Final

Environmental Impact Statement

GUAM AND CNMI MILITARY RELOCATION

Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force

Reader's Guide

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Guam and CNMI Military Relocation EIS
Reader's Guide

Table of Contents

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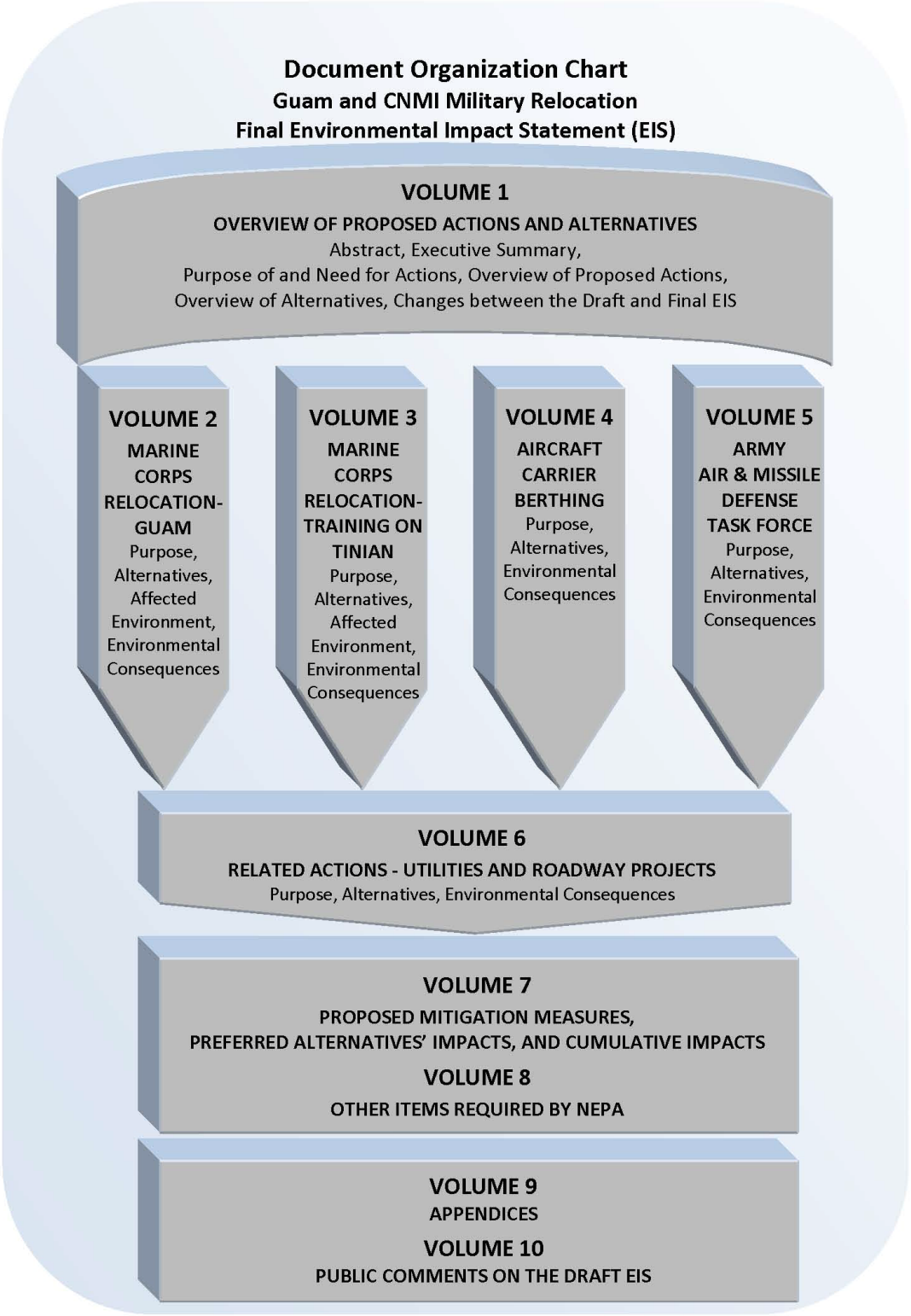
CHAPTER 1.
DOCUMENT ORGANIZATION CHART



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CHAPTER 2.
CHAPTER LIST BY VOLUME

VOLUME 1. OVERVIEW OF PROPOSED ACTIONS AND ALTERNATIVES

Abstract
Executive Summary
Chapter 1 – Purpose of and Need for Actions
Chapter 2 – Overview of Proposed Actions
Chapter 3 – Summary Alternatives
Chapter 4 – Changes between the Draft and Final EIS
Chapter 5 – References

VOLUME 2. MARINE CORPS RELOCATION – GUAM

Chapter 1 – Purpose of and Need for Actions
Chapter 2 – Proposed Action and Alternatives
Chapter 3 – Geological and Soil Resources
Chapter 4 – Water Resources
Chapter 5 – Air Quality
Chapter 6 – Noise
Chapter 7 – Airspace
Chapter 8 – Land and Submerged Land Use
Chapter 9 – Recreational Resources
Chapter 10 – Terrestrial Biological Resources
Chapter 11 – Marine Biological Resources
Chapter 12 – Cultural Resources
Chapter 13 – Visual Resources
Chapter 14 – Marine Transportation
Chapter 15 – Utilities
Chapter 16 – Socioeconomic and General Services
Chapter 17 – Hazardous Materials and Waste
Chapter 18 – Public Health and Safety
Chapter 19 – Environmental Justice and the Protection of Children
Chapter 20 – References

VOLUME 3. MARINE CORPS RELOCATION – TRAINING ON TINIAN

VOLUME 4. AIRCRAFT CARRIER BERTHING

VOLUME 5. ARMY AIR AND MISSILE DEFENSE TASK FORCE

Chapter 1 – Purpose of and Need for Actions
Chapter 2 – Proposed Action and Alternatives
Chapter 3 – Geological and Soil Resources
Chapter 4 – Water Resources
Chapter 5 – Air Quality
Chapter 6 – Noise
Chapter 7 – Airspace
Chapter 8 – Land and Submerged Land Use
Chapter 9 – Recreational Resources
Chapter 10 – Terrestrial Biological Resources
Chapter 11 – Marine Biological Resources
Chapter 12 – Cultural Resources
Chapter 13 – Visual Resources
Chapter 14 – Marine Transportation
Chapter 15 – Utilities
Chapter 16 – Socioeconomic and General Services
Chapter 17 – Hazardous Materials and Waste
Chapter 18 – Public Health and Safety
Chapter 19 – Environmental Justice and the Protection of Children
Chapter 20 – References

VOLUME 6. RELATED ACTIONS – UTILITIES AND ROADWAY PROJECTS

Chapter 1 – Purpose of and Need for Actions
Chapter 2 – Proposed Action and Alternatives
Chapter 3 – Utilities
Chapter 4 – Roadways
Chapter 5 – Geological and Soil Resources
Chapter 6 – Water Resources
Chapter 7 – Air Quality
Chapter 8 – Noise
Chapter 9 – Airspace
Chapter 10 – Land and Submerged Land Use
Chapter 11 – Recreational Resources
Chapter 12 – Terrestrial Biological Resources
Chapter 13 – Marine Biological Resources
Chapter 14 – Cultural Resources
Chapter 15 – Visual Resources
Chapter 16 – Marine Transportation
Chapter 17 – Socioeconomic and General Services
Chapter 18 – Hazardous Materials and Waste
Chapter 19 – Public Health and Safety
Chapter 20 – Environmental Justice and the Protection of Children

Chapter 21 – Section 4(f) and Section 6(f) Evaluation
Chapter 22 – References

VOLUME 7. PROPOSED MITIGATIONS MEASURES, PREFERRED ALTERNATIVES' IMPACTS, AND CUMULATIVE IMPACTS

Chapter 1 – Introduction
Chapter 2 – Overview of Best Management Practices and Mitigation Measures
Chapter 3 – Preferred Alternatives: Summary of Impacts
Chapter 4 – Cumulative Impacts
Chapter 5 – References

VOLUME 8. ADDITIONAL ITEMS REQUIRED BY NEPA

Chapter 1 – Introduction
Chapter 2 – Consistency with Other Federal, State, and Local Land Use Plans, Policies, and Controls
Chapter 3 – Required Permits and Approvals
Chapter 4 – Irreversible and Irretrievable Commitment of Resources
Chapter 5 – Relationship Between Short-Term Use of the Environment and Long-Term Productivity
Chapter 6 – Sustainability and Smart Growth
Chapter 7 – Distribution List
Chapter 8 – List of Preparers
Chapter 9 – References

VOLUME 9. APPENDICES

Appendix A – Public Involvement Materials
Appendix B - Cooperating Agencies
Appendix C - Agency and Elected Official Correspondence
Appendix D - Project Description Technical Appendix (Dredging and Munitions)
Appendix E - Habitat Equivalency Analysis (HEA)
Appendix F - Socioeconomic Impact Assessment Study (SIAS) and Land Acquisition
Appendix G - EIS Resource Technical Appendix
Appendix H - Coastal Consistency Determination (CCD)
Appendix I - Air Impact Study For Guam and CNMI Military Relocation EIS
Appendix J - Supplemental Aircraft Carrier Marine Surveys
Appendix K - Additional Reports

1. Additional Reports – Biology
2. Additional Reports - Aircraft Carrier
3. Additional Reports – Noise
4. Additional Reports - Utilities

Appendix L - Volume 5: Weapons Emplacements Sites Analysis (Classified)
Appendix M -Training
Appendix N - Low Impact Development and Sustainability

VOLUME 10. PUBLIC COMMENTS ON THE DRAFT EIS

Section 1 - Overview of Public Involvement

Section 2 - Overview of Comments and Responses

Section 3 - Summary of Draft EIS Public Comments

Section 4 - Response to Comments

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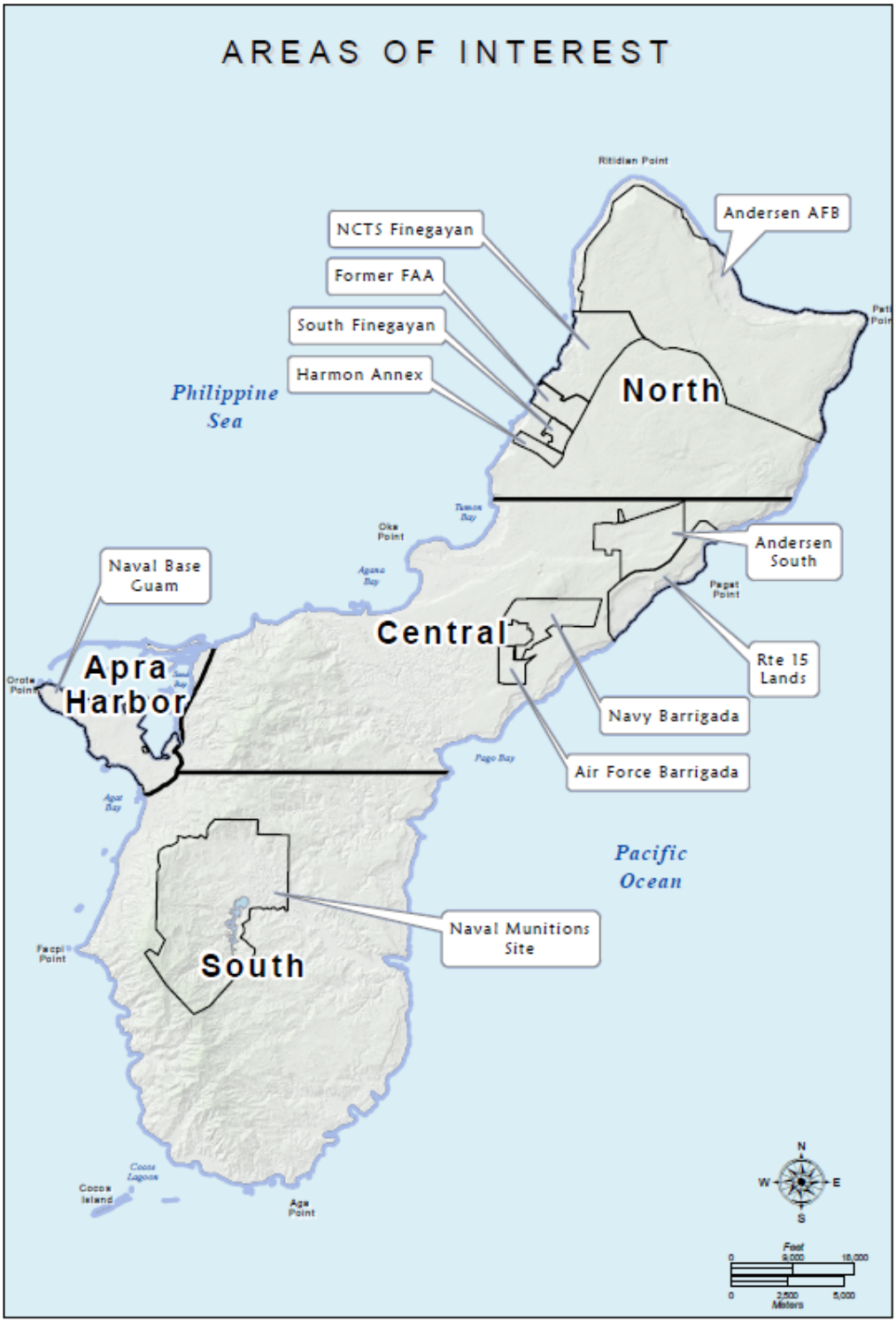
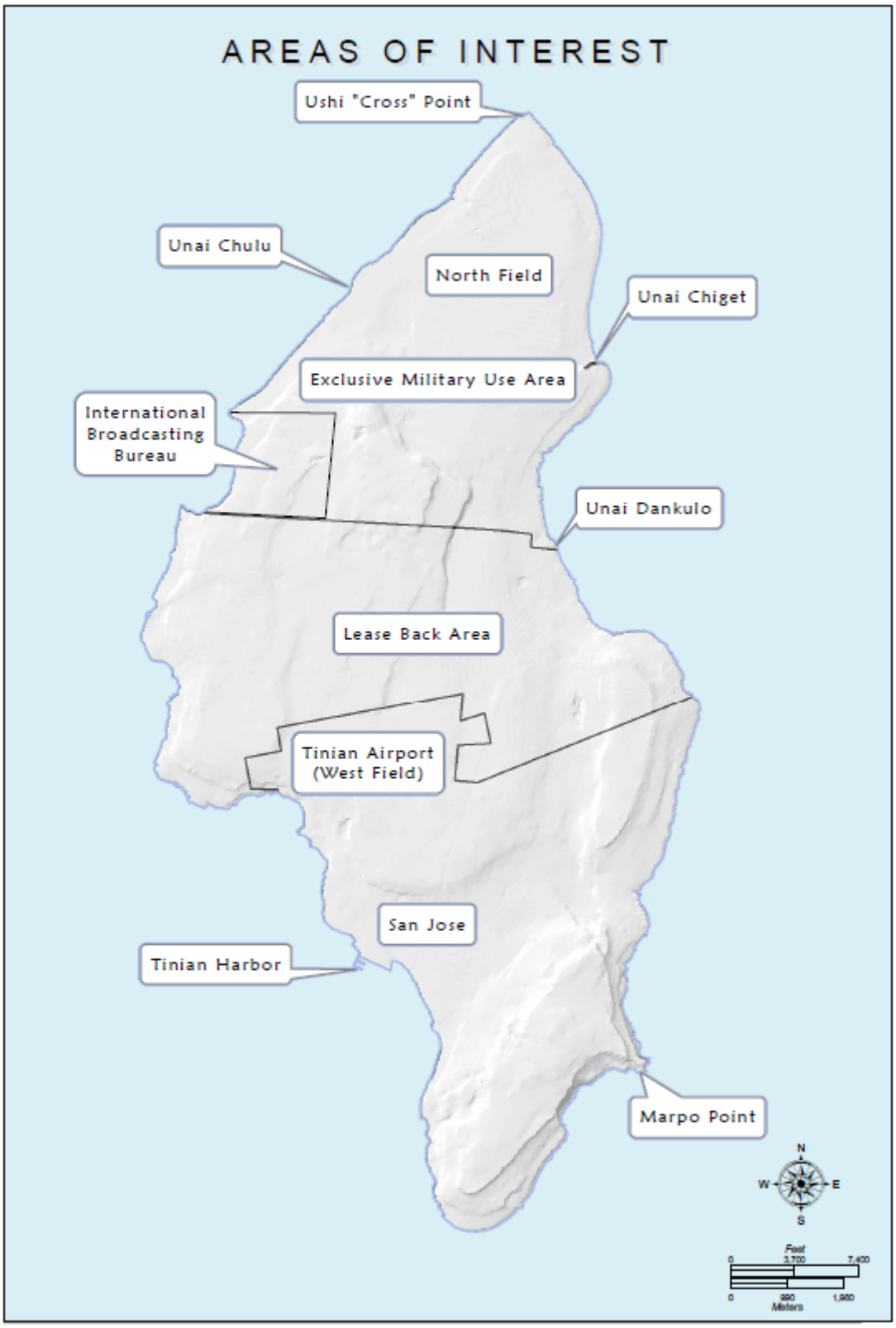
CHAPTER 3.
AREAS OF INTEREST

3.1 GUAM



3.2 CNMI


AREAS OF INTEREST
Ushi "Cross" Point
Unai Chulu
North Field
Unai Chiget
Exclusive Military Use Area
International Broadcasting Bureau
Unai Dankulo
Lease Back Area
Tinian Airport (West Field)
San Jose
Tinian Harbor
Marpo Point
N
W
E
S
Feet
0
3,700
7,400
0
990
1,980
Meters

CHAPTER 4. GLOSSARY

Access—the right to transit to and from and to make use of an area.

Activity—an individual scheduled training function or action such as missile launching, bombardment, vehicle driving, or Field Carrier Landing Practice.

Air Traffic Control Assigned Airspace (ATCAA)—Federal Aviation Administration-defined airspace not over an Operating Area (OPAREA) within which specified activities, such as military flight training, are segregated from other Instrument Flight Rules air traffic.

Airfield—usually an active and/or inactive airfield, or infrequently used landing strip, with or without a hard surface, without Federal Aviation Administration-approved instrument approach procedures. An airfield has no control tower and is usually private.

Airport—usually an active airport with hard-surface runways of 3,000 feet or more, with Federal Aviation Administration-approved instrument approach procedures regardless of runway length or composition. An airport may or may not have a control tower. Airports may be public or private.

Airspace, Controlled—airspace of defined dimensions within which air traffic control service is provided to Instrument Flight Rules flights and to Visual Flight Rules flights in accordance with the airspace classification. Controlled airspace is divided into five classes, dependent upon location, use, and degree of control: Class A, B, C, D, and E.

Airspace, Special Use—airspace of defined dimensions identified as the space or portion thereof over an area on the surface of the earth wherein activities must be confined because of their nature and/or wherein limitations may be imposed upon non-participating aircraft.

Airspace, Uncontrolled—airspace, or Class G airspace, refers to airspace not otherwise designated and operations below 1,200 feet above ground level. No air traffic control service to either Instrument Flight Rules or Visual Flight Rules aircraft is provided other than possible traffic advisories when the air traffic control workload permits and radio communications can be established.

Airspace—the space lying above the earth or above a certain land or water area (such as the Pacific Ocean); more specifically, the space lying above a nation and coming under its jurisdiction.

Amphibious Craft Laydown— location for storing, maintaining and deploying amphibious vehicles.

Army Air and Missile Defense Task Force (AMDTF)—a ground force that includes command and control, missile field teams, maintenance, and logistics/supplies support. They also include Weapons Emplacement Sites that would accommodate Terminal High-Altitude Area Defense (THAAD) and Patriot Missile operations.

Base load power—the minimum load over a given time period. The generation capacity needed to meet the continuous (24/7) demand for the system.

Battalion—in general, a battalion is a group of 5 companies, approximately 960 individuals.

Biosecurity Risk Assessment—a risk assessment to evaluate the proposed actions described in this EIS to determine the potential for invasive species to cause harm to ecological or economic systems on Guam or at locations where they may be inadvertently exported.

Biosecurity Plan—a plan that includes an invasive species risk assessment (biosecurity risk assessment) and management of risks and damage from invasive plant and animal species.

Biosecurity—a multi-level, multi-disciplinary, collaborative program to prevent the introduction and establishment of new invasive species.

Booster—an auxiliary or initial propulsion system that travels with a missile or aircraft and that may not separate from the parent craft when its impulse has been delivered; may consist of one or more units. Boosters contain high explosives sensitive enough to be detonated by a small initiator and powerful enough to set off a less sensitive main explosive charge.

Carrier Vessel Nuclear (CVN)—a nuclear powered aircraft carrier.

Coastal Zone—a region occupying the area near the coastline in depths of water less than 538.2 ft (164.0 m). The coastal zone typically extends from the high tide mark on the land to the gently sloping, relatively shallow edge of the continental shelf. The sharp increase in water depth at the edge of the continental shelf separates the coastal zone from the offshore zone. Although comprising less than 10% of the ocean's area, this zone contains 90% of all marine species and is the site of most large commercial marine fisheries. This differs from the way the term "coastal zone" is defined in the Federal Coastal Zone Management Act where "coastal zone" typically extends from the low tide mark to several hundred feet upland.

Continental United States (CONUS)—the United States and its territorial waters between Mexico and Canada, but excluding Alaska, Hawaii, U.S. territories, and possessions.

Company—in general, a company is a group of 4 platoons, approximately 192 individuals.

Controlled Access—area where public access is prohibited or limited due to periodic training operations or sensitive natural or cultural resources.

Controlled Airspace—airspace of defined dimensions within which air traffic control service is provided to Instrument Flight Rules flights and to Visual Flight Rules flights in accordance with the airspace classification. Controlled airspace is divided into five classes, dependent upon location, use, and degree of control: Class A, B, C, D, and E.

Controlled Firing Area—area where ordnance firing is conducted under controlled conditions so as to eliminate hazard to aircraft in flight.

Council on Environmental Quality (CEQ)—established by the National Environmental Policy Act, the CEQ consists of three members appointed by the President. A CEQ regulation (Title 40 Code of Federal Regulations 1500-1508, as of July 1, 1986) describes the process for implementing the National Environmental Policy Act, including preparation of environmental assessments and environmental impact statements, and the timing and extent of public participation.

Cumulative Impact—the impact on the environment which 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.

Discarded Military Munitions—military munitions that have been abandoned without proper disposal or removed from storage in a military magazine or other storage area for the purpose of disposal. The term does not include unexploded ordnance, military munitions that are being held for future use or planned disposal, or military munitions that have been properly disposed of consistent with applicable environmental laws and regulations.

Distance X—the maximum distance a projectile (including guided missiles and rockets) will travel when fired or launched at a given quadrant elevation with a given charge or propulsion system.

Economic Adjustment Committee (EAC)—established by Executive Order 12788 (as amended), the EAC coordinates Federal interagency and intergovernmental assistance to support the Defense Economic Adjustment Program and help communities respond to economic impacts caused by significant Defense program changes. The EAC is chaired by the Secretary of Defense. The Secretaries of Labor and Commerce serve as the Vice Chair men and there are a total of twenty-two federal agencies and departments represented on the EAC.

Encroachment (per Navy instruction)—any non-Navy action planned or executed that inhibits, curtails, or possesses the potential to impede the performance of Navy activities. Additionally, the lack of action by the Navy to work proactively with local communities, to monitor development plans, or to adequately manage its facilities and real property could also impact the Navy mission and thereby result in encroachment." Therefore, encroachment may stem from both internal (Navy) and external (civilian) sources.

Explosive Ordnance Disposal (EOD)—the detection, identification, field evaluation, rendering-safe recovery, and final disposal of conventional, nuclear, and chemical/biological ordnance. EOD activities are performed by specially trained active duty military personnel.

Explosive Safety Quantity-Distance (ESQD)—for a given quantity of explosive material, the distance separation relationships providing defined types of protection based on levels of risk considered acceptable. The size of the ESQD arc is proportional to the net explosive weight present.

Facilities—physical elements that can include roads, buildings, structures, and utilities. These elements are generally permanent or, if temporary, have been placed in one location for an extended period of time.

