	8.9260	3.1496	2.5435	7.5500e-003	0.4455	0.1099	0.5554	0.1617	0.1033	0.2650	0.0000	687.7042	687.7042	0.0747	0.0000	689.5712
Maximum	**8.9260**	**3.1496**	**2.5435**	**7.5500e-003**	**0.4455**	**0.1099**	**0.5554**	**0.1617**	**0.1033**	**0.2650**	**0.0000**	**687.7042**	**687.7042**	**0.0747**	**0.0000**	**689.5712**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2020	8.9260	3.1496	2.5435	7.5500e-003	0.3589	0.1099	0.4688	0.1158	0.1033	0.2191	0.0000	687.7040	687.7040	0.0747	0.0000	689.5710
Maximum	**8.9260**	**3.1496**	**2.5435**	**7.5500e-003**	**0.3589**	**0.1099**	**0.4688**	**0.1158**	**0.1033**	**0.2191**	**0.0000**	**687.7040**	**687.7040**	**0.0747**	**0.0000**	**689.5710**

Construction of 11 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Architectural Coating	Architectural Coating	1/1/2020	1/1/2020	5	1	
2	Building Construction	Building Construction	1/1/2020	9/1/2020	5	175	
3	Demolition	Demolition	1/1/2020	1/1/2020	5	1	
4	Grading	Grading	1/1/2020	1/7/2020	5	5	
5	Paving	Paving	1/1/2020	1/3/2020	5	3	
6	Site Preparation	Site Preparation	1/1/2020	1/21/2020	5	15	

Acres of Grading (Site Preparation Phase): 6

Acres of Grading (Grading Phase): 7

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 1,110,780; Non-Residential Outdoor: 370,260; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Construction of 11 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Demolition	Excavators	1	8.00	158	0.38
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Grading	Excavators	2	8.00	158	0.38
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	2	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Paving	Pavers	1	8.00	130	0.42
Paving	Rollers	1	8.00	80	0.38
Demolition	Rubber Tired Dozers	1	8.00	247	0.40
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Building Construction	Tractors/Loaders/Backhoes	2	7.00	97	0.37
Grading	Graders	1	8.00	187	0.41
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Paving	Paving Equipment	1	8.00	132	0.36
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Building Construction	Welders	1	8.00	46	0.45

Trips and VMT

Construction of 17 Munitions Storage Igloos for Andersen AFB, Guam

Statewide , Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	0.00	1000sqft	16.70	727,452.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	54
Climate Zone	13			**Operational Year**	2020
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - Assumption: The construction of 48 igloos is expected to occur over three phases and disturb 50 total acres. The total acreage was divided by three to estimate the number of acres disturbed in each phase and allow flexibility.

Construction Phase - Assumption: The number of days needed for each construction phase will be the same for the first two phases of igloo construction, and slightly less for the third phase.

Off-road Equipment -

Grading - Assumption: These numbers were derived from Table 2-2, Alternative 2 Areas of Proposed Action.

Demolition - Assumption: Alternative 2 requires the demolition of 30 existing ECMs amounting to 50,000 sq. ft.

Vehicle Emission Factors -

Vehicle Emission Factors -

Construction Off-road Equipment Mitigation - Assumption: Mitigation measures would take place during construction.

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2018	8.9115	4.3474	3.2395	8.0000e-003	0.5740	0.1882	0.7622	0.2385	0.1760	0.4145	0.0000	733.7142	733.7142	0.0982	0.0000	736.1702
Maximum	**8.9115**	**4.3474**	**3.2395**	**8.0000e-003**	**0.5740**	**0.1882**	**0.7622**	**0.2385**	**0.1760**	**0.4145**	**0.0000**	**733.7142**	**733.7142**	**0.0982**	**0.0000**	**736.1702**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2018	8.9115	4.3474	3.2395	8.0000e-003	0.4046	0.1882	0.5928	0.1470	0.1760	0.3230	0.0000	733.7138	733.7138	0.0982	0.0000	736.1699
Maximum	**8.9115**	**4.3474**	**3.2395**	**8.0000e-003**	**0.4046**	**0.1882**	**0.5928**	**0.1470**	**0.1760**	**0.3230**	**0.0000**	**733.7138**	**733.7138**	**0.0982**	**0.0000**	**736.1699**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**29.51**	**0.00**	**22.23**	**38.35**	**0.00**	**22.06**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Construction of 17 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Architectural Coating	Architectural Coating	1/1/2018	1/2/2018	5	2	
2	Building Construction	Building Construction	1/1/2018	8/15/2018	5	163	
3	Demolition	Demolition	1/1/2018	12/31/2017	5	20	
4	Grading	Grading	1/1/2018	1/12/2018	5	10	
5	Paving	Paving	1/1/2018	1/5/2018	5	5	
6	Site Preparation	Site Preparation	1/1/2018	2/9/2018	5	30	

Acres of Grading (Site Preparation Phase): 6

Acres of Grading (Grading Phase): 7

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 1,091,178; Non-Residential Outdoor: 363,726; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Construction of 17 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Demolition	Excavators	3	8.00	158	0.38
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Grading	Excavators	2	8.00	158	0.38
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Paving	Pavers	2	8.00	130	0.42
Paving	Rollers	2	8.00	80	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Grading	Graders	1	8.00	187	0.41
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Paving	Paving Equipment	2	8.00	132	0.36
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Building Construction	Welders	1	8.00	46	0.45

Trips and VMT

Construction of 20 Munitions Storage Igloos for Andersen AFB, Guam

Statewide , Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	0.00	1000sqft	16.70	727,452.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	54
Climate Zone	13			**Operational Year**	2021
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Project Characteristics -

Land Use - Assumption: The construction of 48 igloos is expected to occur over three phases and disturb 50 total acres. The total acreage was divided by three to estimate the number of acres disturbed in each phase and allow flexibility.

Construction Phase - Assumption: The number of days needed for each construction phase will be the same for the first two phases of igloo construction, and slightly less for the third phase.

Grading - Assumption: These numbers were derived from Table 2-2, Alternative 2 Areas of Proposed Action.

Demolition - Assumption: Alternative 2 requires the demolition of 30 existing ECMs amounting to 50,000 sq. ft.

Vehicle Emission Factors -

Vehicle Emission Factors -

Vehicle Emission Factors -

Construction Off-road Equipment Mitigation - Assumption: Mitigation measures would take place during construction.

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2019	8.8639	4.0041	3.0560	7.9100e-003	0.5740	0.1651	0.7391	0.2385	0.1543	0.3928	0.0000	722.1191	722.1191	0.0959	0.0000	724.5172
Maximum	**8.8639**	**4.0041**	**3.0560**	**7.9100e-003**	**0.5740**	**0.1651**	**0.7391**	**0.2385**	**0.1543**	**0.3928**	**0.0000**	**722.1191**	**722.1191**	**0.0959**	**0.0000**	**724.5172**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2019	8.8639	4.0041	3.0560	7.9100e-003	0.4046	0.1651	0.5697	0.1470	0.1543	0.3014	0.0000	722.1187	722.1187	0.0959	0.0000	724.5169
Maximum	**8.8639**	**4.0041**	**3.0560**	**7.9100e-003**	**0.4046**	**0.1651**	**0.5697**	**0.1470**	**0.1543**	**0.3014**	**0.0000**	**722.1187**	**722.1187**	**0.0959**	**0.0000**	**724.5169**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**29.51**	**0.00**	**22.92**	**38.35**	**0.00**	**23.28**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Construction of 20 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Architectural Coating	Architectural Coating	1/1/2019	1/2/2019	5	2	
2	Building Construction	Building Construction	1/1/2019	8/15/2019	5	163	
3	Demolition	Demolition	1/1/2019	12/31/2018	5	20	
4	Grading	Grading	1/1/2019	1/14/2019	5	10	
5	Paving	Paving	1/1/2019	1/7/2019	5	5	
6	Site Preparation	Site Preparation	1/1/2019	2/11/2019	5	30	

Acres of Grading (Site Preparation Phase): 6

Acres of Grading (Grading Phase): 7

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 1,091,178; Non-Residential Outdoor: 363,726; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Construction of 20 Munitions Storage Igloos for Andersen AFB, Guam - Statewide , Annual

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Demolition	Excavators	3	8.00	158	0.38
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Grading	Excavators	2	8.00	158	0.38
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	3	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Paving	Pavers	2	8.00	130	0.42
Paving	Rollers	2	8.00	80	0.38
Demolition	Rubber Tired Dozers	2	8.00	247	0.40
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Building Construction	Tractors/Loaders/Backhoes	3	7.00	97	0.37
Grading	Graders	1	8.00	187	0.41
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Paving	Paving Equipment	2	8.00	132	0.36
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Building Construction	Welders	1	8.00	46	0.45

Trips and VMT

Construction of 11 Munitions Storage Igloos at Andersen AFB, Guam

Statewide , Annual

1.0 Project Characteristics

1.1 Land Usage

Land Uses	Size	Metric	Lot Acreage	Floor Surface Area	Population
General Light Industry	0.00	1000sqft	16.70	727,452.00	0

1.2 Other Project Characteristics

Urbanization	Urban	**Wind Speed (m/s)**	2.2	**Precipitation Freq (Days)**	54
Climate Zone	13			**Operational Year**	2022
Utility Company	Statewide Average				
CO2 Intensity (lb/MWhr)	1001.57	**CH4 Intensity (lb/MWhr)**	0.029	**N2O Intensity (lb/MWhr)**	0.006

1.3 User Entered Comments & Non-Default Data

Construction of 11 Munitions Storage Igloos at Andersen AFB, Guam - Statewide , Annual

Project Characteristics -

Land Use - Assumption: The construction of 48 igloos is expected to occur over three phases and disturb 50 total acres. The total acreage was divided by three to estimate the number of acres disturbed in each phase and allow flexibility.

Construction Phase - Assumption: The number of days needed for each construction phase will be the same for the first two phases of igloo construction, and slightly less for the third phase.

Off-road Equipment - Assumption: Less equipment would be needed for the construction of 11 igloos, as compared to the other two phases.

Off-road Equipment -

Off-road Equipment - Assumption: Less equipment would be needed for the construction of 11 igloos, as compared to the other two phases.

Off-road Equipment - Assumption: Less equipment would be needed for the construction of 11 igloos, as compared to the other two phases.

Grading - Assumption: These numbers were derived from Table 2-2, Alternative 2 Areas of Proposed Action.

Demolition - Assumption: Alternative 2 requires the demolition of 30 existing ECMs amounting to 50,000 sq. ft.

Vehicle Emission Factors -

Vehicle Emission Factors -

Vehicle Emission Factors -

Construction Off-road Equipment Mitigation - Assumption: Mitigation measures would take place during construction.

Table Name	Column Name	Default Value	New Value
tblConstDustMitigation	WaterExposedAreaPM10PercentReduction	55	61
tblConstDustMitigation	WaterExposedAreaPM25PercentReduction	55	61
tblConstDustMitigation	WaterUnpavedRoadVehicleSpeed	40	0
tblConstructionPhase	NumDays	20.00	1.00
tblConstructionPhase	NumDays	300.00	166.00
tblConstructionPhase	NumDays	20.00	10.00
tblConstructionPhase	NumDays	30.00	5.00
tblConstructionPhase	NumDays	20.00	3.00
tblConstructionPhase	NumDays	10.00	15.00
tblConstructionPhase	PhaseEndDate	12/31/2019	1/1/2020
tblConstructionPhase	PhaseEndDate	12/31/2019	8/19/2020

2.1 Overall Construction

Unmitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2020	8.7659	3.0999	2.4676	7.2900e-003	0.4535	0.1093	0.5629	0.1609	0.1028	0.2637	0.0000	664.2059	664.2059	0.0736	0.0000	666.0448
Maximum	**8.7659**	**3.0999**	**2.4676**	**7.2900e-003**	**0.4535**	**0.1093**	**0.5629**	**0.1609**	**0.1028**	**0.2637**	**0.0000**	**664.2059**	**664.2059**	**0.0736**	**0.0000**	**666.0448**

Mitigated Construction

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio- CO2	Total CO2	CH4	N2O	CO2e
Year	tons/yr										MT/yr					
2020	8.7659	3.0999	2.4676	7.2900e-003	0.3425	0.1093	0.4518	0.1077	0.1028	0.2105	0.0000	664.2057	664.2057	0.0736	0.0000	666.0445
Maximum	**8.7659**	**3.0999**	**2.4676**	**7.2900e-003**	**0.3425**	**0.1093**	**0.4518**	**0.1077**	**0.1028**	**0.2105**	**0.0000**	**664.2057**	**664.2057**	**0.0736**	**0.0000**	**666.0445**

	ROG	NOx	CO	SO2	Fugitive PM10	Exhaust PM10	PM10 Total	Fugitive PM2.5	Exhaust PM2.5	PM2.5 Total	Bio- CO2	NBio-CO2	Total CO2	CH4	N20	CO2e
Percent Reduction	**0.00**	**0.00**	**0.00**	**0.00**	**24.49**	**0.00**	**19.73**	**33.06**	**0.00**	**20.18**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**	**0.00**

Construction of 11 Munitions Storage Igloos at Andersen AFB, Guam - Statewide , Annual

Phase Number	Phase Name	Phase Type	Start Date	End Date	Num Days Week	Num Days	Phase Description
1	Architectural Coating	Architectural Coating	1/1/2020	1/1/2020	5	1	
2	Building Construction	Building Construction	1/1/2020	8/19/2020	5	166	
3	Demolition	Demolition	1/1/2020	1/14/2020	5	10	
4	Grading	Grading	1/1/2020	1/7/2020	5	5	
5	Paving	Paving	1/1/2020	1/3/2020	5	3	
6	Site Preparation	Site Preparation	1/1/2020	1/21/2020	5	15	

Acres of Grading (Site Preparation Phase): 6

Acres of Grading (Grading Phase): 7

Acres of Paving: 0

Residential Indoor: 0; Residential Outdoor: 0; Non-Residential Indoor: 1,091,178; Non-Residential Outdoor: 363,726; Striped Parking Area: 0 (Architectural Coating – sqft)

OffRoad Equipment

Construction of 11 Munitions Storage Igloos at Andersen AFB, Guam - Statewide , Annual

Phase Name	Offroad Equipment Type	Amount	Usage Hours	Horse Power	Load Factor
Architectural Coating	Air Compressors	1	6.00	78	0.48
Demolition	Excavators	1	8.00	158	0.38
Demolition	Concrete/Industrial Saws	1	8.00	81	0.73
Grading	Excavators	2	8.00	158	0.38
Building Construction	Cranes	1	7.00	231	0.29
Building Construction	Forklifts	2	8.00	89	0.20
Building Construction	Generator Sets	1	8.00	84	0.74
Paving	Pavers	1	8.00	130	0.42
Paving	Rollers	1	8.00	80	0.38
Demolition	Rubber Tired Dozers	1	8.00	247	0.40
Grading	Rubber Tired Dozers	1	8.00	247	0.40
Building Construction	Tractors/Loaders/Backhoes	2	7.00	97	0.37
Grading	Graders	1	8.00	187	0.41
Grading	Tractors/Loaders/Backhoes	2	8.00	97	0.37
Paving	Paving Equipment	1	8.00	132	0.36
Site Preparation	Tractors/Loaders/Backhoes	4	8.00	97	0.37
Site Preparation	Rubber Tired Dozers	3	8.00	247	0.40
Grading	Scrapers	2	8.00	367	0.48
Building Construction	Welders	1	8.00	46	0.45

Trips and VMT

Appendix C
Endangered Species Act Documentation

This page intentionally left blank.

Biological Assessment for the Construction of 48 Munition Storage Igloos at Andersen AFB, Guam

Executive Summary

Andersen Air Force Base (AFB) has prepared this Biological Assessment (BA) as part of a request for formal consultation under section 7 of the Endangered Species Act (ESA) (16 United States [U.S.] Code [USC] 1531 *et seq*.). Section 7(a) (2) of the ESA requires federal agencies to ensure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any federally threatened or endangered species, or any species proposed for listing under the ESA, or result in the destruction or adverse modification of designated or proposed critical habitat. This document also supports Department of Defense's compliance with Section 102 of the National Environmental Policy Act (42 USC 4321 *et seq.*) mandating that appropriate consideration be given to environmental resources impacted by the preferred alternative presented in the Environmental Assessment for Munition Storage Igloos at Andersen AFB, Guam.

The purpose of this BA is to analyze and address the potential effects to federally threatened and endangered species under the jurisdiction of the U.S. Navy resulting from construction and operations of forty-eight (48) munition storage igloos located at Andersen AFB, known as earth covered magazines (ECMs) within a 51 acre footprint. The ECMs will be arranged side by side along 5th to 8th Streets between C Avenue and E Avenue (Figure 2.1).

Analysis in this BA of the potential effects to ESA-listed species are based upon the preferred alternative for the proposed action as presented in the Draft Environmental Assessment for Munition Storage Igloos at Andersen AFB, Guam (2018), as well as available population and habitat data for species that occur or may occur within the proposed action area.

Table ES-1 indicates the ESA-listed species that occur or may occur within the proposed action Area and the effects determination. Andersen AFB requests concurrence from the U.S. Fish and Wildlife Service (USFWS) regarding "may affect, but not likely to adversely affect" (NLAA) determinations for the Guam Rail (*Gallirallus owstoni*), Mariana crow (*Corvus kubaryi*), and Mariana fruit bat (*Pteropus mariannus mariannus*). Andersen AFB has determined that implementation of the proposed action is likely to adversely affect (LAA) the threatened plants *Tabernaemontana rotensis* and *Cycas micronesica*. Due to their habitat and behavior, listed Partulid snails are difficult to detect. Partulid snail surveys have been conducted in adjacent habitat to the proposed project location but not in the action area. Andersen AFB plans to conduct preconstruction surveys and translocate snails if found. Therefore, Andersen AFB is requesting a LAA determination for *Partula gibba*, *Partula radiolata*, and *Samoana fragilis* to cover potential take. Best management practices and conservation measures will be included in the proposed action to minimize impacts and off-set effects to these species.

Table ES-1. ESA-Listed Species within Proposed Action Area Based on Field Survey Results at Andersen AFB, Guam, and Effects Determinations.

Common name	Scientific name	ESA Status	Effects Determination
Plants			
	Cycas micronesica	Threatened	Likely to adversely affect
	Taberneamonta rotensis	Threatened	Likely to adversely affect
Avian Species			
Guam rail	*Gallirallus owstoni*	Endangered	May affect, but not likely to adversely affect
Mariana crow	*Corvus kubaryi*	Endangered	May affect, but not likely to adversely affect
Mammal Species			
Mariana fruit bat	*Pteropus mariannus mariannus*	Threatened	May affect, but not likely to adversely affect
Invertebrates			
Humped tree snail	*Partula gibba*	Endangered	Likely to adversely affect
Guam tree snail	*Partula radiolata*	Endangered	Likely to adversely affect
Fragile tree snail	*Samoana fragilis*	Endangered	Likely to adversely affect

Table of Contents

1.0 Background of the Project 5

1.1 Purpose and Need for the Action 6

1.2 Proposed Action Area 6

1.3 Species Addressed in this Biological Assessment 7

1.4 Species and Critical Habitat Eliminated from Detailed Analysis 9

1.5 Recovery Habitat 10

2.0 Details of the Proposed Action 10

2.1 Layout of the Munition Storage Facilities 10

2.2 Site Preparation and Construction Activities 13

2.3 Best Management Practices 13

2.4 Conservation Measures 13

3.0 Environmental Conditions and Status of Endangered Species 15

3.1 Baseline Conditions in the Action Area 16

3.2 Surveys Conducted for this Action 16

3.3 Status and Description of Threatened Cycad (*Cycas micronesica*) 21

3.4 Status and Description of Threatened *Tabernaemontana rotensis* 21

3.5 Status and Description of Threatened Mariana Fruit Bat (*Pteropus mariannus mariannus)* 23

3.6 Status and Description of Endangered Mariana Crow (*Corvus kubaryi*) 25

3.7 Status and Description of Endangered Guam Rail (*Gallirallus owstoni*) 27

3.8 Status and Description of Endangered Partulid Snails: Humped tree snail (*Partula gibba)*, Guam tree snail (*Partula radiolata*), and Fragile tree snail (*Samoana fragilis*) 29

4.0 Potential Direct and Indirect Effects to Listed Species and Designated Habitat 33

4.1 Potential Direct and Indirect Effects to *Cycas micronesica* 33

4.2 Potential Direct and Indirect Effects on *Tabernaemonetana rotensis.* 34

4.3 Potential Direct and Indirect Effects to the Mariana Fruit Bat (*Pteropus mariannus mariannus)* 34

4.4 Potential Direct and Indirect Effects to Partulid Tree Snails (*Partula gibba*, *Partula radiolata*, and *Samoana fragilis* 36

5.0 Cumulative Effects 36

6.0 Conclusion 37

Cycas micronesica 37

Taberneamontana rotensis 38

Partulid Snail Species 38

6.1 Species that the Action "May Affect, Not Likely to Adversely Affect"....38
Mariana Fruit Bat (*Pteropus mariannus mariannus)*....38
Guam Rail (*Gallirallus owstoni*)....39
Mariana Crow (*Corvus kubaryi*)....39
7.0 Literature Cited....40

1.0 Background of the Project

An Environmental Assessment (EA) is being prepared by the Department of Navy (DON), Naval Facilities Engineering Command (NAVFAC), Pacific, on behalf of Andersen Air Force Base (AFB) for the construction of 48 new Hayman-style munitions storage igloos or earth covered magazines (ECM) (Figure 1.1). The EA will satisfy requirements under the National Environmental Policy Act (42 USC 4321 *et seq.*), and analyze the following environmental resource areas: cultural resources, biological resources, air quality, water resources, geologic resources, noise, infrastructure, transportation, public health and safety, hazardous materials, and waste. The EA is currently being developed and will analyze the proposed action and alternatives on environmental resources. Expected completion of the EA is anticipated for 2019. Point of contact for the EA and Biological Assessment (BA) is the 36th Wing (WG) Commander, Andersen AFB.

Andersen AFB is a strategically located forward main operating base. The 36th WG of the Pacific Air Forces is host unit to U.S. Air Force Active, Reserve, National Guard, U.S. Army, and Navy. Its mission is to provide the President of the United States sovereign options to decisively employ airpower across the entire spectrum of engagement. Andersen AFB is postured to project power; deliver reliable aircraft and equipment maintenance capabilities across the globe; maintain a day to day support with expeditionary capabilities; and provide a rapidly deployable force (USAF 2016).

Following a major explosion in 1926, the Navy and Army set new standards for safe storage of munitions. The standard earth covered magazine known as an igloo was the predominant munitions storage structure for World War II and through the early Cold War era. Development on Guam of the current Munition Storage Area I (MSA I) started in 1944 at what was known as North Field. A network of roads was constructed which followed open air pens or pads for bombs to be stored within the forest. The bomb storage area remained as open air pens until permanent munitions igloos were constructed in 1953. Construction of these roads and facilities resulted in forest fragmentation by clearing forest for roads and spaces for large bomb pads (DOD 2018 arch). MSA I provides ongoing support for Andersen AFB, and is essential to its mission. Since the 1940's there has been a constant movement of munitions in and out of the area. The term Earth Covered Magazine (ECM) will be used to describe munitions igloos henceforth.



Figure 1.1. New Hayman-style Earth Covered Magazines Proposed to be Constructed

1.1 Purpose and Need for the Action

In April 2002, the U.S. Air Force Safety Center evaluated existing munitions magazines from the 1950's. The magazines at Andersen AFB failed to meet the evaluation standard rating due to faulty door design. Additionally, the earth coverings on the magazines have deteriorated from age, typhoon winds, and rain. As a result of failing the safety rating, the munition magazines were downgraded from storing 500,000 pounds of net explosive weight to 250,000 pounds of net explosive weight. The age and wear of these facilities have caused a shortfall in munitions storage that is needed to support the current mission. Every functional munition storage unit is currently in use and essential to meet the minimum storage capacity. The loss or temporary loss of a magazine will negatively impact the mission of Andersen AFB. The proposed action incudes building 48 ECM within a 51 acre construction footprint. The ECM will be arranged side by side along 5th to 8th Streets between C Avenue and E Avenue within (MSA I).

This BA was developed to analyze potential impacts to threatened and endangered species in the proposed action area. This analysis is being submitted to the United States Fish and Wildlife Service (USFWS) as part of formal Endangered Species Act (ESA) Section 7 consultation with Andersen AFB. The DON has developed this BA for Andersen AFB, 36th Wing. Consultation will be directed by NAVFAC Pacific with assistance from Andersen AFB and Joint Region Marianas (JRM).

1.2 Proposed Action Area

Andersen AFB is located on the northern tip of Guam on a limestone plateau that occupies approximately 14,000 acres. The proposed munitions storage facilities would be constructed within MSA-1, which is located northwest of Andersen AFB's airfield and southeast of the Northwest Field Training Area. (Figure 1.2).

The majority of Andersen AFB is within the Refuge Overlay Unit of the Guam National Wildlife Refuge. The Guam National Wildlife Refuge was established in 1993 through a Memorandum of Understanding between the USFWS, DON, U.S. Air Force, and Government of Guam (Government of Guam et al. 1993). By way of cooperative agreements signed in 1994, the

USAF, DON, USFWS, and the Guam Department of Agriculture, Division of Aquatic and Wildlife Resources established the Refuge Overlay Units to provide a coordinated program for protecting threatened and endangered species and native flora and fauna, maintaining native ecosystems, and conserving biological diversity on Department of Defense lands on Guam. The agreement recognizes that the primary purpose of lands within the Overlay Refuge is to support the national mission of the Navy and Air Force.