Fleet Area Control and Surveillance Facility (FACSFAC)—Navy facility that provides air traffic control services and controls and manages Navy-controlled off-shore operating areas and instrumented ranges.

Hardfill—a disposal facility for demolition debris (e.g. reinforced and non-reinforced concrete, asphalt, brick, block, tile, stone, roofing material, drywall, wood, and metal) that is not contaminated with solid waste, infectious waste, or hazardous waste.

High Explosive (HE)—an explosive substance designed to function by detonation (e.g., main charge, booster, or primary explosive). High Explosives when initiated change from basic form at a velocity greater than that of sound throughout the material exploding. The reaction, which generates a large volume of gas at high temperature and results in intense shattering effect, is usually referred to as a detonation. Examples: RDX, TNT, dynamite, and HBX.

Impact Area—the identified area within a range intended to capture or contain ammunition, munitions, or explosives and resulting debris, fragments, and components from various weapons systems (e.g., the ground and associated airspace within the training complex) A weapon system impact area is the area within the surface danger zone used to contain fired, or launched ammunition and explosives, and the resulting fragments, debris, and components. Indirect fire weapon system impact areas include probable error for range and deflection. Direct fire weapon system impact areas encompass the total surface danger zone from the firing point or position downrange to distance X.

Instrument Flight Rules (IFR)—regulations and procedures for flying aircraft by referring only to the aircraft instrument panel for navigation.

Major Exercise—a significant operational employment of live, virtual, and/or constructive forces during which live training is accomplished. A Major Exercise includes multiple training objectives, usually occurring over an extended period of days or weeks. An exercise can have multiple training operations (sub-events each with its own mission, objective and time period. Examples include C2X, JTFEX, SACEX, and CAX. Events [JTFEX] are composed of specific operations [e.g., Air-to-Air Missile], which consist of individual activities [e.g., missile launch]).

Maneuver Element—basic element of a larger force independently capable of maneuver. Normally, a Marine Division recognizes its infantry battalions, tank battalion, and light armored reconnaissance (LAR) battalion as maneuver elements. A rifle (or tank/LAR) battalion would recognize its companies as maneuver elements. A rifle (or tank/LAR) company would recognize its platoons as maneuver elements. Maneuver below the platoon level is not normally possible since fire and movement can be combined only at the platoon level or higher. The Army and National Guard recognize a squad and platoon as maneuver elements.

Maneuver—employment of forces on the battlefield through movement in combination with fire, or fire potential, to achieve a position of advantage with respect to the enemy in order to accomplish the mission.

Marine Air-Ground Task Force (MAGTF)— This is how the Marine Corps is set up to perform all types of their military actions. It insures that ground forces and air forces are working together under single leadership and a clear goal.

Marine Expeditionary Force (MEF)—A MEF is the largest MAGTF group, and is comprised of a MEF Headquarters Group, Marine Division, Marine Air Wing and Marine Logistics Group.

Marine Expeditionary Brigade (MEB)—A MEB is larger than a Marine Expeditionary Unit (MEU) but smaller than a Marine Expeditionary Force (MEF). It is comprised of a reinforced infantry regiment, a composite Marine aircraft group, and a brigade service support group. It can function as part of a joint task force, as the lead echelon of the MEF, or alone.

Marine Expeditionary Unit (MEU)—A MEU is the smallest MAGTF group, and is comprised of an air and ground combat team, and combat service support. The specific makeup of the MEU can be customized with additional artillery, armor, or air units.

Marine Corps Ground Unit—Marine Expeditionary Unit Ground Combat Element, or Battalion Landing Team, composed of an infantry battalion of about 1,200 personnel reinforced with artillery, amphibious assault vehicles, light armored reconnaissance assets and other units as the mission and circumstances require.

Material Potentially Presenting an Explosive Hazard (MPPEH)— material owned or controlled by the Department of Defense that, prior to determination of its explosives safety status, potentially contains explosives or munitions (e.g., munitions containers and packaging material; munitions debris remaining after munitions use, demilitarization, or disposal; and range-related debris) or potentially contains a high enough concentration of explosives that the material presents an explosive hazard (e.g., equipment, drainage systems, holding tanks, piping, or ventilation ducts that were associated with munitions production, demilitarization, or disposal operations). Excluded from MPPEH are munitions within the DoD-established munitions management system and other items that may present explosion hazards (e.g., gasoline cans and compressed gas cylinders) that are not munitions and are not intended for use as munitions.

Munitions and Explosives of Concern (MEC)—this term, which distinguishes specific categories of military munitions that may pose unique explosives safety risks means: (A) Unexploded Ordnance (UXO), as defined in 10 U.S.C. 101(e)(5)(A) through (C): (B) Discarded military munitions (DMM), as defined in 10 U.S.C. 2710(e)(2): or (C) munitions constituents (e.g., TNT, RDX) present in high enough concentrations to pose an explosive hazard.

National Environmental Policy Act (NEPA)—42 U.S.C. 4321, et seq passed by Congress in 1969. The Act established a national policy designed to encourage consideration of the influences of human activities, such as population growth, high-density urbanization, or industrial development, on the natural environment. The NEPA procedures require that environmental information be made available to the public and the decision-makers before decisions are made. Information contained in the NEPA documents must focus on the relevant issues in order to facilitate the decision-making process.

Outside the Continental United States (OCONUS)—the areas of Alaska, Hawaii, U.S. territories, and possessions and their territorial waters excluding the U.S. and its territorial waters between Mexico and Canada.

Operation—A combination of activities accomplished together for a scheduled period of time for an intended military mission or task. An operation can range in size from a single unit exercise to a Joint or Combined event with many participants (e.g., aircraft, ships, submarines, troops).

Operational Range—a range that is under the jurisdiction, custody, or control of the Secretary of Defense and is used for range activities; or although not currently being used for range activities, that is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities per 10 U.S.C. 101(e)(3).

Ordnance—broadly encompasses all weapons, ammunition, missiles, shells, and expendables (e.g., chaff and flares).

Peak load—the maximum load consumed or produced by a unit or group of units in a stated time period. It may be the maximum instantaneous load or the maximum average load over a designated period of time. The peak system demand during a period of time (peak demand for a day, hour, month).

Platoon—in general, a platoon is a group of 42 individuals.

Range—a land or sea area designated and equipped for firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, exclusionary areas. Also includes airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the Federal Aviation Administration [10 U.S.C. 101 (e)(3)].

Range Activity—an individual training or test function performed on a range or in an Operating Area. Examples include missile launching, bombardment, and vehicle driving. Individual RDT&E functions are also included in this category.

Range Complex—a geographically integrated set of ranges, operational areas, and associated special use airspace, designated and equipped with a command and control system and supporting infrastructure for freedom of maneuver and practice in munitions firing and live ordnance use against scored and/or tactical targets and/or Electronic Warfare tactical combat training environment.

Range Operation—a live training exercise, a research, development test and evaluation (RDT&E) test, or a field maneuver conducted for a specific strategic, operational or tactical military mission, or task. A military action. Operations may occur independently, or multiple operations may be accomplished as part of a larger event. One operation consists of a combination of activities accomplished together. The type of operation can include air, land, sea, and undersea warfare training or testing. Participants can include a specific number and type of aircraft, ships, submarines, amphibious or other vehicles and personnel.

Range Safety Zone—area around air-to-ground ranges designed to provide safety of flight and personnel safety relative to dropped ordnance and crash sites. Land use restrictions can vary depending on the degree of safety hazard, usually decreasing in magnitude from the weapons impact area (including potential ricochet) to the area of armed overflight and aircraft maneuvering.

Readiness—the ability of forces, units, weapon systems, or equipment to deliver the outputs for which they were designed (includes the ability to deploy and employ without unacceptable delays).

Regiment—a Regiment is a unit of three Battalions, approximately 2,880 individuals.

Restricted Area—a designated airspace in which flights are prohibited during published periods of use unless permission is obtained from the controlling authority.

Safety Zone—administratively designated/implied areas designated to limit hazards to personnel and the public, and resolve conflicts between operations. Can include range safety zones, ESQDS, surface danger zones, special use airspace, hazards of electromagnetic radiation to ordnance/hazards of electromagnetic radiation to personnel areas, etc.

Scoping—a process initiated early during preparation of an Environmental Impact Statement to identify the scope of issues to be addressed, including the significant issues related to the Proposed Action. During scoping, input is solicited from affected agencies as well as the interested public.

Sortie—a single operational training or RDT&E event conducted by one aircraft in a range or operating area. A single aircraft sortie is one complete flight (i.e., one take-off and one final landing).

Special Use Airspace—consists of several types of airspace used by the military to meet its particular needs. Special use airspace consists of that airspace wherein activities must be confined because of their nature, or wherein limitations are imposed upon aircraft operations that are not a part of these activities, or both. Special use airspace, except for Control Firing Areas, are charted on instrument flight rules or visual flight rules charts and include hours of operation, altitudes, and the controlling agency.

Stakeholder—those people or organizations that are affected by or have the ability to influence the outcome of an issue. In general, this includes regulators, the regulated entity, and the public. It also includes those individuals who meet the above criteria and do not have a formal or statutorily defined decision-making role.

Submerged Lands—the areas in coastal waters extending from the Guam coastline into the ocean 3 nautical miles (nm) (5.6 kilometers [km]).

Surface Danger Zone (SDZ)—the area surrounding a range that allows for the probability of a munition not landing within the designated target or impact area within which access is controlled for safety during firing.

Sustainable Range Management—management of an operational range in a manner that supports national security objectives, maintains the operational readiness of the Armed Forces, and ensures the long-term viability of operational ranges while protecting human health and the environment.

Targets—earthwork, materials, actual or simulated weapons platforms (tanks, aircraft, EW systems, vehicles, ships, etc.) comprising tactical target scenarios within the range/range complex impact areas.

Uncontrolled Airspace—airspace of defined dimensions in which no air traffic control services to either instrument flight rules or visual flight rules aircraft will be provided, other than possible traffic advisories when the air traffic control workload permits and radio communications can be established.

Unexploded Ordnance (UXO)—military munitions that (A) have been primed, fused, armed, or otherwise prepared for action; (B) have been fired, dropped, launched, projected or placed in such a manner as to constitute a hazard to operations, property, installations, personnel or material; and (C) remained unexploded either by malfunction, design or any other cause [10 U.S.C. 101 (e)(5)(A) through (C)].

Ungulate—any animal having hoofs such as deer, pigs, cattle, etc.

Upland—an area of land of higher elevation.

U.S. Territorial Waters—sea areas within 12 nm of the U.S. coastline, normally measured from the low water mark on the shoreline.

Visual Flight Rules (VFR)—regulations which allow a pilot to operate an aircraft in weather conditions generally clear enough to allow the pilot to see where the aircraft is going.

Wholly Inert—ordnance with no explosive, propellant, or pyrotechnic component (non-reactive); example: BDU-50, BDU-56 (both are non-reactive heavy-weights with no explosive charges).

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CHAPTER 5.
ACRONYM AND ABBREVIATION LIST

°F	degrees Fahrenheit
36 WG	36th Wing
III MEF	Third Marine Expeditionary Force
AAV	Amphibious Assault Vehicle
AADT	Average Annual Daily Traffic
AASHTO	American Association of State Highway and Transportation Officials
ac	acre(s)
ACE	Air Combat Element
ACHP	Advisory Council for Historic Preservation
ACM	asbestos-containing material
A.D.	Anno Domini
AD/ADFM	Active Duty/Active Duty Family Members
ADA	Americans with Disabilities Act
ADAAG	Americans with Disabilities Act Accessibility Guidelines
ADNL	A-weighted Day Night Average Level
ADT	Average Daily Traffic
AFB	Air Force Base
AFI	Air Force Instruction
A-G	air-to-ground
AGL	above ground level
AICUZ	Air Installation Compatible Use Zone
AIDS	Acquired Immune Deficiency Syndrome
AIP	Agreed Implementation Plan
ALPCD	Alien Labor Processing and Certification Division
AMC	Air Mobility Command
AMDTF	Air and Missile Defense Task Force
AMVOC	Advanced Motor Vehicle Operators Course
AOC	Area of Concern
AOR	Area of Responsibility
APC	Areas of Particular Concern
APCSR	Air Pollution Control Standards and Regulations
APE	Area of Potential Effect
APZ	Accident Potential Zone
ARG	Amphibious Readiness Group
APHIS	Agricultural Animal Plant and Health Inspection Service
ARPA	Archaeological Resource Protection Act
A-S	air-to-surface
ASHRAE	American Society of Heating Refrigeration and Air Conditioning Engineers
ASN	Assistant Secretary of the Navy
AST	Aboveground Storage Tank
ASTM	American Standards Society for Testing and Measurements
ATARA	Alliance Transformation and Realignment Agreement
ATC	Air Traffic Control
ATCAA	Air Traffic Control Assigned Airspace
AT/FP	Antiterrorism/Force Protection
AUPM	Above and Underground Storage Tank and Pesticide Management
B	billion
BA	Biological Assessment
BACT	Best Available Control Technology
BASH	Bird Airstrike Hazard Plan
B.C.	Before Christ
BCD	Base Command Officer
BCDC	Bureau of Communicable Disease Control
BDDT	BASH Detection and Dispersal Team
BEQ	Bachelor Enlisted Quarters
BFHNS	Bureau of Family Health and Nursing Services
BFR	Basic Facility Requirements
BHC	Bird Hazard Condition
BI	Beneficial Impact
BMD	Ballistic Missile Defense
BMDTF	Ballistic Missile Defense Task Force
BMP	Best Management Practice
BMUS	Bottomfish Management Unit Species
BO	Biological Opinion
BOD	biological oxygen demand
BOMBEX	Bombing Exercise
BOQ	Bachelor Officer Quarters
BOW	Bilge Oily Waste
BOWTS	Bilge Oily Waste Treatment System
B.P.	Before Present
BPC	Bureau of Primary Care
BFR	Basic Facility Requirements
BQ	Bachelors Quarters
BRAC	Base Realignment and Closure
BRD	Biological Resources Discipline
BRS	Biennial Reporting System
BRSA	Biological Resource Study Area
BS 0	Battle Site Zero
BSP	Bureau of Statistics and Plans
BSTF	Battle Staff Training Facility
BSTS	Battle Staff Training and Simulation
BTS	brown tree snake
Btu	British Thermal Units
BUMED	Bureau of Medicine and Surgery
C&D	Construction and Demolition
CAA	Clean Air Act
CAAA	Clean Air Act Amendments
CAL	Confined Area Landings
CAST	Combined Arms Staff Trainer

CATEX	Categorical Exclusion
$CBOD_5$	Chemical Biological Oxygen Demand – Five Day
CCU	Consolidated Commission on Utilities
CDC	Center for Disease Control
CDF	Confined Disposal Facility
CDL	Clandestine Drug Labs
CDNL	C-weighted DNL
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Act Information Systems
CESQG	Conditionally Exempts Small Quantity Generators
CEQ	Council on Environmental Quality
CFA	Controlled Firing Area
CFR	Code of Federal Regulations
cfs	cubic feet per second
CG	Guided Missile Cruiser
CGC	Coast Guard Cutter
CGP	Construction General Permit
CH_4	methane
CHC	Community Health Clinic
CHCRT	Currently Harvested Coral Reef Taxa
CIP	Capital Improvements Program
CLOMR	Conditional Letter of Map Revision
CLTC	Chamorro Land Trust Commission
cm	centimeter(s)
cm/s	centimeters per second
CMCC	Civil-Military Coordination Council
CMP	Coastal Management Program
CMUS	Crustacean Management Unit Species
CNM	Commander Navy Region Marianas
CNMI	Commonwealth of the Northern Mariana Islands
CNO	Chief of Naval Operations
CO	carbon monoxide
CO_2	carbon dioxide
COFA	Compact of Free Association
COMNAV	Commander Navy Region
COMPACFLT	Commander, U.S. Pacific Fleet
COMSCINST	Commander, Military Sealift Command Instruction
CONOPS	Concept of Operations
CONSENT	Superfund Consent Decrees
CONUS	Continental United States
CORRACTS	Corrective Action Sites
CPA	Commonwealth Ports Authority
CPF	Commander U.S. Pacific Fleet
CPI	Consumer Price Index
CQC	Close Quarters Combat
CREMUS	Coral Reef Ecosystem Management Unit Species
CRM	Coastal Resources Management
CRMO	Coastal Resources Management Office
CRMP	Coastal Resources Management Program
CRRC	Combat Rubber Raiding Craft
CSA	Customer Service Agreement
CSAR	Combat Search and Rescue
CSG	Carrier Strike Group
CSS	Commander Submarine Squadron
CT	Combustion Turbine
CUC	Commonwealth Utilities Corporation
CVN	Carrier Vessel Nuclear
CVW	Carrier Air Wing
CWA	Clean Water Act
CWCS	Comprehensive Wildlife Conservation Strategy
CY	cubic yard(s)
CZ	Clear Zone
CZMA	Coastal Zone Management Act
DAMOS	Disposal Area Monitoring System
DAR	Defense Access Road
dB	decibel(s)
dBA	A-weighted decibel(s)
dBC	C-weighted decibel(s)
DD	Destroyer
DDESB	Department of Defense Explosive Safety Board
DDESS	Dependent Elementary and Secondary Schools
DDG	Guided Missile Destroyer
DEH	Division of Environmental Health
DELISTED NPL	National Priority List Deletions
DEQ	Division of Environmental Quality
DERP	Defense Environmental Restoration Program
DISID	Department of Integrated Services for Individuals with Disabilities
DLM	Department of Land Management
DLNR	Department of Lands and Natural Resources
DM	Defensive Maneuvers
DMHSA	Department of Mental Health and Substance Abuse
DMM	Discarded Military Munitions
DMR	Discharge Monitoring Report
DNL	Day-Night Sound Level
DO	dissolved oxygen
DoC	Department of Corrections
DoD	Department of Defense
DoDEA	Department of Defense Education Activity
DOE	Department of Energy
DOI	Department of the Interior
DOJ	Department of Justice
DoN	Department of the Navy
DOPAA	Description of Proposed Action and Alternatives
DOT	Department of Transportation

DOT OPS	Department of Transportation Office of Pipeline Safety Incident and Accident Data
DPHSS	Department of Public Health and Social Services
DPL	Department of Public Lands
DPRI	Defense Policy Review Initiative
DPS	Department of Public Safety
DPW	Department of Public Works
DRMO	Defense Reutilization and Marketing Office
DRS	Demand Response Service
DSAY	Discount Service Acre Year
DSMOA	DoD & State/Territorial Memorandum of Agreement
DU	dwelling unit
DU/ac	dwelling units per acre
DYA	Department of Youth Affairs
E&ECR	Erosion and Sediment Control Regulation
EA	Environmental Assessment
EAC	Economic Adjustment Committee
EC	Electronic Combat
ECM	earth-covered magazine
ECO	Environmental Compliance Officer
EC-OPS	Electronic Combat Operations
ECHO	Enforcement and Compliance History Online
ECP	entry control point
EDR	Environmental Data Resources
EET	Energy Efficient Transport
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EJ	Environmental Justice
EMI	Electromagnetic Interference
EMR	Electromagnetic Radiation
EMUA	Exclusive Military Use Area
ENSO	El Niño Southern Oscillation
EO	Executive Order
EOD	Explosive Ordnance Disposal
EPACT	Energy Policy Act of 2005
EPCRA	Emergency Planning & Community Right-To-Know Act
EPP	Environmental Protection Plan
ERA	Ecological Reserve Area
ERNS	Emergency Response Notification System
ER-L	Effects Range-Low
ER-M	Effects Range-Median
ESA	Endangered Species Act
ESAL	Equivalent Single Axle Loading
ESG	Expeditionary Strike Group
ESQD	Explosive Safety Quantity Distance
ESS	Explosive Safety Submission
FAA	Federal Aviation Administration
FACSFAC	Fleet Area Control and Surveillance Facility
FAM	Familiarization and Instrument Flight
FARP	Forward Arming and Refueling Point
FAS	Freely Associated States of Micronesia
FCLP	Field Carrier Landing Practice
FDC	Fire Direction Center
FDM	Farallon de Medinilla
FEMA	Federal Emergency Management Agency
FEP	Fishery Ecosystem Plan
FEPCA	Federal Pesticide Control Act
FFCA	Federal Facilities Compliance Act
FHWA	Federal Highway Administration
FINDS	Facility Index System
FIFRA	Federal Insecticide, Fungicide and Rodenticide Act
FIP	Flight Information Public
FIREX	Firing Exercise
FIRM	Flood Insurance Rate Map
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
FOC	Full Operational Capability
FPPA	Farmland Protection Policy Act
FR	Federal Register
FSM	Federated States of Micronesia
ft	foot/feet
ft^2	square foot/feet
FTA	Federal Transit Administration
FTE	full time equivalent
FTTS	FIFRA/TSCA Tracking System
FTX	Field Training Exercise
FUDS	Formerly Used Defense Sites
FWCA	Fish and Wildlife Coordination Act
FY	Fiscal Year
GAIN	Guam Animals in Need
GALC	Guam Ancestral Lands Commission
GAR	Guam Administrative Regulations
GBB	Gershman, Brickner, & Bratton, Inc.
GBSP	Guam Bureau of Statistics and Plans
GCA	Guam Code Annotated
GCC	Guam Community College
GCE	Ground Combat Element
GCMP	Guam Coastal Management Plan
GCR	General Conformity Rule
GCWCS	Guam Comprehensive Wildlife Conservation Strategy
GDAWR	Guam Division of Aquatic and Wildlife Resources
GDISID	Guam Department of Integrated Services for Individuals with Disabilities
GDLM	Guam Department of Land Management
GDMHSA	Guam Department of Mental Health and Substance Abuse
GDoC	Guam Department of Corrections
GDoL	Guam Department of Labor
GDP	Guam Police Department
GDPHSS	Guam Department of Public Health and Social Services

GDPR	Guam Department of Parks and Recreation
GDPW	Guam Department of Public Works
GDYA	Guam Department of Youth Affairs
GEDA	Guam Economic Development Authority
GEPA	Guam Environmental Protection Agency
GFD	Guam Fire Department
GHG	greenhouse gas
GHMP	Guam Hazard Mitigation Plan
GHPO	Guam Historic Preservation Office
GHRA	Guam Hotel and Restaurant Association
GIAA	Guam International Airport Authority
GIMDP	Guam Integrated Military Development Plan
GIP	Gross Island Product
GIS	Geographic Information System
GJMMP	Guam Joint Military Master Plan
GLUC	Guam Land Use Commission
GLUP	Guam Land Use Plan
GMH	Guam Memorial Hospital
GMHA	Guam Memorial Hospital Authority
GNWR	Guam National Wildlife Refuge
GoJ	Government of Japan
GovGuam	Government of Guam
GPA	Guam Power Authority
gpcd	gallons per capita per day
gpd	gallons per day
GPD	Guam Police Department
GPLS	Guam Public Library System
gpm	gallons per minute
GPSS	Guam Public School System
GRHP	Guam Register of Historic Places
GRN	Guam Road Network
GRT	Gross Receipts Tax
GSCSCR	Government of Guam Soil Erosion And Sediment Control Regulations
GSF	gross square feet
GSM	gross square meters
GTP	2030 Guam Transportation Plan
GTR	Ground Threat Reaction
GUNEX	Gunnery Exercise
GVB	Guam Visitors Bureau
GW	groundwater
GWA	Guam Waterworks Authority
GWMPZ	ground water management protection zone
GWP	global warming potential
GWQS	Guam Water Quality Standards
GWUDI	groundwater under the direct influence of surface water
ha	hectare(s)
HACCP	Hazard Analysis and Critical Control Points
HAP	Hazardous Air Pollutant(s)
HAPC	Habitat Area of Particular Concern
HC	hydrocarbon
HCF	hydroflurocarbon
HCM	Highway Capacity Manual
HDPE	high-density polyethylene
HDD	Horizontal Directional Drilling
HE	high explosive
HEA	Habitat Equivalency Analysis
HERO	Hazards of Electromagnetic Radiation to Ordnance
HERP	Hazards of Electromagnetic Radiation to Personnel
HFC	hydrofluorocarbons
HIE	Helicopter Insertion/Extraction
HIV	Human Immunodeficiency Virus
HMIRS	Hazardous Materials Information Reporting System
HMMP	Hazardous Materials Management Plan
HMMWV	High Mobility Multi-Purpose Wheeled Vehicle
HMU	Habitat Management Unit
HPO	Historic Preservation Office(r)
HPV	high-priority violation
HQ	Headquarters
hr	hour(s)
HSC	Helicopter Sea Combat Squadron
HSIP	Highway Safety Improvement Program
HSV	High Speed Vessel
HSWA	Hazardous and Solid Waste Amendments
HUBZone	Historically Underutilized Business Zone
HVAC	heating, ventilation, and air conditioning
HWMP	Hazardous Waste Management Program
Hz	hertz
IAP	International Airport
IAS	invasive alien species
IBB	International Broadcasting Bureau
ICC	information coordination central
ICIS	Integrated Compliance Information System
ICRMP	Integrated Cultural Resources Management Plan
IGPBS	Integrated Global Presence and Basing Strategy
IFR	Instrument Flight Rules
IMP	Integrated Management Practice
IMS	invasive marine species
in	inch(es)
INRMP	Integrated Natural Resources Management Plan
INST CONTROLS	Sites with Institutional Controls
IOC	Initial Operational Capability
IPCC	Intergovernmental Panel on Climate Change
IPMP	Integrated Pest Management Plan
IPP	Independent Power Producers
IRIS	Integrated Risk Information System
IRP	Installation Restoration Program
ISA	Inter-Service Agreement
ISO	International Organization for Standardization
ISR	Intelligence, Surveillance, and Reconnaissance
ISWMP	Integrated Solid Waste Management Plan

ITC	International Trade Center
IWPS	Island-Wide Power System
JBIC	Joint Bank of International Cooperation
JGPO	Joint Guam Program Office
JSDF	Japanese Self-Defense Force
JRC	Joint Region Commander
JRM	Joint Region Marianas
KD	known distance
kg	kilogram
kg/day	kilograms per day
km	kilometer(s)
km^2	square kilometer(s)
knots	nautical miles per hour
kph	kilometers per hour
kV	kilovolts
kW	kilowatt(s)
kW/hr	kilowatts per hour
L	liter(s)
LAER	Lowest Achievable Emission Rate
LandGEM	Landfill Gas Emissions Model
LAV	Light Armored Vehicle
lb	pound(s)
LBA	Leaseback Area
LBP	lead-based paint
LCAC	Landing Craft Air Cushion
LCE	Logistic Combat Element
LCU	Landing Craft Utility
LEDPA	Least Environmentally Damaging Practicable Alternative
LEED	Leadership in Energy and Environmental Design
L_{eq}	equivalent sound level
LF	linear feet
LFG	Landfill Gas
LHA/LHD	Amphibious Assault Ship
LID	Low Impact Development
LIDAR	Light Detection and Ranging
LLDP	linear low-density polyethylene
L_{max}	Maximum Sound Level
LNG	Liquefied Natural Gas
LOS	Level of Service
LPD	Amphibious Transport Dock
lpm	liters per minute
LQG	large quantity generator
LSD	Dock Landing Ship
LSI	Less than significant impact
LUCIS	Land Use Control Information Systems
LZ	Landing Zone
m	meter(s)
m^2	square meter(s)
m^3	cubic meters(s)
M	million
MAGC	Marine Air Control Group
MAGTF	Marine Air Ground Task Force
MALS	Marine Aviation Logistics Squadron
MAP	Military Access Point
Marine Corps	United States Marine Corps
MARFORPAC	Marine Forces Pacific
MAW	Marine Aircraft Wing
MBP	Micronesia Biosecurity Plan
MBTA	Migratory Bird Treaty Act
MCB	Marine Corps Base
MCMEX	Mine Counter Measures Exercise
MC	Munitions Constituents
MCCS	Marine Corps Community Service
MCL	Maximum Concentration Level
MCMEX	Mine Counter Measures Exercise
MCO	Marine Corps Order
MCP	Mariana Islands Concept Plan
MCTL	Marine Corps Task List
MDA	Missile Defense Agency
MEB	Marine Expeditionary Brigade
MEC	Munitions and Explosives of Concern
MEF	Marine Expeditionary Force
MEU	Marine Expeditionary Unit
MFP/CPF	Marine Forces Pacific/Commander Pacific Fleet
MFR	multi-family residential
MG	million gallons
mg/cm^2	milligrams per square centimeter
MGd	million gallons per day
mg/L	milligrams per liter
mi	mile(s)
mi^2	square miles
MILCON	Military Construction
MIP	Medically Indigent Program
MIRC	Mariana Islands Range Complex
MISSILEX	Missile Exercise
ML	million liters
MLA	Military Lease Area
MLd	million liters per day
MLG	Marine Logistic Group
MLLW	mean lower low water
MLTS	Material Licensing Tracking System
mm	millimeter(s)
MMPA	Marine Mammal Protection Act
MMR	Military Munitions Rule
MMRP	Military Munitions Response Program
MMT	Marine Monitoring Team
MOA	Memorandum of Agreement
MOS	Military Occupational Specialty
MOU	Memorandum of Understanding
MOUT	Military Operations in Urban Terrain
MP	Military Police
MPA	microscopic particulate analyses
MPA	Marine Protected Area
mph	miles per hour
MPLA	Marianas Public Land Authority
MPPEH	material potentially presenting an explosive hazard
MPRSA	Marine Protection, Research, and Sanctuaries Act

MRA	Munitions Response Area
MRC	Marine Research Consultants
MRP	Marine Resource Preserve
MRS	Munitions Response Sites
MSA	Munitions Storage Area
M-SA	Magnuson-Stevens Fishery Conservation and Management Act
MSAT	Mobile Source Air Toxics
MSC	Military Sealift Command
msl	mean sea level
MSM	modular storage magazine
MSWLF	Municipal Solid Waste Landfill Facility
MTVR	Medium Tactical Vehicle Replacement
MUS	Management Unit Species
MUSE	Mobile Utilities Support Equipment
MUTCD	Manual on Uniform Traffic Control Devices
MVA	mega volt ampere
MW	megawatts
MWDK	Military Working Dog Kennel
MWR	Morale, Welfare, and Recreation
N_2O	nitrous oxide
NA	not applicable
NAA	Non-Attainment Area
NAAQS	National Ambient Air Quality Standards
NAC	Noise Abatement Criteria
NATA	National Air Toxics Assessment
NAV	Navy Ashore Vision
NAVCAMS	Naval Communication Area Master Station
NAVFAC	Naval Facilities Engineering Command
NC	New Construction
NCP	National Contingency Plan
NCTMS	Naval Computer and Telecommunications Main Station
NCTS	Naval Computer and Telecommunications Station
ND	Neighborhood Development
NDAA	National Defense Authorization Act
NDWWTP	Northern District Wastewater Treatment Plant
NELHA	National Energy Laboratory of Hawaii Authority
NEO	Noncombatant Evacuation Operations
NEPA	National Environmental Policy Act
NEW	net explosive weight
NEXRAD	Next Generation Weather Radar
NFIP	National Flood Insurance Program
NFRAP	No Further Remedial Action Planned List
NGL	Northern Guam Lens
NGLA	Northern Guam Lens Aquifer
NGO	Non-Governmental Organization
NHL	National Historic Landmark
NHPA	National Historic Preservation Act
NHP	National Historic Park
NI	No impact
NIOSH	National Institute for Occupational Safety and Health
NISC	National Invasive Species Council
NITTS	Noise Induced Temporary Threshold Shift
NLNA	northern land navigation area
nm	nautical mile(s)
nm^2	square nautical mile(s)
NMC-DET	Navy Munitions Command Detachment
NMFS	National Marine Fisheries Service
NMS	Naval Munitions Site
NNPP	Naval Nuclear Propulsion Program
NO_2	nitrogen dioxides
NO_X	nitrogen oxides
NOA	notice of availability
NOAA	National Oceanic and Atmospheric Administration
NOI	Notice of Intent
NOPH	notice of public hearing
NOSSA	Naval Ordnance Safety and Security Activity
NOTAM	Notice to Airmen
NOTMAR	Notice to Mariners
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NPS	National Park Service
NRC	Nuclear Regulatory Commission
NRCHC	Northern Region Community Health Center
NRCS	Natural Resources Conservation District
NRHP	National Register of Historic Places
NRMC	Navy Regional Medical Center
NSR	New Source Review
NSV	North San Vitoris
NTU	nephelometric turbidity unit
NW	nearshore waters
NWF	Northwest Field
NWI	National Wetland Inventory
NWR	National Wildlife Refuge
O_3	ozone
O&M	Operations and Maintenance
ODMDS	Ocean Dredged Material Disposal Site
OEA	Overseas Environmental Assessment
OEIS	Overseas Environmental Impact Statement
OHA	Overseas Housing Allowance
OIA	Office of Insular Affairs
OPA	Oil Pollution Act
OPNAVINST	Office of the Chief of Naval Operations Instruction
OSD	Office of the Secretary of Defense
OSHA	Occupational Safety and Health Administration
OTEC	Ocean Thermal Energy Conversion
P2	Pollution Prevention
PA	Programmatic Agreement
PAC-3	Patriot Advanced Capability-3

PACAF	Pacific Air Forces
PACOM	U.S. Pacific Command
PAG	Port Authority of Guam
PAH	polynuclear aromatic hydrocarbon
Pb	lead
PCB	polychlorinated biphenyl
PCE	perchloroethylene
PE	private entity
PFC	perfluorocarbon
PHCRT	potentially harvested coral reef taxa
PHL	Potential Hearing Loss
PI	potential impact
PK-15	Unweighted Peak, 15% Metric
PL	Public Law
PLS	Public Library System
PM	particulate matter
$PM_{2.5}$	particulate matter less than 2.5 microns in diameter
PM_{10}	particulate matter less than 10 microns in diameter
PMO	Personnel Management Office
PMUS	Pelagic Management Unit Species
POL	petroleum, oil, and lubricants
POV	privately-owned vehicle
PPA	Pollution Prevention Act
PPE	personal protective equipment
ppm	parts per million
ppt	parts per thousand
PSD	Prevention of Significant Deterioration
psi	pounds per square inch
PUC	Public Utilities Commission
pv	photovoltaic
PVC	polyvinyl chloride
PYE	person years of employment
PWC	Public Works Center
QDR	Quadrennial Defense Review
QOL	Quality of Life
RA	Restricted Area
RAATS	RCRA Administrative Action Tracking System
RAB	Restoration Advisory Board
RADINFO	Radiation Information Database
RCRA	Resource Conservation and Recovery Act
RCRIS	Resource Conservation and Recovery Act Information System
REA	Rapid Ecological Assessment
REC	Regional Environmental Coordinator
REDHORSE	Rapid Engineer Deployable Heavy Operations
Req'd	required
RHA	Rivers and Harbors Act
RHIB	Rigid Hull Inflatable Boat
RIA	Regulatory Impact Analysis
RO	reverse osmosis
ROD	Record of Decision
ROI	region of influence
RORO	roll-on roll-off
ROW	right-of-way
RPM	revolutions per minute
RSE	Repair Squadron Engineer
RTA	Range Training Area
SAFETEA-LU	Safe, Accountable, Flexible, Efficient Transportation Equity Act – A Legacy for Users
SAIA	Sikes Act Improvement Act
SARA	Superfund Amendments and Reauthorization Act
SAR	Second Assessment Report
SARNAM	Small Arms Range Noise Assessment Model
SAS	Special Aquatic Sites
SAT	Stationary Armor Target
SBHSR	Ship-Borne Hazardous Substance Regulations
SCC	Security Consultative Committee
SCH	school
SCR	Selective Catalytic Reduction
SCS	Soil Conservation Service
SCUBA	self-contained underwater breathing apparatus
SDWA	Safe Drinking Water Act
SDZ	Surface Danger Zone
SEABEE	Construction Battalion
SECNAV	Secretary of the Navy
SEI	Sea Engineering Inc.
SEL	Sound Exposure Level
SF_6	sulfur hexafluoride
SFR	single-family residential
SHSP	Strategic Highway Safety Plan
SHPO	State Historic Preservation Office
SI	Significant impact
SIAS	Socioeconomic Impact Assessment Study
SI-M	Significant impact mitigable to less than significant
SINKEX	Sink Exercise
SIP	State Implementation Plan
SIT	Stationary Infantry Target
SLAMRAAM	Surface-Launched Advanced Medium-Range Air-to-Air Missile
SLC	Submarine Learning Center
SMMP	Site Management and Monitoring Plan
SNC	Significant Non-Compliance
SNU	Skilled Nursing Unit
SO	stipulated order
SO_2	sulfur dioxide
SOC	species of concern
SOFA	Status of Forces Agreement
SOGCN	Species of Greatest Conservation Need
SOP	Standard Operating Procedure
SPAWAR	Space and Naval Warfare Systems Command
SPCC	Spill Prevention, Control and Countermeasure

SPE	Special Purpose Entity
SPS	Sewage Pump Station
SQG	small quantity generator
SRBM	Short-range Ballistic Missile
SRCHC	Southern Region Community Health Center
SRF	Ship Repair Facility
S-S	surface-to-surface
SSTS	Section Seven Tracking System
STD	sexually transmitted disease
STOM	Ship-to-Objective Maneuver
STP	sewage treatment plant
SUA	Special Use Airspace
SW	surface water/stormwater
SWMD	Solid Waste Management Division
SWMP	Stormwater Management Plan
SWMU	solid waste management unit
SWPPP	Stormwater Pollution Prevention Plan
T&D	Transmission and Distribution
T-AKE	Auxiliary Dry Cargo/Ammunition Ship
T-AKR	Sealift Ship
TAOC	Tactical Air Operations Center
TB	tuberculosis
TBD	To Be Determined
TBP	To Be Provided
TBT	tribulyl tin
TCE	trichloroethylene
TCP	Training Concept Plan
TDS	total dissolved solids
TEC JV	TEC Inc. Joint Venture
TERF	Terrain Flights
THAAD	Terminal High-Altitude Area Defense
TJS	Tactical Jamming System
TMDL	Total Maximum Daily Load
TMP	Traffic Management Plan
TNAP	Traffic Noise Abatement Policy
TNM	Traffic Noise Model
TOC	total organic carbon
TORPEX	Torpedo Exercise
TPFD	Time-Phased Force Deployment
TPY	tons per year
TRIS	Toxic Release Inventory System List
TSCA	Toxic Substance Control Act
TSS	total suspended solids
TTIP	Territorial Transportation Improvement Plan
TTLC	total threshold limit concentration
UAV	Unmanned Aerial Vehicle
UD	unknown distance
UF	usage factor
UFC	Unified Facilities Criteria
UFW	Unaccounted for Water
µg/L	micrograms per liter
UoG	University of Guam
UNFCC	United Nations Framework Convention on Climate Change
U.S.	United States
USACE	U.S. Army Corps of Engineers
USC	U.S. Code
USCG	U.S. Coast Guard
USCRTF	U.S. Coral Reef Task Force
USDA	U.S. Department of Agriculture
USDA-APHIS	U.S. Department of Agriculture Animal and Plant Health Inspection Service
USDA-WS	U.S. Department of Agriculture-Wildlife Services
US ENG CONTROLS	Engineering Controls Site List
USEPA	U.S. Environmental Protection Agency
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service
USGBC	U.S. Green Building Council
USGS	U.S. Geological Service
USLE	Universal Soil Loss Equation
UST	underground storage tank
UXO	unexploded ordnance
v	volt(s)
VA	Veterans Affairs
v/c	volume to capacity
VCO	Volunteer Conservation Officer
VCP	vitrified clay pipe
VFR	Visual Flight Rules
VHF	very high frequency
VHT	vehicle hours traveled
VIF	Vehicle Inspection Facility
VMT	vehicle miles traveled
VOC	volatile organic compound
vpd	vehicles per day
VQCF	Vehicle Queuing Control Facility
VWP	Visa Waiver Program
WA	Warning Area
WPC	Watershed Planning Committee
WPCP	Water Pollution Control Program
WPRFMC	Western Pacific Regional Fisheries Management Council
WQC	Water Quality Certification
WQMP	Water Quality Monitoring Plan
WRDA	Water Resource Development Acts
WRMP	Water Resources Master Plan
WTE	Waste-to-Energy
WTP	Water Treatment Plant
WWII	World War II
WL	wetlands
WWTP	Wastewater Treatment Plant
yd	yard
ZID	zone of initial dilution

Final

Environmental Impact Statement

GUAM AND CNMI MILITARY RELOCATION

Relocating Marines from Okinawa, Visiting Aircraft Carrier Berthing, and Army Air and Missile Defense Task Force

Volume 7: Proposed Mitigation Measures, Preferred Alternatives' Impacts, and Cumulative Impacts

July 2010

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Guam and CNMI Military Relocation EIS

Volume 7: Proposed Mitigation, Preferred Alternatives' Impacts, and Cumulative Impacts

Table of Contents

List of Figures

List of Tables

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CHAPTER 1. INTRODUCTION

Volumes 2 through 6 of this Environmental Impact Statement (EIS) presented project-specific impacts and proposed mitigation measures for the proposed actions and alternatives. In contrast to the previous volumes, Volume 7 (this volume) addresses the impacts of *all* components of the preferred alternatives, in total, for both Guam and Tinian. The purpose of this volume is to list best management practices (BMPs) and proposed mitigation measures identified throughout the EIS (Chapter 2), present the combined impacts of the preferred alternatives (Chapter 3), and present the cumulative impacts of the preferred alternatives in combination with other past, present, and reasonably foreseeable future actions (Chapter 4).

The information provided in Volume 7 is organized into four chapters:

- Chapter 1, Introduction, summarizes the preferred alternatives described in previous volumes for Guam and Tinian. An overview of key natural events and human actions that have influenced the resources on both islands since World War II (WWII) is presented to provide an historical context for the current environmental setting of each island.
- Chapter 2, Overview of Best Management Practices and Proposed Mitigation Measures, summarizes the mitigation and BMPs that were identified in previous volumes of this EIS. Mitigation measures are measures that are proposed to avoid, minimize, rectify, reduce/eliminate, or provide compensation for an impact resulting from implementation of an alternative. Chapter 2 also presents a discussion of force flow reduction and adaptive program management techniques that could be used to further mitigate construction and operations impacts, and minimize impacts to public infrastructure and resources due to increased population.
- Chapter 3, Preferred Alternatives: Summary of Impacts, describes the impacts of the preferred alternatives for achieving the proposed Marine Corps, Navy and Army objectives identified on Guam and Tinian. Volumes 2 through 6 focused on the potential impacts of the numerous proposed actions and alternatives by action proponent and geography. However, there may be impacts generated by the preferred alternatives that are not apparent when independently assessing project-specific impacts from the Marine Corps relocation, Navy transient aircraft carrier berthing, and Army Air Missile Defense Task Force (AMDTF). This is especially true for Guam where there are many different projects proposed under the preferred alternatives. Since fewer actions are proposed for Tinian, the summary of impacts in Volume 3 suffices as the summary analysis; therefore, an additional summary analysis is not provided in this volume. Tinian is located approximately 135 miles (mi) (217 kilometers [km]) from Guam and is not expected to be influenced by environmental impacts on Guam resulting from implementation of the preferred alternatives.

  "No action" is defined as the affected environment without any of the projects proposed in this EIS to support the Marine Corps relocation, Navy transient aircraft carrier berthing, and Army AMDTF. The summary of impacts associated with the preferred alternatives is compared by resource to no action. The preferred alternatives' impacts are compared to resource trends and stressors for each island under no action to assess whether the preferred alternatives would influence island-wide trends in resource health.

Chapter 3 also summarizes secondary impacts of the preferred alternatives and provides a summary of potential Clean Water Act (CWA) Section 404 actions under all alternatives, as described in Volumes 2 through 6.

- Chapter 4, Cumulative Impacts, assesses impacts on the environment resulting from the incremental impact of the preferred alternatives when added to other past, present, and reasonably foreseeable future actions (cumulative projects) regardless of what agency (federal or non-federal) or person undertakes the action. A cumulative project list was generated for the time period between 2004 and 2019. A determination was made whether reasonably foreseeable actions would have an additive effect when combined with the effects of the proposed actions included in the preferred alternatives. For each resource area with a potential for an additive effect, an assessment of severity (e.g., adverse, beneficial and low, moderate, or strong) of those potential cumulative impacts is presented.

1.1 PREFERRED ALTERNATIVES

The term "preferred alternatives" is a collective term that encompasses all components of the preferred alternatives described in previous volumes for the Marine Corps relocation, Navy transient aircraft carrier berthing, and Army AMDTF.

1.1.1 Geographic Boundaries

The geographic boundaries of analyses in Volume 7 are the islands of Guam and Tinian. They are sufficiently distant from each other as to have minimal aggregate effects on each other.

1.1.2 Guam Preferred Alternatives

The proposed actions consist of: 1) constructing facilities and infrastructure to support the relocation of approximately 8,600 Marines and their dependents from Okinawa (Japan) to Guam, 2) constructing a Navy deep-draft wharf with shoreside infrastructure improvements for transient aircraft carriers, and 3) constructing facilities and infrastructure on Guam to support relocation of approximately 600 military personnel and their dependents in order to establish and operate an Army AMDTF.

In summary, implementation of the proposed actions would include the following major components:

- Temporary increase in population associated with the construction-related workforce.
- Permanent increase in the number of military and civilian personnel and dependents on Guam with a transient presence during training on Tinian.
- Increase in number and types of major equipment to support military personnel and operations (e.g., aircraft, ships, amphibious watercraft).
- Increase in number and types of training activities.
- Construction of new facilities and improvements to existing facilities (main cantonment, training, waterfront, airfield, family housing, community support).
- Improvements to existing and construction of new infrastructure (including roads, utilities, etc.).
- Acquisition or long-term leasing of additional land.

Table 1.1-1 lists the key functions requiring new or improved facilities by proponent. The development areas are shown on Figure 1.1-1.

Table 1.1-1. Summary of Preferred Alternatives - Guam

Volume(s)	*2 and 6*	*4*	*5*
Proponent	*Marine Corps*	*Navy*	*Army-Air Missile Defense Task Force*
Function	*Primary Geographic Area- New facilities or existing*		
Main Cantonment	NCTS Finegayan - new facilities	-	-
Family housing and community support	South Finegayan/Former FAA - new facilities	-	-
Waterfront Operations	Inner Apra Harbor - improve existing plus new facilities	Outer Apra Harbor (Polaris Point) - new facilities	-
Airfield operations/ training	Andersen Air Force Base (AFB) - new facilities at existing airfield	-	Andersen AFB –new facilities
Live fire training	East of Andersen South - new facilities	-	-
Non-firing training	Andersen South - new facilities at existing training area	-	Northwest Field – new facilities
Munitions storage	Naval Munitions Site/Andersen AFB - new facilities at existing storage area	-	Andersen AFB – new facilities
Utilities			
Power	Recondition up to 5 existing GPA permitted facilities to provide peaking power/reserve capacity	-	-
Water	Andersen AFB and Navy Barrigada- new wells, storage and distribution facilities	-	-
Wastewater	Northern District Wastewater Treatment Plant - upgrade existing facilities to secondary treatment	-	-
Solid waste	Apra Harbor - Navy landfill - existing facility	-	-
Roadways	Across island - improve existing roadways and build new roadways	-	-

Legend: - = Not applicable
Note: While the Army and Navy missions would share many of the new facilities and roadways, the Marine Corps requirements generate most of the infrastructure construction and improvements.

1.1.3 Tinian Preferred Alternative

The proposed actions on Tinian are for the development and operation of four firing ranges; each range is located within the Military Lease Area (MLA). Volume 3 describes the proposed actions. The proposed ranges are:

1. Rifle known distance range.
2. Automated combat pistol/multipurpose firearm qualification course.
3. Platoon battle course.
4. Field firing range.

The preferred alternative for firing ranges is shown on Figure 1.1-2.