1.3 Species Addressed in this Biological Assessment

Section 7(a)(2) of the ESA states, "Each Federal agency shall, in consultation with and with the assistance of the Secretary of the Interior, insure that any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered species or threatened species." To "jeopardize the continued existence of" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species in the wild by reducing the reproduction, numbers, or distribution of that species [50 CFR §402.02]. The list of species addressed in this biological assessment is presented below with their current ESA status and biological affects determination (Table 1).

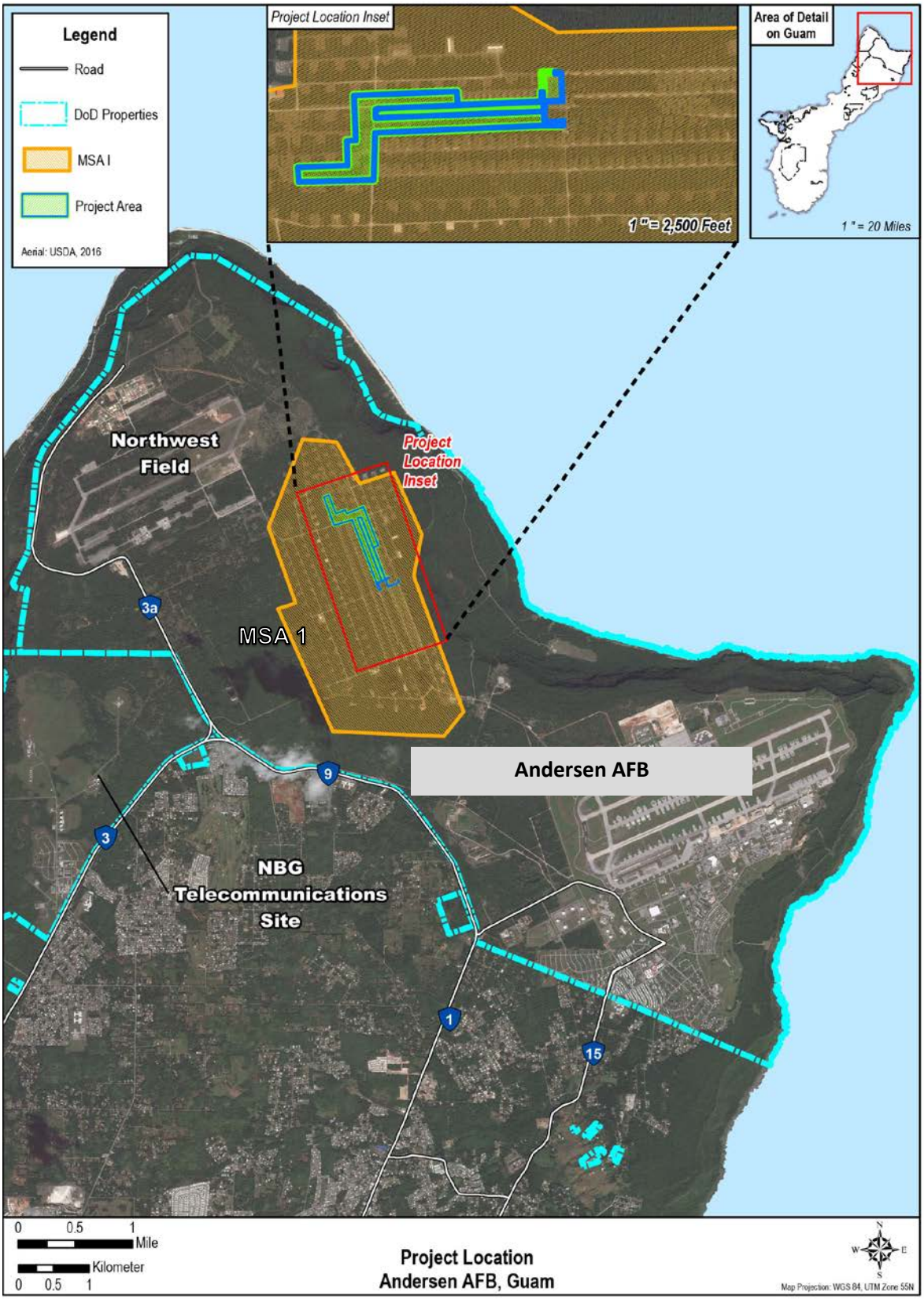


Figure 1.2. Location of MSA I on Andersen AFB

Table 1. ESA-Listed Species within Proposed Action Area on Andersen AFB, Guam, and Effects Determination

Common name	Scientific name	ESA Status	Effects Determination
Plants			
	Cycas micronesica	Threatened	Likely to adversely affect
	Taberneamonta rotensis	Threatened	Likely to adversely affect
Avian Species			
Guam rail	*Gallirallus owstoni*	Endangered	May affect, but not likely to adversely affect
Mariana crow	*Corvus kubaryi*	Endangered	May affect, but not likely to adversely affect
Mammal Species			
Mariana fruit bat	*Pteropus mariannus mariannus*	Threatened	May affect, but not likely to adversely affect
Invertebrates			
Humped tree snail	*Partula gibba*	Endangered	Likely to adversely affect
Guam tree snail	*Partula radiolata*	Endangered	Likely to adversely affect
Fragile tree snail	*Samoana fragilis*	Endangered	Likely to adversely affect

Andersen AFB determination of "likely to adversely affect" is based on survey results discussed in the effects assessment but does not reach a scale to impact the continued existence of the species.

1.4 Species and Critical Habitat Eliminated from Detailed Analysis

Based on field surveys conducted within and in the vicinity of the area for this action, the following species are eliminated from further detailed analysis because they are not in the action area: Mariana eight spot butterfly (*Hypolimnas octocula marianensis*), Mariana wandering butterfly (*Vagrans egistina*)), Slevin's Skink (*Emoia cyanura*), Serianthes nelsonii, *Bulbophyllum guamense*, *Dendrobium guamense*, *Eugenia bryanii*, *Hedyotis megalantha*, *Heritiera longipetiolata*, *Maesa walkeri*, *Nervilia jacksoniae*, *Phyllanthus saffordii*, *Psychotria malaspinae*, *Solanum guamense*, *Tinospora homosepala*, and *Tuberolabium guamense*.

Critical Habitat for the Mariana crow (*Corvus kubaryi*) and Mariana fruit bat (*Pteropus mariannus mariannus*) has been designated on the Guam National Wildlife Refuge at Ritidian Point (USFWS 2004). The action area is not within any of the designated critical habitats and no effects is anticipated for the species designated critical habitat.

1.5 Recovery Habitat

"Recovery habitat" is a term that was defined in the 2010 Navy Biological Opinion (BO) for the Relocation of U.S. Marine Corps from Okinawa to Guam by the USFWS to mean "habitat that is currently suitable to support the recovery of listed species (USFWS 2010)." Recovery habitat for species extirpated in the wild is covered in this consultation to be consistent with other consultations with the USFWS. The USFWS has mapped habitat across Guam for species extirpated from the wild and labeled these lands as recovery habitat. Although this term has no legal basis, these habitats could host the reintroduction of extirpated species once threats have been removed or sufficiently managed. Habitat protection for these species is important for the eventual recovery of the species. Andersen AFB acknowledges the need to conserve recovery habitat for listed species and has assessed impacts to identified areas by the amount of suitable habitat available for the species. Suitable habitats are areas that could provide foraging, nesting, roosting, or other function for one or more life stages of a covered species such as a native forest or an area free of predators. Recovery habitat for the Guam Micronesian kingfisher (*Todiramphus cinnamomina reichenbachii*) does not occur within MSA I. Therefore, no impact to Guam Micronesian kingfisher recovery habitat is anticipated as a result of the proposed project.

2.0 Details of the Proposed Action

The 36th WG proposes to construct new munitions storage facilities and infrastructure upgrades in MSA I. The action incudes building 48 ECM within a 51 acre construction footprint. The ECM will be arranged side by side along 5th to 8th Streets between C Avenue and E Avenue. Andersen AFB has chosen this arrangement to have the smallest amount of operational impacts to current ECM, and does not require the need to demolish operating munitions storage units (Figure 2.1).

Other alternatives have been analyzed and eliminated from detailed evaluation in the Draft Environmental Assessment due to the current 36th WG munitions storage capacity deficit (DOD 2018). Natural resources including protected species are just one environmental media analyzed in the Environmental Assessment. Selecting the proposed action is dependent on mission related requirements and other environmental media. Demolishing ECM that is operational without immediate replacement would cause a storage shortfall. In order to upgrade or replace any of the existing storage magazines, the munitions in that existing magazine (and possibly surrounding magazines) would have to be temporarily relocated for safety purposes. There is no other location on Andersen AFB that could safely accommodate a temporary relocation of munitions from the existing igloos. The only safe option would be to temporarily store munitions at an installation other than Andersen AFB during renovation or construction periods. The 36th WG would not be able to meet their current mission requirements if their existing capabilities were further reduced by temporarily storing munitions at other installations.

2.1 Layout of the Munition Storage Facilities

The magazine storage area consists of ECM arranged in rows linked together by a network of

roads. A grassy buffer area approximately 20 feet (ft) surrounds each magazine. Beyond the buffer area is highly fragmented forest that separates the rows of munitions magazines. The land area shows signs of past land grading. Historically, the land area was impacted by agroforestry, small-scale agriculture, and military use during WWII (Cardno 2017).

The proposed Hayman style ECM would be used to store up to 500,000 pounds of munitions. The 48 ECM would be arranged in various clusters, 8 ECM along 8th street, 2 along 7th street, 25 along 6th street, and 13 along 5th street. Each magazine would be 81 ft (24.4 m) long by 25 ft wide (9.1m) for an area of 2,400 ft^2 (222 m^2). The walls and roof are designed to be covered in a minimum of 24 inches (60.9 cm) of fill with a topping of shotcrete to prevent plant growth and erosion. Access to the storage area would be provided through a pair of blast resistant structural steel access doors. Each ECM would have a concrete apron connecting it to the roadway. Spacing between each ECM is approximately 50 ft and a buffer area of 50 ft will be spaced around each cluster. This buffer area will be cleared of vegetation; graded for water drainage; and managed for grass cover. Total area to be cleared as a grassy buffer zone is 21 acres. Total area of impact for all the construction will be 51 acres. Arrangement of the bunkers is shown in Figure 2.1.

Existing access roads from 5th to 8th street are in poor condition and would be improved with pavement. New roads would be 24 ft wide with 2 foot shoulders and constructed of asphaltic concrete. Concrete aprons 24 ft long and 26 ft wide will connect the ECM to the road. A staging area to hold equipment and materials for the construction phase is also planned. It will clear 1.6 acres of previously disturbed shrub and grassy area near the northern corner of 5th Street and D Avenue.

A utility connection line will provide communication and electrical service to all of the storage units. The line will connect each ECM and other clusters of magazines by underground utility corridor duct banks or trench. The duct banks would be 2-4 ft deep and 6 ft wide with a cleared area of 6 ft for back hoe. Total width of the corridor would be a 12 ft wide path. Some of these lines are sited through forest along Avenue D and will require clearing (see purple lines on Figure 2.1). A pad mounted transformer and new building with standby generator would be constructed at the intersection of 5th Street and D Avenue.

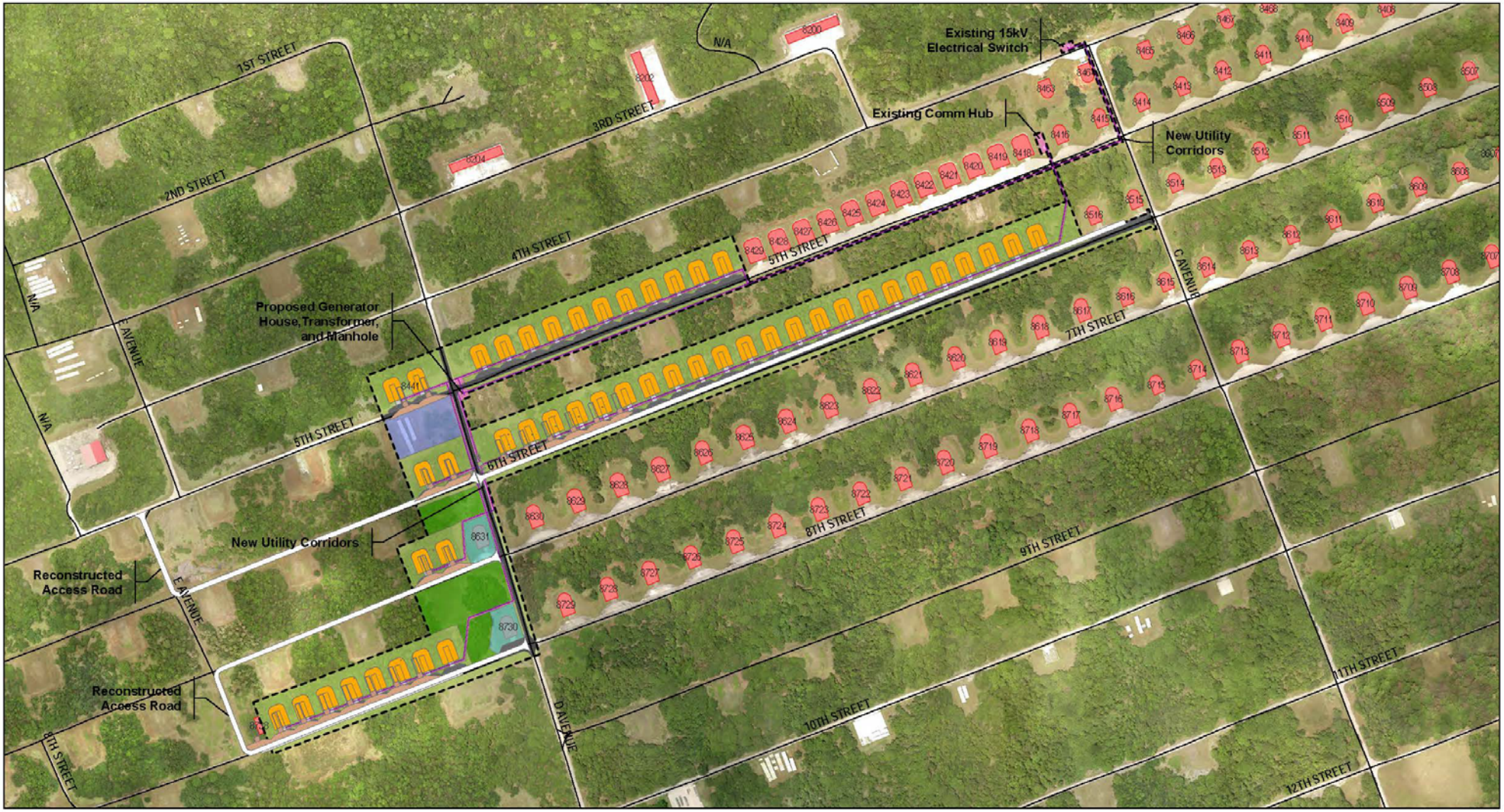


Figure 2.1 Site Lay Out of Andersen AFB Munitions Igloos

Legend

- Existing Road Centerline
- Reconstructed Access Road
- Study Area*
- Proposed Utility Corridor Centerline
- Proposed Munitions Igloos (ECM)
- Portland Cement Concrete
- Ashphalt Concrete
- ECM Access Road
- Pervious Construction Area (Grading - 50 ft buffer)
- Pervious Utility Corridor (12 ft. wide, 2-4 ft. Trenching)
- Construction Staging Area
- Existing Igloo Site
- Non-Impacted Pervious Surface
- Impervious Surface (Igloos, Pavement)
- Existing Muntions Igloos

COA/Alternative 1 Areas of Proposed Action	Acres
Impervious Surface (Igloos, Pavement)	19.4
Pervious Construction Area (Grading, LID)	21.7
Pervious Utility Corridor	3.5
Construction Staging Area	1.6
Existing Igloo Site	1.3
Non-Impacted Pervious Surface	3.9
TOTAL	51.4

N

0 200 400 Feet

0 50 100 Meters

NAVFAC

Date: 9/14/2018

2.2 Site Preparation and Construction Activities

During site preparation, surface vegetation will be cleared and grubbed (i.e., roots and stumps extracted), and the ground will be excavated for the storage unit flooring. Ground disturbance during construction would include site grading to establish positive drainage control and perimeter mound to control runoff. Best management practices for soil erosion and sedimentation control will be implemented in accordance with project-specific drainage and erosion control plans. Project construction is planned to occur between 2019 and 2021.

2.3 Best Management Practices

Andersen AFB has identified best management practices and designed conservation measures to avoid or minimize impacts to ESA-listed species. These best management practices are typically process improvement activities and are described below.

(1) Contractor Education Program.

The contractor education program is to ensure construction contractor personnel are informed of the biological resources in the project area including invasive species awareness, avoidance measures, and reporting requirements. Information about *Cycas micronesica*, *Tabernaemontana rotensis*, Mariana fruit bat, and native tree snails will be included in the contactor education program to ensure construction personnel are aware of these species and the need to avoid inadvertent impacts.

(2) Mariana Fruit Bat (*Pteropus mariannus mariannus*)

This minimization procedure will reduce the likelihood of Mariana fruit bat disturbance. One week prior to the onset of work, a biologist will conduct a survey of the area for the presence of Mariana fruit bats. If a fruit bat is present within 492 ft (150 m) of the project site, the work in that area will be postponed until the bat has left the area on its own volition. If a fruit bat moves into the project footprint while work is ongoing (i.e., the fruit bat selected the site with ongoing noise and activity), work may continue to proceed. These measures are intended to prevent, avoid and minimize potential disturbance-related effects to fruit bats. Night time construction is not anticipated; however, if necessary, lighting would be hooded and directed away from forested habitat.

2.4 Conservation Measures

The following conservation measures are specific to the action and promote the continued existence of *Cycas micronesica*, *Tabernaemontana rotensis*, Mariana fruit bat, and native tree snails. These conservation measures are meant to off-set the effects of forest clearing and removal of plants in the construction site.

(1) Reconnaissance Surveys, Salvage, and Translocation

Andersen AFB will conduct pre-construction surveys for ESA-listed plants and snails prior to habitat disturbance for species that cannot be avoided in the construction footprint. Pre-construction surveys will verify the locations of federally listed species and evaluate them for salvaging and translocation. The ability to salvage plants or collect seeds will be dependent on

the season and health of the plant. A permitted biologist will make the determination of "health," evaluate if the plant is producing seeds or pups, and decide if the plant, pups, or seeds will survive transplantation. If Andersen AFB is not able to meet the minimum percent survival ratio with whole plants or viable seeds from within the project footprint, then Andersen AFB will pursue seed collection, tissue germination, and plant division and/or stem cuttings, as suitable to the species, from other sources outside the project footprint to provide seedlings to meet out-planting success targets. The plant translocation and planting will follow the current protocols utilized by the DOD for the Marine Corps Relocation from Okinawa to Guam project. The ability to translocate snails will be determined by an authorized biologist. All biologists are agents of Andersen AFB and shall report directly to Andersen AFB and DON regarding all compliance issues; this includes all draft and final reports of non-compliance. An authorized biologist for snails is someone currently authorized to conduct relevant activities for each species under a Section 10(a)(1)(A) permit or authorized by the USFWS pursuant to this Section 7 consultation.

a. Specific Information for *Cycas micronesica*.

All *Cycas micronesica*, cycads, identified within the project footprint would be impacted by the proposed action. Salvaging adult trees or pups will be determined by a permitted biologist. Adult cycads may be evaluated for survivorship; uprooted; treated for Asian cycad scale; and transplanted to a suitable habitat (Marler 2012). Cycads may also have basal suckers (cycad pups) that can be detached from the parent tree that are considered duplicates of the parent tree. Taking multiple copies of the tree will be considered to increase survivorship and candidates for translocation. Healthy basal suckers would be temporarily housed at a DOD-approved native plant nursery on Guam until ready to be transplanted in coordination with subject matter experts. All cycads suitable for salvage that cannot be avoided during construction will be transplanted and moved to Tarague Basin or other approved location. The number of individuals salvaged is dependent on the health of the plant and whether or not it would survive transplantation. The number of individuals salvaged may differ than the number represented in this BA because the known number of healthy plants found within the project footprint may increase or decrease based on the results of the pre-construction survey. A 50% survivorship of the total number of plants salvaged is expected after one year of maintenance and monitoring (USFWS 2017). Maintenance including watering, weeding, pest removal and plant protection will be conducted. Cycad pup survival will be considered established in the wild when they do not require any supplemental watering, fertilizer, or support structures, and show stem growth of at least 1.0 cm. as measured below the base of the existing leaves (fronds) since planting in the field. Monitoring will be done monthly or more frequently depending on the conditions of the plants to determine growth and status of the plants.

b. Specific Information for *Tabernaemontana rotensis*.

All *Tabernaemontana rotensis* identified within the project footprint will be impacted by the proposed action. A permitted biologist will determine the number of *Tabernaemontana rotensis* impacted and will collect a commensurate number of seeds if available. Viable seeds

will be collected by a permitted biologist to propagate new individuals in a DOD approved native plant nursery on Guam. A 50% survivorship of the total number of seeds collected is expected after one year of maintenance and monitoring. Plants will be transplanted to Tarague Basin or other approved location. Transplantation timing will be site specific. Seed collection and out planting will be done in coordination with subject matter experts. Maintenance including watering, weeding, pest removal and plant protection will be conducted. Monitoring will be done monthly or more frequently depending on the conditions of the plants to determine growth and health status.

c. Specific information for Partulid Snail Species.
Andersen AFB proposes to conduct pre-construction surveys for federally listed snails utilizing the methodology described in the *Federal Candidate Species Surveys on Guam* prepared by Dr. Daniel Lindstrom et al. from the University of Guam (2013), within the 51 acres of the action area and if found, an authorized biologist will translocate them to suitable habitat within the Tarague Basin or other approved site. Snails will be transported in containers that are clean and only used for the transportation of listed snails. Vegetation where the snail occurs will be clipped and the individual snail will be transported on the clipped vegetation. Snails to be transported will be kept at ambient temperatures during transport. The authorized biologist will release the snail(s) on suitable native vegetation within the Tarague Basin or other approved location.

Prior to commencing translocation of *Partula radiolata*, *Partula gibba*, or *Samoana fragilis* Andersen AFB shall submit the statement of qualifications for potential biologists to USFWS unless the biologist already has a 10(a)(1)(A) permit for the species. The USFWS will provide a response (either concurrence or a detailed explanation of why the person does not meet the qualifications) no later than 30 calendar days after statement is sent. If after 30 calendar days there is no response from the USFWS, Andersen AFB will assume concurrence from the USFWS. The qualifications to work with the aforementioned species include the following:
a. A bachelor's degree with an emphasis in wildlife biology, zoology, ecology, botany, horticulture, ecology, or a related science;
b. At least 100 documented hours of experience conducting translocation and monitoring of *Partula radiolata*, *Partula gibba*, or *Samoana fragilis* or a closely related species.
c. Applicant must provide contact information of three references familiar with their work related to part b (above).

(2) Annual Reporting of Propagation/Translocation Activities. Andersen AFB will submit an annual report to the USFWS. The permitted biologists will record observations of each species during the reconnaissance surveys. The report will summarize the type of activities (e.g., health status of plants, propagation, translocation, etc.) conducted on each species and the status of relocation efforts.

3.0 Environmental Conditions and Status of Endangered Species
The action area is the area within which the action is likely to produce stressors that have direct or indirect effects to ESA-listed species. The threatened or endangered species that could be in

the action area are also described in this chapter. A description of the status of the species and information about their population is presented.

3.1 Baseline Conditions in the Action Area

The action area on Andersen AFB consists of old Hayman style munition storage bunkers surrounded by maintained grassy fields and other forested vegetation. The forested vegetation is fragmented, degraded limestone forest with small patches of tower karst. The understory has been highly disturbed by feral pigs (*Sus scrofa*) and Philippine deer (*Rusa marianna*) leaving little to no vegetation. Large areas of rutted soil occur from pig rooting action

Limestone Degraded forest.

The forest canopy varied from full closure to intermediate with *Artocarpus-Ficus* and some rock outcrops. Dominant species were *Guamia mariannae*, *Hibiscus tiliaceus*, and *Ochrosia mariannensis*. The upper canopy occasionally consisted of *Ficus prolixa* and *Intsia bijuga*. Mid canopy trees *Premna obtusifolia*, *Cynometra ramiflora*, *Morinda cirifolia*, *Cycas micronesica*, and *Psychotria hombroniana* were frequent. *Jasminum marianum* was found infrequently. *Ochrosia mariannensis, Eugenia palumbis, Pandanus tectorius*, *Pandanus dubius*, *Cocos nucifera,* and *Maytenus thompsonii* were all occasionally encountered throughout the forest. *Tabernaemontana rotensis, Pouteria obovata, Pongamia pinnata, Morinda umbellata,* and *Drypetes dolichocarpa* were rare in this vegetation type (DON 2017). Much of this vegetation type is degraded condition it would not provide quality habitat use.