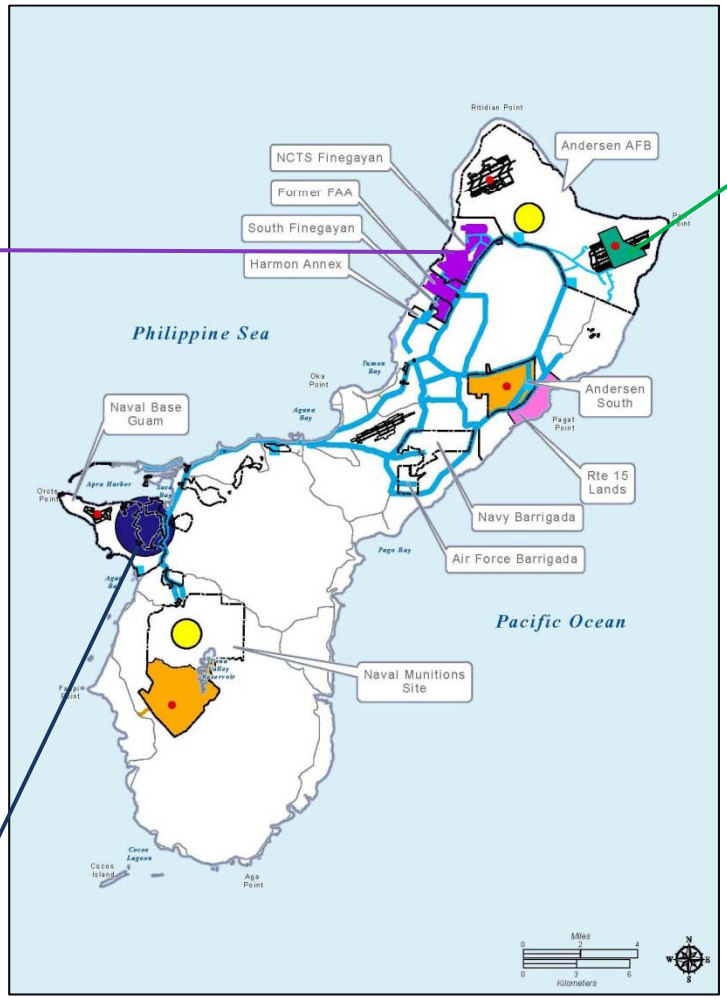
Figure 1.1-1 Overview of Preferred Alternatives on Guam

Main Cantonment Functions

- Headquarters (HQ) and Administrative:
  - Administrative offices
  - Vehicle maintenance
  - Communications
  - Security
  - Warehousing
  - Armory
  - Fuel storage
  - HAZMAT, DRMO, Recycling
- Base Operations:
  - Administrative offices
  - Police/fire facilities
  - Base Access
  - Warehousing
  - Legal services, dental services, family services, and MWR support
- Bachelor's Quarters and Temporary Lodging
- Family Housing
- Educational Facilities
- Quality of Life Functions:
  - Community center, commissary, exchange, post office, theater, recreational, etc.
  - Applied instruction and auditorium
  - Services: restaurant, bank, gas station

Waterfront Functions

- Amphibious task force ship berthing
- Embarkation and cargo inspection and staging area
- LCAC/AAV laydown area
- Apra Harbor medical/dental clinic
- Relocations: Military Working Dog Kennels, USCG wharf and support facilities
- Aircraft carrier wharf and navigation channel



Interim Utilities & Roadways

- Roadways [new & existing]
- Solid waste, water, wastewater, & power

Airfield Functions

- Air embarkation
- ACE beddown:
  - Hangars/aprons
  - Administrative
  - Maintenance
  - Fire and rescue

Training Functions

- Training Range Complex:
  - Live-firing ranges
  - Indoor small arms range
  - Demolition range
- Ammunition storage
- Non-firing Ranges:
  - Obstacle course
  - Hand-to hand combat
  - Gas chamber
  - Advanced motor vehicle course
  - Rappelling
  - Engineer equipment and decontamination training facility
  - Maneuver training
  - Range support buildings
- Aviation Training:
  - Tactical air operations training
  - Improved airfield
  - Landing zones
  - Air traffic control
- Command, Control and Simulation:
  - Battle Staff Training
  - Combined arms training
  - Audio visual and simulation training

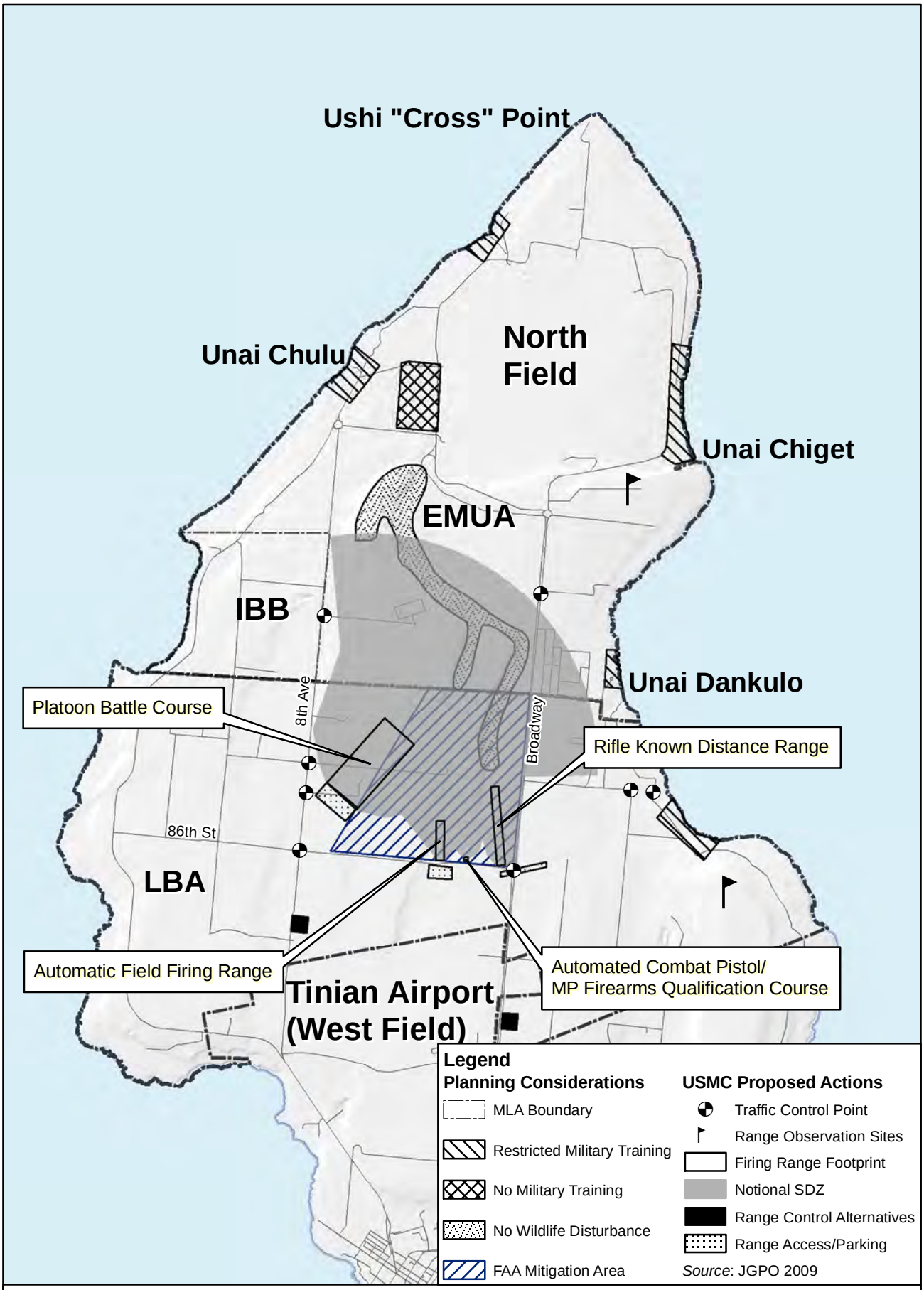


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Figure 1.1-2
Range Training Area Alternative 1

1.2 NO ACTION

"No action" as it is used in Volume 7, represents the island-wide (Guam and Tinian) status quo, assuming none of the proposed actions in this EIS are implemented. The resources would be subject to the same influences (stressors) that they are today. Chapter 3 describes no action by resource. The current trends in the conditions of resources are assumed to proceed at the same rate into the future for most resources.

1.3 HISTORICAL PERSPECTIVE - GUAM

The proposed actions on Guam would result in significant changes to the natural and built environments. Historically, there have been events – both naturally occurring and the result of man's actions (anthropogenic) – that have also resulted in significant impacts to the island environment. This section provides a brief overview of Guam and the events that have shaped its history and altered the ecology of the island. The individual resource assessments in Chapter 3 provide more detail.

1.3.1 Location and Brief Social History

Guam is an island in the western Pacific Ocean and is an organized, unincorporated territory of the U.S. It is one of five U.S. territories with an established civilian government (Office of Insular Affairs 2007). The island's capital is Hagatna (formerly Agana). Guam is the largest and southernmost of the Mariana Islands. It is 30 mi (48 km) long and 4 mi (6 km) to 12 mi (19 km) wide. Guam lies between 13.2°N and 13.7°N and between 144.6°E and 145.0°E; it has an area of 212 square miles [mi^2] (549 square kilometers [km^2]) making it the 32nd largest island of the U.S. Guam is the closest land mass to the Mariana Trench, a deep subduction zone that lies beside the island chain to the east. Challenger Deep, the deepest surveyed point in the Western Pacific Ocean, is southwest of Guam at 35,797 feet [ft] (10,911 meters [m]) deep. The highest point on Guam is Mount Lamlam, which is 1,332 ft (406 m) above sea level. Since it extends into the Mariana Trench, it is also considered the tallest mountain in the world (measured from below sea level).

Guam, which was formed by an uplift of undersea volcanoes, is surrounded by coral reefs near the shore. The island is composed of two distinct geologic areas of about equal size. The northern part of the island is a high coralline limestone plateau rising 850 ft (259 m) above sea level. This area contains the northern water lens, which is the main source of fresh water for Guam. The southern region is mountainous with elevations from 700 ft (213 m) to 1,300 ft (396 m) above sea level.

The Chamorros, Guam's indigenous people, first populated the island approximately 4,000 years ago (Tasi 2009). The island has a long history of European colonialism and was controlled by Spain until 1898 when it was surrendered to the U.S. as part of the Treaty of Paris following the Spanish American War. As the largest island in Micronesia, and the only American-held island in the region before WWII, Guam was captured by the Japanese shortly after the attack on Pearl Harbor, Hawaii, and was occupied for two and a half years. Guam was subject to fierce fighting when American troops recaptured the island on July 21, 1944, a date commemorated every year as Liberation Day.

1.3.2 Guam Today

Guam's economy depends primarily on tourism, DoD installations, and locally-owned businesses. Residents of Guam pay federal income tax; they do not vote in federal elections, and their representative in Congress cannot vote.

Guam is a popular destination for Japanese and other east-bound tourists since it requires a relatively shorter flight from Asia or Australia (as compared to Hawaii). Tumon, the tourist hub, features more than 20 large hotels, accommodating over a million tourists per year and providing access to seven public golf

courses. Although 75% of Guam's tourists are Japanese, Guam also receives a sizable number of tourists from South Korea, the U.S., the Philippines, and Taiwan.

1.3.3 Historical Events That Have Affected Guam

1.3.3.1 Key Natural Events and Occurrences Affecting the Ecology of Guam

Earthquakes

Guam experiences occasional earthquakes due to its location on the western edge of the Pacific Plate and near the Philippine Sea Plate. In recent years, earthquakes with epicenters near Guam have had magnitudes ranging from 5.0 to 7.8.

- On October 30, 1936 (October 29, Universal Time), a magnitude 6.7 shock occurred about 80 mi (125 km) southwest of Guam resulting in cracked walls and fallen tile and plaster for Guam households and businesses. The seismic observer at Guam reported 25 tremors during the day of October 30.
- Another earthquake originated in the same area as the 1936 shock on September 16, 1970. The magnitude 6.2 tremor also caused minor damage on Guam.
- A similar occurrence on November 1, 1975 (magnitude 6.2) produced damage on Guam that reached $1 million. The earthquake was felt strongly on many parts of the island.
- On January 27, 1978, a magnitude 5.2 earthquake centered near the east coast of Guam caused considerable damage on the island.
- On August 8, 1993, the largest earthquake (magnitude 7.8) recorded on Guam occurred south of the Mariana Islands, injuring 48 people on Guam and causing extensive damage to hotels in the Tumon Bay area. Many landslides and rockslides were reported mainly in the southern half of the island. The estimate of loss from damage to commercial buildings was placed at $112 million with loss from damage to private residences estimated at several million dollars.

Unlike the Anatahan volcano in the Northern Mariana Islands, Guam is not volcanically active (Official Site of Guam 2007). However, due to its proximity to Anatahan, vog ("volcanic" and "smog") does occasionally affect Guam (USGS-CNMI 2007). Vog is a form of air pollution that results when sulfur dioxide and other gases and particles emitted by an erupting volcano react with oxygen and moisture in the presence of sunlight. Vog contains chemicals that can damage the environment and the health of plants, humans and other animals.

Typhoons

Guam is located in what has been nicknamed "Typhoon Alley" and it is common for the island to be threatened by tropical storms and typhoons during the wet season. An average of three tropical storms and one typhoon pass within 180 nautical miles (nm) (330 km) of Guam each year. In the last decade, Guam has been hit directly by four typhoons with sustained winds of greater than 150 miles per hour (mph) and has suffered high waves and winds from large systems passing close to Guam.

The most intense typhoon to pass over Guam within the last decade was Super Typhoon Pongsona; with sustained winds of 144 mph and gusts peaking at 173 mph, it slammed into Guam on December 8, 2002 resulting in massive destruction islandwide. Typhoon Pongsona maintained a 40-mi (65-km)-wide eye upon crossing the northern populated portion of Guam; Andersen Air Force Base (AFB) was in the eye for two hours.

Due to the high winds, Typhoon Pongsona left the entire island of Guam temporarily without electrical power or phone service. The winds collapsed several walls at the Guam Memorial Hospital resulting in

major damage throughout the northern two-thirds of the facility; several hotels, churches, and schools also received moderate damage. 65% of the island's water wells were also inoperable resulting in most of Guam being without water service following the storm (FEMA 2003a). Officials estimate the typhoon destroyed 1,300 homes, severely damaged 1,825 homes, and lightly damaged 4,800 homes (Gillespie 2002).

Pongsona produced storm surge flooding of up to 20 ft (6 m) at some locations, with 9-13 ft (3-4 m) recorded near the eyewall. Considerable storm surge flooding occurred from Tumon southward to Piti, leaving some buildings on the west coast of the island flooded with 4 ft (1 m) of water. The combination of strong storm surge and rough waves caused considerable beach erosion and severe coastal damage, including impacts to coral (NCDC 2003).

Typhoon Pongsona was the last typhoon of the 2002 Pacific typhoon season and was the most expensive U.S. disaster in 2002 with damage estimated at $700 million (FEMA 2003b). The public also considers Pongsona to be the worst typhoon to ever strike Guam (Kelly 2003).

Wildfires

Wildfires plague the forest areas of Guam every dry season despite the island's humid climate. Most fires are caused by man with 80% resulting from arson (Neill and Rea 2004). Poachers often start fires to attract deer to the new growth. Invasive grass species that rely on fire as part of their natural life cycle grow in many regularly burned areas. These grasslands and barrens have replaced previously forested areas, leading to greater soil erosion.

During the rainy season, sediment is carried by the heavy rains into the Fena Lake Reservoir and Ugum River, thereby leading to water quality problems for southern Guam. Eroded silt also destroys the marine life in reefs around the island.

Accelerated rates of upland erosion due to wildfires, clearing and grading forested land, recreational off-road vehicle use, and wild populations of introduced mammals continue to result in increased rates of sedimentation in southern Guam. Estimates suggest that between 1975 and 1999, Guam lost nearly a quarter of its tree cover, while an increase in badlands acreage (bare soil with extremely high erosion rates) and other erosion-prone surface cover types have been observed. The numerous fires set each year and the popular use of off-road vehicles are believed to be major contributors to the development and persistence of these erosion-prone surface cover types (Burdick et al. 2008).

According to the Guam Department of Agriculture's Forestry and Soil Resources Division, more than 750 fires were reported annually between 1979 and 2001, burning over 155 mi^2 (401 km^2) during this time period (Burdick et al. 2008). The acreages of the largest fires (>1,000 acres [ac] {405 hectares [ha]}) during the years 1979 - 2002 are shown in Table 1.3-1.

Table 1.3-1. Wildfires on Guam

Date	*Size (ac)*	*Cause*
May 1998	1,970	Incendiary
March 1995	1,000	Navy Incendiary
March 1987	1,000	Incendiary
Feb 1983	1,446	Debris Burning
Jun 1983	1,108	Incendiary
April 1979	1,000	Debris Burning

Source: Neill and Rea 2004.

A Wildland Fire Management Plan currently is in place that has been developed by the U.S. Forest Service (USFS) for DoD lands (USFS 2008). The plan currently includes a series of recommended actions to develop and implement an effective wildland fire management plan, covering such topics as staffing, equipment, training, and development and implementation of fire management strategies, prevention, suppression methods, preparedness, impacts, and management techniques.

Invasive Species

An invasive species is often defined as an introduced species that spreads widely and causes harm. On Guam, invasive species have caused significant alteration of wildlife and vegetation populations. Some of these species are discussed below.

Brown Tree Snake (BTS)

Shortly after WWII, and before 1952, the BTS was accidentally transported from its native range in the South Pacific to Guam, probably as a stowaway on a ship cargo (Fritts and Leasman-Tanner 2001). The snake was first detected on Guam in the 1950s near the Naval Port (central Guam), but may not have become conspicuous away from the port area until the early 1960s. By the mid 1960s, the snake had colonized over half of the island. In 1968, BTS had reached the extreme northern end of the island and was present throughout the island, although its densities varied widely from region to region (U.S. Pacific Command 2006). As a result of abundant prey resources on Guam and the absence of natural predators that rely on the snake as a part of their diet, BTS populations have reached very high densities unknown outside of their range (Fritts and Leasman-Tanner 2001).

With the high density of BTS, the disappearance of birds on the island soon followed. By 1963, several formerly abundant species of native birds had disappeared from the central part of the island where snakes were most populous. By the late 1960s, birds had begun to decline in the central and southern parts of the island and remained abundant only in isolated patches of forest on the northern end of the island. Snakes began affecting the birds in the north-central and extreme northern parts of the island in the 1970s, and most native forest species were virtually extinct when they were listed as threatened or endangered by the USFWS in 1984. The native bird species remaining on Guam are extremely patchy in distribution, occurring only in special habitats where some protection from snakes exists.

Currently, small mammals are extremely rare in most forested habitats of Guam. Predation by the BTS is the most likely primary factor preventing recruitment to the single population of native Mariana fruit bats remaining on Guam. Lizard densities, particularly of introduced species with high reproductive rates, remain high, thereby supporting the snake population. Although larger snakes are showing signs of stress, exhibited by low fat reserves, the ability to shift from birds to rodents or lizards has enabled the snake to reach and maintain extraordinarily high densities of as many as 13,000 per mi^2 (5.019 per km^2). This is higher than snake densities in the rainforests of the Amazon Basin of Ecuador where 51 different snake species occupy the same habitat (U.S. Pacific Command 2006).

This predator has caused the disappearance of nearly all of the native forest birds on Guam including the extinction of the Guam rail and the Micronesian kingfisher. The snake's decimation of the bird population and resultant loss of avian seed dispersers has also caused declines in the reproductive rate of introduced plants and shrubs.

The abundance of the BTS has also caused far reaching secondary ecological impacts. The snake is responsible for the decline of the fruit bat - a crucial species for the pollination and seed dispersal of tropical trees. Also, without the presence of certain avian insectivores, insect populations may have experienced population booms which negatively impacted local agriculture. The cultural fabric of the

island communities are negatively impacted by the BTS as well. Fruit bats, an important part of indigenous rituals and celebrations on the Mariana Islands, have shown great declines since the introduction of the BTS. In addition to these negative biological impacts, the BTS impacts the economy of the island through damages to equipment causing large-scale electrical power outages. Since 1978, over 1,200 power outages have occurred as a result of the BTS shorting high voltage electrical lines and transformers. Moreover, continuously increasing populations of the BTS are responsible for predation of farm animals, poultry, and pets, leading to further economic consequences. The snakes are mildly venomous to humans and their non-fatal bite can cause severe sickness in young children (Hodgson et al. 1998).

Because Guam is a major transportation hub in the Pacific, numerous opportunities exist for BTS on Guam to be introduced accidentally to other Pacific islands as passive stowaways on ship and air traffic from Guam. Numerous sightings of this species have been reported on other islands including Wake Island, Tinian, Rota, Okinawa, Diego Garcia, Hawaii, and even Texas in the continental U.S. An incipient population is probably established on Saipan (Fritts and Leasman-Tanner 2001). The chemical compound para-acetylaminophenol (in some contexts, it is simply abbreviated as APAP) has been used to help eradicate the snake on Guam (Avis 2007). The Guam Customs & Quarantine Agency is also training detector dogs to seek out BTS throughout Guam in an effort to further mitigate and reduce their escalating population.

Coconut Rhinoceros Beetle

An infestation of the coconut rhinoceros beetle (CRB), *Oryctes rhinoceros*, was detected on Guam on September 12, 2007. CRB is not known to occur in the U.S., except in American Samoa. CRB is native to southern Asia and is distributed throughout Asia and the Western Pacific including in Sri Lanka, Samoa, American Samoa, Palau Islands, New Britain, West Irian, New Ireland, Pak Island and Manus Island (New Guinea), Fiji, Cocos (Keeling) Islands, Mauritius, and Reunion.

CRBs in the adult stage cause the most harm; they are generally night-time fliers and when they alight on a host, they chew down into the folded, emerging fronds of coconut palms to feed on sap. V-shaped cuts in the fronds and holes through the midrib are visible when the leaves grow out and unfold. If the growing tip is injured, the palm may be killed, or severe loss of leaf tissue may cause decreased nut set. Feeding wounds may also serve as an infection pathway for pathogens or other pests. The effects of adult boring may be more severe on younger palm trees where spears are narrower. Mortality of young palms as a result of CRB damage has already been observed on Guam.

The description of the current situation is summarized from a progress report by Moore (2009). The beetle has spread along the northwest coast of Guam with the main infestation from Tumon Bay to Tanguisson Beach, south of NCTS Finegayan, with isolated breeding sites noted at Agana Bay and Uranao. A total of 739 beetles had been trapped as of May 2009. If the beetle is not controlled, it is estimated that half of the coconut palms on Guam could be killed based on experience on other islands. Eradication would require the following: (1) sanitation - the removal of breeding sites, (2) trapping adults, and (3) prophylactic tree treatment.

Tinangaja

Invasive animal species are not the only threat to Guam's native flora. Tinangaja, a virus affecting coconut palms, was first observed on the island in 1917 when copra (dried white flesh of coconut) production was still a major part of Guam's economy. Though coconut plantations no longer exist on the island, the dead and infected trees that have resulted from the epidemic are seen throughout the forests of Guam (Burdick et al. 2008).

Also during the past century, the dense forests of northern Guam have been largely replaced by thick tangantangan brush (*Leucaena* - native to the Americas). Most of Guam's foliage was lost during WWII, and in 1947, the U.S. military introduced tangantangan by seeding the island from the air to prevent erosion. In southern Guam, non-native grass species also dominate much of the landscape.

Fadang Tree – Alien Insects Species

Guam's fadang tree (*Cycas micronesica*) population is currently threatened by alien species that feed on its leaves. This tree has been growing in the Mariana Islands for thousands of years and was one of the most common garden plants in Guam homes about 200 years ago (UoG 2009). The UoG has completed the establishment of a conservation planting of Guam's endangered fadang tree on the island of Tinian. The DoD funded the conservation project and provided access to their lands in northern Tinian for implementing the effort to help stave off the ongoing threats to survival of the species.