***Vitex* Forest**

This vegetation type is a monotypic stand of Vitex parviflora. This is a medium- to large-sized tree. In some areas, *Hibiscus tiliaceus* scattered is through the community. The understory of this community is often dominated by *Pandanus tectorius*, as a small tree, shrub, or sapling.

3.2 Surveys Conducted for this Action

Endangered plant surveys were conducted from November 2016 to January 2017 in the entire MSA I (Figure 3.1). The plant survey targeted ESA listed plants and host plants for the Mariana wandering butterfly (*Maytenus thompsonii*) and Mariana eight-spot butterfly (*Procris pedunculata,* and *Elatostema calcareum*). ESA plants and *M. thompsonii* were identified and GPS points were collected. Health of plants was documented and plant life stage (adult or seedling) was noted. GPS locations were plotted on a map (see Figure 3.1).



Figure 3.1. ESA Listed Plant Locations in the MSA, Andersen AFB

Legend

- Existing Road Centerline
- Reconstructed Access Road
- Study Area*
- Proposed Utility Corridor Centerline
- Proposed Munitions Igloos (ECM)
- Portland Cement Concrete
- Ashphalt Concrete
- ECM Access Road
- Pervious Construction Area (Grading - 50 ft buffer)
- Pervious Utility Corridor (12 ft. wide, 2-4 ft. Trenching)
- Construction Staging Area
- Existing Igloo Site
- Non-Impacted Pervious Surface
- Impervious Surface (Igloos, Pavement)
- Existing Muntions Igloos
- *Tabernaemontana rotensis (UoG 2016)*
- *Cycas micronesica (UoG 2016)*

N

0 200 400 Meters

0 50 100 Feet

NAVFAC

Date: 9/14/2018

Surveys for endangered animals were not conducted in the action area but adjacent site next to the action area (Figure 3.2). Extensive transect surveys in the adjacent site focused on Guam tree snails (Humped tree snail (*Partula gibba*), Guam tree snail (*Partula radiolata*), Fragile tree snail (*Samoana fragilis*), butterflies (Mariana eight spot (*Hypolimnas octocula marianensis*), Mariana wandering butterfly (*Vagrans egistina*), and the Slevin's Skink (*Emoia cyanura*).

Surveys for two species of butterflies were conducted by for by identifying their host plants during transect surveys in the adjacent site. Only the host plant for the Mariana wandering butterfly, *Maytenus thompsonii* was found. The Mariana wandering butterfly was not found after inspection of its host plant. Furthermore, it has not been observed since 1979 and is presumed extirpated from Guam (USFWS 2015). Host plants for the Mariana eight-spot butterfly, *Procris pedunculata* and *Elatostema calcareum*, were not found during the surveys. Similar results from the University of Guam surveys in support of this project did not find host plants for the Mariana eight-spot in the adjacent site and action area (UoG 2017). This is an indicator that the Mariana eight spot butterfly is not present in the action area.

A survey for the Slevin's Skink (*Emoia cyanura*) was conducted during the transect surveys in the adjacent site. The species has not been seen in the wild since 1945 and is considered absent on Andersen AFB. The skink has been only observed on Cocos Island since the early 1990's (USFWS 2015). No Slevin's Skinks were found in the adjacent site and it is assumed that they also are not present in the action area.

Although fauna surveys were not conducted, the action area represents the same habitat as the adjacent site. These two locations are also contiguous and have the same forest composition. Thus, it is expected that survey results would be very similar. During the development of this BA, the action area shifted from the adjacent site to the current location due to operational reasons explained in Section 2.0.

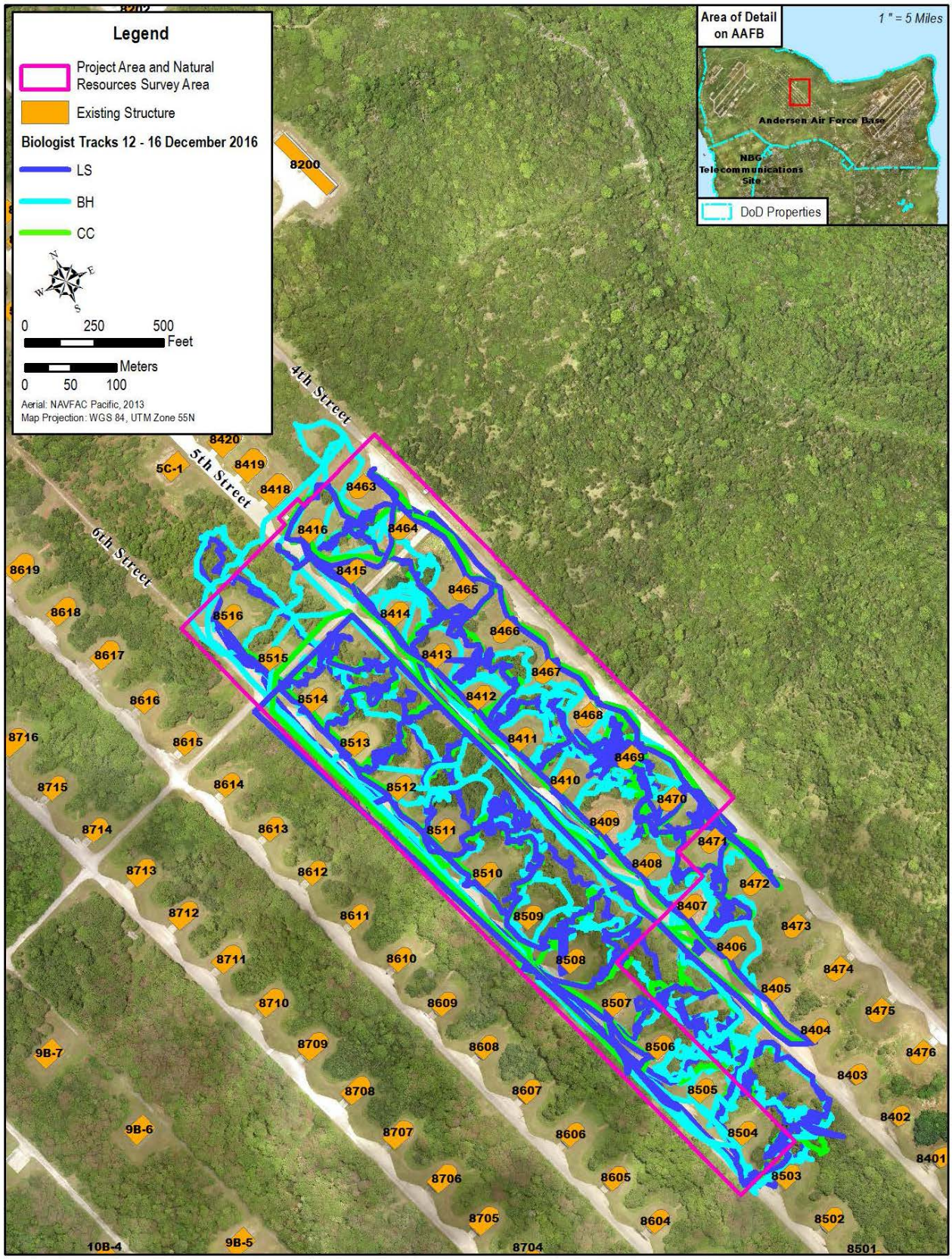


Figure 3.2 GPS Tracks of Survey Coverage within the Adjacent Survey Area.

3.3 Status and Description of Threatened *Cycas micronesica*

Regulatory Status

Cycas micronesica was listed as threatened under the ESA in 2015 (USFWS 2015b). No critical habitat has been designated for this species. A recovery plan for *Cycas micronesica* has not been completed. At the time of listing, there were 15 to 20 location occurrences of *Cycas micronesica* totaling 900,000 to 950,000 individuals in Micronesia including Guam, Rota, Yap, and Palau (USFWS 2015b). On Guam and Rota, at the time of listing, the USFWS believed that there were fewer than 630,000 individuals in the entire range (USFWS 2015b).

Environmental Baseline of the Species

On Guam there are approximately 516,000 individuals that occur from the shoreline to limestone cliffs (USFWS 2015b). Vegetation surveys within MSA I identified 7,863 *Cycas micronesica*. Approximately 724 *Cycas micronesica* are located within the 51 acres of the action area (DON 2017). Locations of the trees are identified in Figure 3.1. Trees varied in heath with some having damage to the crown and others being healthy.

Habitat

Cycas micronesica are found from the shoreline vegetation to mountain summits including limestone cliffs, forest edges, and plateaus. Few cycads are found within savanna grasslands. *Cycas micronesica* can grow in soils or in the cracks of limestone outcroppings (DON 2017). Limestone forests are characterized as areas having exposed limestone outcroppings at the surface with little to no soils. Woody species make up the upper canopy consisting of *Artocarpus mariannensis*, *Ficus prolixa*, *Mammea odorata*, *Cordia subcordata*, *Merrilliodendron megacarpum*, and *Pandanus tectorius* (Donnegan et al 2002).

Threats

Since 2014, Cycas micronesica have been attacked by the cycad aulacaspis scale (Aulacaspis yasumatsui), a nonnative pest causing rapid mortality to the plants. Feral pigs and introduced deer damage plants through herbivory and physical damage. Other threats to the cycads include nonnative insects, habitat destruction, typhoons, low population numbers and climate change (USFWS 2015b).

Recovery Needs

In order to recover *Cycas micronesica*, individuals of this species need to be protected throughout its range. *Cycas micronesica* populations should have age structures consisting of seedlings, juveniles, and adult plants. Trial bio controls targeting the cycad aulacaspis scale, should be considered to stabilize the population. Ungulate control and fencing restoration sites are crucial steps in managing cycad populations (USFWS 2017).

3.4 Status and Description of Threatened *Tabernaemontana rotensis*

Regulatory Status

Tabernaemontana rotensis was listed as threatened under the ESA in 2015 (USFWS 2015). Critical habitat for this species has not been designated. A recovery plan has not been

completed for this species. *T. rotensis* is endemic to Guam and Rota, and at the time of listing, noted to be very rare (DON 2017). There are 9 known individuals on Rota, and 6 locations on Guam where the species occur equaling a range wide total of 22,384 individuals (DON 2017). Threats to *T. rotensis* include habitat loss, non-native plants and animals, typhoons, and climate change (USFWS 2015). Leaves are arranged oppositely, flowers are white and produce orange fruit.

Environmental Baseline of the Species

There are six known locations of this species on Guam, totaling 22,375 individuals. Vegetation surveys in 2017 identified 542 *T. rotensis* within MSA I, including 83 plants in the action area. Both seedlings (44 plants) and mature plants (39 plants) were found in the project footprint (DON 2017). Locations of the trees are identified in Figure 3.1.

Habitat

Tabernaemontana rotensis grows in full sun to deep shade in forest with limestone crevices (Raulerson and Rinehart 1991, p 94). They are found in areas with little to no slope (<15%). Guam native species especially *Cycas micronesica* were the most co-occurring plants with *Tabernaemontana rotensis* (DON2007). Avian seed dispersers are absent from Guam limiting the spread of seeds. Seedlings are found in the vicinity of mature trees increasing competition for resources. This species is considered a pioneer species, and relatively easy to propagate from seed (USFWS 2017).

Threats

The following threats to the species contributed to its listing and continue to be limiting factors to recover the species.

Habitat loss and degradation:

- Incremental habitat loss due to wild fire, urbanization, and agricultural development is increasingly threatening the availability of habitat.
- The presence of nonnative plants and other nonnative ungulates (pigs, goats, and water buffalo), and Philippine deer, is likely to further degrade remaining forest habitats, thus impeding their ability to survive.
- The spatial distribution is a major concern, as so many individuals are growing in close proximity throughout Andersen AFB. This aggregated pattern increases the vulnerability of the population, especially to the threat of habitat loss and is exacerbated by the fact that most individuals on Andersen AFB are located in sites with less than 15% slope, which is also terrain suitable for human development.

Population recruitment:

- The lack of dispersal by birds restricts the spatial extent of the populations on Guam. Clustered populations can exhibit less genetic diversity becoming less resilient evolutionarily and more vulnerable to stochastic events causing a disproportionate effect (extreme events or disease) and thus prone to extinction pressures
- Typhoons will continue to degrade forest and the affected forest areas may require several years to regenerate. Typhoons may actually open canopy space for full sun light

to germinate *T. rotensis* seeds and promote the population; however, a viable seed bank must exist.

Recovery Needs

In order to recover *T. rotensis*, the remaining individuals of this species need to be protected on Guam and Rota. *Tabernaemontana rotensis* populations should have age structures consisting of seedlings, juveniles, and adult plants. Ungulate and invasive species control should be implemented throughout its range. On Guam, restoring areas with this species' natural dispersers (*e.g*., native frugivore birds) would expand the distribution of *T*. *rotensis* population into new habitat niches, niches that would have likely been naturally occupied by the *T*. *rotensis* population prior to the loss of seed dispersal on Guam. Outplanting or relocation of wild seedlings within protect areas would help increase their abundance and distribution on Guam and Rota (USFWS 17).

3.5 Status and Description of Threatened Mariana Fruit Bat (*Pteropus mariannus mariannus)*

Regulatory status

Guam population of the Mariana fruit bat was listed as endangered on August 1984 (USFWS 1984). Critical habitat is designated for this species. A Revised Recovery Plan was completed for the Mariana fruit bat in 2009 (USFWS 2009). In 2005, the USFWS down listed the Mariana fruit bat from endangered to threatened. This was based on research indicating that *Pteropus mariannus mariannus* is not a subspecies endemic only to Guam and that the Guam population is part of a subspecies including bats on other islands that interact with each other (USFWS 2005). The subspecies is endemic to the Mariana Islands archipelago. This medium-sized fruit bat, weighs 11.6-20.3 ounces (oz) (330-577 grams [g]) and has a wingspan of 34-42 in (86-107 cm). Males are slightly larger than females. The underside is black to brown with interspersed gray hair creating a grizzled appearance. The shoulders and sides of the neck are bright golden brown, but may be paler in some individuals. The head varies from brown to dark brown (Andersen AFB 2008).

Environmental Baseline of the Species

In 2018, the Andersen AFB base-wide fruit bat survey estimated a population of 35 bats (Hartzell pers comm 2018). In 2017, the base-wide survey estimated a population size of 57 bats, extrapolated from the count and flyover habitat on Andersen AFB (DON 2018). Most of the sightings were in the Habitat Management Unit and the southern corner of MSA I. In 2016, the base wide count estimated the population size to be 45 bats. Survey stations within MSA I did not detect any bats. Peak abundance in the Habitat Management Unit was 112 individuals. This estimate is based on a given period of time and a transient group. Only two bats were observed at Pati Point after quarterly surveys. A similar, large scale survey conducted in 2014 recorded less than 10 bats (DON 2016).

Habitat

Fruit bats use several forest types, including primary and secondary limestone forest, ravine forest, old coconut groves, wetlands, coastal forests, and stands of *Casuarina equisetifolia* with

native and introduced plant species. Grasslands with few trees are also used by the fruit bat. Foraging sometimes occurs on farms and suburban residential areas with flowering and fruiting trees. On Guam, bat colonies and roost sites usually occur in remote sites, especially near or along cliff lines (USFWS 2009). Fruit bats prefer to roost in locations with large emergent trees. *Ficus* spp. and *Mammea odorata* were favored but roosting has shifted to ironwood, *Aglaia mariannensis*, *Macaranga Thompsonii*, *Ochrosia oppositifolia*, *Elaeocarpus joga*, *Guettarda speciosaI*, and *Artocarpus* spp because of typhoon damage (USFWS 2009). In December 2015, bats were observed within the Habitat Management Unit using the interior forest in four different roosting locations (USFWS 2017, D. Lujan, AAFB pers. comm. 2016).

Fruit bats have been observed to feed on fruits, flowers, and leaves of 39 plant species, including 11 introduced plant species. Primary species include *Artocarpus* spp, *Carica* spp, *cycas micornesica*, *Ficus* spp, *Pandanus* spp, and *Terminalia catappa*. Fruit bats are important component of tropical forest ecosystem because they disperse plant seeds and help maintain forest diversity and contribute to plant regeneration (USFWS 2009). On Guam, the remaining colony probably forages on overlay refuge lands of the Guam National Wildlife.

Physical and Biological Requirements

The physical and biological features for the Mariana fruit bat to forage, find shelter, roost, and rear of young are found in areas with limestone, secondary, ravine, swamp, agricultural, and coastal forests composed of native and introduced plant species. These forest types provide the physical or biological features of (USFWS 2004):

- Plant species used for foraging, such as *Artocarpus* spp., *Carica papaya*, *Cycas micronesica*, *Ficus* spp., *Pandanus tectorius*, *Cocos nucifera*, and *Terminalia catappa*; and
- Remote locations, often within 328 ft. (100 m) of cliff lines that are 260 to 590 ft. (80 to 180 m) tall, with limited exposure to human disturbance and that contain mature *Ficus* spp., *Mammea odorata*, *Casuarina equisetifolia*, *Macaranga thompsonii*, *Guettarda speciosa*, *Ochrosia oppositifolia*, and other tree species that are used for roosting and reproductive activity.

Threats

Primary threats to the Mariana fruit bat are illegal hunting and habitat destruction by human disturbances. Illegal hunting and predation from brown treesnake are widely accepted as reasons for lack of fruit bat recovery on Guam (USFWS 2009a). Fruit bat pups can be vulnerable to brown treesnake predation when not being carried by their mother (Wiles 1987; Wiles et al. 1995; Wiles 1983; USFWS 2009).

Recovery Needs

Increasing populations should exist on three of the five southern islands (Saipan, Tinian, Aguiguan, Rota, and Guam), and six of the northern islands where Mariana fruit bats have persisted historically (Anatahan, Sarigan, Guguan, Alamagan, Pagan, Agrihan, Asuncion, and Maug; USFWS 2009). To meet recovery objectives, stable or increasing Mariana fruit bat subpopulations should at a minimum be distributed on the islands that currently have extant populations (USFWS *in review*). The final version of the Mariana fruit bat recovery plan is

currently in review, and recovery criteria stated here may change upon completion of the final plan. There is not currently enough protected Mariana fruit bat habitat on Rota, Guam, Tinian, or Saipan to support substantial population recovery on any of those islands. Even if sufficient habitat is set aside in conservation to support recovery of populations, controlling illegal hunting may continue to be a challenge that limits recovery of the species (USFWS 2014).

Recovery Habitat

The USFWS identified bat habitat as vegetation communities of primary and secondary limestone forest, coconut plantation, ravine forest, and groves of ironwood used for foraging, roosting, and breeding (based on vegetation mapping by the U.S. Forest Service 2006). According to the USFWS 2010 BO, a total of 29,308 ac (11,860 ha) of Mariana fruit bat recovery habitat is on Guam. The necessary amount of recovery habitat for the Mariana Fruit bat has not been determined (USFWS 2010). There is 28.7 acres of recovery habitat in the action area (Figure 3.3).

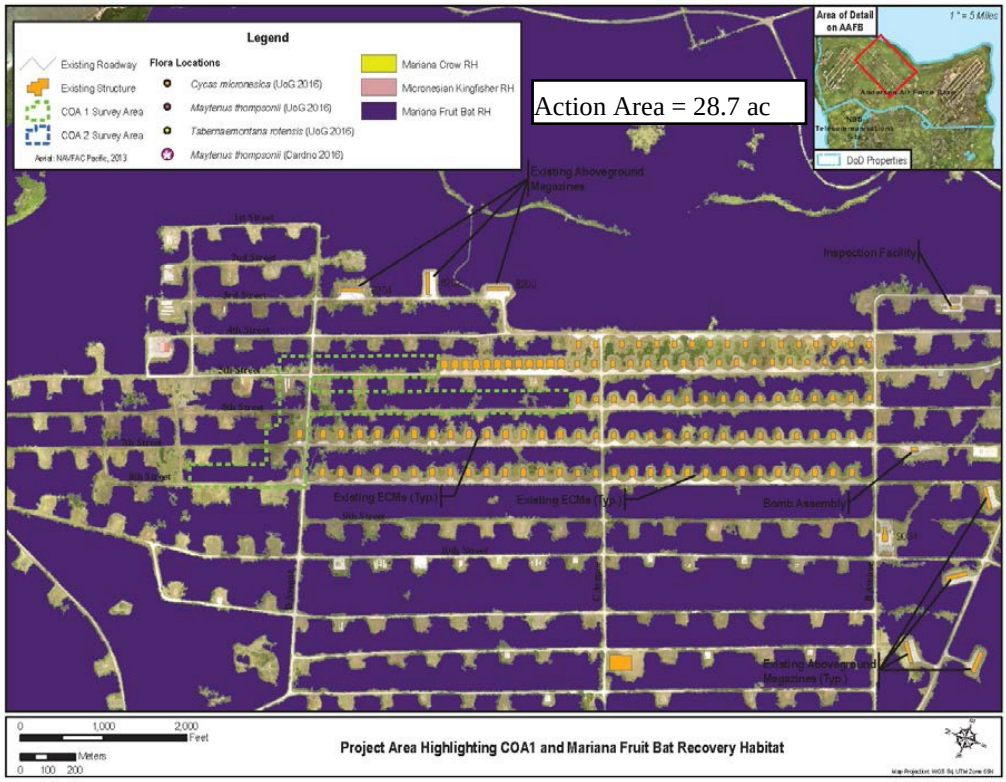


Figure 3.3 Mariana Fruit Bat Recovery Habitat Impacted.

3.6 Status and Description of Endangered Mariana Crow (*Corvus kubaryi*)

Regulatory Status

The Mariana crow was federally listed as endangered on August 27, 1984 and was considered extirpated from Guam in 2011 (USFWS 2013b). Critical Habitat for the species was designated on Guam and Rota (USFWS 2004). At the time of listing, only a small remnant population survived at the northern end of Guam.

Environmental Baseline
Andersen AFB hosted a translocation, captive recovery, and release program for the Mariana crow in an area of large scale brown treesnake control within MSA I. Since 1997, a total of 31 Mariana crows have been released, but none have survived. In 2010, 10 crows were distributed on the northern cliff forest on Andersen AFB (US Navy 2013). A single banded male was observed in July 2011 and last heard in August 2011 (SWCA 2012). The next closest population of crows is on the island of Rota, approximately 56 miles away (USFWS 2015). In 2013, surveys on Rota counted 46 pairs during the breeding season (Kroner 2014).

Habitat
Limestone forest, secondary, ravine, wetland, agricultural, and coastal forests composed of native and introduced plant species provide foraging and roosting habitat for the crow. Emergent, sub canopy trees including *Ochrosia mariannensis*, *Macaranga thompsonii*, *Intsia bijuga, Premna bousifolia*, *Eugenia reinwardtiana*, *Ficus* spp., and *Elaeocarpus joga* with dense cover are used for breeding.

Threats
Primary threats to the Mariana crow are predation by cats, rats, monitor lizards (*Varanus indicus*), and the brown treesnake. Brown treesnake predation is believed to be the overriding factor in the decline, recovery, and re-introduction of Mariana crow on Guam. Habitat degradation due to grazing of feral ungulates and expansion of invasive plants coverage are also factors (USFWS 2005b).

Recovery Habitat
According to the 2015 Reinitiation for the Marine Corps Relocation Biological Opinion, only limestone forest and ravine forest are considered habitat suitable to support the recovery of listed species (USFWS 2015). The USFWS estimated approximately 13,962 and 10,957 acres of potential Mariana crow habitat in northern and southern Guam respectively (USFWS 2015).

Recovery Habitat Needs
Based on assessment of habitat on Guam, a minimum of 7,463 acres of appropriate habitat on northern Guam and 7,166 acres in southern Guam would be needed to recover the species on Guam. A total of 23.9 acres of recovery habitat currently exists within the 51- acre action area (Figure 3.4).

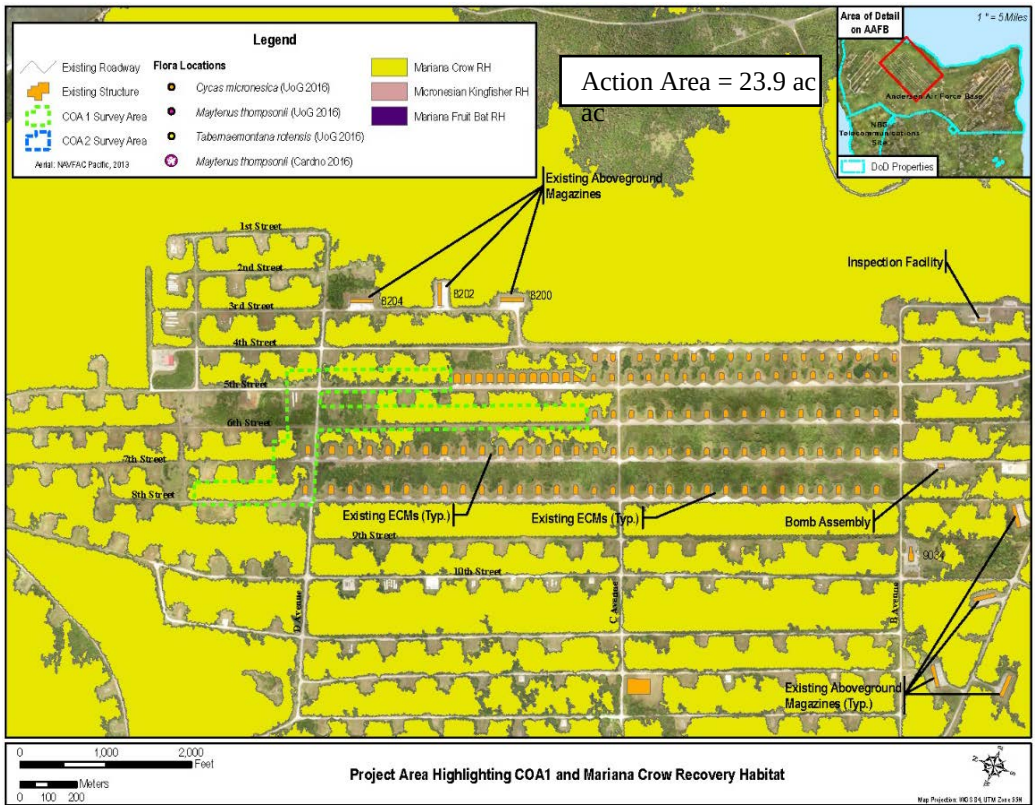


Figure 3.4 Mariana Crow Recovery Habitat Impacted.