Coral Reefs

The entire island of Guam is classified as a coastal zone consisting of 20 watersheds. It is surrounded by 116.5 mi (187.5 km) of shoreline divided into three distinct classifications: rocky coastline, sandy beaches, and mangrove mud flats. The rocky coastline classification surrounds the northern end of the island with a few isolated stretches in the south. It is approximately 72.5 mi (116.6 km) in length or 62% of the total shoreline. Sandy beaches are scattered intermittently around the island and comprise 35.9 mi (57.7 km) of shoreline, or 31% of the total. The remaining 8.1 mi (13.0 km) or 7% of the total shoreline are classified as mangrove mud flats and are centered mainly within Apra Harbor and Merizo.

There are also approximately 14.2 mi^2 (367.8 km^2) of coral reefs, 0.55 mi^2 (1.4 km^2) of seagrass beds, 1.43 mi^2 (3.7 km^2) of estuarine systems, and 21.73 mi^2 (56.3 km^2) of marine bays. Shallow fringing coral reefs with outer slopes and margins support live coral colonies surrounding most of Guam. The bordering fringing reefs in the south are broader than in the north. The width of these reefs range from very narrow benches (as narrow as 10 to 20 ft [3.05 to 6.09 m]) on the northeastern coast, to broad reef flats forming the popular recreational and fishing areas in Tumon, Hagatna, Agat, and Asan Bays and on the shore side of Cocos Island Lagoon. These reefs are extremely valuable in terms of marine life, aesthetics, food supply, recreation, and protection of Guam's highly erodible shorelines from storm waves, currents, and tsunamis. Two large barrier reef systems occur at Cocos Island Lagoon and at Apra Harbor. Cocos Island Lagoon and its reefs form an atoll-like environment about 4 mi^2 (10.3 km^2) in area, with a greatest lagoon depth of approximately 40 ft (12 m). The uplifted limestone plateau of Orote, Cabras Island and a large artificial breakwater, which was built on a shallow reef platform and adjacent submerged bank, bound the much deeper lagoon of Apra Harbor, with depths over 120 ft (36 m) (Burdick et al. 2008).

Guam's coral reefs are also an important component of Guam's tourism industry. The reefs and the protection that they provide make Guam a popular tourist destination for Asian travelers. According to the Guam Economic Development Authority, the tourism industry accounts for up to 60% of the government's annual revenues and provides more than 20,000 direct and indirect jobs.

In 1997, the Government of Guam established five marine preserves: Tumon Bay, Piti Bomb Holes, Sasa Bay, Achang Reef Flat, and Pati Point. They were established as a response to decreasing reef fish stocks, but fishing restrictions were not fully enforced until 2001. Fishing activity is restricted in the marine preserves with limited cultural take permitted in three of the five areas. While management practices are enforced in the five marine preserves, there is currently limited management and enforcement in the other areas.

The health of Guam's coral reefs varies considerably depending on a variety of factors including geology, human population density, level of coastal development, level and types of uses of marine resources, oceanic circulation patterns, and frequency of natural disturbances, such as typhoons and earthquakes (Burdick et al. 2008). Many of Guam's reefs have declined in health over the past 40 years. The average live coral cover was approximately 50% in the 1960s (Randall 1971 in Porter et al), but dwindled to less than 25% live coral cover by the 1990s with only a few reefs having over 50% live cover (Birkeland, 1997 in Porter et al.). In the past, however, Guam's reefs have recovered after drastic declines. For example, an outbreak of the crown-of-thorns starfish in the early 1970s reduced coral cover in some areas from 50-60% to less than 1%. Twelve years later, live coral cover was restored to pre-1970s conditions (Colgan 1987 in Porter et al.).

In the *State of the Coral Reef Ecosystem on Guam*, Porter et al. evaluated a number of environmental and anthropogenic stressors on the reef ecosystem on Guam including:

- climate change and coral bleaching,
- disease,
- tropical storms,
- coastal development and runoff,
- coastal pollution,
- tourism and recreation,
- fishing,
- trade in coral and live reef species,
- ships, boats, and groundings,
- marine debris,
- aquatic invasive species,
- security training activities, and
- offshore oil and gas exploration.

The conclusion of this *State of the Coral Reef Ecosystem* assessment was that the health of Guam's coral reefs varies significantly. Reefs unaffected by sediment and nutrient loading, such as those in the northern part of the island and in between river outflows in the south, have healthy coral communities. Guam's reefs have been spared from large-scale bleaching events and coral diseases which are prevalent in so many parts of the world. Unfortunately, a number of Guam's reefs are impacted by land-based sources of pollution and heavy fishing pressure. Land-based sources of pollution on Guam were the number one priority focus area in 2002. Sedimentation, algal overgrowth due to decreased fish stocks, and low recruitment rates of both corals and fish continue to be important issues that must also be addressed.

1.3.3.2 Key Anthropogenic Events Affecting the Ecology of Guam

Historical events, most notably WWII, have dramatically altered the ecology of Guam. A brief summary of key historical events follows.

The U.S. Navy continued to use Guam as a refueling and communication station until 1941, when it fell to invading Japanese forces shortly after the attack on Pearl Harbor, Hawaii. The Japanese military occupation of Guam lasted from 1941 to 1944 and was a brutal experience for the Chamorro people, whose loyalty to the U.S. became a point of contention with the Japanese. All surviving American military personnel and civilians were evacuated to internment camps in Japan. Several American servicemen remained on the island and were hidden by the Chamorro people.

After weeks of pre-invasion bombardment by the U.S. Navy, the Battle of Guam began on July 21, 1944 with American troops landing on the western side of the island. After several more weeks of heavy fighting, the Japanese forces officially surrendered on August 10, 1944. Guam's two largest pre-war communities (Sumay and Hagatna) of central Guam were virtually destroyed during the Battle of Guam. Many Chamorro families were forced to live in temporary re-settlement camps near the American invasion beaches before moving to permanent homes constructed in the island's outer villages. Guam's southern villages largely escaped damage.

Guam was subsequently converted into a forward operations base for the U.S. Navy and the Army Air Force. Airfields were constructed in the northern part of the island (including Andersen AFB), the island's pre-WWII Naval Station was expanded, and numerous facilities and supply depots were constructed throughout the island.

In 1947, following the devastation of the war, a shrubby tree called tangantangan (*Leucaena*) was seeded from aircraft to protect the land from erosion. It now grows in impenetrable thickets over much of the north of the island, preventing erosion and supplying some fuel wood, but having forever altered native ecosystems (Holmes III 2001).

Other direct anthropogenic disturbances include deliberate damage to the marine environment by the human population on Guam, including military personnel; examples include destructive fishing methods such as dynamite fishing and the deliberate collection of corals and live rock for aquarium use.

1.4 HISTORICAL PERSPECTIVE - TINIAN

Historically, there have been a number of events – both naturally occurring and the results of man's actions – that have resulted in significant impacts to the environment of Tinian. This section is a brief overview of Tinian and the events and occurrences that have shaped its history as well as altered the ecology of the island.

1.4.1 Location and Brief History

Tinian is about 5 mi (8 km) southwest of Saipan, and is separated from it by the Saipan Channel. Tinian has a land area of 39 mi^2 (101.01 km^2). One of the four constituent municipalities of the Northern Marianas, the Tinian municipality consists of Tinian, Saipan, and the uninhabited island of Aguijan (2.74 mi^2, or 7.09 km^2). The total area of the municipality is 41.74 mi^2 (108.1 km^2).

Tinian is about the same size and shape as Manhattan (New York City), and when U.S. forces occupied it during WWII, they laid out a system of roads with the same general plan and orientation as Manhattan. The main north-south road was named Broadway, and it runs parallel to the other main north-south road named 8th Avenue. Tinian, one of the of the three principal CNMI islands, is perhaps best known for being the location from which the American atomic bomb attacks on Japan during WWII were launched. During the war, six airstrips were constructed on Tinian and two more on Saipan to accommodate the U.S. B-29 aircrafts (NCDC 2003).

1.4.2 Tinian Today

Tinian has a small resident population and therefore relies heavily on tourism. San Jose is Tinian's largest village. Tourism facilities on the island include the Dynasty Hotel (a luxury hotel and casino with shops, restaurants, etc.) as well as several other smaller hotels, restaurants and bars. Tinian's commuter airport is served by two airlines, Freedom Air, and Star Marianas Air, which operate daily scheduled flights and charter flights, respectively. There is also daily ferry boat service between Tinian and Saipan (Pacific Wrecks 2009).

1.4.3 Historical Events and Occurrences Affecting the Ecology of Tinian

1.4.3.1 Key Natural Events

Earthquakes

Tinian is located on the Mariana Ridge, a volcanic arc approximately 1 mi (1.6 km) west of the Mariana Trench. This ridge was formed as a result of subduction of the Pacific Plate under the Philippine Plate. Due to movement of these lithospheric plates, Tinian is vulnerable to earthquakes.

Volcanoes

Tinian is not volcanically active (Neill and Rea 2004). However, due to its proximity to Anatahan, vog ("volcanic" and "smog") does occasionally affect Tinian as described for Guam.

Typhoons

The CNMI is in what is known as weather condition *four* at all times, which means that 40-mph winds are possible within 72 hours. These cyclonic disturbances can quickly and unexpectedly develop into typhoon force winds of 120 mph or greater. The frequency of typhoons affecting Tinian is the same as for Guam.

The Super Typhoon Pongsona that struck Guam on December 8, 2002 also struck Tinian with sustained winds of 78 mph and gusts up to 85 mph. The combination of winds and other effects from the typhoon destroyed 114 houses, severely damaged 154 homes, and caused minor damage to 306 homes; about 200 families were left homeless on Tinian. The typhoon produced a storm surge of 22 ft (6 m) at Songsong Village (FEMA 2003b).The winds damaged power lines causing two island-wide power outages. Major crop damage was reported (Kelly 2003).

Species of Interest

Tinian Monarch

The Tinian monarch, or "Chuchurican Tinian" in the Chamorro language, is a small forest bird found only on the island of Tinian in the CNMI. This small, six-inch bird is a member of the monarch flycatcher family. It has a light reddish chest and neck, olive brown back, dark brown wings and tail, white wing bars, white rump, and a white-tipped tail. Tinian monarchs forage and breed throughout the entire island in both the non-native tangantangan forests and the native limestone forests.

The Tinian monarch was originally listed as an endangered species on June 2, 1970, because the population was extremely small. The primary threat to the species was habitat loss. This resulted from forest clear-cutting prior to WWII for cattle grazing and sugarcane farming and from extensive construction during the war. The monarch began to thrive as soon as tangantangan forests grew back, replacing the native forests. A survey of the monarch population in 1982 showed that approximately 37,000 birds inhabited the island, and the species was subsequently reclassified to threatened status. A survey conducted in 1996 indicated that the population had increased to approximately 56,000 birds.

Because populations of the Tinian monarch have rebounded and habitat loss is no longer a threat, the USFWS removed Endangered Species Act (ESA) protections for this forest bird in 2004. Because of the threat of the BTS becoming established on Tinian, the USFWS will continue to monitor the status of the species for at least five years (Foote 2004).

Fadang Tree

The UoG completed the establishment of a conservation planting of Guam's endangered fadang tree on the island of Tinian. The DoD had funded the entire project and provided access to their lands in northern

Tinian for implementing the effort to help stave off the ongoing threats to survival of the species. The fadang tree is called *Cycas micronesica* by scientists, and belongs to a unique group of plants called cycads. It has grown for thousands of years in the forests on Guam and Rota with no real threats (UOG 2009), but two exotic insect species have recently invaded Guam and Rota, and their voracious appetite for fadang trees has pushed the tree into the endangered status. Fadang is the only plant of its kind in the Mariana Islands, and this extensive planting on Tinian has become a crucial component of the ongoing conservation efforts to save the species.

1.4.3.2 Key Anthropogenic Events Affecting the Ecology of Tinian

WWII and Its Effects on Tinian

The capture of Saipan, Tinian, and Guam in the Central Pacific in mid-1944 was one of the key actions in the Pacific during WWII. Air bases in the Marianas were essential in order to accommodate the new B-29 Superfortress, a U.S. bomber that was just beginning to be mass-produced in early 1944 and had a flying range equal to the distance from the Mariana Islands to Japan and back - about 1,500 mi (2,414 km).

Airfields were constructed on Guam, Saipan and Tinian. The construction of the airfields on Tinian was the largest building activity the U.S. Naval Construction Battalion (Seabees) had ever undertaken up to that time and the largest airport of WWII was on Tinian. Six runways, each 8,500 ft (2590 m) long, were constructed to support the B-29s. Barracks to accommodate 50,000 troops were built on Tinian, and Navy Seabees hauled, blasted and packed down enough coral to fill three times the volume of Boulder Dam - nearly 112 million cubic yards of fill (Global Security 2005).

Prior to WWII, Tinian was a major sugarcane growing and processing center, but the War left only a denuded forest.

Post WWII Utilization of Tinian

The 1976 Covenant (Public Law 94-241) creating the CNMI established jurisdiction of U.S. laws, agencies, and programs; provided for a CNMI Constitution, an elected government and defined self-rule; and granted U.S. citizenship to CNMI residents. The Covenant also brought to the CNMI substantial and extended financial support from the U.S. A major portion of this financial support came in the form of payments made to the CNMI for the leasing of about two-thirds of the island of Tinian. In 1983, a lease agreement covering these lands was signed, and DoD assumed control and possession over the northern two-thirds of Tinian. The lease agreement is for 50 years, with a renewal option for an additional 50 years.

Under the terms of the lease agreement, none of leased lands may be privately-owned, nor are any CNMI residents allowed to live or develop property there. Essentially, the DoD controls all land uses within the leased area. Any non-military uses within the leased area must be approved by the DoD. Presently, the U.S. military uses major portions of the leased land area for training exercises.

The 16,100 ac (6,515.4 ha) leased area is known as the Military Lease Area (MLA) and is divided into two sections. The northern half is the Exclusive Military Use Area (EMUA) and the southern half is referred to as the Leaseback Area (LBA). North Field and the national historic landmark are located within the EMUA. The EMUA is used for periodic military training exercises. It is open to the public for recreational purposes when it is not being used for military training. DoD uses of the EMUA include both large and small field exercises. Marine units hold large-scale amphibious assaults and joint training exercises within the EMUA, utilizing its beaches as entry points to inland areas for maneuvers and for landing fixed-wing aircraft and helicopters. The DoD uses abandoned buildings, some of which are historically related to WWII and North Field within the EMUA, for urban warfare practice. The roads that

connect the training area with Tinian's commercial harbor and airport to the south are used by the DoD during training exercises.

The LBA is a joint use area, where both military and non-military activities may take place. The LBA has been leased back to the CNMI for uses that are compatible with long-term DoD needs, primarily grazing and crop production.

The MLA remains largely undeveloped, with no permanent military installations or staffed facilities. At the present time, there are no major construction projects planned for the MLA. None of the roads are fenced or gated, and public access to North Field during non-maneuver times is not restricted.

CHAPTER 2. OVERVIEW OF BEST MANAGEMENT PRACTICES AND PROPOSED MITIGATION MEASURES

This chapter presents an overview of all Best Management Practices (BMPs) and the proposed mitigation measures discussed in Volumes 2 through 6 of this EIS. In addition, the chapter introduces the mitigation measures monitoring plan and construction-phase adaptive program management. The Council on Environmental Quality (CEQ) drafted a *Guidance for NEPA Mitigation and Monitoring* (February 18, 2010) that outlines three goals to improve agency mitigation measures and monitoring. These goals and Final EIS consistency with these goals is summarized as follows:

1. *Proposed mitigation measures should be considered throughout the NEPA process. Decisions to employ mitigation measures should be clearly stated and those mitigation measures adopted by the agency should be identified as binding commitments to the extent consistent with agency authority and reflected in the NEPA documentation and any agency decision documents.*

   The Final EIS, Volume 7, Chapter 2 includes a summary table of mitigation measures proposed in Volumes 2 through 6. Mitigation measures coordinated with agencies continue to evolve as regulatory agency consultations and permit application reviews (i.e., Biological Opinions, Programmatic Agreements, etc.) proceed. The Final EIS proposes mitigation measures to reduce or avoid environmental impacts identified during the NEPA environmental review process; however, the Final EIS and NEPA environmental review process do not commit the DoD to the proposed mitigation measures. Commitment to a mitigation measure would be established in the Record of Decision (ROD), which is informed by the Final EIS. Environmental requirements can also change or emerge post-ROD as a result of agency consultations and coordination, permit conditions, and new laws, regulations, and policies.

2. *A monitoring program should be created or strengthened to ensure measures are implemented and effective.*

   A Post-ROD Mitigation Monitoring Plan would be developed with the ROD to track the implementation of mitigation measures committed within the ROD. Naval Facilities Engineering Command Marianas (NAVFAC MAR) ultimately would be responsible for preparing and implementing the post-ROD monitoring plan. As a matter of policy, the Navy adaptively manages its construction programs to monitor the effectiveness of mitigation measures and adjusts them as necessary to improve effectiveness during and after construction (CNO 2007, CMC 2008).

3. *Public participation and accountability should be supported through proactive disclosure of and access to agency mitigation monitoring reports and documents.*

   The DoD will commit to implementing mitigation measures identified in the ROD. The DoD intends to work collaboratively with members of the public and agencies throughout implementation of the proposed action and mitigation measures. Many of the mitigation measures proposed in this Final EIS were recommended or coordinated with agencies or recommended to the DoD in comments. Virtually all monitoring reports and documents are available to the public and access is provided under the Freedom of Information Act, within a reasonable timeframe, upon request to DoD public affairs or community planning and liaison offices.

Mitigation is a general term that refers to actions implemented to avoid, minimize, rectify, reduce/eliminate, or provide compensation for an environmental impact. In 40 Code of Federal Regulations (CFR) 1508.20, the CEQ defines mitigation as:

- Avoidance: Avoids the impact by changing the action. Does not take certain actions that would cause the environmental effect.
- Minimization: Minimizes impacts by changing the intensity, timing, magnitude, or duration of the action and its implementation.
- Rectifying: Rehabilitating, repairing, or restoring damage that may be caused by implementing the proposed action.
- Reducing/Eliminating: Reduction or elimination of the impact over time.
- Compensation: Replacing damage and improving the environment elsewhere, or provide substitute resources such as funds to pay for the environmental impact.

Best Management Practices (BMPs). This EIS distinguishes between BMPs and mitigation measures. Although both meet the CEQ definition of mitigation described above, for the purposes of this EIS, BMPs are existing policies, practices, and measures required by law, regulation, or Department of Defense (DoD) policy that 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 mitigation measures in this EIS because BMPs are 1) existing requirements for the proposed action, 2) ongoing, regularly occurring practices, and 3) not specific to this proposed action. In other words, the BMPs identified in this EIS are inherently part of the proposed action and are not additional mitigation measures proposed as a result of the NEPA environmental review process for the proposed action. An exhaustive list of BMPs is not provided in this EIS; only those BMPs referred to in analysis in this EIS are identified.

Proposed Mitigation Measures. For the purpose of this EIS, mitigation measures are additional, project-specific measures proposed as a result of the NEPA environmental review process. Mitigation measures may be routinely applied across many DoD projects, but DoD commitment to a mitigation measure, as defined herein, is determined on a project-by-project basis. The proposed mitigation measures are not existing requirements or components of the proposed action presented in this EIS and their implementation is not assumed in the analysis presented in this EIS. Instead, this EIS proposes mitigation measures for implementation to avoid, minimize, rectify, reduce, or compensate for project-specific impacts of the proposed action identified during the environmental review of the proposed action. The proposed mitigation measures would become requirements upon decision to implement the measures as recorded in a ROD. Compensatory mitigation measures may have a regulatory driver, such as the Clean Water Act, but the compensatory mitigation measure is a project-specific mitigation measure determined on a project-by-project basis. Likewise, conditions of a USFWS Biological Opinion or State Historic Preservation Office (SHPO) Programmatic Agreement under NHPA for cultural resources, if finalized, are treated as mitigation measures in this EIS.

A Post-ROD Mitigation Monitoring Plan would be developed with the ROD to track the implementation of mitigation measures identified in the ROD. NAVFAC MAR ultimately would be responsible for preparing and implementing the post-ROD monitoring plan. As a matter of policy, the Navy adaptively manages its construction programs to monitor the effectiveness of mitigation measures and adjusts them as necessary to improve effectiveness during and after construction (CNO 2007, CMC 2008).

Navy personnel would provide oversight for successful implementation of the proposed mitigation measures. Many construction-related environmental requirements are attached to permits since conditions

and mitigation measures are often developed in coordination with agencies and expressed in agency opinions or agreements. For mitigation measures involving opinions, agreements, or permits with agencies, the applicable agencies also often provide oversight. For example, there would be agency and Navy personnel involved with monitoring terrestrial biological and cultural resources mitigation measures. Additional agency coordination is proposed to mitigate impacts to utility infrastructure under the Adaptive Program Management mitigation measure detailed in Section 2.4.

2.1 BEST MANAGEMENT PRACTICES ON GUAM AND TINIAN

This section provides a summary of BMPs considered in the analysis in this EIS. These BMPs are implemented during design, construction or operations by the DoD and are embedded in numerous policies and orders. Table 2.1-1 provides a summary of the key BMPs referred to in the analysis in this EIS; however, the list is not intended to be exhaustive by including all BMPs that would be implemented as part of the proposed action. The table indicates the phase of the project the BMP would be applied. In addition, the primary resources that would benefit from the BMP are identified.

Table 2.1-1. Summary of Key Best Management Practices (Guam and Tinian)

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
1	Erosion Control	A range of BMPs would control erosion during construction and operations to eliminate and/or minimize nonpoint source pollution in surface waters due to sediment. Erosion control BMPs include, but are not limited to, the following practices and procedures. **Construction:** • Erosion control through site approval process (whereby the Navy reviews each proposed project for its erosion potential, and involves the designated installation Natural Resource Specialist in the process). • Topsoil removed from the site would be placed in the immediate area and reused for re-compaction purposes (if appropriate, in accordance with geotechnical recommendations). • Soil exposed near water as part of the project would be protected from erosion with erosion control blankets (organic or synthetic fibers held together with net to cover disturbed areas) after exposure, and stabilized as soon as practicable (with vegetation matting, hydroseeding, etc.). • Flatten landfill slopes for increased soil stability. • Silt-containment (silt fences and other physical barriers that intercept runoff from drainage areas). • Re-vegetate as soon as possible after any ground disturbance or grading. • Minimize construction and grading during times of inclement weather. • Soil piles and exposed slopes covered during times of inclement weather. • Stockpiling of excavated materials behind impermeable berms and away from the influence of river waters and runoff. • Implement a re-vegetation program to ensure graded benches are fully vegetated as landfills mature. • Vegetation/mulch stabilization (applying coarse plant residue to cover soil surface. The vegetation/mulch should be free of invasive species viable reproductive parts, such as rhizomes, seeds, and plants). • Level spreader (non-erosive outlet for runoff to disperse flow uniformly across slope). • Rock outlet protection (rock protection placed at end of culverts). • Sediment basin (barrier that retains sediment from runoff).		X	X	X	X	X	X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
		Operation: • Restrict vehicles in training areas (ensure that all training areas, including transit routes necessary to reach training areas, are clearly identified or marked. Restrict vehicular activities to designated/previously identified areas).								
2	Stormwater Management under the Clean Water Act (CWA): Stormwater Management Plan (SWMP)	In compliance with the federal CWA under Section 401, the proposed actions would require a SWMP. A SWMP is a document that describes the minimal procedures and practices used to reduce the surface flow and subsequent discharge of pollutants to storm drainage systems. Elements of a SWMP include structural and non-structural practices such as: • Check dams (small temporary stone dam across drainage). • Diversion dike/swale (berm or ditch that channels water to desired location). • Lined waterway (lined outlet for drainage). • Stormdrain inlet protection (permeable barrier around inlets reducing sediment let into storm drain). • Stormwater ponds and wetlands. • Infiltration practices (capture/temporarily store water before infiltrating into the soil). • Use of groundwater recharge wells and infiltration basins, where applicable. • Filtering practices (capture/temporarily store water and pass through filter beds of sand, organic matter, soil, or other media).	X	X	X	X	X	X	X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
3	Stormwater Management under the CWA: Stormwater Pollution Prevention Plan (SWPPP)	Stormwater Management Pollution Prevention Plan (SWPPP). A SWPPP is a self-implementing plan for compliance with an installation's stormwater permit. • Facilities would be required to comply with the SWPPP during construction and then during day-to-day operations to ensure that stormwater remains free of contaminants. • The SWPPP requires development of pollution prevention measures to reduce and control pollutants in stormwater discharge. • Where applicable, provisions of any Construction General Permit(s) would be fully implemented on non-DoD properties. • Where applicable, consistency with CNMI and/or Guam Stormwater Management Manuals. • A site-specific SWPPP tailors the plan to the facility and associated activities most likely to have a negative impact on stormwater. Applicable SWPPPs would manage stormwater and erosion at each training location.		X	X	X	X	X	X	X
4	Water Quality Monitoring Plan (WQMP)	Development of Water Quality Monitoring Plan (WQMP). WQMPs evaluate the effectiveness of environmental permits and/or performance standards. Monitoring plans identify ambient or control conditions at a particular site and capture deviations from those conditions resulting from a project or operations of a facility. WQMPs may range in complexity from visual inspections for sedimentation and protection measure failure to laboratory or field analysis of chemical and biological effects on water quality or organisms (acute/chronic bioassay), dependent on a given water resource.		X	X	X	X	X	X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
5	Leadership in Energy and Environmental Design (LEED) Certification	Current Navy/Marine Corps policy supports Leadership in Energy and Environmental Design (LEED). The policies support and facilitate Silver certification for bases. LEED is a voluntary point system tool that measures the degree of sustainability features incorporated into a development. Some LEED requirements include: • Reduction of electrical energy use in buildings by 10% to save power. • Construction materials: use of local sources. Navy guidance and qualification for LEED Silver points requires that 50% non-hazardous waste and demolition debris are recycled. • Increased water efficiency. • Renewable energy. The sustainability/LEED initiatives would help reduce potable water use and should have a positive effect on demand for wastewater treatment.	X	X	X	X	X	X	X	X
6	Low Impact Development (LID)	The Navy would implement Low Impact Development (LID) design technology to make use of innovative methods to capture stormwater. Recommendations of a Comprehensive Drainage and LID Implementation Study would also be implemented. Examples of LID design include: • Grassed channel (channel stabilized by vegetation to convey water down a slope). • Grassed vegetation maintained on berms. • Integrated pest management, including proper handling of construction waste (cans, tires, drums, etc.) to avoid stagnant water collection that could harbor mosquitoes and other vectors. • Native plant landscaping. • Avoidance of pesticides and fertilizers. • Bio-retention strips. • Watershed-based management. A watershed protection management approach could consider: • Participating in the development of a watershed management plan. • Implementing and adopting specific watershed protection strategies. • Designing land use planning techniques that reduce or shift impervious cover and enhance percolation. • Work towards achieving important water resource goals.	X	X	X	X	X	X	X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
		On Tinian, LID would include the use of ecologically, leach field friendly chemicals for treatment of wastewater.								
7	Energy Policy Act of 2005 (EPACT)	Energy Policy Act (EPACT) compliance includes analysis and life-cycle cost analysis using a simulated model and the following energy conservation measures: • Buildings achieve an energy consumption level that is 30% below the level achieved by ASHRAE Standard 90.1. • Use low energy consuming products that are either Energy Star-qualified or Federal Energy Management Program-recommended. • Optimize building orientation to reduce cooling loads or energy loads to cool the buildings. • Optimize building insulation. • Seal building envelope for air tightness. • Incorporate "cool roof" building designs. • Use motion detectors to reduce lighting and to setback cooling in unoccupied buildings. • Natural lighting.	X	X	X	X	X	X		X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
8	Water Conservation Plan	Water Conservation Plans include as the use of: • Low-flow faucets. • Ultra-low-consumption toilets/urinals with electric flush sensors. • Low-flow showerheads. • Lower flow commercial-type "Energy Star" washing machines in housing units. • Energy and water-saving dishwashers (Energy Star). • Water softeners only as needed. • wastewater recycling in industrial washing and rinsing of aircraft and vehicles. • Water-efficient cooling systems. • Minimal landscape irrigation and no irrigation at housing. • Rainwater collection and reuse. • Meters installed at all facilities and key locations within the water distribution system that can significantly improve the ability to quickly identify leaks and take corrective action. In addition, educate the military population regarding practices that would conserve water (including full-load clothes washing).	X	X	X		X			
9	Hazardous Materials Management Plans (HMMP)	HMMPs describe implementation procedures for the transportation, storage, use, and disposal of hazardous materials. HMMPs would also include waste minimization plans that provide protocols designed to encourage and promote the efficient use of hazardous materials, substitute products that are less toxic whenever feasible, minimization of their use, and promote recycling and reuse of hazardous materials. HMMPs would contain procedures such as: • Hazardous materials spill/release control (use of secondary containment and leak detection methods in operations involving liquid hazardous substances). • Construction materials and all construction-related materials should be free of leachable pollutants. • Train personnel (DoD personnel and contractors are trained in proper labeling, container, storage, staging, and transportation requirements for hazardous substances. Also, they are trained in accordance with spill prevention, control, and cleanup methods).		X	X	X	X		X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
		• Perform all vehicle maintenance activities at existing DoD maintenance shops. • Ensure that all personnel and contractors store, handle, and dispose of all POL per all applicable local and federal laws, regulations, and requirements. • As necessary, expand Defense Reutilization Marketing Offices (DRMO) hazardous materials storage, transportation, and disposal capacity prior to any expected increases. Note that a Joint Military Master Plan provides specific details regarding several new facilities. These new facilities would be required to store, handle, and dispose of the estimated increases in hazardous substances that would occur from the potential DoD unit transfers to Guam. • Contaminated topsoil removed from the site should be properly disposed of in an approved landfill in accordance with applicable regulatory requirements • Ensure that sediments to be dredged and soils to be excavated are well characterized, properly handled, and disposed of to minimize dispersal of any contaminants that may be present. • Temporary equipment laydown or construction staging areas would be located in previously disturbed (e.g., paved) areas. • Minimize the use of contaminated sites for new construction. When new construction occurs on sites where contamination and/or munitions and explosives of concern have been identified, ensure that the risk of human/ecological risk and exposure is minimized via the use of site-specific health and safety plans, engineering and administrative controls, and PPE. These site-specific health and safety plans must specifically address how these controls would be implemented to ensure the protection of human health and the environment. In addition, as appropriate conduct Phase I and II Environmental Site Assessments prior to construction activities and ensure that designs consider and address contaminated sites as appropriate.								

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
10	Hazardous Waste Management Program (HWMP)	HWMPs include waste minimization plans that provide protocols designed to encourage and promote the efficient use of hazardous waste, substitute products that are less toxic whenever feasible, minimize their use, and promote recycling and reuse of hazardous waste. HWMPs include the following recommendations: • Update and implement the existing HWMP to include procedures for the transportation, storage, use, handling, and disposal of hazardous waste. Also, modify project-specific hazardous waste disposal protocol as appropriate. • Ensure personnel and contractor training regarding project- and facility-specific hazardous waste plans. • The use of spill/release control (use of secondary containment and leak detection methods in operations involving liquid hazardous substances). • Ensure all DoD personnel and contractors are trained in accordance with the Guam public law (PL) 29-26 regarding the importation, handling, use, and application of pesticides (e.g., during maintenance, pre and post construction, and general operations activities). • Ensure appropriate housekeeping protocol (improving overall hazardous waste housekeeping practices, keeping area swept, wiping up spills, etc.). • Perform all maintenance activities at existing DoD maintenance shops. • Ensure that DRMO has sufficient hazardous waste storage, transportation, and disposal capacity prior to any expected increases. Note that a Joint Military Master Plan provides specific details regarding several new facilities. These new facilities would be required to store, handle, and dispose of the estimated increases in hazardous substances that would occur from the potential DoD unit transfers to Guam. • Ensure all federal, local, and DoD laws and regulations are being observed via inspections/audits/surveillances and implement corrective actions as necessary. Also ensure that all personnel and contractors manage, store, handle, transport, and dispose of hazardous wastes in accordance with applicable local (Guam EPA or CNMI Department of Environmental Quality (DEQ), USEPA, RCRA, and HSWA requirements. • Ensure that contaminated topsoil removed from sites is properly disposed		X	X	X	X			X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
		of in accordance with applicable regulatory requirements. • Ensure that sediments to be dredged and soils to be excavated are well characterized, properly handled, and disposed of to minimize dispersal of any contaminants that may be present. • Temporary equipment laydown or construction staging areas would be located in previously disturbed (e.g., paved) areas. • Minimize the use of contaminated sites for new construction. When new construction occurs on sites where contamination and/or MEC has been identified, ensure that the risk of human/ecological risk and exposure is minimized via the use of site-specific health and safety plans, engineering and administrative controls, and PPE in accordance with CFR 29 1910.120 (hazardous waste operations and emergency response operations). These site-specific health and safety plans must specifically address how these controls would be implemented to ensure the protection of human health and the environment. In addition, as appropriate conduct Phase I and II Environmental Site Assessments prior to construction activities and ensure that designs consider and address contaminated sites as appropriate.								

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
11	Spill Prevention, Control and Counter-measures Plans (SPCC) and Facility Response Plans (FRPs)	• Update and implement existing SPCC plan to assess and respond to hazardous substance spills and/or releases. • Update and implement existing FRPs for responding to releases, leaks, or spills of hazardous substances. • Ensure DoD personnel are trained as to proper labeling, container, storage, staging, and transportation requirements for hazardous substances. Also, ensure they are trained in accordance with spill prevention, control, and cleanup methods. • Ensure petroleum, oil and lubricants (POL)/fuel transfers kept away from water bodies and a response/contingency plan is in place in the event of any releases, leaks, or spills. • Ensure proper labeling of all hazardous substance containers to prevent inappropriate storage or use. • Contaminant migration control (e.g., reducing contaminant migration pathways by preventing releases to drains, pipelines, and sewers and the use of absorbent pads and materials to prevent and control spills and releases). • Ensure that contaminants (e.g., oils, greases, lubrication fluids for heavy equipment) are properly stored at work sites and temporary construction staging areas to avoid spills, releases, and leaks. • Ensure that emergency response plans are in place for responding to releases, leaks, or spills of hazardous substances. • Minimize the risk of uncontrolled leaks, spills, and releases through industry and Navy accepted methods for spill prevention, containment, control, and abatement. • Minimize the risk of human exposure to contaminated media through the use of a site-specific health and safety plan, engineering and administrative controls, and appropriate personal protective equipment (PPE) (e.g., indicating where eye-wash stations, fire extinguishers, etc., are located).		X	X	X	X	X	X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
12	Integrated Pest Management Plan (IPMP)	• DoD would develop and implement a comprehensive IPMP. This IPMP would encompass all activities regarding the importation, handling, storage, use, and application of pesticides as well as address prevention of the introduction of potential invasive species to Guam. • DoD personnel and contractors would be trained in accordance with Guam public law (PL) 29-26 regarding the importation, handling, use, and application of pesticides (e.g., during maintenance, pre and post construction, and general operations activities).		X	X					X
13	Munitions and Explosives of Concern (MEC)	• Comply with all applicable MEC protocol, procedures, and guidance including, but not limited to the Naval Ordnance Safety and Security Activity (NOSSA) Instruction 8020.15B Explosives Safety Review, Oversight, and Verification of Munitions Responses prior to any construction/demolition or other site activities. • Reduce the potential exposure to unexploded ordnance (UXO) through surveys or other means to identify and remedy this hazard prior to building upon a site. Work would be conducted by qualified UXO specialists. • Implement routine firing range clearance operations (e.g., annually or as needed), perform sampling and analysis as deemed necessary, and implement all applicable DoD MEC operations guidance to minimize or eliminate potential MEC explosion hazards and other adverse impacts (including depositions with potential to leach into the subsurface). • Implement land use controls, signage, periodic inspections, and other means to ensure no unauthorized access to firing ranges, MEC, and/or hazardous substances. • Train construction crews on identifying and responding to MECs encountered in the field. UXO personnel would be available to monitor earthmoving activities.		X	X		X		X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
14	Land Use Planning and Project Design	Land Use Planning and Project Design BMPs include: • Minimize impacts through design, and incorporating site plans that attempt maximum land use efficiency. Place future industrial use sites in the vicinity of similar DoD industrial uses. • Use the community development planning process to minimize impacts to land use. • Maintain a perimeter buffer within DoD property boundaries. • Reduce seismic, liquefaction and ground shaking by following Unified Facility Code 3-310-04 Seismic Design for Buildings (USACE 2007). • Construction planning would avoid locating new buildings over unstable karst features to prevent collapse and reduce unnecessary compaction. • Avoid locating new building construction in flood hazard areas, or if necessary, fortify or elevate them above base flood elevation where possible. • Minimize land acquisitions. • Install utilities in existing corridors to the extent possible. • Avoid the acquisition of public facilities, such as park land, to the extent practical (FHWA).	X	X		X	X	X		
15	Natural Resource Management (Terrestrial Focused)	Various measures are currently used to minimize impacts to the terrestrial environment from project-related activities such as: • No-Training Areas within a 328-ft (100-m) radius around Mariana swiftlet caves at Naval Munitions Site (NMS). • No-Training Areas around wetlands with known Mariana common moorhen nesting activity. • Implement Brown Tree Snake (BTS) Control and Interdiction or Management Plans (COMNAV Instruction 5090.10A, dated February 2005; Andersen AFB 36 WG Instruction 32-7004 dated March 2006). • Prevent the spread of invasive species by implementing a training SOP; troops would receive awareness training and would inspect all gear and clothing (e.g., boots, bags, weapons, pants) for soil accumulations, seeds, invertebrates, and possible inconspicuous stow away BTS. • Trap BTS at swiftlet caves. The Navy has been contracting with USDA Wildlife Services to trap BTS at the swiftlet caves and in housing areas.		X	X		X	X		X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
16	Natural Resource Management (Marine Focused)	Minimize contamination of the marine environment from project-related activities through actions such as: • Contractors are required to have and to implement a contingency plan to control and contain toxic spills, including petroleum products. Appropriate materials to contain and clean potential spills would be maintained and readily available at the work site. • All construction project-related materials and equipment placed in the water would be free of pollutants. The project manager and heavy equipment operators would perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations would be postponed or halted should a leak be detected, and would not proceed until the leak is repaired and equipment cleaned. This information is written into the construction contract conditions. • Fueling of construction project-related vehicles and equipment would take place at least 50 feet away from the water, preferably over an impervious surface. With respect to construction equipment (dredging barges) that cannot be fueled out of the water, spill prevention booms would be employed to contain any potential spills. Any fuel spilled would be cleaned up immediately. • A plan would be developed and implemented to prevent construction debris from entering or remaining in the marine environment during the project.		X	X		X		X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
17	Public Outreach/ Education	Develop and implement a Public Outreach Program to: • Inform residents, businesses, and service providers about the project schedule and other relevant information. • Implement public awareness education seminars and workshops regarding the dangers of munitions and explosives of concern (MEC) the importance of staying off firing ranges, and what to do if MEC is suspected or observed. • Promote public meeting announcements by posting ads and placing public notices in multiple places and on the internet. • Provide public meeting written materials translated in Chamorro and Filipino, supply an interpreter at public meetings. Mail announcements of public meetings to areas that may be disproportionately impacted by proposed actions (i.e., residents of Dededo, Yigo, Barrigada, Mangilao, Piti, Santa Rita, Agat, and Talofofo). • Mail announcements of public meetings to more rural areas in the south (i.e., Agat and Talofofo). • Hold public meetings in areas accessible to public transportation and in the southern region in locations accessible to as many people in that region as possible noting that public transportation may not be available in all rural areas.		X		X		X	X	X
18	Army Corps of Engineers (USACE)	USACE permit conditions and BMPs from recent Apra Harbor projects (that minimize degradation of water quality and impacts to fish and wildlife resources) provide the following recommendations (the project–specific permit may have additional conditions and protective measures): • All project-related materials and equipment (dredges, barges, etc.) placed in the water should be clear of pollutants prior to use; i.e., no project-related materials (fill, revetment rock, etc.) should be stockpiled in the water (intertidal zones, reef flats, etc.). • All debris removed from the marine/aquatic environment should be disposed at an approved upland or ocean-dumping site. • No contamination (trash or debris disposal, alien species introductions, etc.) of adjacent marine/aquatic environments (reef flats, channels, open ocean areas, stream channels, etc.) should result from project-related		X	X	X	X	X	X	

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
		activities. • Fueling of project-related vehicles and equipment should take place away from the water. • A contingency plan to control petroleum products accidentally spilled during the project should be developed. • Absorbent pads and containment booms should be stored on-site to facilitate the clean-up of accidental petroleum releases. • Any under-layer fills used should be protected from erosion with stones (or concrete cover layer units) as soon after placement as practicable. • Dredged material dewatering areas should be constructed and operated in accordance with all permit requirements. (Where applicable, a dewatering plan would be submitted to the GEPA prior to placing dredged material in upland placement sites.) • Whenever possible, dredged material would be reused. Where applicable, prior to disposal of dredge materials, a sampling and analysis plan would be submitted to the GEPA. • Provide advanced public notice of dredging activities to minimize conflicts with commercial shipping, recreational boating and other recreational activities. • Additional ship traffic should be addressed through scheduling and communications between Port Operations and contractors. In addition, USACE 404 and 401 permits require compliance with conditions and measures to protect water quality such as: • The installation of silt curtains in nearshore, shallow water areas to control turbidity. • Dredging operations may be suspended during inclement weather to prevent accidental release of dredged material and to ensure the integrity of silt curtains or other containment barriers, if utilized. • Water quality monitoring. • Adjustments resulting from water quality monitoring such as slowing or stopping operations.								
19	Transportation Federal Highway	Roadway project construction BMPs include the following recommendations: • Individual roadway projects should be designed and constructed in		X		X	X	X		X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
	Administration-(FHWA) specific	accordance with the Safe, Accountable, Flexible, and Efficient Transportation Equity Act: A Legacy for Users (SAFETEA-LU) objectives. • Final roadway designs should avoid contaminated sites where possible. • Temporary equipment laydown or construction staging areas should be located in previously disturbed (e.g., paved) areas. • Material from demolition of existing road pavements should be stored in previously disturbed areas whenever possible. • Final roadway designs should include coordination with the responsible party to ensure that roadway construction does not interfere with ongoing remediation activities. • A Phase II environmental site assessment should be conducted for roadway projects with Right-of Way (ROW) acquisitions of non-residential property. • Individual roadway projects should be designed and constructed in accordance with recommendations of the project- and site-specific geotechnical investigation, and applicable geotechnical code requirements. • In accordance with Section 10106 (*General Requirements: Erosion and Sediment Control Plans*) of the GSESCR, an Erosion and Sediment Control Plan for roadway construction/work should be prepared, submitted to the GEPA for review and approval, and implemented in construction plans and practices to the maximum extent practicable. • Prevent leaks or spills of contaminants by ensuring all temporary equipment laydown or construction staging areas are constructed with secondary containment for storage of any hazardous or petroleum products (FHWA). • Locate temporary equipment laydown or construction staging areas in previously disturbed (e.g., paved) areas (FHWA).								

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
20	Noise Abatement	BMPs to abate noise from roadway construction include the following: • Ensure that all equipment items have the manufacturers' recommended noise abatement measures, such as mufflers, engine enclosures, and engine vibration isolators, intact and operational. • Inspect all construction equipment at periodic intervals to ensure proper maintenance and presence of noise control devices (e.g., mufflers and shrouding). • Turn off idling equipment. • Implement a construction noise monitoring program to limit the impacts. • Plan noisier operations during times least sensitive to receptors. • Avoid scheduling construction during nighttime hours (10:00 p.m. to 7:00 a.m.) and on weekends. • Keep noise levels relatively uniform and avoid impulsive noises. • Maintain good public relations with the community to minimize objections to the unavoidable construction impacts. • Provide frequent activity updates of all construction activities.		X	X			X		
21	Utilities	For roadway projects, planning and continued coordination with utility providers during the preliminary engineering and final design, and construction stages of the project should minimize or eliminate interruption in utility service to customers. • Where feasible, utility relocations should be undertaken prior to roadway construction activities.		X						
22	Cultural Resources	• Archaeological monitoring of medium probability areas during construction in consultation with the State Historic Preservation Officer. • For post review discoveries, an assessment would be made for National Register of Historic Places eligibility in consultation with the State Historic Preservation Office. • For areas or properties that have not been inventoried for historic properties, the DoD would follow Standard Operating Procedures as outlined in the Integrated Cultural Resources Management Plan and Section 106 consultation.		X	X	X				
23	Range Training Area Management	Update the existing training area management plans to include the new ranges. There are many management practices addressed in the plan including the following:			X	X	X	X	X	X

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
	Plan	• Remove expended rounds from the ranges periodically and transporting them to an appropriate recycling contractor or smelter in accordance with appropriate regulations. • Develop and implement a Range Safety Program to conduct or coordinate training area safety, emergency response (medical and fire), Explosive Ordnance Disposal, Training Mishap Investigations, safety training, and range inspections. • Develop and implement a Fire Management Plan. • Implement all applicable DoD Range Management procedures and protocol. • Adhere to protective measures established in natural and cultural resource management plans. • Controls for training area airspace in accordance with Federal Aviation Administration regulations and agreements, with an objective of use by multiple agencies with minimal interference and maximum safety. • Manage of movement and access into and within the training area by monitoring and controlling use of surface roads, shorelines and adjacent water areas, and airspace above the Range Training Area. • Publication of advanced notice for periods of range use to airman, mariners, and the general public as required for safe training area operations. • Comply with water protection measures and Military Handbook 1027/3B to minimize the potential for groundwater leachate to affect the production wells, proposed range maintenance activities and training operations would be in compliance with • Implement Military Handbook 1027/3B contains procedures for reducing potential impacts from ranges. These include adding soil amendments to maintain the soil pH between 6 and 8, maintaining vegetation on berms and drainage ways and turf on the range, contaminant monitoring, and reclamation and recycling of spent ammunition. • Implement a monitoring program to identify any early indications of lead movement so that action could be taken to address any potential water quality impacts.								

Item	BMP	Description	Activities			Resources				
			Design	Construction	Operation	Geological & Soil	Water	Terrestrial Biological	Marine Biological	Hazardous Materials
24	Environmental Protection Plan (EPP)	An Environmental Protection Plan (EPP) is required for projects at the discretion of the GEPA Administrator**.** EPPs are specifically identified in 22 Guam Annotated Regulations, Division II, Chapter 10, Section 10103.C.5 (d). EPPs would include nonpoint source control management measures including erosion and sedimentation control, vegetation, wildlife resource protection measures, fugitive dust control, solid and hazardous waste management and disposal procedures, nutrient management plan, integrated pest management strategy/plan, confined animal facilities management plan, irrigation water management plan, personnel safety procedures, work site maintenance, and typhoon contingency plans, as necessary, depending on the work, project, activity and facility function.		X	X	X	X	X	X	X
25	Seismic Design for Buildings (SD4B)	During project design and construction, hazards associated with earthquakes and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007).	X	X		X				
26	Armed Forces Ballast Water Management Program	Ships must strictly comply with fuel transfer and ballasting procedures to ensure ballast water does not become contaminated with oil or any other waste. Ships using self-compensating fuel tanks are required to ensure adequate margin is preserved to prevent inadvertent discharges of oil with the compensating water. Navy ships must prevent the introduction of non-native organisms into natural ecosystems. Ship Ballast Water and Anchor System Sediment Control provide measures to prevent introductions of aquatic species.			X				X	
27	Awareness Training	Increase awareness training regarding the consequences of drug and alcohol use.		X	X					
28	Domestic Animal Control (MCO 11000.22)	Limits the number and type of household pets allowed per military family and requires microchip identification of pets.		X	X			X		

Item	*BMP*	*Description*	*Activities*			*Resources*				
			Design	*Construction*	*Operation*	*Geological & Soil*	*Water*	*Terrestrial Biological*	*Marine Biological*	*Hazardous Materials*
29	US Army Corps of Engineers (USACE)	Compliance with USACE 404 and 401 permit conditions such as: • The installation of silt curtains in nearshore shallow water areas to control turbidity. • Dredging operations may be suspended during inclement weather to prevent accidental release of dredged material and to ensure the integrity of silt curtains or other containment barriers, if utilized. • Water quality monitoring. • Adjustments resulting from water quality monitoring such as slowing or stopping operations.		X			X		X	

2.2 PROPOSED MITIGATION MEASURES ON GUAM AND TINIAN

Implementing the proposed actions described in each volume of this EIS would result in impacts to various resources either during construction or from steady-state operations after construction. This section lists the proposed mitigation measures identified during the NEPA environmental review of the proposed actions. Implementation of the mitigation measures would avoid or reduce the impacts resulting from proposed construction and operations. Generally, there are two categories of proposed mitigation measures that are discussed in this EIS:

- Mitigation measures within DoD control - DoD has statutory authority to implement actions taking place on lands under its control. DoD has limited statutory authority to implement natural and cultural resources mitigation measures on non-DoD land.
- Mitigation measures outside of DoD control - Except for the limited authority applicable to natural/cultural resources identified above, DoD does not have statutory authority to undertake mitigation measures on non-DoD land.