3.7 Status and Description of Endangered Guam Rail (*Gallirallus owstoni*)

Regulatory Status

The Guam rail was emergency listed as endangered on April 11, 1984. In May 1985, the Guam Division of Wildlife Resources conducted surveys to capture rails but, "was unable to locate more than one or two individual rails" (USFWS 1990). The Guam rail was believed to have been extirpated in the wild on Guam by 1987 (Wiles et al. 1995). Critical habitat for the rail has not been designated on Guam. The rail persists in captivity on Guam, and in twelve U.S. mainland zoos (USFWS 2015).

Environmental Baseline

Efforts to establish a nonessential experimental population in the island of Rota has been underway since 1989. The Rota population is designed as non-essential experimental under Section 4(d) and 9 of the ESA (USFWS 1989). The population serves as a source population for future translocation of rails to Guam when the brown treesnake has been controlled or eradicated in Guam.

Guam rails were experimentally introduced to Andersen AFB at Area 50 within Northwest Field in 1998 and in 2003. This population did not survive reintroduction as 80% died from feral cat predation, and the small release area did not support the population (US Navy 2013). A population of breeding rails has become established on Cocos Island(off of the southern coast of Guam) under a Safe Harbor Agreement permitted under Section 10(a)(1)(A) of ESA. The rails are

monitored to learn more about survivorship, breeding behavior, habitat preferences and nesting success (USFWS 2014).

Habitat

The Guam rail prefers edge habitats, especially grassy or secondary vegetation areas which provide good cover; mature forest is deemed only marginal for the Guam rail (USFWS 1990b). Scrub forest, other shrubs and grasses, and urban cultivated are considered primary Guam rail habitat because they include shrubby edge habitat.

Threats

The primary reason for extirpation is believed to be from predation by cats and the brown treesnake. These are the two known threats that preclude the successful reestablishment of the Guam rail on Guam (USFWS 1990). Other introduced predators have contributed to the extirpation of the species including: feral dogs, cats, three species of rats (*Rattus exulans, R. rattus, and R. norvegicus*), and the monitor lizards.

Recovery Habitat

There are approximately 24,698 ac (9,995 ha) and 24,886 ac (10,063 ha) of recovery habitat in northern and southern Guam, respectively, or a total of 49,584 ac. There is 22.6 acres of Guam rail recovery habitat within the action area (Figure 3.5).

Recovery Habitat Needs

The necessary amount of recovery habitat for the species is a total of 41,184 acres (16,668 ha) in Norther and Southern Guam (USFWS 2010). Before the Guam rail is considered for down listing from endangered to threatened, the repatriation of 1,000 birds to northern Guam and 1,000 birds to southern Guam (total = 2,000 individuals; USFWS 1990a).

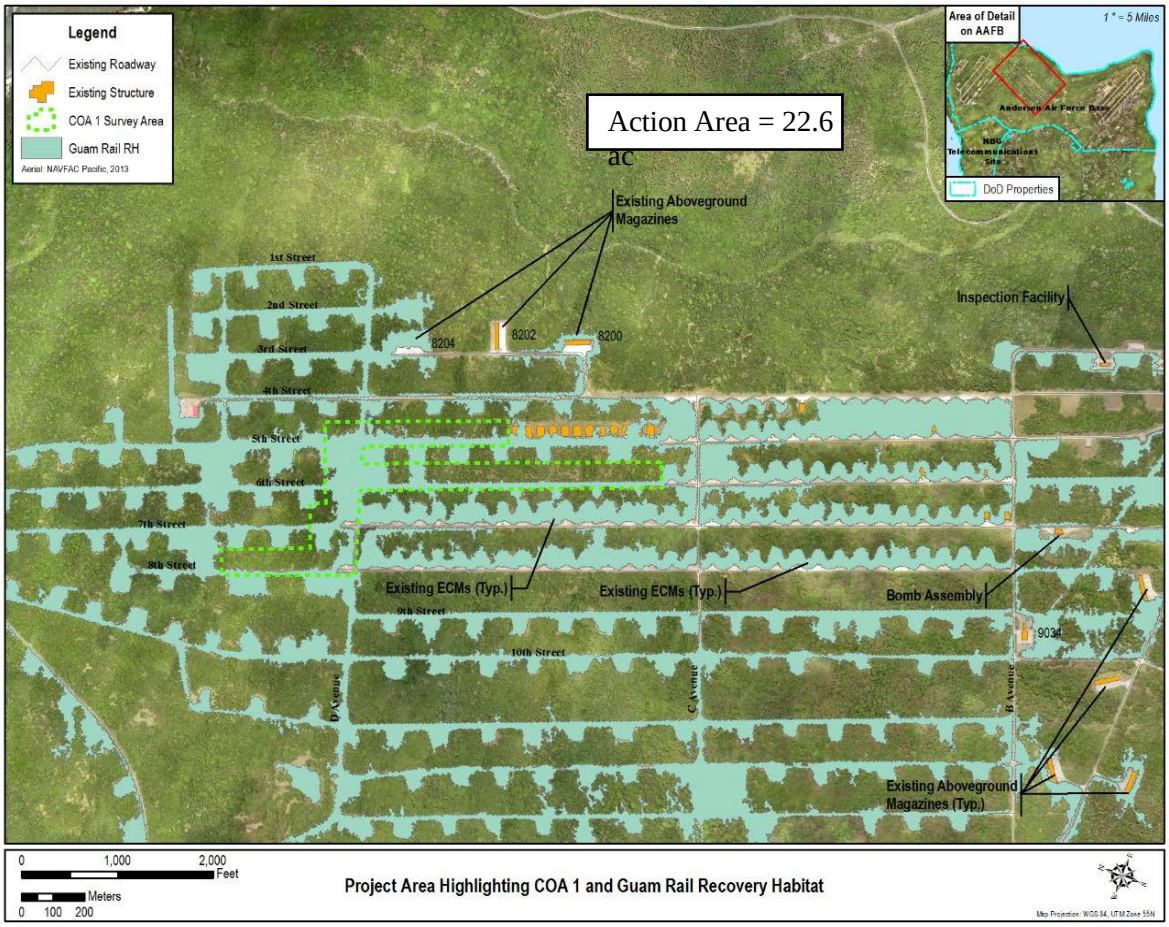


Figure 3.5 Guam Rail Recovery Habitat Impacted.

3.8 Status and Description of Endangered Partulid Snails: Humped tree snail (*Partula gibba),* Guam tree snail (*Partula radiolata*), and Fragile tree snail (*Samoana fragilis*)

Regulatory Status

The Humped tree snail, Guam tree snail, and Fragile tree snail were listed as endangered under the ESA on October 1, 2015 (USFWS 2015). No critical habitat has been designated for these species. A recovery plan for these species has not been completed.

Environmental Baseline of the Species

Guam Tree Snail

Prior to World War II the Guam tree snail existed everywhere suitable vegetation existed (USFWS 2015). In 1925, Guam tree snails were found at 37 sites across Guam, and 2,278 individuals were collected. In 1989, the populations were resurveyed, but only 9 of the sites supported snails. Guam tree snails were found at 7 new populations during the same survey (USFWS 2015). At the time of listing in 2015, there were no more than 26 colonies of Guam tree snails, with between 10 and 150 individuals per colony (USFWS 2015).

Ritidian Point was the site of a targeted search on July 17, 2013, where 20 Guam tree snails were documented (USFWS 2017). Most of the Guam tree snails on Andersen are found at

Taragüe Basin (Figure 3.3). Guam tree snails were sighted in November 2016 at Andersen South. Surveys in the same area by the United States Department of Agriculture Wildlife Services reported three live snails in 2016. Department of Navy personnel returned to the locations where these snails were sighted and confirmed presence of 35 live snails. In February 2017, a total of 38 live snails were documented at Andersen South (Olmsted, 2017, personal communication).

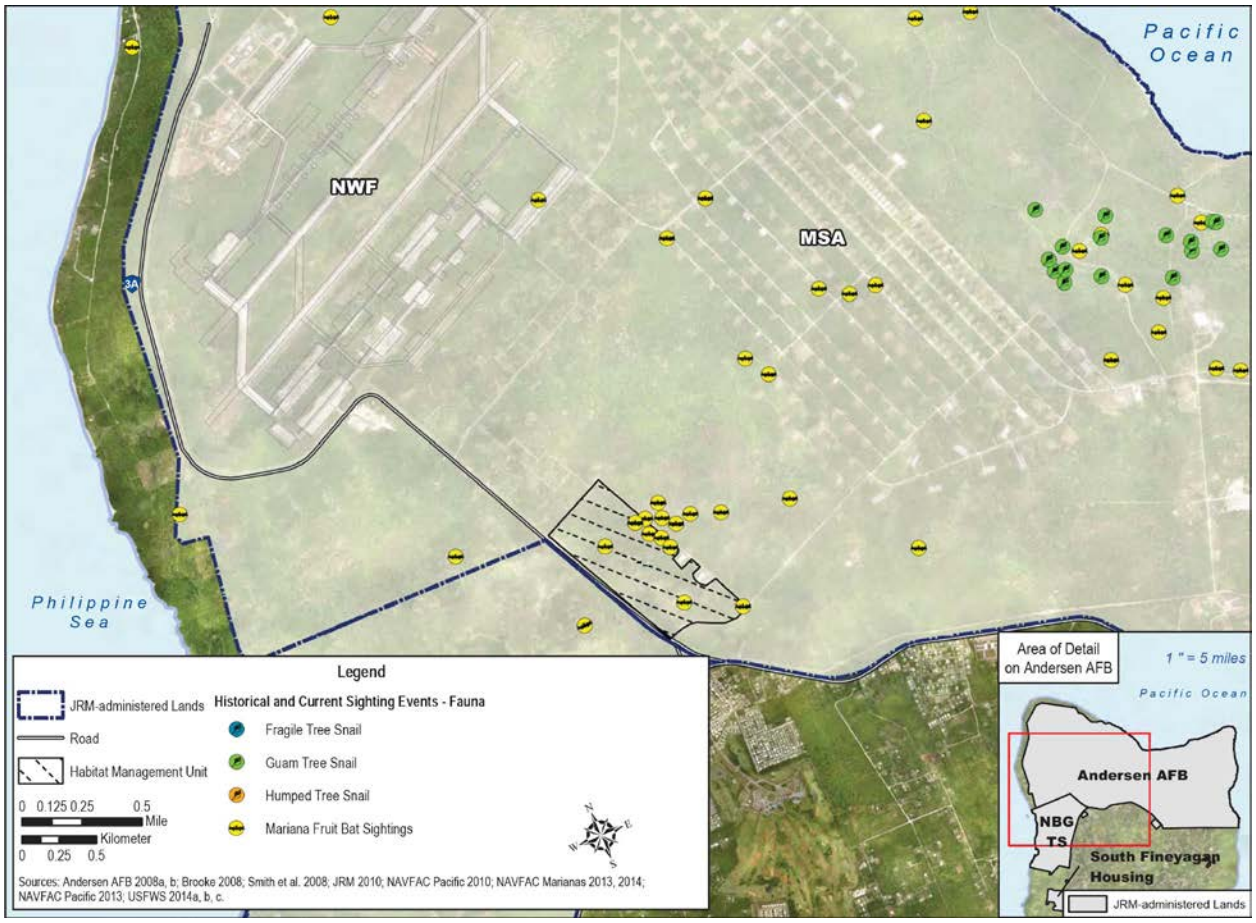


Figure 3.6 Endangered Fauna in the Magazine Storage Area 1 on Andersen AFB.

Humped Tree Snail

The humped tree snail is the least common of the three listed tree snail species on Guam. At the time of listing in 2015, the population of humped tree snails on Guam was estimated to be approximately 100 individuals. The humped tree snail is only found at Haputo Beach (Lindstrom & Benedict 2014). Population decline of humped tree snails has been reported on most islands of the CNMI; however, population estimates for the archipelago is unknown (CNMI DLNR 2015). In 2008, no humped tree snails were found on Rota, Tinian, or Aguiguan potentially due to habitat loss related to extensive deforestation and agriculture (Smith et al. 2008; Hadfield 2010).

Fragile Tree Snail

Historically, the fragile tree snail was known from 13 populations in northern Guam and one on Rota. It was originally described as rare and low in number (Crampton 1925; Easley 1970). In 1989, fragile tree snails were found only in the presence of the Guam tree snail and in only 6 of 26 surveyed sites distributed across Guam (Hopper and Smith 1992). By 2013, only two colonies were known on Guam; Pugua Point and Lost Pond (Lindstrom 2014).

No live Partulid snails, bleached or fresh shells or fragments were observed during the surveys in the adjacent site (see Figure 3.2). Survey protocols used the methodology described in the *Federal Candidate Species Surveys on Guam* prepared by Dr. Daniel Lindstrom et al. from the University of Guam, (2013). The current habitat would not provide recolonization conditions for the native Partulid tree snail due to the overwhelming presence of *Euglandina* and carnivorous flatworm (Cardno 2017). The trilad flatworms prey on Partulids and pose a threat to the overall population. A continuous swath of dead African giant snail (*Achatina fulica*) shells suggest that the *Euglandina* is present and any snail in the area would be at risk of predation. Although the action area was not surveyed for Partulids, the surveys in the adjacent site serve as an indicator sample for the presence of the species. In 2018, similar threatened and endangered species surveys were conducted at a well site in MSA I related to the Marine Corps relocation program as a proxy for determining presence of Partulids. The presence of federally listed snails was not observed and further demonstrated limited distribution of the snails.

Snail Habitat and Biological Requirements

Partulid snails prefer cool dense, shaded native forest communities, with high humidity and reduced air movement to conserve moisture. There is no discrete host plant for Guam's native snails as they have been observed on a range of native and nonnative trees (USFWS 2015).

The Guam tree snail is endemic to the island of Guam and is the most commonly encountered Partulid snail on the island. Historically, Guam tree snails occurred across the island in widely available strand vegetation, forested river borders and lowland and highland forests. The Guam tree snail has been found in coconut forests, similar to the humped tree snail; however, the Guam tree snail's range also includes scrub and limestone forests, especially those dominated by *O. mariannensis*. They have been found on a wide variety of plants including both natives and nonnatives (Lindstrom & Benedict 2014).

The Humped are generally an arboreal species, found in the sub-canopy of mixed native forests with good understory and ground cover (Hopper & Smith 1992; Smith et al. 2008; Hadfield 2010)). There is no particular obligate relationship with any particular type of tree or bush; however, they are most often found on the endemic *Piper guamensis*. They are also commonly found on coconut palms and ferns, including *Microsorium punctatum*, on Guam. Compared to P. radiolata, humped tree snails were generally observed on fewer host species (Hooper and Smith 1992).

The fragile tree snail is only found on the islands of Guam and Rota. They are found on the same vegetation as other Partulids on Guam (USFWS 2015b).

Threats
The following threats to the species contributed to its listing and continue to be an issue in the ability of the species to recover.

Loss or degradation of habitat. Ungulates not only graze upon the host plant species, but cause profound changes to the understory of forest habitats, which in turn affect tree snail populations (Smith *et al*, 2008; Smith, 2013). Changes of forest to *L. leucocephala* stands that forms dense thickets that crowd out native canopy trees. This transition has created a drier understory which is likely less suitable for *Partula* and *Samoana* (Hopper and Smith 1992).

Nonnative species predation. The nonnative carnivorous flatworm (*Platydemus manokwari*), predatory snails (rosy wolf snail (*Euglandina rosea* and *Gonaxis* spp.) and rats significantly threaten tree snail persistence. The carnivorous flatworm is native to New Guinea and was first observed on Guam in 1977. The rosy wolf snail is native to southeast North America and was introduced to Guam deliberately as a biocontrol for the giant African snail (*Achatina fulica*) Invasive Species Compendium 2018).

Low population numbers. The low degree of genetic heterogeneity throughout the island makes the species less resilient evolutionarily and more prone to extinction pressures. Most populations are small and are isolated from other colonies.

Stochastic events. Typhoons and disease are likely to have disproportionate effects on small populations and/or those with little to no genetic diversity

Human development. Development may threaten Partulid populations as they result in a loss, fragmentation and/or degradation of native forest habitat and the plants on which the tree snails live.

Recovery Needs
The eradication of ungulates from occupied sites, as well as sites that previously contained the Guam tree snail, will serve both to enhance conditions for populations already present and contribute to additional habitat that may become occupied.

Predation rates and sources of predation must be assessed in order to minimize their impact when possible and effectively manage Partulid snail populations on Guam. It is necessary to further characterize the impact of the flatworm, by assessing their activity patterns, habitat and dietary preferences, distribution and reproductive capacity in order to reduce predation by the nonnative species.

Comprehensive studies are needed on the basic biology of the Guam tree snail. Relatively little is known about their life history and much needs to be learned before their conservation can be effectively addressed. There is very little knowledge about basic biological requirements, reproductive output, survival rates, longevity, predation risks, activity patterns, feeding behavior, and seasonal patterns of abundance.

Additional surveys focused in locations that have not yet been adequately surveyed should be prioritized. Surveys are needed to examine locations that are isolated and physically difficult to access on Guam.

4.0 Potential Direct and Indirect Effects to Listed Species and Designated Habitat

This chapter presents an analysis of potential direct and indirect effects on federally listed species from implementation of the proposed action. Direct effects are the direct or immediate effects of the project on the species or its habitat. Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur. All direct and indirect project effects on listed species have been further classified and evaluated based on their anticipated longevity (i.e., temporary or permanent effects).

As they relate to the federally listed species and suitable habitat considered in this BA, direct and indirect effects from proposed activities within the action area have been evaluated herein based upon: (1) an understanding of the methods and equipment that would be used during construction and operation of facilities, (2) knowledge of the potential for such methods and equipment to disturb the natural resources on which the subject species depend, and (3) awareness of the types of effects that have resulted from similar actions in the past.

4.1 Potential Direct and Indirect Effects to *Cycas micronesica*

Anticipated effects to *Cycas micronesica* from the action consist of plant destruction and habitat modification. All *Cycas micronesica* within the project footprint will be taken during the construction of the munition igloos, approximately 724 individuals. The removal represents 0.14% of the population on Guam (based on an estimated 516,000 *Cycas micronesica* estimated to occur on Guam). Range wide, this loss represents 0.11% of the population for Guam and Rota. Habitat destruction, fragmentation, and degradation are of concern to the species, as is the scale infestation that impacts tree health. Past land management practices and the introduction of invasive species has contributed towards forest degradation. This holds true for the Andersen AFB MSA I and proposed project site, where historical use of the MSA I has significantly lowered the quality of habitat for *Cycas micronesica*.

As part of Andersen AFB action, a number of best management practices and conservation measures (Section 2.3 and 2.4) are provided. The Contactor Education Program (Section 2.3(1)) will prevent inadvertent damage by educating contractors on how to identify and avoid *Cycas micronesica.* Conservation measures described in Section 2.4 minimize the effects to the species survival include: pre-construction surveys, salvage, and translocation of *Cycas micronesica*. All healthy salvageable *Cycas micronesica* would be treated for Asian cycad scale and transplant them into a suitable habitat (Tarague Basin or other approved site). These steps are taken to remove scales and prevent scales from being translocated with the cycad, thereby reducing the likelihood of scales spreading to area outside of the project site. Conservation measures also include supervision of translocations by a permitted biologist.

4.2 Potential Direct and Indirect Effects on *Tabernaemonetana rotensis.*

Anticipated effects to *Tabernaemontana rotensis* from the action consist of plant destruction and habitat modification. All *T. rotensis* within the project footprint will be removed by construction activities, approximately 83 individuals. This removal represents less than one percent (0.36%) of the population on Guam. Habitat loss, fragmentation, and degradation are of concern to the species. Past land management practices and the introduction of invasive species has contributed towards forest degradation. This holds true for the Andersen AFB MSA I and proposed project site, where historical use of the MSA I has significantly lowered the quality of habitat for *T. rotensis*.

Raulerson and Rinehart (1991) found *T. rotensis* to be very edge tolerant, with preferences for open patches within limestone forests, and occurrences along forest edges. The forest in the action area is highly fragmented with sections less than 400 feet wide. *T. rotensis* trees found in the area tended to be in the forest and at the edge of clearings. Since construction of the ECM and network of roads in 1955, *T. rotensis* in the action area were able to persist in the environment. After construction more *T. rotensis* could regrow from the seedbank along the edge habitat created. However, given the abundance of ungulates in the area, seedlings may be eaten.

As part of Andersen AFB action, a number of best management practices and conservation measures (Section 2.3 and 2.4) are provided. Conservation measures described in Section 2.4 minimizes the effect to the species survival including seed collection by a permitted biologist. Plants show a high survival rate after outplanting. The Contractor Education Program (Section 2.3(1)) will prevent inadvertent damage by educating contractors on how to identify and avoid *T. rotensis*.

4.3 Potential Direct and Indirect Effects to the Mariana Fruit Bat (*Pteropus mariannus mariannus)*

Anticipated effects to the Mariana fruit bat from the action consist of sound disturbance from construction, disturbing roosting bats, and modifying recovery habitat.

Noise levels associated with the construction of the 48 new ECM would cause short-term impacts to the species. Typical construction noise stems from equipment and increased truck and vehicle access to the location. Construction of the ECMs will be done using concrete casting and heavy construction equipment. The temporary construction noise will impact the action area and in the adjacent forest. It is anticipated that Mariana fruit bats would avoid the action area and adjacent sites only during constriction because of noise disturbance. Best management practices are in place to reduce disturbance of bats during construction. Section 2.3 outlines procedures to surveys the area for Mariana fruit bats before construction. If bats are present, construction will be delayed until they have left the site. After construction, minimal noise disturbance will be from short-term operations at the MSA I.

Current Base Operation Noise

Aircraft noise has been shown to disturb fruit bats on Guam where the issue has been most well studied at Pati Point on Andersen AFB (Morton 1996; SWCA 2008; SWCA 2012). Morton

(1996) monitored fruit bat response to aircraft overflights at Pati Point when the colony numbered 400. Fruit bats exhibited increased vigilance, distress, aggression, and maintenance behaviors. Measurements of the level of aircraft noise do not appear to have been recorded. In another study, conducted from 2007 to 2008, when bat numbers dropped from 55 to 21 individuals, bats were observed to display alertness behaviors (i.e., behaviors resulting in increased energetic demands) following aircraft overflights. Six percent of all overflights caused bats to flush. Noise levels resulted in flushing measured above 106 dBC (SWCA 2008).
The most recent study on fruit bat response to aircraft overflights occurred in 2010 after Pati Point was considered an abandoned colony (SWCA 2012). Up to eight fruit bats were observed on 15 February 2011, but the site was fully abandoned prior to the end of the sampling period (21 November 2011) suggesting overnight roosting at alternate locations (SWCA 2012). During aircraft overflights, bats showed an increase in energetic demands and flushed when peak noise events were recorded at levels above 90 dBA/101 dBC (SWCA 2012). The MSA I is exposed to aircraft noise due to its proximity to the air runway.

Weather Disturbance
In the Marianas, severe storms and typhoons are a primary source of natural disturbance, in addition to volcanic eruptions and man-made disturbances. Storm impacts to fruit bats include loss of habitat, behavioral changes, and destruction of fruit trees as food sources. Though fruit bats have evolved along with periodic severe storm activity, these disturbance threats, coupled with other anthropogenic sources of disturbance puts fruit bats at greater risk of population decline (USFWS 2009).

Hunting
Fruit bats have been used as a food source in the Marianas since the arrival of humans. The hunting and consumption of fruit bats is a recognized cultural tradition of native islanders (Lemke 1992, Sheeline 1991). Commercial trade of fruit bats persisted until it was made illegal by the Convention on International Trade of Endangered Species of Wild Fauna and Flora in 1987 (CITES 2017). However, illegal hunting persists and has been identified as a contributing factor to the decline of the fruit bat population on Guam (Wiles 1987b; Wiles and Brooke 2009; USFWS 2009). For example, in 2007 during the Andersen AFB runway approach lighting construction activities northeast of the Andersen AFB runway near Pati Point, construction workers were reported poaching fruit bats from the Pati Point colony (PEER 2009).

Predation
Fruit bats have no real non-human predators; however, pups can be vulnerable to brown treesnake predation when not being carried by their mother (Wiles 1987; Wiles et al. 1995; Wiles 1983; USFWS 2009).

Recovery Habitat
All of the current *Vitex* and degraded limestone forest within the project foot print is considered fruit bat habitat that is poor quality due to past historical impacts and ongoing operations. The impact to 28.7 acres of suitable habitat represents less than 0.09% of suitable habitat lost. The overall remaining 29,279 acres of bat suitable habitat is large enough to

support the remaining population of Marianas fruit bat on Guam, and would not reduce the likelihood for recovery of the species. To date, the recovery plan for the species has not been updated to reflect the criteria for determining habitat suitability for recovery of the species. However, habitat loss and degradation is considered one of the highest threats to fruit bats on Guam.

4.4 Potential Direct and Indirect Effects to Partulid Tree Snails (*Partula gibba*, *Partula radiolata*, and *Samoana fragilis*)

Anticipated effects to Partulid snails from the action consist of forest clearing and risks associated with potential snail translocation. This construction project will clear 51 acres of forest that is in poor quality for snail habitat. Much of this vegetation is common in degraded limestone forest present across Guam. The current forest has gone through significant changes from agriculture, forest destruction from the war, and development of the MSA, thus limiting the possibilities of snails to be established in the area. Additionally, ungulates have had a significant impact on the Partulid tree snails from vegetation damage and habitat modification. Deer and pigs have been seen in the area causing damage to the already degrade forest. The action area has also been documented to have the predatory triclad flatworm, a significant threat to Partulid snails. Although these factors limit the habitat quality, the forest does have elements for snails. Therefore, the action may affect 51 acres for snails.

Risks associated with translocation include stressing the snails, contamination, and nails dying during translocation. Translocation methods described in 2.4 are established to reduce or eliminate the risks. Stress of translocation is addressed by removing snails on the vegetation they are found. Keeping snails in containers no greater than 1 hour will also reduce transportation stress. Contamination is address by using containers only designated for snail use, and handling of snails will be done by latex gloves if snail can't be removed with substrate. Translocating snails.

Surveys for Partulid tree snails were conducted near the action area with similar habitat and none were found. In 2017, the alternative site was surveyed with no results of Partulid tree snails or old shells. In 2018, threatened and endangered species surveys were conducted at a project site within the MSA related to the Marine Corps relocation program. The presence of federally listed snails were not observed during these surveys. These surveys indicated that the likelihood of Partulids found in the action area is low. As a preventative measure, prior to forest clearing, surveys for Partulid tree snails will be conducted as mentioned in Conservation Measures (section 2.4). In the unlikely event a snail is found, it will be translocated to the Tarague Basin or other approved location. Given the potential need to translocate these species, Andersen AFB has determined the project may affect and is likely to adversely affect *Partula gibba*, *Partula radiolata*, and *Samoana fragilis*.

5.0 Cumulative Effects

Cumulative effects include the effects of future State, tribal, local, or private actions that are reasonably certain to occur in the action area considered in this biological assessment. The

action area is on Federal property and actions by the State, local, commercial, or other DOD agency development will need to be coordinated through Andersen AFB. No State, local, or private actions are planned for MSA 1 that need to be analyzed as cumulative effects. Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to Section 7 of the Act.

Federal actions that are reasonably certain to occur in the action area or adjacent sites are listed below:

- 2017 Reinitiation of the 2015 Department of the Navy U.S. Marine Corps Relocation from Okinawa to Guam and Associated Activities on Guam (01EPIF00-2015-F-0025)
  The USFWS determined that the action is not likely to appreciably reduce the survival and recovery of the Mariana eight spot butterfly, *Dendrobium guamense*, *Tuberolabium gaumense*, *Tabernaemontana rotensis*, *Heritiera longipetiolata*, *Cycas micronesica*, and *Bulbophyllum guamense*, and Partulid snails. The USFWS has also determined that the action is not likely to adversely modify designated Mariana fruit bat critical habitat. Conservation measures to benefit these species are adjacent to the MSA.

- December 2017Aerial Application of Acetaminophen for Brown Treesnake in the Habitat Management Unit BA. The DOD determined that the action may affect, not likely to adversely affect *Cycas micronesica*, *Bulbophyllum guamense*, *Tabernaemontana rotensis*, *Tuberolabium guamense*, *Partula gibba*, and *Partula radiolata*, *Samoana fragilis*. DOD determined that the action is likely to adversely affect *Pteropus mariannus mariannus*.
- Intelligence, Surveillance, Reconnaissance, and Strike Capability (ISR/Strike) BO. Increased air traffic disturbance to the Mariana fruit bat colony at Pati Point. An ungulate exclosure and habitat improvements are planned as mitigation projects.

6.0 Conclusion

Andersen AFB is presenting effects determinations for USFWS concurrence for species included in this consultation. Based on surveys conducted within the project area and assessment of potential impacts, Andersen AFB concludes that the action is **likely to adversely affect** the Guam cycad (*Cycas micronesica*), *Taberneamontana rotensis*, and Partulid snails. However, best management practices and conservation measures are planned to minimize the effects to these species.

Cycas micronesica

The action is likely to adversely affect *Cycas micronesica* because all individuals, approximately 715, would be subject to removal during the construction of the earth covered magazines. The individuals removed represent 0.13 % of the known population on Guam and ~0.08% of the known population throughout the species range.

All conservation measures and BMP associated with the action would reduce potential adverse effects. Measures including translocation, propagation of pups, and out-planting will reduce the effects of lost plants. The amount of cycads salvaged will be dependent on the health of the

plant and whether or not it will survive transplantation. A 50% survivorship of the total number of plants salvaged is expected after one year of maintenance and monitoring. The project will result in a loss of habitat; however, the forest has been severely impacted in the past, and is considered degraded under existing conditions. Historical vegetation clearing and fragmentation has adversely impacted habitat at the project location.

Taberneamontana rotensis

The action is likely to adversely affect *Taberneamontana rotensis* because all individuals, approximately 83, would be subject to removal through the construction of earth covered magazines. The individuals removed represent 0.36% of the known population on Guam and 0.37% through the known species range.

All conservation measures and best management practices associated with the action including translocation, propagation and out-planting will reduce potential adverse effects. A permitted biologist will collect a commensurate number of seeds as *T. rotensis* impacted but the exact number of seeds is dependent on the availability and viability of the seeds. A 50% survivorship of propagated seeds is expected after one year of maintenance and monitoring. Although a portion of the forest habitat will be lost, the existing habitat is degraded, and is therefore less valuable than pristine habitat for recovery of the species.

***Partulid* Snail Species**

The proposed action is likely to adversely affect 51 acres of vegetation for the Partulid tree snails (*Partula gibba, Partula radiolata, and Samoana fragilis*) through the construction of ECM. No live or bleached Partulid shells were observed in the alternative site. Vegetation removal will be minimized to the greatest extent practicable to prevent habitat loss. Before construction of the ECM, snail surveys will be conducted in the action area as identified in the Conservation Measures. If preconstruction surveys identify Partulid snails, they would be translocated to Tarague Basin or other approved location.

6.1 Species that the Action "May Affect, Not Likely to Adversely Affect"

Mariana Fruit Bat (*Pteropus mariannus mariannus)*

Fruit bats use the proposed project area in small numbers. Habitat quality is low due to historic land use practices, and is degraded from current, ongoing mission-related activity and noise associated with MSA operations. The wide spread occurrence of invasive species has also contributed to reduced habitat quality. Due to the low quality of habitat and the relatively small size of the project area, the project is not expected to be of high importance for fruit bat sustainability and recovery. Facility construction is projected between 2019 and 2022. Construction will be done in phases with clearing and site preparation starting first followed by assemblage of the structures. Once construction is complete, noise and activity at the project area is expected to return to current ambient conditions. Construction noise is expected to be less than noise associated with some aircraft use in the area.

Fruit bats in areas adjacent to the project site are subject to aircraft overflights, ongoing MSA

operations, and construction projects related to the USMC buildup (01EPIF00-2015-F-0025; 01EPIF00-2016-F-0185). Therefore, Andersen AFB believes the short-term construction disturbance is proportionate with surrounding ambient conditions. Based on these effects, the action **may affect, but not likely to adversely affect** the Mariana fruit bat.

Guam Rail (*Gallirallus owstoni*)

There are approximately 49,584 acres of Guam rail recovery habitat mapped by the USFWS, including 24,655 acres of rail recovery habitat on northern Guam. Construction of the new ECMs would change the dominant limestone and *Vitex* forest to managed grassland and edge habitat near the fragmented forest, a favorable habitat for the species (USFWS 2015a). The current area holds 22.6 acres of suitable habitat for the rail. After construction, grassy buffer areas around the ECM will be created totaling 21.7 acres. The total loss of rail suitable habitat will be 0.9 acres following construction. The impact to less than one acre of suitable habitat would not preclude recovery of the species, as the overall remaining suitable habitat is large enough to support a population of Guam rails.

Although the action will cause an immediate loss of suitable habitat, the rail is currently extirpated from the wild on Guam and the off island populations would not encounter impacts from the action. The opportunity of reintroduction of these extirpated species on Guam is uncertain, and is primarily dependent on eradication or suppression of the brown treesnake population. There is no projected date for reintroduction on Andersen AFB or suppression of the brown treesnake to support reintroduction. Until the rail is successfully reintroduced, no impacts are anticipated from construction and operational activities. Based on these effects, the action **may affect, but not likely to adversely affect** the Guam rail.

Mariana Crow (*Corvus kubaryi*)

There are approximately 24,919 acres of crow recovery habitat on Guam, including 13,962 acres in northern Guam. A total of 23.9 acres (0.09%) of crow habitat island-wide would be cleared as a direct result of the action. In northern Guam, 0.17% of this habitat will be impacted by the prosed action. After implementation of this project, there will be 24,895 acres of habitat island-wide, including 13,938 acres of habitat in northern Guam. The impact to 23.9 acres of habitat would not preclude recovery of the species, as the overall remaining habitat is large enough to support a population of Marianas crow in the northern section of Guam.

The opportunity for reintroduction of this extirpated species on Guam is uncertain at this time, and is primarily dependent on the eradication or significant suppression of the brown treesnake. Currently, there is neither a plan nor projected dates for reintroduction of the Mariana crow on Guam. The loss of habitat does not impact the continued survival of the species as it doesn't currently survive in the wild on Guam. Based on the potential effects to the Mariana crow from habitat loss due to construction, implementation of the action **may affect, but not likely to adversely affect** the Mariana crow.

7.0 Literature Cited

Andersen Air Force Base. 36th Wing & Mission Priorities. Accessed: July 2017, Updated April 2016. < http://www.andersen.af.mil/>

Brooke, A. (2008). Mariana Fruit Bat Surveys on Navy Properties, Guam. NAVFAC Marianas, Environmental, Guam. December

Cardno. 2017. Natural Resources Survey Report in support of the Environmental Assessment of Proposed Munitions Storage Igloo Construction, Andersen Air Force Base, Guam. Contract: Contract N62742-11-D-1801

Donnegan, A. Joesph., Butler, Sarah., Grabowiecki, Walter. et al. 2002. Guam's Forest Resources. United States Forest Service. Portland, OR.

Department of Defense (DOD). 2018. Draft Environmental Assessment: Munitions Storage Igloos, Andersen Air Force Base, 36th Wing, Guam.

Department of the Navy (DON). 2018. Final Technical Report: Cultural Resources Investigations Within the Munitions Storage Area, Andersen Air Force Base, Yigo, Guam. Prepared for: Naval Facilities Engineering Command Pacific. Contract Number: N62742-14-R-1888 TEC-AECOM JV. January 2018.

DON. 2017. Revised Biological Assessment for the Marine Corps Relocation from Okinawa to Guam. Prepared for: U.S. Fish & Wildlife Service, Pacific Islands Fish and Wildlife Office (Honolulu, Hawaii). Prepared for: Naval Facilities Engineering Command Pacific. Contract Number N62742-14-D-1863 CTO 0023. March 2017.

DON. 2018. Monitoring Mariana Fruit Bats on Andersen Air Force Base, 2017-2018. Prepared for NAVFAC Marianas, Guam Tammy Mildenstein, university of Guam, under Cooperative Agreement Number N40192-15-2-8001.

DON. 2016. Monitoring Mariana fruit bats on Andersen Air Force Base. Prepared under Cooperative Agreement Number N40192-15-2-8001.

Government of Guam, U.S. Air Force, U.S. Navy, and USFWS. 1993. Memorandum of Understanding among the Government of Guam and the U.S. Air Force and the U.S. Navy and the U.S. Fish and Wildlife Service for the Establishment and Management of the Guam National Wildlife Refuge, Guam. 1993.

Invasive Species Compendium.2018. Euglandina rosea. Published on 2018 July. At https://www.cabi.org/ISC/about

Kroner, A. 2014. Mariana crow pair estimate report, 2013-2014. Report to USFWS. University of

Washington, Seattle, Washington.

Lindstrom, D. and J. Benedict. 2014. Federal Candidate Species Surveys on Guam. University of Guam (UOG). Coperative Agreement N40192-12-2-8001.

Marler, Thomas. 2012. Cycad Removal and Transplanting Andersen Air Force Base, Guam. Contract number: N40192-12-P-5001

SWCA. 2012. Mariana Fruit Bat and Mariana Crow Noise Study and Demographic Survey, Andersen AFB, Guam. January 2012.

U.S. Fish and Wildlife Service (USFWS). 1990. Native Forest Bird of Guam and Rota of the Commonwealth of the Northern Mariana Islands Recovery Plan. U.S. Fish and Wildlife Service, Portland, OR

U.S. Fish and Wildlife Service. 2004. Endangered and threatened wildlife; Designation of critical habitat for the Mariana fruit bat and Guam Micronesian kingfisher and the Mariana crow on Guam and in the Commonwealth of the Northern Mariana Islands; Federal Register 69:62943-62990. October 28, 2004.

U.S. Fish and Wildlife Service. 2009. Draft Revised Recovery Plan for the Mariana Fruit Bat or Fanihi (*Pteropus mariannus mariannus*). U.S. Fish and Wildlife Service, Portland, Oregon. xiv + 83 pp.

U.S. Fish and Wildlife Service. 2017. Reinitiation of the 2015 Biological Opinion on the Department of the Navy's Relocation of U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam. Pacific Islands Fish and Wildlife Office, Honolulu.

U.S. Fish and Wildlife Service. 2015. Biological Opinion for the Department of Navy's Relocation of the U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam. Pacific Islands Fish and Wildlife Office, Honolulu.

USFWS to the Department of the Navy. 2015a. Endangered and Threatened Wildlife and Plants; Endangered Status for 16 Species and Threatened Status for 7 Species in Micronesia; Final Rule. Federal Register, 80, 190.

USFWS to the Department of the Navy. 2015b. Modification to Memorandum of Agreement Between the Department of the Navy and the U.S. fish and Wildlife Service Designation of Alternative Configuration for Guam the Micronesian Kingfisher Recovery Habitat in Northern Guam. Washington DC: Department of Defense.

U.S. Navy. 2013. Final Integrated Natural Resources Management Plan for Joint Region Marianas. Prepared under contract N40192-10-R-9915. December 2013.

University of Guam (UoG). 2017. Plant Surveys, Joint Region Marianas Munitions Storage Area Survey. Contract No. N4192-14-2-8002.

Raulerson, L. and Rinehart, A. 1991. Trees and Shrubs of the Northern Marianas Island. Saipan: Coastal Resources Management Office of the Governor, Commonwealth of the Northern Marianas Island.

Appendix D
National Historic Preservation Act Section 106 Documentation

This page intentionally left blank.

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS 36TH WING (PACAF)
ANDERSEN AIR FORCE BASE GUAM

17 April 2018

36 Civil Engineer Squadron
Environmental Flight
Unit 14007
APO AP 96543-4007

RECEIVED
4:45 pm
APR 17 2018
GUAM HISTORIC RESOURCES DIVISION

Ms. Lynda Bordallo Aguon
State Historic Preservation Officer (SHPO)
Guam Historic Resources Division
Department of Parks and Recreation
490 Chalan Palasyo
Agaña Heights, Guam 96910

Subject: Section 106 Consultation—**Construct Forty-Eight Hayman Igloos within MSA-1** at Andersen Air Force Base, Guam, **RCS 18-5001**

Dear Ms. Aguon:

Andersen Air Force Base (AAFB) requests your review of a proposed project for the construction of forty-eight storage igloos within the Munitions Storage Area 1 (MSA-1) on Andersen Air Force Base (AAFB) [see Attachment 1]. Pursuant to Section 106 of the National Historic Preservation Act (NHPA), we have reviewed the proposed project scope and determined it is an undertaking as defined in 36 CFR 800.16(y).

Project Location and Description:

The igloos are to be located along 5th, 6th, 7th and 8th Streets in MSA 1 (see Attachment 2). They will be constructed with precast vertical concrete walls, reinforced concrete floor and roof slabs, and will measure approximately 25 feet wide and 81 feet long. The walls and roof are designed to be covered in a minimum of 24 inches of fill with a topping of shotcrete to prevent plant growth and erosion. Each new igloo would have approximately 2,025 square feet (ft^2) of floor space.

A paved apron between an adjacent road and the access doors would be required for each igloo. Each apron would consist of two separate elements: an asphaltic concrete transition approximately 26.5-feet deep and 127-feet wide and a Portland cement concrete apron centered on the entrance doors measuring approximately 24-feet deep and 26-feet wide. Approximately 8000 linear feet of new utility lines will be undergrounded in a trench 2 feet wide by 3 feet deep along the edge of the existing roadways and these will connect at the front of each igloo (see Attachment 3).

Area of Potential Effect:

The Area of Potential Effect (APE) for this project shows as the area within the gray dotted line in Attachment 2.

Identification of Historic Properties:

Archaeology:

The project is located in the munitions storage area of AAFB. The APE was partially surveyed by PHRI (DeFant and Leon Guerrero 2006), and was entirely surveyed by TEC-AECOM (Dixon et al. 2018). Five sites fall within the APE (see Attachment 2). Two sites, 66-08-2100 and 66-08-2103 were assessed as ineligible to the National Register of Historic Places (NRHP). Three sites were assessed as eligible: 66-08-2101, 66-08-2102 and 66-08-2922. These sites are the drivers for the mitigation actions discussed in the Determination of Project Effects section, below.

Site 66-08-2101 is a prehistoric sherd scatter identified along the margins of a cleared area approximately 70 m west of 7th Street and 75 m north of D Avenue. Three shovel tests were excavated in the site, two of which contained sherds, charcoal and shell fragments.

Site 66-08-2102 is a very small, yet relatively dense, scatter of prehistoric ceramics situated 30 m east of 6th Street and 300 m north of C Avenue. This site is located in a clearing just on the edge of dense vegetation. A shovel test in the site contained charcoal fragments, shell fragments and two sherds.

Site 66-08-2922 is a small Latte Period artifact scatter including prehistoric ceramics, fragments of a ground pumice tool and a broken *Tridacna* shell adze. A human bone fragment was also recovered from the site. Excavations revealed a low density, low diversity ceramic assemblage and a small refuse deposit.

Built Environment:

MSA-1 was assessed by an architectural historian and there are no eligible historic structures within the APE (Dixon et al. 2018).

Determination of Project Effect:

On 30 January 2018 Richard Olmo, Andersen Air Force Base Cultural Resources Manager met with State Archaeologist John Mark Joseph at the Historic Resources Division to discuss project impacts. As a result of this meeting and in a follow-up telephone conversation Mr. Joseph proposed that if we treated the sites in the following ways, we would achieve a finding of **No Adverse Effect** for the project.

Site 66-08-2103 (ineligible) will be "subject to inadvertent discovery" during the construction process. This follows the provisions of the *Final Integrated Cultural Resource Management Plan for Andersen AFB* (ICRMP) [SEARCH, 2015] and those of 36 CFR 800.13 Post Review Discovery.

The close proximity of the ineligible site 66-08-2100 and the eligible sites 66-08-2101 and 66-08-2922 suggests that these are portions of a single site that was disrupted during WWII construction. Sites 66-08-2100, 66-08-2101 and 66-08-2922 will have adverse effects mitigated through avoidance by

Under the Privacy Act of 1974, you must safeguard all information, if required, reflected on this document and, if applicable, all attachments. Disclosure of information is IAW AFI 33-119, AFI 33-127, AFI 33-129, DoD 5400. 7-R/Air Force Supplement (Freedom of Information Act), AFI 33-332 (Privacy Act), AFI 33-219, and PL 93-579.

removing the igloo that coincides with that location and by altering the path of the proposed utility lines.

Site 66-08-2102, which falls under the footprint of three igloos will have adverse effects mitigated through archaeological data recovery. A data recovery plan shall be submitted to SHPO for approval, and the work executed prior to the onset of construction.

Human remains encountered during these excavations or in association with any of the project's construction activities will trigger ICRMP Standard Operating Procedures and Guam law, and require further consultation with the SHPO.

As noted above, mitigation actions outlined above are stipulated for this project. Consequently, Andersen Air Force Base determines that there will be **"no adverse effect"** by the proposed undertaking. Andersen Air Force Base respectfully requests concurrence from Guam SHPO with this determination. In accordance with 36 CFR 800.5(c) (1), if we receive no response from your office within 30 days of receipt of this letter we will assume no objections to the determination of project effect and site eligibility.

If archaeological resources are inadvertently discovered during ground-disturbing activities, then the Standard Operating Procedures contained with the *Final Integrated Cultural Resource Management Plan for Andersen AFB* (SEARCH, 2015) will be followed as well as the provisions of 36 CFR 800.13 Post Review Discovery.

We value your support in our efforts to continue carrying out the United States Air Force's responsibility regarding the management of its cultural resources. Should you have any questions or require additional information about this proposed project, please feel free to contact me via phone at (671) 366-1019 or e-mail at richard.olmo@us.af.mil.

Sincerely,

Richard K. Olmo
Archaeologist/CRM AAFB
Conservation Resources
Environmental Flight

Attachments:
1. Igloos sites Topo
2. Igloos Air Photo
3. Igloos Utilities

Under the Privacy Act of 1974, you must safeguard all information, if required, reflected on this document and, if applicable, all attachments. Disclosure of information is IAW AFI 33-119, AFI 33-127, AFI 33-129, DoD 5400. 7-R/Air Force Supplement (Freedom of Information Act), AFI 33-332 (Privacy Act), AFI 33-219, and PL 93-579.

REFERENCES

DeFant, David and Lynn Leon Guerrero

2006 Archaeological Survey of Seven Parcels within the Munitions Storage Area, Andersen Air Force Base, Island of Guam. PHRI, Hilo.

Dixon, Boyd, Trina Meiser, Robert Jones and Isla Nelson

2018 Final Technical Report: Cultural Resources Investigations Within the Munitions Storage Area, Andersen Air Force Base, Yigo, Guam. Prepared by TEC-AECOM JV for NAVFAC Pacific

SEARCH

2015 *Integrated Cultural Resources Management Plan for Andersen Air Force Base, Joint Region Marianas*. Prepared for NAVFAC Marianas.

Under the Privacy Act of 1974, you must safeguard all information, if required, reflected on this document and, if applicable, all attachments. Disclosure of information is IAW AFI 33-119, AFI 33-127, AFI 33-129, DoD 5400. 7-R/Air Force Supplement (Freedom of Information Act), AFI 33-332 (Privacy Act), AFI 33-219, and PL 93-579.

Eddie B. Calvo
Governor
Ray Tenorio
Lt. Governor

Department of Parks and Recreation
Government of Guam
490 Chalan Palasyo, Agana Heights, Guam 96910
Director's Office: (671) 475-6288
Parks Division: (671) 475-6291
Guam Historic Resources Division: (671) 475-6294/5
Facsimile: (671) 477-2822

William N. Reyes
Director
John P. Taitano
Deputy Director

In reply refer to:
RC 2018-0610

May 3, 2018

Richard K. Olmo
Archaeologist/ CRM AAFB
36 Civil Engineers Squadron
Conservation Resources
Unit 14007
APO AP 96543-4007

Subject: Section 106 Review
Undertaking: Construct Forty-Eight Hayman Igloos Within MSA-1, Andersen Air Force Base, Guam (RCS 18-5001)

Dear Mr. Olmo,

We have reviewed your Section 106 request on the subject undertaking and agree that Guam Historic Properties Inventory sites 66-08-2101, 66-08-2102, and 66-08-2922 are eligible for the National Register of Historic Places. We look forward to reviewing the draft archaeological data recovery plan. With an approved archaeological data recovery plan in place we will concur with the determination of "No Adverse Effect" and the provisions set forth for inadvertent discoveries.

Please do not hesitate to contact our office should you have any questions.

Sincerely,

William N. Reyes
Director

Lynda Bordallo Aguon
State Historic Preservation Officer

Appendix E
Coastal Zone Management Act Correspondence

[To Be Provided in Final EA]

This page intentionally left blank.

Appendix F
Munitions Storage Area Plant Survey Report

This page intentionally left blank.

Final

Natural Resources Survey Report in Support of the Environmental Assessment for Proposed Munitions Storage Igloo Construction, Andersen Air Force Base, Guam

Prepared for:

Department of the Navy
Naval Facilities Engineering Command, Pacific
Joint Base Pearl Harbor-Hickam HI

Prepared by:

Honolulu HI

Prepared under: Contract N62742-11-D-1801, Task Order 0025

February 2017

This page intentionally left blank.

EXECUTIVE SUMMARY

Cardno biologists conducted surveys for species listed under the U.S. Endangered Species Act (ESA), Guam ESA, and Migratory Bird Treaty Act (MBTA) within the Munitions Storage Area (MSA) on Andersen Air Force Base (AAFB), Guam during December 12-16, 2016. These surveys were conducted in support of the Environmental Assessment (EA) for Proposed Munitions Storage Igloo Construction at AAFB. Per the Statement of Work, target species included Federal and Guam ESA-listed reptiles and tree snails, Federal ESA-listed butterflies, associated tree snail and butterfly host plants, and birds listed under the MBTA.