Mitigation measures involving expansion or improvement to utilities, roadways, and other public services can be addressed by state and local governments using revenues from an expanded tax base, adjusted utility rates, connection fees, and other service charges. Taxes, rates, fees, and service charges are the tools state and local governments commonly use to address increased demand or improvements to public services they provide or control. Recognizing Guam's unique circumstances and that world economic conditions may make it difficult for Guam to address measures on non-DoD lands using normal revenue sources, the DoD is committed to working with Guam and the full array of federal executive agencies to identify potential sources of funding to assist Guam in implementing mitigation measures on non-DoD land.

Both DoD-controlled and non-DoD controlled mitigation measures that would avoid, minimize, replace, or compensate for impacts if implemented by DoD or non-DoD agencies are included in Table 2.2-1. The measures listed in Table 2.2-1 are applicable to the preferred alternatives, unless noted otherwise. Reasonable alternatives were developed based on a consideration for avoiding and/or minimizing potential impacts as a result of implementing the proposed alternatives. All proposed mitigation measures identified in the table are considered within DoD control and would be implemented by DoD unless otherwise noted in **bold** text in the table (e.g., **This measure falls within GovGuam authority to implement)**. Some of the mitigation measures are applicable to multiple resource areas and these are noted in *italics*. The table provides only a brief summary of each mitigation measure proposed in the EIS. For more information about a mitigation measure, refer to the section(s) of the EIS identified in the third column of the table.

Table 2.2-1. Summary of Proposed Mitigation Measures (Guam and Tinian)

Proposed Mitigation Measure		*Reference*
Geological and Soil Resources (GS)		
GS-1	Avoid known sinkholes and place a buffer zone of vegetation around them to prevent further erosion or expansion. Erect educational signs and/or fencing where appropriate. Any sinkholes discovered would be evaluated to determine significant impacts and projects would be designed in consideration of these sinkholes as appropriate.	V2.3.2.3.5 V2.3.2.8 V3.3.2.6 V3.3.2.7 T3.3.2-6 V5.3.2.2.1 T5.3.2-5
Water Resources (WR; See also Marine Biological Resources category)		
WR-1	Attempt to avoid impacts to wetlands; if avoidance is not possible then minimize potential impacts. Section 404 of the CWA requires mitigation of unavoidable wetland disturbances. Compensate by creating new wetlands or restoring, enhancing, or preserving existing wetland areas to, at a minimum, replace the area.	V2.4.2.4.6 V2.4.2.5.6 T2.4.2-8 V2.4.2.9 V5.4.2.2.3 T5.4.2-4
WR-2	Channel widening, lining and/or re-contouring.	V6.6.2.6.7 T6.6.2-7
WR-3	Pier placement and/or reconfiguration.	V6.6.2.6.7 T6.6.2-7
WR-4	Utility line relocation where utilities cause obstructions to stream flow.	V6.6.2.6.7 T6.6.2-7
WR-5	Debris removal, incorporation of debris noses upstream of piers and wingwalls.	V6.6.2.6.7 T6.6.2-7
WR-6	Aquatic habitat enhancements at Camp Covington or other identified areas to mitigate for bridge and culvert replacements in accordance with Section 404 of CWA permitting requirements.	V6.6.2.6.7 T6.6.2-7
Air Quality (AQ)		
AQ – 1	Install permanent ambient air quality monitoring station for SO_2 and PM in coordination with USEPA and GEPA.	V2.5.2.8
AQ - 2	Install temporary air quality monitoring station for SO_2 and PM near Northern Guam construction site.	V2.5.2.8
Noise (N) Human Receptors		
N-1	Operations (Firing Ranges): noise barriers installed where feasible and practical.	V2.6.2.2.2
N-2	During construction, install noise barriers where feasible and practical such as constructing concrete block walls as sound barriers to reduce noise levels.	V2.6 V2.6.2-19 V5.6.2.2.1 V5.6.2.7 T5.6.2-4
N-3	Techniques for reducing noise impacts from firing ranges include: • Maintaining the current dense foliage, and • Constructing berms to contain the sound, when practical.	V2.6.2.2.1
N-4	Operations (Roadways): sound walls were determined to be feasible (based on engineering considerations) and reasonable in accordance with Guam's Traffic Noise Abatement Policy following identification of noise receptors within project corridors and preparation of noise studies. **(This measure would fall within DoD, FHWA, and GovGuam authority to implement)**	V5 6.2.2.1 V5 6.2.5 V5 T6.2.6 V6.8.2.1.2
Airspace – No Mitigation Measures		
Land and Submerged Land Use (LU)		

Proposed Mitigation Measure		*Reference*
LU-1	Provide access to land and submerged land to extent practical. DoD is working with stakeholders to develop plans for cultural stewardship and access that balance operational needs, public safety concerns, and the continuing public use and enjoyment of these sites.	V2.8.2.9
LU-2	GovGuam to revise community land use plans to address proposed DoD land uses. **(This measure would falls within GovGuam authority to implement)**	V2.8.3.1 V2.8.3.6 V2.8.2.9 V2.8.2.6
LU-3	In the event legal access to a non-federally controlled property is acquired under the proposed action, DoD would assist the landowner in obtaining a new legal access.	V2.8.2.6
Recreational Resources (RR)		
RR-1	GovGuam to update Guam Comprehensive Outdoor Recreation Plan that addresses recreational user use, demand, preference, conflicts, and conditions. **(This measure would falls within GovGuam authority to implement)**	V2.9.2.2.6 V2.9.2.8 T2.9.2-1
RR-2	DoD would offer resources consistent with DoD policy in the form of time and donation or use of equipment to assist the volunteer conservation officer (VCO) at Andersen AFB.	V2.9.2.2.6 V2.9.2.8 T2.9.2-1
RR-3	Collaborate with the GDAWR to establish outreach programs and docent (person who leads guided tours) programs for the five marine preserves and other environmentally sensitive areas on Guam.	V2.9.2.2.6 V2.9.2.8 T2.9.2-1
RR-4	Provide for improvements and maintenance of federally owned portions of Tanguisson Beach, along with the management of the coastline to the north of Hilaan that contains significant natural, cultural, scenic, and recreational resources.	V2.9.2.2.6 V2.9.2.8 T2.9.2-1
RR-5	To alleviate impacts to the limited recreational resources at Polaris Point during construction and carrier visits, additional on-base shuttle bus services to Dadi Beach, Gab Gab Beach, and other DoD recreational facilities would be provided to ensure Sailors and airmen have the ability to access comparable and/or alternate recreational resources. For off-base recreational resources, Sailors and airmen would be able to take commercial shuttles and taxis.	V4.9.2.6.1 T4.9.2-6
RR-6	Establishment of outdoor recreation areas on NCTS Finegayan. This would also mitigate impacts to biological resources.	V2.9.2.2.6 V2.9.2.8 T2.9.2-1
RR-7	To compensate for potentially significant impacts to beach and ocean recreational resources from the proposed actions on Guam, DoD to improve the Seaman Service Club Beach in Piti. The existing beach pilings, shelter, and bathroom would be improved. Available recreational activities include: kayaking, snorkeling, and beach combing.	V2.9.2.2.6
Terrestrial Biological Resources (TB)		
TB-1	Translocate Guam tree snails at Navy Barrigada to another site on DoD lands after approval by USFWS and Guam DAWR. (Note that these are not required for Main Cantonment Alternatives 1, 2, and 8. Alternative 2 is the Preferred Alternative.)	V2.10.2.1 T2.10.2-22 V5.10.2.7 T5.10.2-8
TB-2	Approximately one week prior to clearing vegetation a qualified biologist would survey the project site for the occurrence of ESA-listed species (e.g., Mariana fruit bats, Mariana crows, and Mariana moorhens), and if present, the work would be postponed. Additionally, conduct biological surveys for Mariana common moorhens prior to initiating pavement strengthening or bridge replacement adjacent to wetlands.	V2.10.2.1 T2.10.2-22 V3.10.2.2.3 V3.10.2.7 T3.10.2-14 V5.10.2.3.1 V6,12

Proposed Mitigation Measure		*Reference*
TB-3	Ensure periodic updates of the Joint Region Marianas Training Handbook with procedures to protect special-status species during project-specific training.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6 V3.10.2.2.3 V3.10.2.7 T3.10.2-14
TB-4	Appropriate native and non-invasive species would be planted in all new landscapes upon completion of proposed construction activities. Plants to be used would be selected from a list of recommended plants identified in the consolidated landscape plan. Construction specifications would address salvaging valuable tree species from areas to be cleared during construction.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6
TB-5	Lighting will be designed to meet minimum safety, anti-terrorism, and force protection requirements. To the maximum extent practical, hooded lights would be used at all new roads and facilities proposed for construction and use near sea turtle land based habitat and within Mariana fruit bat habitat.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6 V4.10.2.2.2 V4.10.2.3.1
TB-6 (MB)	To prevent disturbance of sensitive species in recreational areas, restrictions on the use of Haputo Beach and ERA would be included within the Joint Region INRMP. *This mitigation measure is also applicable to the marine biological resources category (MB).*	V2.10.2.1 T2.10.2-22 V2.10.2.2.2 V2.10.2.2.6 V2.11.2.7 V2.11.2.2.6 T2.11.2-16 V4.11.1
TB-7	Pyrotechnics would only be used during low-fire risk conditions in accordance with Range Training Area Management Plan SOPs.	V2.10.2.2.4
TB-8	The DoD would fund research on the Mariana fruit bat. The long-term goal is to develop guidelines to be used in recovery and sustainable management of fruit bats on different islands.	V2.10.2.1 T2.10.2-22
TB-9	An ungulate management plan would be finalized by the DoD for DoD lands on Guam to include specific management and control of ungulates.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6
TB-10	The U.S. Forest Service (USFS) has developed a fire management plan that the DoD would use to develop Instruction to implement fire management actions on DoD (USFS 2008). The Instruction would also include BMPs such as for cleaning gear and equipment to prevent the spread of non-native invasive species resulting from wildfire suppression.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6 V3.10.2.2.3 V3.10.2.7 T3.10.2-14
TB-11	To compensate for the removal of a portion of the existing FAA Mitigation Area, the mitigation area would be expanded and reconfigured and the replacement would be at a minimum 2:1 ratio.	V3.10.2.2.3 V3.10.2.7 T3.10.2-14
TB-12	The 5-Step HACCP planning method for reducing or eliminating the spread of unwanted species would be used for high-risk activities. HACCP methodology would be incorporated into contracting documents associated with high-risk projects.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6 V3.10.2.7 T3.10.2-14
TB-13	Comprehensive pre-construction surveys for the eight-spot butterfly host plants in the Route 15 range area would be conducted to determine the presence of host plants, larvae, and adult butterflies within the project area for Mariana eight spot butterflies. As part of the Joint Region INRMP, periodic surveys would be conducted once the ranges are operational to	V2.10.2.1 T2.10.2-22 V2.10.2.2.6

Proposed Mitigation Measure		*Reference*
	provide long-term monitoring of the status and presence of this species within the Route 15 Range Complex.	
TB-14 (MB)	The DoD would develop a biosecurity program to be employed throughout the construction phase of the military build-up. The program would have terrestrial and aquatic resource response capabilities. The DoD's biosecurity program would address non-native, invasive species issues on DoD property within Guam and the CNMI. *This mitigation measure is also applicable to the MB category.*	V2.10.2.1 T2.10.2-22 V2.10.2.2.6 V2.11.2.7 V2.11.2.2.6 T2.11.2-16 V4.11.1
TB-15	To prevent the spread of coconut rhinoceros beetle, the DoD would include specifications in contracts for inspections, proper re-use or disposal of vegetation within coconut rhinoceros beetle quarantine area. Biosecurity measures would ensure that yard waste and vegetation debris is not harboring coconut rhinoceros beetle or the waste is treated prior to re-use or movement off construction site.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6
TB-16	Management options would be assessed for invasive species that are threatening special-status or SOGCN species.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6
TB-17	DoD would provide funding during the construction phase of the Proposed Action to develop methods to eradicate or significantly suppress BTS on DoD lands.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6
TB-18	Require DoD recreational boaters departing from DoD marinas who travel to other islands to conduct BTS self-inspections.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6
TB-19	The DoD would expand the existing environmental education program for new personnel arrivals (personnel undergoing Permanent Change of Station).	V2.10.2.1 T2.10.2-22 V2.10.2.2.6
TB-20	DoD would submit proposals: • To expand the existing Orote ERA to protect Orote Island (seabird nesting habitat), Adotgan Point, and the Spanish Steps area that supports sea turtle nesting. The expansion would add approximately 32 ac (13 ha) of terrestrial habitat to the Orote ERA; • For a NMS ERA. The proposed ERA would encompass approximately 553 ac (234 ha) of habitat for listed species; • For a Ritidian Point ERA. The entire proposed Ritidian Point ERA would be approximately 781 ac (316 ha) of habitat for listed species; • For a Pati Point ERA. The proposed ERA would include approximately 713 ac (289 ha) of habitat for listed species, and • To develop a continuous band of protected area from Andersen AFB at the proposed Pati Point ERA through GovGuam's Anao Conservation Area south to the proposed Route 15 Range Complex. **(This measure falls within DoD and GovGuam authority to implement).** *This mitigation measure is also applicable to the MB category.*	V2.10.2.1 T2.10.2-22 V2.10.2.2.6 V2.11.2.7 V2.11.2.2.6 T2.11.2-16 V4.11.1
TB-21	The DoD would develop a restoration plan for the Camp Covington wetlands in an effort to increase suitable habitat for the Mariana common moorhen. If Camp Covington is deemed unsuitable for wetland enhancement or restoration, the Atantano wetlands would be evaluated for restoration potential.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6
TB-22	The DoD would enter into an MOU with USFWS and NMFS outlining the	V2.10.2.1

Proposed Mitigation Measure		*Reference*
(MB)	details of a joint investigation on sea turtle population abundance estimates, demographic information, near shore habitat use, baseline populations, and long-term population parameters. This would be a 3 to 5 year joint DoD-USFWS-NMFS capture-mark-recapture laparoscopy program for green sea turtles occurring in near shore waters surrounding Guam, Saipan, Tinian, and Rota. *This mitigation measure is also applicable to the MB category.*	T2.10.2-22 V2.10.2.2.6 V4.10.2.6 V2.11.2.7 V2.11.2.2.6 T2.11.2-16 V4.11.1
TB-23	Additional surveys for the moth skink and Pacific slender-toed gecko on DoD lands will be addressed in the Joint Region INRMP.	V2.10.3.6
TB-24	The DoD would establish an outdoor recreation area at the proposed Main Contonment area at NCTS Finegayan to help direct recreation away from sensitive habitats near and within the Haputo ERA (beaches, cliff line forests).	V2.10.2.1 T2.10.2-22
TB-25	Collect demographic information for the Mariana fruit bat in the Marianas archipelago.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6
TB-26	Develop and implement a Guam and Tinian Native Forest Enhancement Plan to improve and restore the ecosystem and control erosion.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6 V3.10.2.2.3 V3.10.2.7 T3.10.2-14
TB-27	Upon termination of any agricultural leases in the leaseback area on Tinian, DoD would work with CNMI land use and natural resource officials to ensure that native forest habitat concerns for ESA-listed species are taken into account.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6 V3.10.2.2.3 V3.10.2.7 T3.10.2-14
TB-28	If nesting Mariana common moorhens are present within the limits of construction, clearing and construction would be postponed until the chicks have fledged. If work stops for more than 1 week, pre-construction surveys would be repeated to ensure that no moorhens have begun to nest.	V3.10.2.2.3 V3.10.2.7 T3.10.2-14
TB-29	On Tinian, if Micronesian megapodes are present within 492 ft (150 m) of the project site, the work would be postponed until the megapode has left the area. If megapodes are nesting within 984 ft (300 m) of the project site, the work would be postponed and the USFWS contacted immediately as no nesting is known to occur there	V3.10.2.2.3 V3.10.2.7 T3.10.2-14
TB-30	Construction personnel would receive natural resource awareness briefings which address special-status species, avoidance measures and reporting requirements. *This mitigation measure is also applicable to the MB category.*	V2.10.2.1 T2.10.2-22 V2.10.2.2.6 V3.10.2.2.3 V3.10.2.7 T3.10.2-14 V2.11.2.7 V2.11.2.2.6 T2.11.2-16 V4.10 V4.11.1
TB-31	The DoD would hire two full-time biological monitors during the construction phase on Guam and Tinian. The Biological Monitors would be responsible for oversight of avoidance, minimization, mitigation measures, and conservation measure implementation by the construction contractors for projects associated with the proposed action.	V2.10.2.1 T2.10.2-22 V2.10.2.2.6 V3.10.2.2.3 V3.10.2.7 T3.10.2-14

Proposed Mitigation Measure		*Reference*
TB-32	The DoD would re-evaluate and re-structure the current vegetation monitoring and anchor points that have been established on Guam and Tinian to provide information necessary for long-term habitat monitoring associated with DoD natural resources management efforts.	V2.10.2.2.2 V2.10.2.2.6 T2.10.2-22 V3.10.2.2.3 V3.10.2.7 T3.10.2-14
TB-33	The Micronesia Biosecurity Plan is being developed to address potential invasive species impacts associated with the actions proposed in this EIS as well as to provide a plan for a comprehensive regional approach. The MBP would include risk assessments for invasive species throughout Micronesia and procedures to avoid, minimize, and mitigate these risks. It is being developed in conjunction with experts within other federal agencies including the NISC, USDA-APHIS, the USGS, and the SERC. The MBP is intended to be a comprehensive evaluation of risks in the region, including all Marine Corps and Navy actions on Guam and Tinian. For actions proposed in this EIS, biosecurity measures would be implemented to supplement existing practices to address invasive species. *This mitigation measure is also applicable to the MB category.*	V2.10.2.1 T2.10.2-22 V2.10.2.2.6 V3.10.2.2.3 V3.10.2.7 T3.10.2-14 V3.11.2.7 T3.11.2-6 V4.10.2.2.2 V4.11.2 V5 10.2.3.1 T510.2-8
Marine Biological Resources (MB)		
MB-1	No in-water blasting would be allowed.	V4.11.2.2.4 T4.11.2-22
MB-2	Water quality would be monitored for in-water construction projects during the construction phase.	V2.11.2.2.6 T2.11.2-16 V4.4 V4.11.2.2.4 T4.11.2-22
MB-3	Preliminary shutdown safety zones corresponding to where sea turtles could be injured or harassed would be established based upon empirical field measurements of pile driving sound levels at the construction site. The sound pressure levels (SPLs) would be monitored on the first day of pile driving to ensure accuracy of contours. Until validation of the harm threshold, no pile driving may occur within 100 m of sea turtles and no dredging operations shall occur within 50 m of sea turtles. Safety zones would be re-established to accommodate validated harm threshold and reported to NMFS with acoustic monitoring data. Monitoring of sea turtle harassment safety zones would be conducted by qualified observers, including two observers for safety zones around each pile driving and dredging site. Monitoring shall commence 30 minutes prior to the start of pile driving. If a sea turtle is found within the safety zone, pile driving or dredging of the segment shall be until the animal(s) has been visually observed beyond the impact zone or 30 minutes have passed without re-detection. Pile driving of dredging may continue into the night, but where there has been an interruption of the activity the activity would not be initiated or re-initiated during nighttime hours when visual clearance cannot be conducted.	V2.11.2.2.6 T2.11.2-16 V4.11.2.2.4 T4.11.2-22
MB-4	Pile driving and dredging would commence using soft-start or ramp-up techniques, at the start of each work day or following a break of more than 30 minutes. Pile driving would employ a slow increase in hammering, whereas dredging would commence with slow and deliberate deployment of the bucket or chisel to the bottom for the first several cycles to alert protected species and allow them an opportunity to vacate the area prior to full-intensity operations.	V2.11.2.2.6 T2.11.2-16 V4.11.2.2.4 T4.11.2-22
MB-5	No pile driving or dredging would be conducted after dark unless that work has proceeded uninterrupted since at least one hour prior to sunset,	V2.11.2.2.6 T2.11.2-16

Proposed Mitigation Measure		*Reference*
	and no protected species have been observed near the respective safety range for that work.	V4.11.2.2.4 T4.11.2-22
MB-6	If a sea turtle or other listed species is found injured within the vicinity of the action area, all in-water pile driving or dredging activities shall cease immediately, regardless of their effect on the noted turtle and the Navy would contact the regional NMFS stranding coordinator.	V2.11.2.2.6 T2.11.2-16 V4.11
MB-7	Construction related vessels within Apra Harbor shall remain at least 50 yards from sea turtles, reduce speed to 10 knots or less in the proximity of sea turtles (if practicable, 5 knots or less in areas of suspected turtle activity), and, when consistent with safety practices, put engine in neutral and allow the turtle to pass if approached by a turtle. Additionally, sea turtles shall not be encircled or trapped between multiple construction-related vessels or between construction-related vessels and the shore.	V2.11.2.2.6 T2.11.2-16 V4.11
MB-8	All construction-related equipment would be operated and anchored to avoid contacting coral reef resources during construction activities or extreme weather conditions. Anchor lines from construction vessels would be deployed with appropriate tension to avoid entanglement with sea turtles. Construction-related materials that may pose an entanglement hazard would be removed from the project site if not actively being used.	V2.11.2.2.6 T2.11.2-16 V4.11
MB-9	Anchors, anchor chain, wire rope and associated anchor rigging from construction related vessels would be restricted to designated anchoring areas within the construction footprint (ie, soft bottom) or within the area that would be permanently impacted.	V4.11 V2.11.2.7 V2.11.2.2.6 T2.11.2-16
MB-10	As prescribed in permits for previous construction activities (i.e., Kilo Wharf) during pile driving or dredging activities, if a visible plume is observed outside the silt curtains, the construction activity would be suspended, evaluated, and corrective measures taken. *This mitigation measure is also applicable to the water resources category (WR).*	V2.4.2.7 T2.4.2-8 V2.11.2.2.6 T2.11.2-16 V4.4.2.2.6 T4.4.2-6 V4.11.2.2.4
MB-11	Incorporate seasonal dredging prohibitions, which may include: • Cessation of dredging operations during the period of peak coral spawning (7-10 days after the full moon in July) in consultation with the University of Guam (UoG) Marine Lab. • Dredging or filling of tidal waters would not occur during hard coral spawning periods, usually around the full moons of June, July, and August.	V2.11.2.2.6 T2.11.2-16 V4.11.2.2.4 T4.11.2-22
MB-12	Construction related vessels would be restricted from Sasa Bay so as to reduce potential impacts to sea turtles and other protected marine and/or wildlife species. *This mitigation measure is also applicable to the terrestrial biological resources category (TB).*	V4.10.2.2.1 V4.10.2.2.2 V4.10.2.6 V2.11.2.2.6 T2.11.2-16 V2.11.2.7
MB-13	Provide marine biological resources education and training on Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA) and Essential Fish Habitat (EFH) to military personnel. This may include Base Orders, natural resource educational training (i.e., watching of short ERA/MPA video) and documentation (i.e., preparation of *Military Environmental/ Natural Resource Handbook,* distribution of natural resource educational materials to dive boat operators), or a combination of all.	V2.11.2.7 V2.11.2.2.6 T2.11.2-16 V4.11
MB-14	Aboard dredge-related tug, barge or scow vessels at sea, use the minimum lighting necessary to comply with navigation rules and best safety practices to help reduce potential impacts on protected species such as sea	V2.10.2.1 T2.10.2-22 V2.10.2.2.6