A team of three Cardno biologists conducted pedestrian surveys along a predetermined transect grid throughout all potential habitat for the target species in the project area. Since the MSA is characterized by patches of open, regularly mowed land alongside roads and wrapping around the circumference of munitions storage igloos, two general types of searches were employed during this project. The first set of surveys concentrated on the forested areas, and the second set focused on the surfaces of igloo structures.

Within the surveyed forested areas, there were only a few small isolated patches of tower karst containing native limestone forest habitat. The vast majority of the survey area, including the vegetated portions, consisted of flat, highly disturbed, closed-canopy degraded limestone forest with an open understory, with evidence of severe ungulate damage throughout.

The endemic Micronesian cycad (*Cycas micronesica*) was the only Federal and Guam ESA-listed species observed in the survey area. *Maytenus thompsonii*, the host plant for the Federal ESA-listed Mariana wandering butterfly (*Vagrans egistina*), was also observed throughout the survey area. No host plants for the Federal ESA-listed Mariana eight-spot butterfly (*Hypolimnas octocula marianensis*) were observed within the survey area. Although numerous host plants for ESA-listed tree snails were observed, no ESA-listed tree snails were observed.

Three species of birds protected under the MBTA were observed: Pacific golden plover (*Pluvialis fulva*), Pacific reef heron (*Egretta sacra*), and yellow bittern (*Ixobrychus sinensis*). However, all were transient and no birds were observed nesting within the survey area.

Results of these surveys will be incorporated in the EA to support the evaluation of potential environmental impacts of the proposed action on biological resources. If applicable, results will also be incorporated into a Biological Assessment prepared in support of ESA section 7 consultation and will be used to develop measures to avoid, minimize, or mitigate potential impacts to ESA-listed species.

This page intentionally left blank.

Final
Natural Resources Survey Report in Support of the Environmental Assessment for Proposed Munitions Storage Igloo Construction, Andersen Air Force Base, Guam

Table of Contents

EXECUTIVE SUMMARY 1

ACRONYMS AND ABBREVIATIONS iii

CHAPTER 1 INTRODUCTION 1-1

1.1 Overview 1-1
1.2 Natural Resources Team 1-1
1.3 Location 1-1

CHAPTER 2 VEGETATION COMMUNITIES AND TARGET SPECIES 2-1

2.1 Vegetation Communities 2-1
2.2 Overview of Target Species 2-3
2.2.1 Birds 2-4
2.2.1.1 Micronesian Starling 2-4
2.2.1.2 Migratory Birds 2-4
2.2.2 Reptiles 2-4
2.2.2.1 Azure-tailed Skink 2-4
2.2.2.2 Slevin's Skink 2-4
2.2.2.3 Moth Skink 2-4
2.2.2.4 Pacific Slender-toed Gecko 2-4
2.2.2.5 Micronesian Gecko 2-5
2.2.3 Tree Snails 2-5
2.2.3.1 Humped Tree Snail 2-5
2.2.3.2 Guam Tree Snail 2-5
2.2.3.3 Fragile Tree Snail 2-5
2.2.4 Butterflies 2-5
2.2.4.1 Mariana Eight-spot Butterfly 2-5
2.2.4.2 Mariana Wandering Butterfly 2-6

CHAPTER 3 METHODS 3-1

3.1 Survey Area 3-1
3.2 Survey Descriptions 3-1
3.2.1 Vegetated Area Surveys 3-1
3.2.2 Munitions Storage Igloo Surface Surveys 3-3

CHAPTER 4 RESULTS 4-1

4.1 Birds 4-1
4.2 Reptiles 4-3
4.3 Tree Snails 4-3
4.4 Butterflies 4-5

CHAPTER 5 DISCUSSION.....5-1

CHAPTER 6 REFERENCES.....6-1

CHAPTER 7 LIST OF PREPARERS.....7-1

List of Figures

Figure 1-1. Location of Guam in the Western Pacific Region and the Mariana Islands.....1-2
Figure 1-2. Project Area within the MSA, AAFB.....1-3
Figure 2-1. Vegetation Communities within the Project Area.....2-1
Figure 2-2. Project Area with Visible Remnants of Past Limestone Grading.....2-2
Figure 2-3. Small Patch of Tower Karst Located within the Project Area.....2-2
Figure 3-1. Survey Transect Grid Overlain on the Project Area.....3-2
Figure 4-1. GPS Tracks of Survey Coverage within the Project Area.....4-2
Figure 4-2. Skinks Observed within the Project Area: (a) Curious Skink and (b) Pacific Blue-tailed Skink. (c) Skink Eggs.....4-3
Figure 4-3. Geckos Observed within the Project Area on Munition Igloos: (a) Mourning Gecko (b) House Gecko (c) Eggs within an Adult Gecko (delineated by green arrow).....4-3
Figure 4-4. Non-Native Invertebrates Observed in the Project Area: (a) *Satsuma* sp.; (b) Lined Tree Snail; (c) *Platydemus manokwari;* and (d) Giant African Snail.....4-4
Figure 4-5. Locations of *Maytenus thompsonii* within and Adjacent to the Project Area.....4-6

List of Tables

Table 1-2. Natural Resources Team.....1-1
Table 2-1. Target Species for Biological Surveys Conducted in the MSA.....2-3
Table 4-1. Summary of Observed Target Tree Snail Host Plant Species by Transect.....4-4
Table 4-2. Summary of Observed Target Butterfly Host Plant Species by Transect.....4-5
Table 4-3. Locations of *Maytenus thompsonii* Observed throughout the Project Area.....4-7

Appendices

Appendix A: *Maytenus thompsonii* (MATH) Photo Log

ACRONYMS AND ABBREVIATIONS

AAFB	Andersen Air Force Base
ac	acre(s)
DAWR	Division of Aquatic and Wildlife Resources
EA	Environmental Assessment
ESA	Endangered Species Act
ft	foot/feet
GovGuam	Government of Guam
GPS	Global Positioning System
ha	hectare(s)
km	kilometer(s)
m	meter(s)
mi	mile(s)
MATH	*Maytenus thompsonii*
MBTA	Migratory Bird Treaty Act
MSA	Munitions Storage Area
NAVFAC	Naval Facilities Engineering Command
U.S.	United States
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGS	U.S. Geological Survey

This page intentionally left blank.

CHAPTER 1
INTRODUCTION

1.1 Overview

An Environmental Assessment (EA) is being prepared to assess the potential impacts from the proposed construction of munitions storage igloos at Andersen Air Force Base (AAFB), Guam. The proposed action includes the demolition of existing igloos and construction of 48 Hayman-style munitions storage igloos within the Munitions Storage Area (MSA). This report provides the results of biological surveys within the project area which will be incorporated into the EA to support the evaluation of potential environmental impacts of the proposed action on biological resources. If applicable, results will also be incorporated into a Biological Assessment prepared in support of Federal Endangered Species Act (ESA) section 7 consultation and will be used to develop measures to avoid, minimize, or mitigate potential impacts to ESA-listed species.

In accordance with the September 26, 2016 Statement of Work for Task Order 0025 (Naval Facilities Engineering Command [NAVFAC] Pacific 2016), the TEC-AECOM Joint Venture[1] team completed terrestrial biological resource surveys within the MSA on AAFB. Project tasks are as follows:

- Prepare a survey plan.
- Conduct surveys for butterflies, reptiles, and tree snails listed under the Federal ESA, Guam ESA, and Migratory Bird Treaty Act (MBTA), and host plant communities for ESA-listed butterflies and tree snails.
- Prepare a survey report (this document).

1.2 Natural Resources Team

The personnel involved in performing the project tasks are listed in Table 1-2. One subcontractor (Duenas, Camacho & Associates, Inc. [DCA]) assisted Cardno in the surveys.

Table 1-2. Natural Resources Team

Role	*Name*	*Organization*
Program Director	John Ford	Cardno
Project Manager	Peer Amble	Cardno
Quality Control	Rick Spaulding	Cardno
Survey Personnel	Brenden Holland, Lorraine Shaughnessy Claudine Camacho	Cardno DCA

1.3 Location

Guam is the largest and southernmost island within the Mariana Islands archipelago, approximately 1,550 miles (mi) (2,495 kilometers [km]) south of Japan and 1,620 mi (2,607 km) east of the Philippines (Figure 1-1). AAFB is located on the northeastern portion of Guam's limestone plateau and occupies approximately 15,360 acres (ac) (6,216 hectares [ha]). The MSA is located in the northwestern region of AAFB and occupies approximately 1,280 ac (518 ha). The project area for the proposed action is a 49-ac (20-ha) parcel located along the central eastern edge of the MSA (Figure 1-2).

[1]The TEC-AECOM Joint Venture is a contractual partnership between AECOM and Cardno, formerly TEC, Inc.

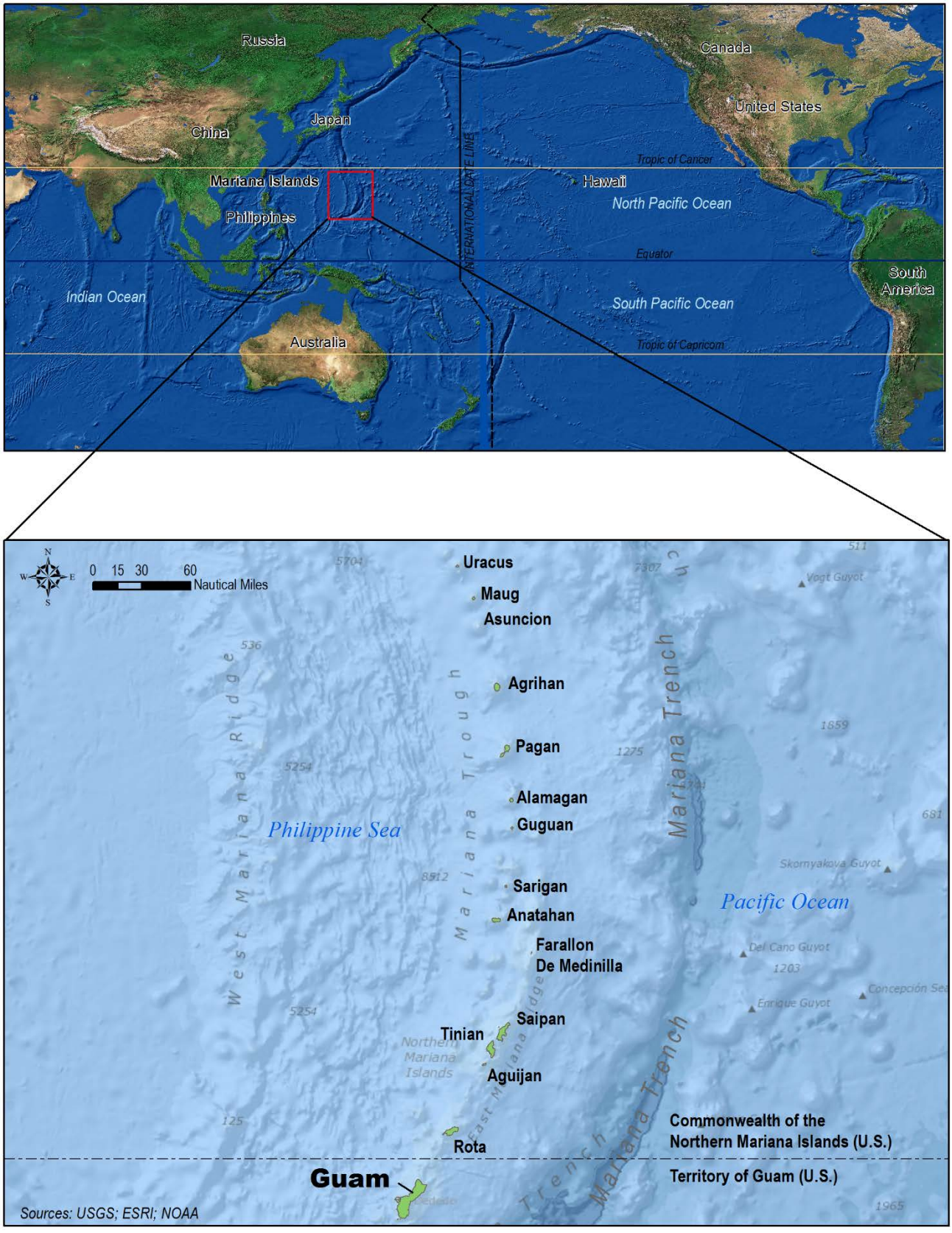


Figure 1-1. Location of Guam in the Western Pacific Region and the Mariana Islands



Figure 1-2. Project Area within the MSA, AAFB

This page intentionally left blank.

CHAPTER 2
VEGETATION COMMUNITIES AND TARGET SPECIES

2.1 Vegetation Communities

The MSA is located at the edge of the northern Guam limestone plateau. The original native limestone vegetation was largely composed of *Artocarpus marianensis*, *Pandanus* spp., and *Ficus* spp. among others. Historically, the plateau has been impacted by extensive agricultural and military use, which began in the early 1800s, continued during World War II, and continues today (Mueller-Dombois and Fosberg 1998). Vegetation mapping was conducted on AAFB lands in 2015 relying on a combination of desktop mapping, aerial imagery, and ground-truthing efforts (NAVFAC Marianas 2016). Based on this recent vegetation mapping, the project area is composed of 10.4 ac (4.2 ha) of *Vitex* forest and 38.9 ac (15.7 ha) of developed land (Figure 2-1).

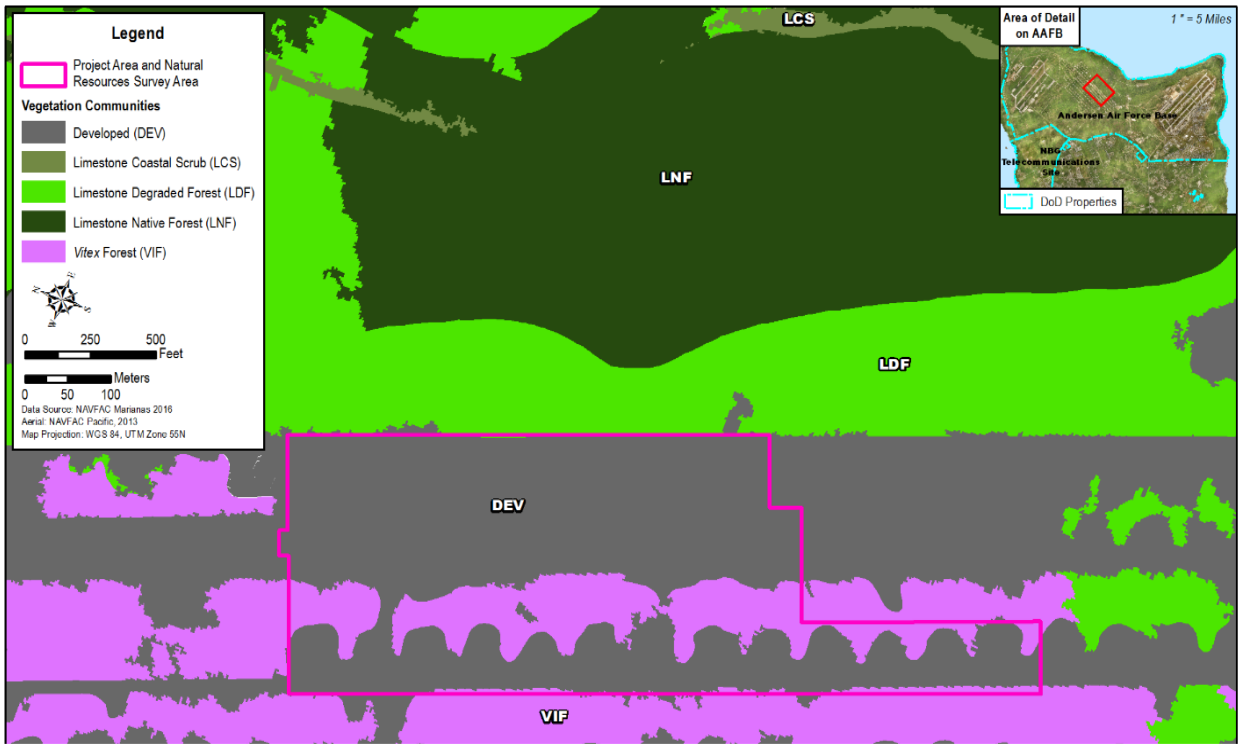


Figure 2-1. Vegetation Communities within the Project Area

Much of the land in the current project area is visibly graded (Figure 2-2). This disturbance to the limestone forest, in addition to continued ungulate activity that prevents recruitment and recovery of native flora, is what presumably allowed the non-native *Vitex parviflora* to overtake the canopy. However, a few small isolated patches of tower karst still exist within the project area (Figure 2-3). Despite considerable disturbance, some native flora such as *Ficus* spp., *Ochrosia oppositifolia,* and *Premna obtusifolia* persist. Within the larger strips of forested habitat there is closed canopy dominated by *Guamia mariannae*, although little or no understory and recruitment of new plants were observed. Throughout the forested areas there was fresh sign of ungulate activity, including Philippine deer (*Rusa marianna*) and feral pig (*Sus scrofa*) scat, and several small herds of deer were observed during the surveys.



Figure 2-2. Project Area with Visible Remnants of Past Limestone Grading



Figure 2-3. Small Patch of Tower Karst Located within the Project Area

2.2 Overview of Target Species

Natural resources surveys were conducted to detect the presence of species listed as endangered, threatened, proposed for listing, or a candidate for Federal ESA listing, as well as Guam-listed species. Species that had the potential to be detected during surveys are listed in Table 2-1, followed by detailed descriptions below. In addition, migratory birds protected under MBTA also have the potential to occur in the project area. Known host plants for ESA-listed tree snails and butterflies were also documented.

Table 2-1. Target Species for Biological Surveys Conducted in the MSA

*Common Name/ Chamorro Name**	*Scientific Name*	*Federal Status*[(a)]	*GovGuam Status*[(b)]	*Status of Guam Population*[(a, c)]	*Habitat*
Birds					
Micronesian starling/Såli	*Aplonis opaca*	--	E	Primarily occurs in urban areas and Cocos Island.	Cavity nester; all habitats but prefers forest.[(c)]
Reptiles					
Azure-tailed skink/ Guali'ek halom tåno'	*Emoia cyanura*	--	E	Extirpated	Dry open areas along the coast.[(c)]
Slevin's skink/ Guali'ek halom tåno'	*Emoia slevini*	E	E	Extirpated; only found on Cocos Island.	Forested areas.[(a)]
Moth skink/ Guali'ek kanton tåsi	*Lipinia noctua*	--	E	Very rare	Native limestone forest.[(c)]
Pacific slender-toed gecko/Guali'ek	*Nactus pelagicus*	--	E	Very rare	Forest edge.[(c)]
Micronesian gecko/ Guali'ek	*Perochirus ateles*	--	E	Extirpated	Native limestone and *Cocos* forests.[(c)]
Invertebrates					
Humped tree snail/Akaleha	*Partula gibba*	E	E	Very rare	Coastal backstrand limestone forest.[(a, d)]
Guam tree snail/Akaleha	*Partula radiolata*	E	E	Very rare	Coastal backstrand limestone forest.[(a, d)]
Fragile tree snail/Akaleha	*Samoana fragilis*	E	E	Very rare	Coastal backstrand limestone forest.[(a, d)]
Mariana eight-spot butterfly/Ababbang	*Hypolimnas octocula marianensis*	E	--	Very rare	Coastal backstrand limestone forest.[(a, d)]
Mariana wandering butterfly/Ababbang	*Vagrans egistina*	E	--	Extirpated	Native limestone forest.[(a, d)]
Butterfly Host Plants					
None/Tapun ayuyu	*Elatostema calcareum*	--	--	Uncommon	Coastal backstrand limestone forest.[(a, d)]
None/Lulujut	*Maytenus thompsonii*	--	--	Common	Native limestone forest.[(a)]
None/None	*Procris pedunculata*[(b)]	--	--	Uncommon	Coastal backstrand limestone forest.[(a, d)]

Notes: *Chamorro names are from U.S. Fish and Wildlife Service (USFWS) (2015) and Government of Guam (GovGuam) (2009); [(a)]USFWS 2015; [(b)]GovGuam 2009; [(c)]Guam DAWR 2015; [(d)]NAVFAC Marianas 2015

2.2.1 Birds

The avifauna on Guam was significantly impacted after the introduction of the brown tree snake (*Boiga irregularis*) in the 1940s (Fritts and Rodda 1998; Wiles et al. 2003). The four remaining native species on the island include Micronesian starling and yellow bittern (*Ixobrychus sinensis*), and the Federally and Guam ESA-listed endangered Mariana swiftlet (*Aerodramus bartschi*) and Mariana common moorhen (*Gallinula chloropus guami*). Of these species, the Micronesian starling and the yellow bittern are found on AAFB.

2.2.1.1 Micronesian Starling

Micronesian starlings are social birds and are often found in groups. They build nests in the cavities of trees, limestone cliffs, and man-made structures (Vogt and Williams 2004). Their decline in the forest is a result of the introduction of and predation by the brown treensnake; however, their adaptability to urban development is likely one of the reasons it is one of the few surviving native bird species on Guam.

2.2.1.2 Migratory Birds

Species listed under the MBTA and that have the potential to occur on AAFB within the project area include Pacific golden plover (*Pluvialis fulva*) and yellow bittern. The Pacific golden plover is a seasonal migrant and the yellow bittern is a resident breeder (NAVFAC Marianas 2013).

2.2.2 Reptiles

2.2.2.1 Azure-tailed Skink

The azure-tailed skink is very similar to the Pacific blue-tailed skink (*Emoia caeruleocauda*) and is only discernable by specific characteristics found on the fourth toe. Historically, azure-tailed skinks occurred in southern Guam around the Geus River. Currently, the azure-tailed skink is considered extirpated from Guam (Guam DAWR 2015) but still occurs on Cocos Island (Kerr 2013a).

2.2.2.2 Slevin's Skink

Slevin's skink (*Emoia slevini*), or Mariana skink, is the only endemic reptile to the Mariana Islands. The historic range for Slevin's skink included Guam (including Cocos Island), Rota, Tinian, Sarigan, Guguan, Aguiguan, Alamagan, Pagan, Asuncion. Although never common on Guam and has not been verified in the wild on Guam since 1945, it still occurs on Cocos Island (USFWS 2015).

2.2.2.3 Moth Skink

The moth skink inhabits several Pacific islands, but in the Mariana Islands is only known to occur on Guam. It inhabits forested areas, and is thought to stay mainly on the ground or low on trunks of trees (Vogt and Williams 2004). The last recorded occurrence of this species on Guam was in 2009 at NBG Telecommunications Site, Naval Munitions Site, Cabras, and on AAFB, south of the MSA (NAVFAC Pacific 2010).

2.2.2.4 Pacific Slender-toed Gecko

The Pacific slender-toed gecko is nocturnal and unlike most geckos on Guam, is primarily ground dwelling within rocky terrain but occasionally can be found on the trunks of trees. It was observed on NBG Telecommunications Site and the Naval Munitions Site in 2009 (NAVFAC Pacific 2010) and southwest of the MSA within the Habitat Management Unit on AAFB (U.S. Geological Survey [USGS] 2013).

2.2.2.5 Micronesian Gecko

The Micronesian has not been seen on Guam since the 1970s, is thought to be extirpated as a result of the brown treesnake, and currently only occurs on Cocos Island (Rodda and Fritts 1992). It prefers undisturbed native limestone forests and large trees, but has also been seen on human structures and untended coconut groves (NAVFAC Pacific 2010).

2.2.3 Tree Snails

Three species of partulids, in two genera, are currently known to occur Guam: fragile tree snail, Guam tree snail, and humped tree snail. However, all three of these species have experienced massive range reductions, primarily due to habitat destruction and introduced predators. All three species were listed as endangered under the Federal ESA in October 2015 (USFWS 2015). Plants known to support partulid tree snails on Guam include but are not limited to: *Aglaia mariannensis*, *Artocarpus mariannensis*, *Asplenium nidus*, *Barringtonia asiatica*, *Carica papaya*, *Cocos nucifera*, *Erythrina variegata*, *Ficus tinctoria*, *Hernandia nymphaeifolia*, *Hernandia sonora*, *Mammea odorata*, *Merrilliodendron megacarpum*, *Ochrosia oppositifolia*, *Pandanus dubius*, *Piper guahamense*, and *Thelypteris* sp. (Hopper and Smith 1992; Smith et al. 2008).

2.2.3.1 Humped Tree Snail

The humped tree snail is endemic to the Mariana Islands and is the most widely distributed species of all Mariana tree snails and was once the most commonly encountered partulid on Guam (Smith et al. 2008; Kerr 2013b). To date, humped tree snails have not been observed on AAFB.

2.2.3.2 Guam Tree Snail

The Guam tree snail is endemic to Guam. It forms symbiotic relationships with several specific species of native plants, and is therefore generally found in native limestone forest. Guam tree snails have been observed within the Tarague basin east of the Combined Arms Training and Maintenance (CATM) Range (NAVFAC Marianas 2014, 2015).

2.2.3.3 Fragile Tree Snail

The fragile tree snail occurs in Guam and in Rota and is the only tree snail in the genus to occur outside of southeastern Polynesia. To date, fragile tree snails have not been observed on AAFB.

2.2.4 Butterflies

The Mariana eight-spot butterfly and the Mariana wandering butterfly are endemic to the Mariana Islands and both species were recently listed as endangered under the Federal ESA (USFWS 2015).

2.2.4.1 Mariana Eight-spot Butterfly

The Mariana eight-spot butterfly is one of two subspecies of *Hypolimnas octocula*, the second subspecies being found in Palau. It is considered rare, found in forest or forest clearings. On Guam, it has been found in forested areas where populations of its host plants, *Procris pedunculata* and *Elatostema calcareum*, are established. Both of these host plants, which larvae feed upon, are found only in karst substrates in native limestone forest (Schreiner and Nafus 1997; NAVFAC Marianas 2015; USFWS 2015). The Mariana eight-spot butterfly has been recently observed on AAFB east of the MSA within Tarague Basin east of the CATM Range and between the CATM Range and the AAFB flightline; north of the MSA at Ritidian Point and Northwest Field; and east of the MSA at Pati Point (NAVFAC Marianas 2014, 2015).

2.2.4.2 Mariana Wandering Butterfly

The Mariana wandering butterfly is endemic to the Mariana Islands and was known to occur on Guam and Rota (Schreiner and Nafus 1997). In the 1930s it was considered rare but widespread. Specimens of the butterfly were collected in the early 1970s; however, it has not been confirmed in the wild since 1979 and is considered extirpated from Guam (USFWS 2015).

The host plant for the wandering butterfly, *Maytenus thompsonii*, known as lulujut or luluhut in Chamorro, is a regionally endemic medium-sized tree commonly found in the understory of native limestone forest on Guam (Raulerson and Rinehart 1991). Its branches often grow in an irregular growth pattern from a central crown that is generally found 4 feet (ft) (1.5 meters [m]) off the ground to create a sprawling canopy layer in the understory. As a result, *M. thompsonii* branches are often entangled among the branches of other forest trees.

CHAPTER 3
METHODS

3.1 Survey Area

The survey area consisted of a 49-ac (20-ha) sector of the MSA at AAFB (Figure 3-1). Pedestrian surveys using visual searches for targeted species were carried out December 12-16, 2016 by a team of three Cardno biologists.

3.2 Survey Descriptions

Target species included ESA-listed geckos, skinks, butterflies, and tree snails, and host plants for tree snails and butterfly species (see Table 2-1 and Section 2.2 for detailed list of species and descriptions). While host plants are not protected, search for butterfly (species-specific) and partulid tree snail (more generalist) host plants enhanced probability of detection of cryptic target butterflies and tree snails.

Surveys were conducted with MSA escorts, and each biologist recorded their individual survey tracks with a Garmin 62s or eTrex 20 Global Positioning System (GPS) unit. Surveys focused on areas of suitable habitat and presence of host plants for habitat specialists, including butterflies and partulid tree snails (e.g., native limestone forest and suitable mixed forest with introduced and native vegetation and closed canopy). While none of the target species had been documented in this area in recent decades, access to the area is carefully controlled due to a high level of security, so that few surveys had been conducted in this area in some time, warranting careful and thorough search efforts for each of the target species.

Since the MSA is characterized by patches of open, regularly mowed land alongside roads and wrapping around the circumference of each munitions storage igloo, in order to cover all of the potential protected species habitat, two general types of searches were employed during this project. The first concentrated on vegetated areas, the second was conducted along the front surfaces of munitions storage igloos. For all survey efforts, in addition to recording GPS tracks and waypoints, photographs of relevant observations were taken when authorized and field notes included written descriptions of any observed target animal species or butterfly host plants.

3.2.1 Vegetated Area Surveys

For vegetated area survey methods, the transect design included a grid overlain on the entire project area. Transects were set through non-landscaped, vegetated forest strips of variable width with 2 running parallel to the roadways and 13 covering the shorter forest strips running perpendicular to the roads between existing igloo structures. The two roughly North-South lengthwise transects were located between 5th and 6th streets (Transect A, approx. 2,953 ft [900 m] long) and between 4th and 5th streets (Transect B, approx. 1,969 ft [610 m] long). The shorter East-West transects were between 328 ft [100 m] and 656 ft [200 m] in length (Transects 1-13). Together, they covered the extent of potential suitable habitat within the project area (Figure 3-1).

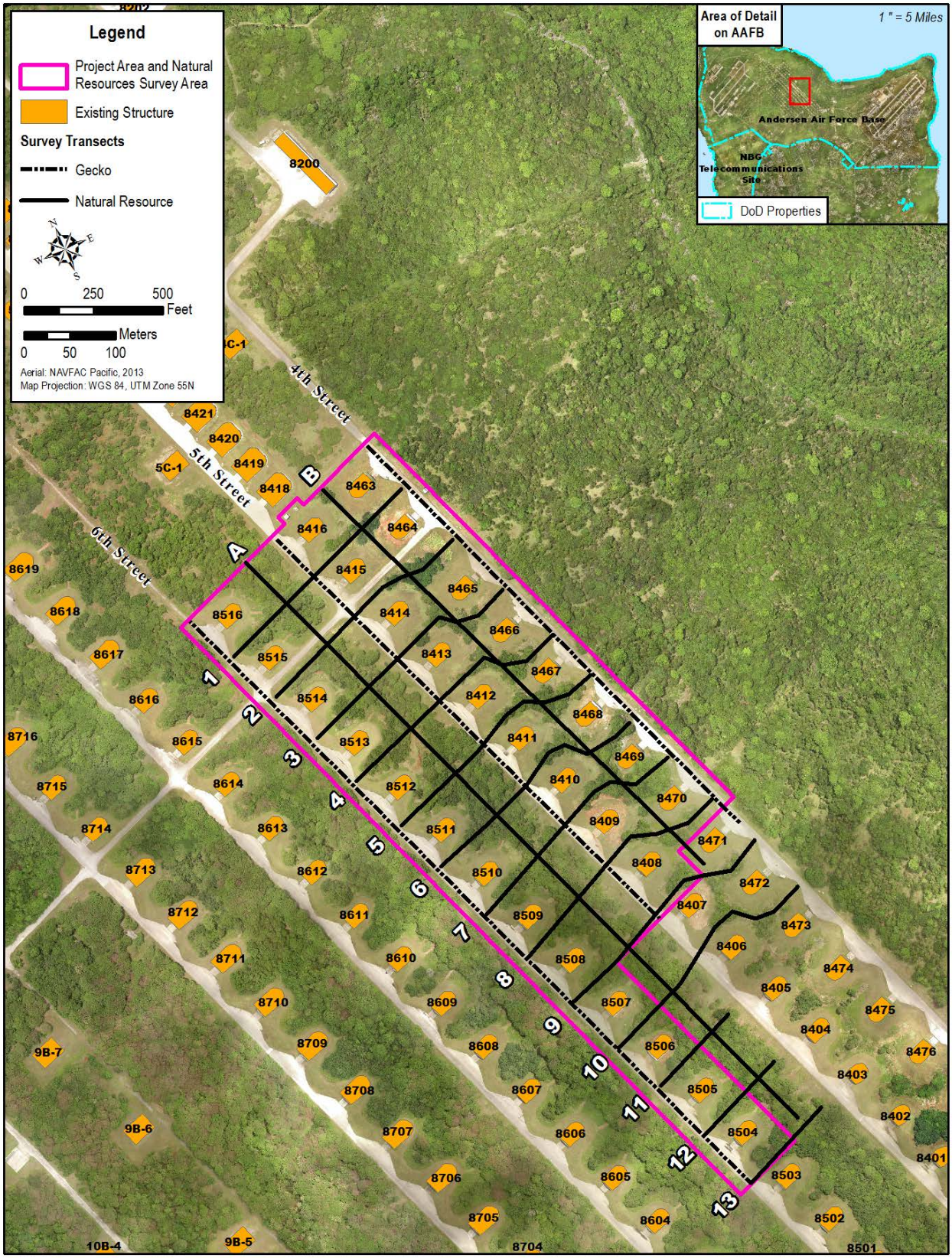


Figure 3-1. Survey Transect Grid Overlain on the Project Area

Visual search methods within the forest strips consisted of a roughly three-zone search approach, where surveyors continually scanned while moving forward, from low to high and back:

1) Ground-focused inspection of leaf litter, soil, low-lying rock and boulder surfaces (primarily for ground-dwelling skinks);
2) Above ground searches of shrubs, tree trunks, and vertical surfaces of karst pinnacles and large boulders (primarily for host plants and signs of butterfly life stages); and
3) Eye level and above searches using Nikon Monarch 10x42 binoculars of tree leaves, branches, vines, trunks, crevices, and sunlit clearings (primarily for tree snails, geckos, host trees, and flying adult butterflies).

Search methods also included timed (10-30 minutes), thorough team sub-searches of each butterfly host plant encountered and any tree harboring tree snails. Main objectives of butterfly host plant sub-searches were to identify evidence of any life stage of the two protected butterfly species and to include presence and condition of eggs, chrysalises, caterpillars, and caterpillar-caused leaf damage. Tree snails are generalists in terms of host plants, and any species with broad, smooth leaves are potential hosts; therefore, plants with these features were searched. The main objectives of potential tree snail host plant sub-searches (10-20 minutes) was to quantify the total number of ESA-listed tree snails present and the size class distribution if ESA-listed tree snails were found.

3.2.2 Munitions Storage Igloo Surface Surveys

The second general survey method was used in the open areas of the MSA, and employed use of hand-held flashlights to search the front of 48 munitions igloo structures, specifically targeting geckos. This method concentrated on manmade surface materials (concrete, fiberglass, and steel) that provided hiding places for geckos. Gecko transects ran along 4th, 5th, and 6th streets as seen in Figure 3-1. Five general areas were searched on each igloo structure: 1) steel screen vents covered by a rectangular louvered plate with eight slots, one vent per door; 2) stainless steel door hinges, each igloo door has three stainless steel hinges; 3) steel padlock housings on each pair of doors; 4) steel strips covering the top of door jams; and 5) space behind the fiberglass sign located to the right of the doors.

This page intentionally left blank.

CHAPTER 4
RESULTS

Weather conditions were variable during the surveys conducted December 12-16, 2016, with heavy, sustained precipitation occurring for the duration of Day 1, continuing into the early portion of Day 2, followed by 3.5 days of consistent hot and dry conditions. Cardno biologists traversed a total of 38.7 mi (62.3 km) searching for target species within the 49-ac (20-ha) project area (Figure 4-1).

4.1 Birds

No Federal or Guam ESA-listed birds were observed during the surveys. Three non-native resident species (black drongo [*Dicrurus macrocerus*], island collared dove [*Streptopelia bitorquata*] and black francolin [*Francolinus francolinus*]) and three MBTA-listed species (Pacific golden plover, Pacific reef heron [*Egretta sacra*], and yellow bittern) were observed during surveys. A number of black drongo were observed flying over the survey area and resting on tree tops. Island collared dove were seen and heard throughout the survey period. A pair of black francolin was observed feeding in the late afternoon on the edge of the forest. The three MBTA-listed species are described below.

Several Pacific golden plovers were seen along the road edges in the project area throughout the survey period. The Pacific golden plover is a medium-sized shorebird that breeds in Alaska and Siberia during the summer months and migrates to islands in the Pacific Ocean to winter (Johnson and Connors 2010). On Guam, it can often be found in open fields, pastures, shorelines, and mudflats.

One Pacific reef heron and several yellow bitterns were seen in flight passing overhead during surveys. The Pacific reef heron feeds both at night and during the day and can be seen hunting along the coast or in swampy areas. The bittern is a small wading bird and is common on all of the southern Mariana Islands (Vogt and Williams 2004). Bitterns can be observed in wetlands, forest edges, and scrub habitats. On Guam, they can often be seen in fields, parks, and on grassy edges along roads.

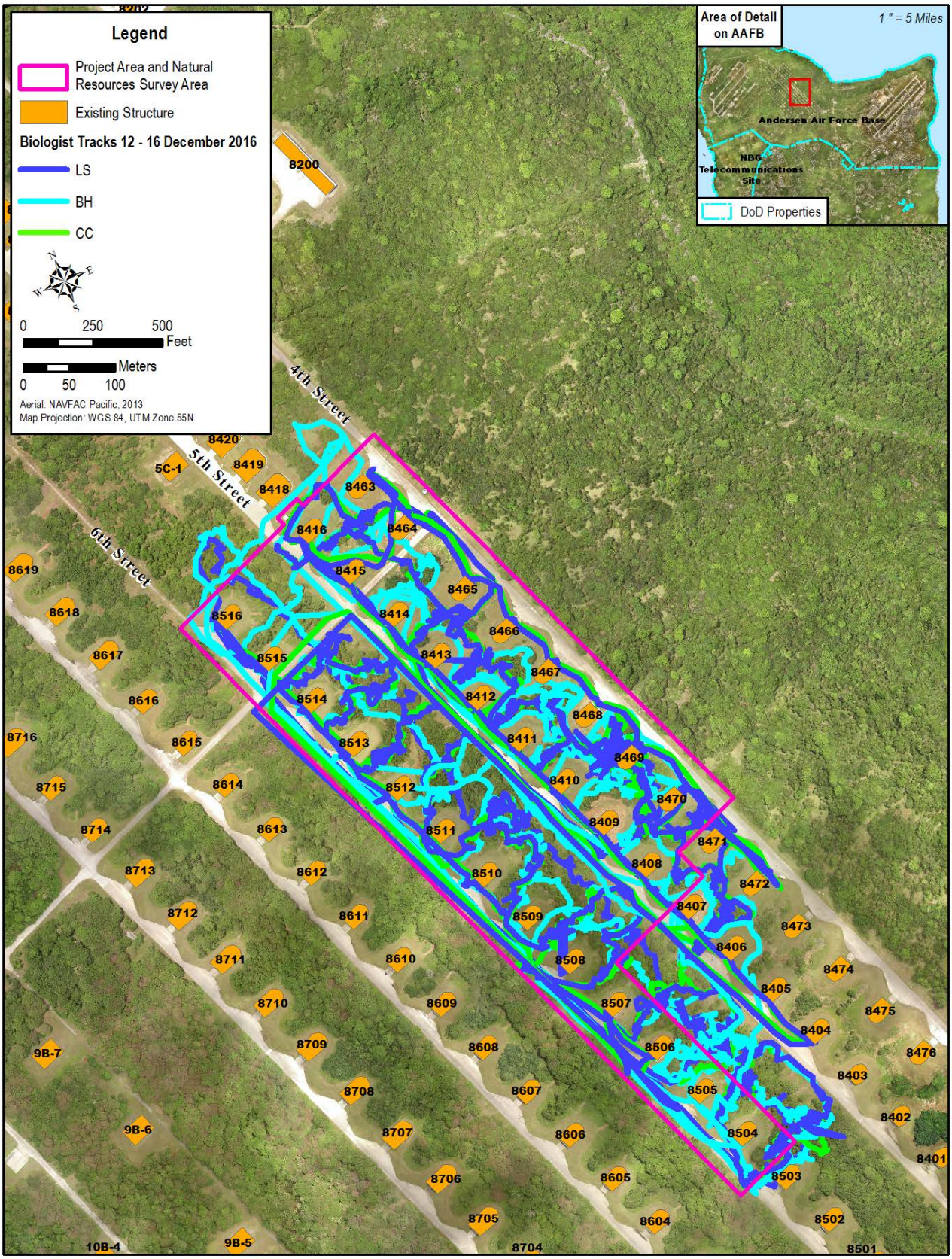


Figure 4-1. GPS Tracks of Survey Coverage within the Project Area

4.2 Reptiles

No listed species of reptiles were observed during the surveys. Two species of skink, three species of gecko, one Brahminy blind snake (*Indotyphlops braminus*), and one Pacific monitor lizard (*Varanus indicus*) were observed. The observed skinks include the non-native curious skink (*Carlia fusca;* Figure 4-2a) and the native Pacific blue-tailed skink (Figure 4-2b). Skink eggs were found throughout the survey area (Figure 4-2c). The curious skink was much more abundant than the Pacific blue-tailed skink; for example, in a timed survey effort, 73 curious skinks and 3 Pacific blue-tailed skinks were recorded during 12 person-hours.



Figure 4-2. Skinks Observed within the Project Area: (a) Curious Skink and (b) Pacific Blue-tailed Skink. (c) Skink Eggs.

Observed geckos include the native mutilating gecko (*Gehyra mutilata*) and mourning gecko (*Lepidodactylus lugubrus*; Figure 4-3a), and the non-native house gecko (*Hemidactylus frenatus*; Figure 4-3b). The mutilating gecko was observed on two occasions in the forest on trees hiding under peeling bark. Several mourning geckos and house geckos were observed during surveys of the front side of the munitions storage igloos. Geckos were found hiding in the vents, locks, and jambs of the igloo doors, behind door hinges and signs, as well as under the lip above the door. All life stages (juveniles and adults of both species, as well as females with eggs [Figure 4-3c]) were frequently observed.



Figure 4-3. Geckos Observed within the Project Area on Munition Igloos: (a) Mourning Gecko (b) House Gecko (c) Eggs within an Adult Gecko (delineated by green arrow).

4.3 Tree Snails

No native tree snails were observed during the surveys. However, two species of non-native arboreal gastropods were observed: east Asian land snail *Satsuma* sp. and tropical American lined tree snail (*Drymaeus multilineatus*) (Figures 4-4a and 4-4b, respectively). The occurrence of these species suggests that conditions within the forested areas of the MSA may be suitable for the persistence of tree snails. However, the invasive flatworm *Platydemus manokwari*, a known predator of tree snails, was observed to occur in high abundance (Figure 4-4c). No partulid shells or shell fragments were observed. Sun-bleached and weathered white shells of the giant African snail (*Achatina fulica*) were abundant throughout the

forested areas (Figure 4-4d). Less abundant, though apparently of about the same age, were shells of the invasive predator rosy wolf snail (*Euglandina rosea*), intentionally released several decades ago as a biocontrol for the giant African snail.



Figure 4-4. Non-Native Invertebrates Observed in the Project Area: (a) *Satsuma* sp.; (b) Lined Tree Snail; (c) *Platydemus manokwari;* and (d) Giant African Snail.

Table 4-1 provides a summary of common forest plants, including host plants for tree snails, seen throughout the transects. Several tree snail host plants were observed including *Ochrosia oppositifolia*, *Pandanus tectorius*, and *Cycas micronesica*.

Table 4-1. Summary of Observed Target Tree Snail Host Plant Species by Transect

	*Transect**														
Species	*A*	*B*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Aglaia mariannensis	+	+	+	+	+	-	+	+	+	+	+	+	+	-	+
Alocasia macrorrhizos	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Annona reticulata	+	+	-	+	+	-	-	+	-	-	+	-	+	-	-
Artocarpus marianensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Asplenium nidus	+	+	+	+	+	+	-	+	-	+	+	+	+	+	+
Cocos nucifera	-	+	-	-	+	-	-	-	-	-	-	-	-	-	-
Cordia subcordata	-	+	+	+	+	-	-	-	-	+	-	-	-	-	-
Cycas micronesica	+	+	+	+	+	-	+	+	+	+	+	+	+	+	+
Cynometra ramiflora	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Eugenia reinwardtiana	-	+	-	-	-	-	-	-	-	-	-	+	-	+	-
Ficus spp.	-	+	-	-	-	+	-	-	-	+	+	+	-	+	-
Flagellaria indica	+	+	-	-	-	-	-	+	-	-	+	-	-	+	-
Glochidion marianum	-	-	-	-	-	-	-	-	-	-	-	-	-	+	+
Guamia mariannae	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Guettarda speciosa	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Hernandia sonora	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Hibiscus tiliaceus	+	+	+	+	+	+	+	+	+	+	+	+	+	+	+
Intsia bijuga	-	-	-	-	-	-	-	-	-	-	-	-	+	-	+
Ixora triantha	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Leucaena leucocephala	-	+	+	+	+	+	-	+	-	+	-	+	+	+	+
Macaranga thompsonii	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Mammea odorata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Melanolepis multiglandulosa	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
Merrilliodendron megacarpum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Morinda citrifolia	+	-	-	+	+	+	+	+	-	-	-	-	-	-	-
Ochrosia mariannensis	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Ochrosia oppositifolia	+	+	+	+	+	+	-	+	-	-	+	+	-	+	+
Pandanus dubius	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Pandanus tectorius	+	+	-	+	-	-	-	+	-	+	+	+	+	+	+
Piper guahamense	+	-	-	-	-	-	-	-	-	-	+	-	-	-	-

Table 4-1. Summary of Observed Target Tree Snail Host Plant Species by Transect

Species	*Transect**														
	A	*B*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Pisonia grandis	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Premna obtusifolia	+	+	+	+	+	+	-	+	+	+	+	+	+	+	+
Pteris tripartita	+	+	-	-	+	-	+	+	+	-	+	+	-	+	+
Spathodea campanulata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syngonium angustatum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Syzigium thompsonii	-	-	-	-	-	-	-	-	-	-	-	+	+	+	+
Thelypteris opulenta	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Thespesia populnea	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes: * - = not observed; + = observed.

4.4 Butterflies

No native butterflies were observed during MSA surveys. While the butterfly host plants *Procris pedunculata* or *Elatostema calcareum* were not seen in the project area, several *Maytenus thompsonii* were seen (as discussed below). Despite dedicated timed searches on and around each individual *Maytenus* found, no sign of the Mariana wandering butterfly was observed. Several non-target butterfly species were seen. Black citrus swallowtail (*Papilio polytes*) and common eggfly (*Hypolimnas bolina*) were frequently seen on every transect.

Table 4-2 provides a summary of butterfly host plants seen throughout the transects. A total of 23 individual *Maytenus thompsonii* (MATH) trees were observed at 19 locations (Figure 4-5, Table 4-3, and Appendix A). Of the 23 trees found, 13 were observed flowering and 8 fruiting; no seedlings or saplings were observed.

Table 4-2. Summary of Observed Target Butterfly Host Plant Species by Transect

Species	*Transect*														
	A	*B*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
Elatostema calcareum	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Maytenus thompsonii	-	+	+	-	+	-	-	+	+	+	+	+	+	+	-
Procris pedunculata	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Note: - = not observed; + = observed.

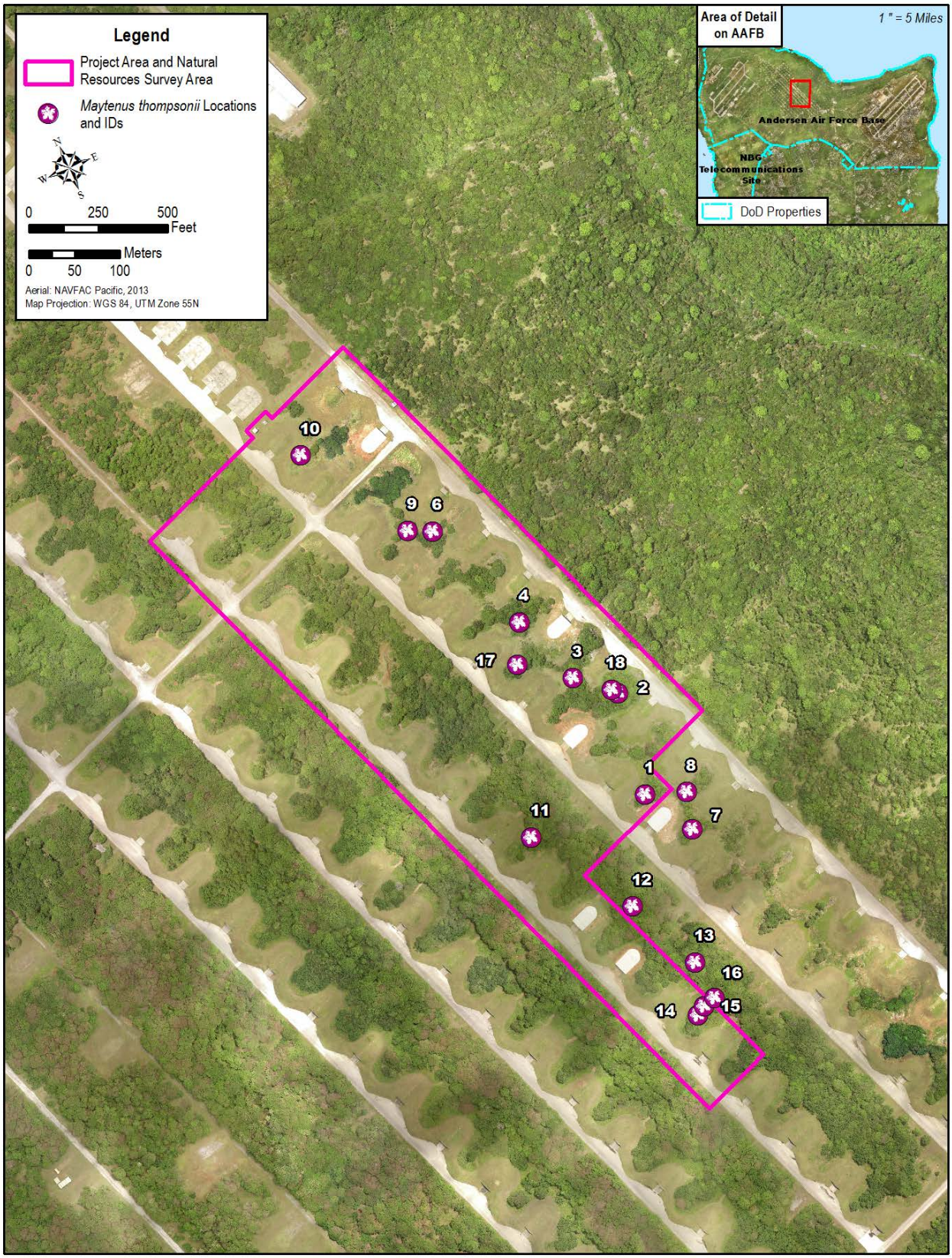


Figure 4-5. Locations of *Maytenus thompsonii* within and Adjacent to the Project Area

Table 4-3. Locations of *Maytenus thompsonii* Observed throughout the Project Area

Waypoint	*Latitude*	*Longitude*	*Date (2016)*	*Transect*	*No. of Trees*	*Light**	*Height (m)*	*Flower/ Fruit**	*Photo Record***	*Observations*
MATH 1	13.604929	144.889605	12/13	B	1	F	3.5	-/-	-	Live *Satsuma* sp. (introduced tree snail) observed on tree.
MATH 2	13.605953	144.889761	12/13	B	3	F	3-4.5	-/- -/- -/-	-	One *Guettarda speciosa* and several *Cycas micronesica* individuals in vicinity; *C. micronesica* fruiting; *Perperomia mariannensis* growing on *Guettarda speciosa*.
MATH 3	13.606268	144.889405	12/13	B	1	F	6.4	+/-	-	Large wasp nest located nearby; patch of tower karst located nearby with *Ficus* sp.; hawkmoth caterpillar observed on *Stictochardia tiliaefolia.*
MATH 4	13.606989	144.889130	12/13	B	1	F	4.8	-/-	-	Several *Hibiscus tiliaceus* in vicinity.
MATH 5	Not available†		12/13	B	1	F	5.6	+/-	-	MATH reaches up to canopy; trunk is decayed with loose bark; mutilating gecko (*Gehyra mutilata*) observed on trunk between bark; gecko eggs found in vicinity.
MATH 6	13.608158	144.888692	12/13	B	1	P/O	4	+/+	-	Several *Cocos nucifera* in vicinity forming canopy cover.
MATH 7	13.604424	144.889906	12/13	10	1	F	4.8	+/-	-	Long red petioles sprouting along branches; *Syzygium thompsonii* and a large downed tree (>2ft dbh) in vicinity.
MATH 8	13.604785	144.890004	12/13	9	1	F	4.8	+/-	-	Long red petioles sprouting along branches; five trunks observed splitting at the base.
MATH 9	13.608265	144.888464	12/13	3	1	P	4	+/+	-	Red petioles sprouting at the base of trunk.
MATH 10	13.609372	144.887772	12/13	1	1	F	6	-/-	-	*Satsuma* sp. observed alive on tree.
MATH 11	13.604983	144.888376	12/14	8	1	F	5.6	+/+	+	Several epiphytes observed on trunk; bleached *Pithia* sp. shell and skink eggs found near base; located near a *Cycas micronesica* and a fruiting *Melanolepus multiglandulosa*.
MATH 12	13.603955	144.889039	12/14	10	1	F	8.8	+/-	+	Marginal and central leaf damage observed.
MATH 13	13.603201	144.889392	12/14	11	2	P	8.8	+/+ +/+	+	Two MATH trees located side by side; marginal and central leaf damage observed on both.
MATH 14	13.602706	144.889202	12/15	12	1	F	6.8	-/-	+	Somewhat intact karst; marginal and central leaf damage observed; *Ficus* sp. nearby has engulfed neighboring windthrown *Premna obtusifolia* and is tangled around MATH.
MATH 15	13.602769	144.889300	12/15	12	1	F	7	+/+•	+	*Syzygium thompsonii* located in vicinity; marginal and central leaf damage observed.
MATH 16	13.602796	144.889433	12/15	12	1	P	7	+/+	+	Marginal and central leaf damage observed.
MATH 17	13.606607	144.888943	12/16	6	1	P	5.6	+/-	+	*Cycas micronesica* individuals in vicinity; *Ficus* sp. nearby is a potential threat.
MATH 18	13.606011	144.889718	12/16	7	1	P	6.4	-/+	+	*Cycas micronesica* individuals located in vicinity.
MATH 19	Not available†		12/15	12	2	P	4	-/- -/-	+	Two MATH trees located side by side; marginal and central leaf damage observed on both.

Notes: *- = not present; + = present; F = filtered; O = open; P = partial.

**Camera authorization for the MSA was not obtained until December 14.

†Due to technical problems with the GPS unit, waypoints for MATH locations 5 and 19 are not available.

•Reproductive structures observed were high in the canopy and appeared to be either small flower buds or fruits.

This page intentionally left blank.

CHAPTER 5
DISCUSSION

Of the target species, only birds protected under the MBTA and host plants for the Mariana wandering butterfly and tree snails were observed during the surveys. *Maytenus thompsonii*, the host plant for the Mariana wandering butterfly, was encountered at 19 locations throughout the project area, with a total of 23 individuals observed. Despite thorough searches of each tree encountered, no sign of the Mariana wandering butterfly was seen. Likewise, a variety of common plants known to serve as host plants for listed tree snails were observed within the survey area. However, no sign of ESA-listed tree snails was observed during the surveys. While several species of reptiles were seen (i.e., curious skink, house gecko, mourning gecko, and Pacific blue-tailed skink), no ESA-listed reptiles, such as Slevin's skink or azure-tailed skink, were observed. Observed MBTA-listed birds included Pacific golden plover, Pacific reef heron, and yellow bittern; no nests were seen in the survey area.

The brown tree snake and the western Pacific monitor lizard are both voracious predators, known to feed on ground and tree dwelling vertebrates during all life stages. The activity of one or both species and may have played a role in the extirpation of native skinks and geckos on Guam (Rodda and Fritts 1992), including within the MSA. Although no brown tree snakes were observed during the surveys, this is not surprising as this species is both nocturnal and highly cryptic. One juvenile monitor was observed during a MSA forest transect.

The reasons for the decline and scarcity of the Mariana wandering butterfly are presently unclear. The species has not been observed on Guam since 1979 and is considered extirpated (USFWS 2015). The habitat in the project area supports adult butterfly activity as evidenced by the conspicuous presence of non-listed butterfly species (e.g., adequate wind barriers and suitable nectaring opportunities). Unlike Mariana eight-spot butterfly, which seems limited primarily by host plant availability, the Mariana wandering butterfly's host plant, *Maytenus thompsonii*, is relatively common in native limetone habitat on Guam, including within the survey area. Many of the trees appear quite healthy and were over 20 ft (6 m) in height. However, there is some uncertainty surrounding the reliance of the Mariana wandering butterfly on *M. thompsonii*. The only documented evidence that *M. thompsonii* is a host plant was a single rearing of a wandering butterfly in captivity (Swezey 1942). Noted lepidopterists convey uncertainty that *M. thompsonii* is the sole host plant for this endangered butterfly (Moore 2017; Rubinoff 2017; Wright 2017). It is possible that a decline in an undocumented host plant played a role in its extirpation. In addition, it is possible that Mariana wandering butterfly populations have been disproportionately predated upon by an invasive species or other predator having a preference and/or expanded range (possibly invasive parasitoid wasps, orb weaving spiders, etc.).

In contrast, the Mariana eight-spot butterfly has recently been observed on AAFB in a number of locations where its host plants occurred (NAVFAC Marianas 2014, 2015), and it seems likely that host plant availability and connectivity may be factors in both its current distribution and challenges to its recovery. The host plants *Procris pedunculata* and *Elatostema calcareum* are highly susceptible to the impacts of introduced ungulates (e.g., browsing, trampling), and both are restricted to native limestone forest characterized by sharp edged tower karst terrain that impedes access by non-native deer and pig. Neither host plant was seen within the survey area.

In general, recent surveys have found that remaining suitable habitat for both butterflies and tree snails on Guam tends to be located along a band circumscribing the outer edges of the coastal escarpment, including coastal backstrand forest. Of primary concern in terms of impact and distribution of butterfly host plants

(*Procris/Elatostema*) is damage due to invasive ungulate herbivory and pest infestation. By far the most common and severe damage observed during previous host plant surveys was due to ungulate grazing and trampling by Philippine deer, which are abundant in the MSA, as well as rooting by feral pigs. In areas where ungulate activity has been observed, only those host plants that are afforded protection on shear tower karst tops tend to survive (NAVFAC Marianas 2014, 2015). This type of habitat was extremely rare during the current surveys, only two small patches were observed, and ungulate activity was high throughout the project footprint, perhaps explaining the absence of Mariana eight-spot butterfly and its host plants in the survey area.

The absence of partulid tree snails within the survey area may be related to land use history and deforestation of the area, combined with the lack of the natural ability of tree snails to recolonize areas where they experienced historical extirpation, despite subsequent return of host trees. The fact that non-native arboreal gastropods were observed in the survey area, namely the east Asian bradybaenid *Satsuma* sp. and the tropical American lined tree snail, suggests that conditions are suitable in the forested areas of the MSA for persistence of tree snails. However, ground searches in the area revealed two interesting observations: a lack of partulid shells, either fresh or fossil, and high abundance of the non-native predatory flatworm *Platydemus manokwari*. This, in addition to a nearly continuous swath of dead African giant snail shells, suggests that any snail moving along the ground would be subject to high risk of predation by flatworms. Therefore, the current habitat conditions would render recolonization by native partulid tree snails highly unlikely.

CHAPTER 6
REFERENCES

Fritts, T.H. and G.H. Rodda. 1998. The role of introduced species in the degradation of island ecosystems: a case history of Guam. Annual Reviews in Ecology and Systematics 29: 113-140.

GovGuam. 2009. Endangered Species Regulation No. 9. Department of Agriculture, Mangilau, Guam. November 6.

Guam DAWR. 2015. Draft State Wildlife Action Plan. Department of Agriculture, Government of Guam, Mangilao, Guam. January 20.

Hopper, D.R. and B.D. Smith. 1992. The status of tree snails (Gastropoda: Partulidae) on Guam, with a resurvey of sites studied by H.E. Crampton in 1920. Pacific Science 46: 77–85.

Johnson, O.W. and P.G. Connors. 2010. The Cornell Lab of Ornithology All About Birds: Pacific Golden Plover *Pluvialis fulva*. https://www.allaboutbirds.org/guide/Pacific_Golden-Plover/lifehistory. Accessed 3 January 2017.

Kerr, A.M. 2013a. Illustrated Guide to the Reptiles and Amphibians of the Mariana Islands, Micronesia. University of Guam Marine Laboratory Technical Report 150. March.

Kerr, A.M. 2013b. The partulid tree snails (Partulidae: Stylommatophora) of the Mariana Islands, Micronesia. University of Guam Marine Laboratory Technical Report 152. May.

Moore A. 2017. Ethology of and host trees for *Vagrans egistina*. Unpublished data. Personal communication with B. Holland, Sr. Biologist, Cardno, Honolulu, HI. January.

Mueller-Dombois, D. and F.R. Fosberg. 1998. Vegetation of the Tropical Pacific Islands. Ecological Studies 132. Springer-Verlag, Inc., NY.

NAVFAC Marianas. 2013. Threatened and Endangered Species and Migratory Birds Monitoring Report, Naval Support Activity Andersen, Guam. Prepared by HDR, San Diego, CA for Globetek Group, Guam. February.

NAVFAC Marianas. 2014. Final Project Report: Federal Candidate Species Surveys on Guam. Prepared by D.P. Lindstrom and J.C. Benedict, University of Guam. January.

NAVFAC Marianas. 2015. Federal Candidate Endangered Species Surveys at Andersen Air Force Base. Prepared by B.S. Holland and D. Rubinoff, University of Hawaii – Manoa. June 22.

NAVFAC Marianas. 2016. Land Use/Land Cover and Recovery Habitat Analysis for Lands Managed by Joint Region Marianas on Guam. Prepared for NAVFAC Marianas, Guam by Cardno, Honolulu, HI. June.

NAVFAC Pacific. 2010. Herpetological Surveys on Department of Defense Lands, Guam, in Support of a Marine Corps Relocation Initiative to Various Locations on Guam. Prepared by SWCA Environmental Consultants, Hagatna, Guam for AECOM, Inc., Bloomfield, NJ under Contract with NAVFAC Pacific, Pearl Harbor, HI. February 25.

NAVFAC Pacific. 2016. Revised Statement of Work, Protected Fauna Surveys in Support of: Andersen AFB Igloo MILCON Project (9 August 2016), Section 7 *in* Revised Amendment No. 0031 to the Statement of Architect-Engineering Services for National Environmental Policy (NEPA) Documents and Environmental Studies at Various Navy and Marine Activities, Pacific Basin and Indian Ocean Areas. Contract N62742-11-D-1801, Task Order No. 0025. September 26.

Raulerson, L. and A. Rinehart. 1991. Trees and Shrubs of the Northern Mariana Islands.

Rodda G.H. and T.H. Fritts. 1992. The impact of the introduction of the Colubrid snake *Boiga irregularis* on Guam's lizards. Journal of Herpetology 26: 166-174.

Rubinoff, D. 2017. Ethology of and host trees for *Vagrans egistina*. Unpublished data. Personal communication with B. Holland, Sr. Biologist, Cardno, Honolulu, HI. January.

Schreiner, I.H. and D.M. Nafus. 1997. Butterflies of Micronesia. University of Guam Press.

Smith, B.D., R. Cooper-Nurse, and A.M. Gawel. 2008. Survey of Endangered Tree Snails on Navy-Owned Lands in Guam. Prepared for the U.S. Navy.

Swezey, O.H. 1942. Insects of Guam – I, Lepidoptera (Butterflies of Guam). Bernice P. Bishop Museum Bulletin 172:31-38.

USFWS. 2015. Endangered and threatened wildlife and plants; Endangered status for 16 species and threatened status for 7 species in Micronesia; Final rule. Federal Register 80: 59424-59497.

USGS. 2013. Observations of Pacific slender-toed gecko at the HMU, AAFB. Personal communication via email from B. Lardner, Biologist, USGS Brown Treesnake Project, Guam to G. Metzler, Biologist, Cardno TEC, Honolulu, HI. April 25.

Vogt, S.R. and L.L. Williams. 2004. Common Flora and Fauna of the Mariana Islands. WinGuide, Saipan, Northern Mariana Islands.

Wiles, G.J., J. Bart, R.E. Beck, Jr., and C.F. Aguon. 2003. Impacts of the brown tree snake: Patterns of decline and species persistence in Guam's avifauna. Conservation Biology 17: 1350-1360

Wright, M. 2017. Ethology of and host trees for *Vagrans egistina*. Unpublished data. Personal communication with B. Holland, Sr. Biologist, Cardno, Honolulu, HI. January.

.

CHAPTER 7
LIST OF PREPARERS

Cardno prepared this report under contract with NAVFAC Pacific. The primary government individuals who contributed to the review of this document include:

NAVFAC Pacific, Joint Base Pearl Harbor-Hickam, HI
Justin Fujimoto – Natural Resource Specialist, Navy Natural Resources Lead

36 CES/CEVN, Andersen Air Force Base
Jim Watkins – Natural Resources Specialist, Air Force Natural Resources Lead
Shermaine Garcia – Natural Resources Specialist

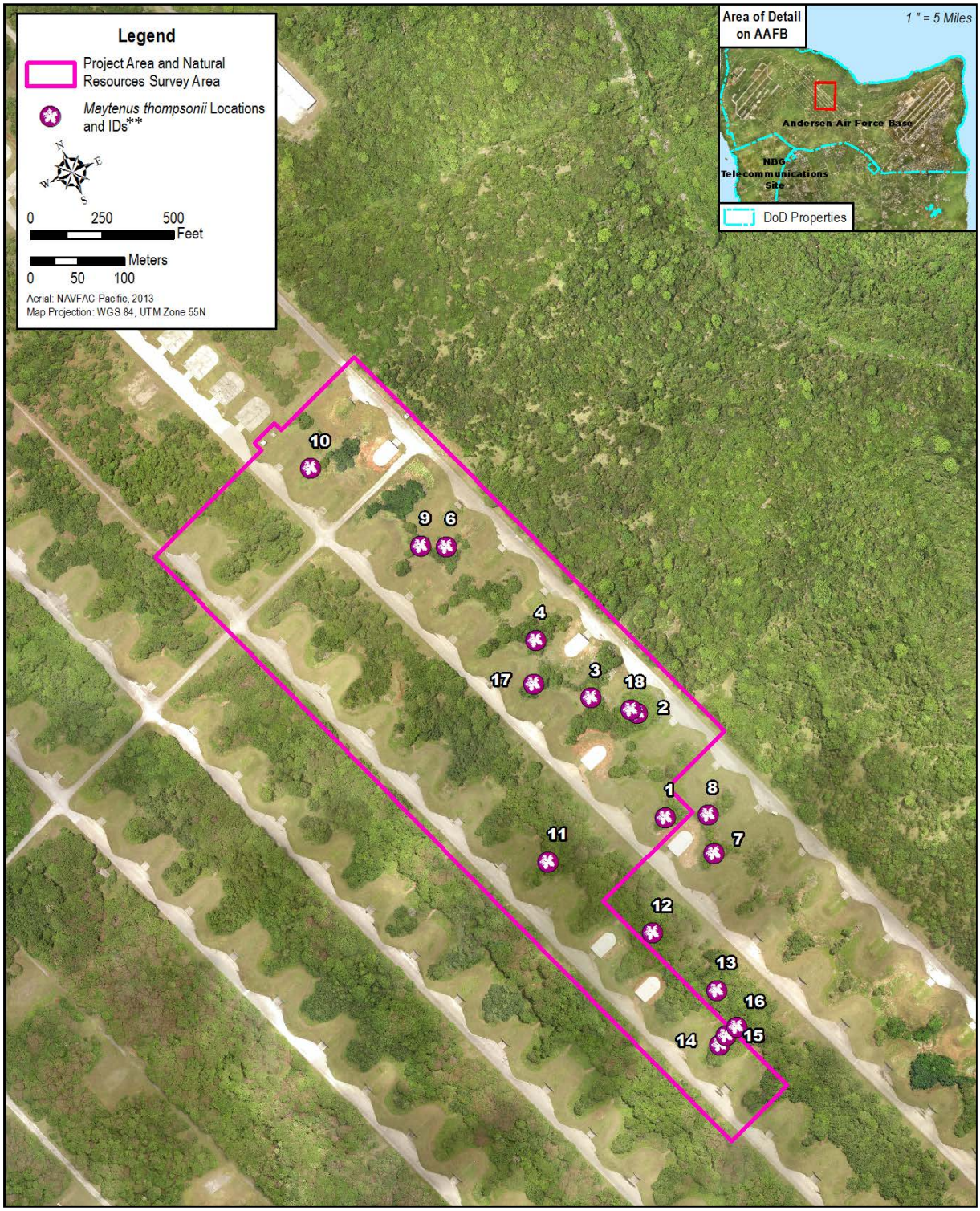
The professional staff responsible for conducting the surveys and the preparation of this document are:

Cardno, Honolulu, HI
Peer Amble, BA – Project Manager
John Ford, MS – Natural Resources Lead
Brenden Holland, PhD – Field Biologist
Lorraine Shaughnessy, MS – Natural Resources Survey Lead, Field Biologist
Rick Spaulding, MS – Quality Control
Priscilla Topping, MS – Technical Editor
Kerry Wells, BA – Geographic Information System (GIS) Specialist/Graphics

Duenas, Camacho & Associates, Inc., Hagatna, GU
Claudine Camacho, BS – Senior Botanist/Field Biologist

This page intentionally left blank.

Maytenus thompsonii (MATH) Photo Log*



*Photos for *Maytenus thompsonii* locations 1 – 10 do not exist since camera authorization in the MSA was not granted until Wednesday, December 14.
**GPS points are not available for locations 5 and 19.



Number of trees: 1

Height: 3.5 m

Light Condition: Filtered

Reproduction: Flowering and fruiting

Light Condition: Windthrow; heavy ungulate rooting; bleached *Pithia* sp. shell and skink eggs found near base; located near a *Cycas micronesica* and a fruiting *Melanolepus multiglandulosa*.

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions









MATH 11



Number of trees: 1

Height: 5.5 m

Light Condition: Filtered

Reproduction: Flowering

Observations: Windthrow; high ungulate activity; extensive leaf damage (holes in central portion of leaf).

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions









MATH 12



Number of trees: 2 (3 m apart)

Height: 5.5 m (branches intertwined in the canopy)

Light Condition: Partial

Reproduction: Only one tree was observed flowering, fruiting, and sprouting at the base.

Observations: Heavy ungulate rooting; extensive leaf damage (marginal and central); located near a *Cycas micronesica*.

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions









MATH 13



Number of trees: 1

Height: 6.8 m

Light Condition: Filtered

Reproduction: None observed

Observations: High ungulate activity; extensive leaf damage (marginal and central); *Ficus* sp. engulfed neighboring windthrown *Premna obtusifolia* and tangled around *Maytenus thompsonii*.

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions









MATH 14



Number of trees: 1

Height: 7 m

Light Condition: Filtered

Reproduction: Possible flower buds or fruits seen high in canopy.

Observations: Windthrow; heavy ungulate rooting; extensive leaf damage (marginal and central); *Syzygium thompsonii* located 1.5 m away.

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions









MATH 15



Number of trees: 1

Height: 7 m

Light Condition: Partial

Reproduction: Flowering and fruiting

Observations: Windthrow; ungulate activity; extensive leaf damage (marginal and central).

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions

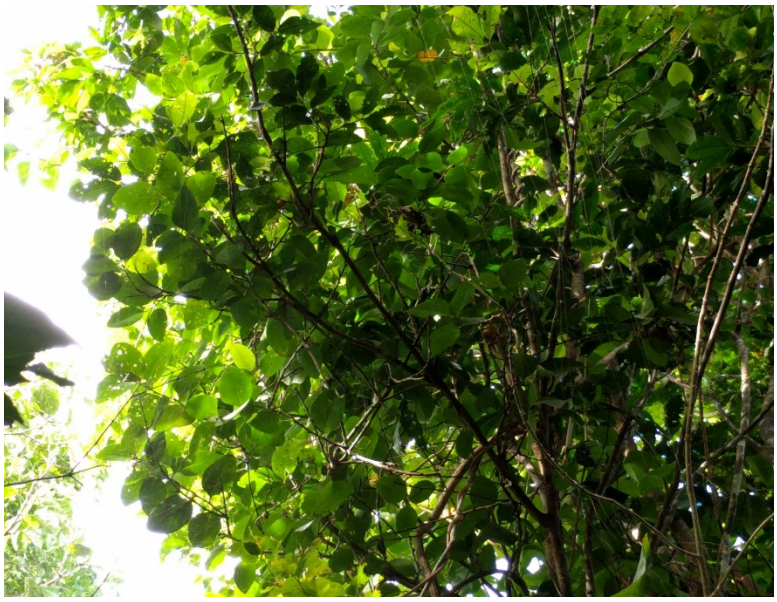








MATH 16



Number of trees: 1

Height: 3.5 m

Light Condition: Partial

Reproduction: Flowering only

Observations: Windthrow; ungulate activity; located near a 2.5 m-tall *Cycas micronesica*.

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions

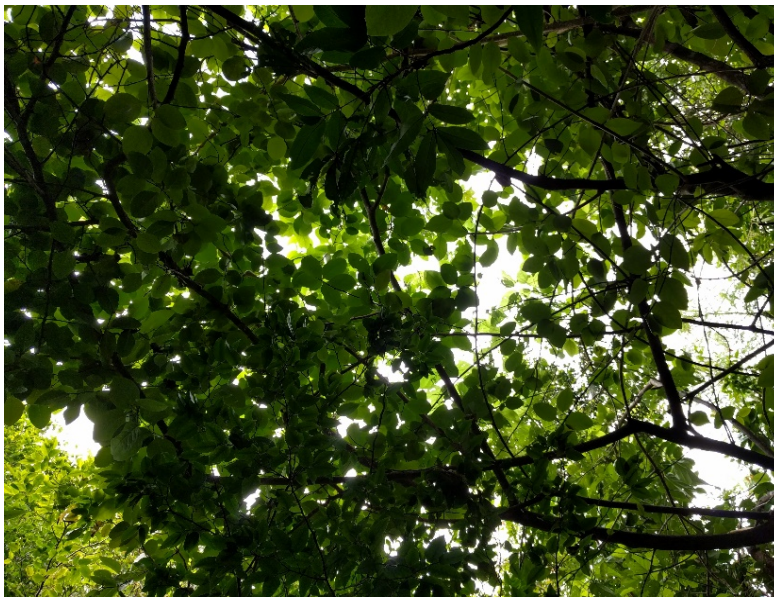








MATH 17



Number of trees: 1

Height: 4 m

Light Condition: Partial

Reproduction: Fruiting only

Observations: Windthrow; ungulate activity; located near a 2.5 m-tall *Cycas micronesica*.

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions









MATH 18



Number of trees: 2 (0.25 m apart)

Height: 4 m

Light Condition: Partial

Reproduction: None observed, sprouting at the base.

Observations: Windthrow; heavy ungulate rooting; extensive leaf damage (marginal and central).

No sign of the Mariana wandering butterfly (*Vagrans egistina*)

Photos of the Surrounding Habitat in the Four Cardinal Directions









MATH 19