Proposed Mitigation Measure		*Reference*
	turtles. *This mitigation measure is also applicable to the TB category.*	V2.11.2.2.6 T2.11.2-16
MB-15	No barge overflow during dredging operations. *This mitigation measure is also applicable to the WR category.*	V2.4.2.7 T2.4.2-8 V4.4.2.2.6 T4.4.2-6 V4.11
MB-16	Where practicable, installation of silt curtains during channel and/or harbor dredging operations to maintain water quality and provide coral protection. *This mitigation measure is also applicable to the WR category.*	V2.4.2.7 T2.4.2-8 V4.4.2.2.6 T4.4.2-6 V2.11.2.2.6 T2.11.2-16 V4.11.2.2.4
MB-17	The following are being considered as elements for coral mitigation measures for consideration under the development of the compensatory mitigation plan: • Coral reef restoration via water quality improvements through watershed restoration. • Coral reef restoration via water quality improvements through WWTP upgrades/improvements. • Coral reef restoration via site-specific water quality improvements through retrofitting road stormwater controls at a range of sites on Guam. • Coral reef restoration within non-DOD federal property. • Aquaculture of native herbivorous fish • Coral transplantation • Establishment of marine protected area(s) MPA(s) • Artificial reefs • Support for enhanced enforcement of fishing and recreational diving regulations. • Marine debris removal • Remove nuisance algae • Installation of recreational mooring buoys • Coral reef restoration inside Apra Harbor through water quality and habitat improvements.	V4.11.2.2.4
Cultural Resources (CR) – (based on ongoing NHPA Section 106 Consultations, unless otherwise noted)		
CR-1	Data recovery of historic properties such as archaeological sites on the island of Guam in accordance with Section 106 consultation.	V2.12.2.2.5 V2.12.2.8 T2.12.2-6 V5.12.2.3.3 T5.12.2-4
CR-2	CNMI Curation Assessment. Artifacts from non-DoD properties follow local regulations regarding the handling and repatriation of cultural materials or human remains.	V3.12.2.2.3 V3.12.2.6 T3.12.2-5
CR-3	Historic property awareness training of DoD employees to promote protection of sensitive sites. (All Alternatives for Volume 2; all Alternatives for Volume 5).	V5.12.2.2.1 V2.12.2.2.5 V2.12.2.8 T2.12.2-6
CR-4	Data recovery of historic properties such as archaeological sites on the	V3.12.2.7

Proposed Mitigation Measure		*Reference*
	island of Tinian in accordance with Section 106 consultation.	T3.12.2-5
CR-5	Guam Synthesis – Data would be compiled and synthesized into one document written for the public. This disseminates information to the public and mitigate for limited access (All Alternatives).	V2.12.2.2.5 V2.12.2.8 T2.12.2-6 V5.12.2.2.1 V5.12.2.7 T5.12.2-4
CR-6	Cultural Landscape Report (CLR) for Northern Guam – the CLR would focus on installations affected by the relocation in the Northern Limestone Plateau and includes Finegayan, Andersen AFB, the Rte. 15 Range areas, Andersen South, and Barrigada (All Alternatives).	V2.12.2.2.5 V2.12.2.8 T2.12.2-6 V5.12.2.2.1 V5.12.2.7 T5.12.2-4
CR-7	Guam Curation Assessment. Curation of cultural materials and/or artifacts from DoD properties would be in a facility that meets 36 CFR 79. Curation Assessment would help in making determination of where DoD collections are curated. Artifacts from non-DoD properties follow local regulations regarding the handling and repatriation of cultural materials or human remains.	V2.12.2.2.5 V2.12.2.8 T2.12.2-6 V5.12.2.2.1 V5.12.2.7 T5.12.2-4
CR-8	Incorporate recommendations of Cultural Landscape Report (CLR) for Tinian NHL in the next version of the Cultural Resource Management Plan when not in conflict with natural resources.	V3.12.2.7 T3.12.2-5
CR-9	Thematic Synthesis Publications for the areas affected by the ranges on Tinian. Themes include: • Camp Churo "Old Village" • Japanese Farmsteads on Tinian • West Field	3.12.2.7 T3.12.2-5
CR-10	Update North Tinian Historic Properties Driving Tour Pamphlet.	3.12.2.7 T3.12.2-5
CR-11	Natural resources of cultural concern would be avoided if possible. However in places where impacts could not be avoided, artisans would be given an opportunity to harvest and collect these resources. (NEPA mitigation) *This mitigation measure is also applicable to the TB category.*	V2.12.2.2.5 V2.12.2.8 T2.12.2-6 V5.12.2.2.1 V5.12.2.7 T5.12.2-4
CR-12	Allow *suruhanus* access for medicinal plant collection on DoD properties, if the plants collected are not threatened or endangered species and where security requirements are not prohibitive. (NEPA mitigation) *This mitigation measure is also applicable to the TB category.*	V2.12.2.2.5 V2.12.2.8 T2.12.2-6 V5.12.2.2.1 V5.12.2.7 T5.12.2-4
CR-13	Indirect effects to Pagat (Sites 04-0021 and 04-0022) would be mitigated by the development of an access plan in the Range Management Plan. Public consultation in the form of a public meeting or public review would occur as part of the plan development process.	V2.12.2.2.5 V2.12.2.8 T2.12.2-6
CR-14	Update and execution of Pagat (Sites 04-0021 and 04-0022) Preservation Plan.	V2.12.2.2.5 V2.12.2.8 T2.12.2-6
CR-15	Avoidance of Latte Stone Park (Site 08-0141). Interpretive signage to be corrected and upgraded.	V2.12.2.3.4 T2.12.2-6 V5.12.2.2.1 V5.12.2.7 T5.12.2-4
CR-16	Indirect effects to Pagat (Sites 04-0021 and 04-0022) would be mitigated	V2.12.2.2.5

Proposed Mitigation Measure		*Reference*
	by allowing public access (e.g., recreational and tourism) to the sites when ranges are not in use. (NEPA mitigation)	V2.12.2.8 T2.12.2-6
CR-17	Access to Mt. Jumullong Manglo would be maintained through existing trail. (NEPA mitigation)	V2.12.2.2.4
CR-18	Eighth Avenue would remain open and driveable to allow access to the Tinian NHL.	V3.12.2.2.1 V3.12.2.3.1 V3.12.2.4.1
CR-19	Cumulative effects regarding the cultural heritage of Guam and CNMI would be mitigated through the establishment of a 5-year program to develop a historic preservation plan for Guam and CNMI. (NEPA mitigation)	V2.12 V3.12
Visual Resources (VR)		
VR-1	To maintain the existing visual appearance, land clearing and grading should be minimized to the extent possible on lands proposed for range uses.	V2.13.8 T2.13.2-6 V3.13.2.2.3 V3.13.2-7 T3.13.2-5
VR-2	Minimize impact by using native flora to create a natural-appearing "screen" around the cleared range areas, outside of the firebreaks/perimeter roads.	V2.13.8 T2.13.2-6 V3.13.2.2.3 V3.13.2-7 T3.13.2-5
VR-3	Prepare Installation Appearance Plan and implement design guidelines for all buildings.	V2.13.8 T2.13.2-6 V5.13.2.7 T5.13.2-4
VR-4	Develop and implement a landscape plan focused on retention of mature specimen trees during construction (where possible) and the establishment of a full suite of vegetation representing Guam's native flora.	V2.13.8 T2.13.2-6 V5.13.2.7 T5.13.2-4
VR-7	Create a buffer area and screen development on NCTS between the Haputo Point Overlook and adjacent proposed development.	V5.13.2.2.1 V5.13.2.7 T5.13.2-4
VR-8	Provide an open railing to the extent possible to provide views from bridges out to the adjacent areas.	V6.15.2.6
VR-9	Hide utility crossings on bridges and in between bridge girders or use other methods of screening utilities on bridges to improve views from a bridge and to enhance the structures integration into the overall landscape.	V6.15.2.6
VR-10	Preserve existing trees or stands of vegetation by shifting the roadway alignment to the extent feasible where roadways are widened.	V6.15.2.6
Transportation - Marine – No mitigation measures		
Transportation - Road (TR)		
TR-1	Agana Bridge #1 is eligible for inclusion in NRHP. The historic stylized parapet design would be included in the replacement bridge.	V6.21.2.3
TR-2	Coordinate with utility improvements. Planning and continued coordination with utility providers during the preliminary engineering and final design and the construction stages of roadway projects would be necessary to minimize or eliminate interruption in utility service to customers. The Joint Region Marianas would coordinate with the affected service provider in each instance to ensure that work is conducted in accordance with the appropriate requirements and criteria. In addition, coordination efforts would lay out utility reroutes, identify potential conflicts, ensure that construction of the proposed project minimizes disruption to utility operations, and formulate strategies for overcoming	V6.3.2.6.1 V6.3.2.6.5

Proposed Mitigation Measure		*Reference*
	problems that may arise. If interruptions of utility service are required, they would be restricted in duration and geographic extent. Careful scheduling of these disruptions and advance notification to occupants of the adjacent properties that would be affected by temporary service interruptions would help to avoid any critical service periods. Where feasible, utility relocations would be undertaken in advance of roadway construction activities.	
TR-3	Implement remaining non-DAR funded off-base road projects. (17 roadways and 42 intersections that are DAR-certified or determined to be DAR-eligible and additional road projects currently being evaluated for DAR eligibility.) **(This measure falls within DoD and FHWA authority to implement)**	V6.4.2.3
TR-4	For off-base roadways: Create a detailed Traffic Management Plan which would identify and provide alternate traffic detour routes, construction materials hauling routes, bus stops, transit routes and operation hours, pedestrian routes, and residential and commercial access routes to be used during the construction period. Specific aspects of the Plan could include: • Travel demand management. • Encourage moped and motorcycle use. • Develop transportation demand measures to discourage single-occupant vehicle use. • Stagger work hours. • Provide corporate shuttles for local circulation. • Better delivery system for purchases. • Flextime – compressed work weeks. • Promote trip reduction planning. • Traffic management would follow the Manual on Uniform Traffic Control Devices, as deemed necessary and applicable. • The Manual on Uniform Traffic Control Devices provides several examples on dealing with traffic through many different types of roadway construction activities. • Whenever possible, construction would be phased to allow two lanes of traffic to remain open. • If two lanes of traffic are not permissible, traffic would be reduced to one lane. • Should it be required for all lanes of traffic to be closed, a detour route would be clearly signed. • Appropriate measures would be taken to maintain access to businesses. • Should construction require a business access to be closed, the business owner would be given reasonable notice of the construction activities and the estimated duration of closure. • Pedestrian routes would remain open and clear of any debris • Should a pedestrian route be closed, a detour route would be clearly signed and maintained throughout construction to ensure pedestrian safety. • All emergency services would be given sufficient notice of construction activities and relative detour routes as to not affect their response times. • GovGuam DPW would develop a public outreach program about the project construction schedule, relocation plans and assistance programs, traffic-impacted areas and the Traffic Management Plan.	V6.4.2.3

Proposed Mitigation Measure		*Reference*
	(This measure falls within FHWA and GovGuam authority to implement)	
T-5	To mitigate for land acquired at Chinese Park for roadway widening, replacement park land would be provided in accordance with policies outlined in Land and Water Conservation Fund State Assistance Program Manual. Location of land acquisition to be identified in final design phase.	V6.21.6.1
Utilities and Infrastructure (UI) Subcategories of Utilities: W = water, SW = solid waste, P = power, WW = wastewater		
UI/W-1	Arrange for DoD to transfer excess water production capacity to Guam Water Authority (GWA) at their request to mitigate Guam potable water supply impacts (if GWA has a water shortage). Set up additional physical interconnections in the transmission systems. **(This measure would be implemented cooperatively by DoD and GovGuam)**	V6.3.2.3.1
UI/W-2	Carefully monitor the chloride concentrations in the sub-basins and adjust well pumping rates to reduce localized impacts to the NGLA sub-basin if high chloride concentrations are detected in individual wells. **(This measure would be implemented cooperatively by DoD and GovGuam)**	V6.3.2.3.1 V5.4.2.2.2
UI/W-3	Set up a joint GWA, GEPA, CCU, and DoD Northern Guam Lens Aquifer (NGLA) advisory panel, with technical assistance from the University of Guam [UOG], Water Engineering Resource Institute [WERI], USGS, and others as appropriate.	V6.3.2.3.1
UI/W-4	GWA could implement improvements to reduce water losses associated with unaccounted for water (UFW) (i.e., leakage or theft). GWA current UFW reduction plan is 20%. **(This measure falls within GovGuam authority to implement)**	V6.3.2.3.1
UI/W-5	GovGuam could implement control measures such as accepting private consortiums infrastructure development, moratoriums, and measures through building permit approvals or other mechanisms to steer new development to areas with adequate water. **(This measure falls within GovGuam authority to implement)**	V6.3.2.3.1
UI/W-6	Through the workforce housing permit approval process, GovGuam could charge development impact fees that would go toward financing improvements to GWA water system. **(This measure falls within GovGuam authority to implement)**	V6.3.2.3.1
UI/W-7	If the GWA cannot meet the projected increase in demand resulting from induced civilian growth, GovGuam could implement measures to control the rate of induced growth through the building permit process and/or by restricting the number of water and sewer connection requests that are approved. **(This measure falls within GovGuam authority to implement)**	V6.3.2.3.1
UI/W-8	Accelerate development of new GWA supply wells and treatment and distribution (T&D) systems. **(This measure falls within GovGuam authority to implement)**	V6.3.2.3.1
UI/W-9	GWA could assess system development charges to contractors to generate funding for system upgrades to help meet anticipated demands. **(This measure falls within GovGuam authority to implement)**	V6.3.2.3.1
UI/W-10	Incentivize water conservation on Guam. **(This measure falls within GovGuam authority to implement)**	V6.3.2.3.1
UI/W-11	Provide sewer services to current users of septic tanks and leachfields to protect the quality of water in the NGLA. **(This measure falls within GovGuam authority to implement)**	V6.3.2.3.2

Proposed Mitigation Measure		*Reference*
UI/W-12	DoD would participate in a federal inter-agency effort to identify other federal programs and funding sources for GovGuam for the following: • Reduce water losses associated with unaccounted for water (UFW) (i.e., leakage or theft). GWA current UFW reduction plan is 20%; • Development of new GWA supply wells and treatment and distribution (T&D) systems; • Incentives for water conservation, and/or • Providing sewer services to eliminate individual wastewater treatment systems.	V6.3.2.3.2
UI/WW-1	Government of Japan (GoJ) financing could be provided for the repairs and upgrades to the Hagatna WWTP. **(This measure falls within DoD and GovGuam authority to implement)**	V6.3.2.4.1
UI/WW-2	GWA could add chemical coagulants and/or increase the surface overflow rate (within the normal design range) of the clarifier to improve plant operations so that the primary clarifier would be able to treat the additional 0.1 million gallons per day (MGd) (0.5 mld) without adverse effects on the North District Wastewater Treatment Plant (NDWWTP). This could be applied to other WWTPs being impacted by the proposed action. This would be done with advance regulatory approval. **(This measure would be cooperatively implemented by DoD and GovGuam)**	V6.3.2.4.1
UI/WW-3	GoJ financing could be provided for the repairs and upgrades to the GWA northern and central wastewater collection systems. **(This measure falls within GovGuam authority to implement)**	V6.3.2.4.1
UI/WW-4	GWA could improve the southern WWTPs and the Hagatna WWTP and their associated collection systems or impose development moratoriums for areas served by those plants until appropriate upgrades have been made. **(This measure falls within GovGuam authority to implement)**	V6.3.2.4.1
UI/WW-5	GovGuam could implement control measures such as accepting private consortiums infrastructure development, moratoriums, and measures through building permit approvals or other mechanisms to steer new development to areas with adequate wastewater service. This could reduce the demand at NDWWTP by 1.4 MGd (5.3 mld). This one mitigation measure would reduce the peak flow to the NDWWTP to 10.7 MGd (40.5 mld) at the peak year (2014), within the design capacity of the NDWWTP **(This measure falls within GovGuam authority to implement)**	V6.3.2.4.1
UI/WW-6	Reduce on-island construction workforce requirements by using off-island prefabrication techniques.	V6.3.2.4.1
UI/WW-7	GWA could assess a system development charge to contractors and workforce housing developers that could be used to fund improvements to the wastewater systems. **(This measure falls within GovGuam authority to implement)**	V6.3.2.4.1
UI/WW-8	GovGuam could implement measures to control the rate of induced growth through the building permit process and/or by restricting the number of sewer connection requests that are approved. **(This measure falls within GovGuam authority to implement)**	V6.3.2.4.1
UI/WW-9	GovGuam could incentivize water conservation measures by offering rebates on upgrades to water saving devices in an effort to reduce wastewater flows. This is done periodically on the mainland. Upgrading current water devices to low-flow water saving models would reduce current demand.	V6.3.2.4.1

Proposed Mitigation Measure		*Reference*
	(This measure falls within GovGuam authority to implement)	
UI/SW-1	DoD would utilize transfer stations to allow consolidation of solid waste before it is hauled off base to the Layon Landfill in order to reduce the number and cost of hauling solid municipal waste and to allow screening of solid municipal waste prior to disposal at the Layon Landfill. **(This measure would be cooperatively implemented by DoD and GovGuam)**	V6.3.2.5
UI/SW-2	DoD would construct two recycling centers, one in Northern Guam and possibly one in Southern Guam to process recyclable materials collected by the source separation recycling program and to serve as a drop-off facility for recyclable materials generated by on-base residential, commercial, and industrial sectors. **(This measure would be cooperatively implemented by DoD and GovGuam)**	V6.3.2.5
UI/SW-3	DoD would implement programs to divert construction and demolition debris away from landfill disposal such as diverting concrete without lead-based paint, asphalt concrete, and scrap metal from construction and demolition projects.	V6.3.2.5
UI/SW-4	Construct at least one materials resource recovery facility (MRRF). A MRRF would recover and segregate recyclable materials from the solid waste stream thereby reducing the quantity of solid waste being disposed at the Layon or Navy Sanitary Landfill. **(This measure would be cooperatively implemented by DoD and GovGuam)**	V6.3.2.5
UI/SW-5	DoD would participate in a federal inter-agency effort to identify other federal programs and funding sources for GovGuam for the following: • Providing municipal solid waste transfer stations; • Construct recycling center(s); and/or • Construct at least one materials resource recovery facility.	V6.3.2.5
Socioeconomics and General Services (SE) Subcategories of SE: CI = Chamorro Issues / Community Cohesion, CR = Crime and Social Order, LA = Land Acquisition, PP = Population, PS = Public Service, Growth Permitting and Regulatory Agencies, T = Tinian, CNMI.		
Socioeconomics and General Services: Chamorro Issues / Community Cohesion (SE/CI)		
SE/CI-1	Implement a collaborative effort with construction worker contractors to implement an orientation course on Guam local culture, language and history, designed in conjunction with the Guam Department of Chamorro Affairs and Chamorro cultural specialists, to be attended by all arriving H2B workers.	V2.16.1.15 T2.16.2-69 V4.16.1.5 T4.16.2-24
SE/CI-2	Implement a mayoral outreach task force aimed at developing military-civilian relationships, to minimize local community perceptions of separations of military and civilian communities. The task force would work with each mayor and their staff to integrate military participation in existing cultural or recreational community events, expand on existing military outreach activities, and develop new civilian-military collaborative projects as determined by the task force and mayors.	V2.16.1.15 T2.16.2-69 V4.16.1.5 T4.16.2-24
SE/CI-3	Implement an orientation course on Guam local culture, language and history, designed in conjunction with the Guam Department of Chamorro Affairs and Chamorro cultural specialists, to be attended by all arriving active-duty DoD personnel their dependents, and military civilian workers	V2.16.1.15 T2.16.2-69 V4.16.1.5 T4.16.2-24

Proposed Mitigation Measure		*Reference*
	This mitigation measure is also applicable to the cultural resources category (CR).	
SE/CI-4	Develop a military-civilian cultural organization to promote tours, education, and volunteer opportunities.	V2.16.1.15 T2.16.2-69 V4.16.1.5 T4.16.2-24
SE/CI-5	Expand sister village programs to promote military civilian community interaction.	V2.16.1.15 T2.16.2-69 V4.16.1.5
SE/CI-6	Implement the use of UoG and GCC locations for DoD adult education classes, to promote community integration, consistent with DoD policies.	V2.16.1.15 T2.16.2-69 V4.16.1.5 T4.16.2-24
SE/CI-7	Implement an orientation course on Guam local laws and culture, language and history, designed in conjunction with GovGuam public safety agencies, the Guam Department of Chamorro Affairs and Chamorro cultural specialists, to be attended by all arriving service members prior to shore leave on the island of Guam. *This mitigation measure is also applicable to the CR category.*	V4.16.1.5 T4.16.2-24
SE/CI-8	DoD would assist by leading a federal inter-agency effort to identify other federal programs and funding sources for GovGuam addressing the following: • Supporting the development of Chamorro cultural sites and activities, such as a museum and/or cultural center, Chamorro language immersion school, adult Chamorro language education, and cultural performance and arts organizations; • Job counseling assistance to be made available to low income families through the Guam Department of Labor (with US funds), which would include training sessions on how to fill out job applications, identify skills, and prepare resumes for job opportunities; • Before and/or after school programs for children on Guam including formal and informal education, while allowing their parent(s) the time to get a job. • Transportation to job sites made available for those without the means to travel to work.	V2.16.1.15 T2.16.2-69 V4.16.1.5 T4.16.2-24
Socioeconomics and General Services: Civilian Housing Demand (SE/CH)		
SE/CH-1	DoD would assist by leading a federal inter-agency effort to identify other federal programs and funding sources for GovGuam addressing the following: • Collaboration between federal housing agencies and GovGuam to examine currently existing caps on HUD vouchers and other housing allowances, and the appropriateness of these caps for Guam; • Development of support programs and transitional housing for homeless individuals and families on Guam; • Expansion of the stock of low- to moderate-income housing on Guam; • Support for GEDA efforts to obtain funding from HUD to provide community development projects and affordable housing programs. *This mitigation measure is also applicable to the Public Health & Safety category (PHS).*	V2.16.1.15 T2.16.2-69

Proposed Mitigation Measure		*Reference*
Socioeconomics and General Services: Crime and Social Order (SE/CR)		
SE/CR-1	DoD would increase collaborative programs with GovGuam public safety agencies to develop a comprehensive and regular shore patrol system, and maintain a regular visible preventative presence. *This mitigation measure is also applicable to the PHS category.*	V2.16.1.15 T2.16.2-69 V4.16.1.5 T4.16.2-24
SE/CR-2	DoD would continue to participate in CMTF to address community crime and social order concerns such as effective crime prevention strategies and information sharing. *This mitigation measure is also applicable to the PHS category.*	V2.16.1.15 T2.16.2-69 V4.16.1.5 T4.16.2-24
SE/CR-3	DoD would continue cross-training exercises with the GovGuam safety agencies. *This mitigation measure is also applicable to the PHS category.*	V2.16.1.15 T2.16.2-69 V4.16.1.5 T4.16.2-24
SE/CR-4	DoD would assist by leading a federal inter-agency effort to identify other federal programs and funding sources for collaborative efforts between the governments of Guam, CNMI and FAS to enhance cultural awareness. *This mitigation measure is also applicable to the PHS category.*	V2.16.1.15 T2.16.2-69 V4.16.1.5 T4.16.2-24
Socioeconomics and General Services: Land Acquisition (SE/LA)		
SE/LA-1	Mitigation for the increase in DoD controlled lands on Guam would include conducting new screenings on a periodic basis to identify additional excess DoD lands that could be returned.	V2.16.1.15 T2.16.2-69
SE/LA-2	Expedite the return of lands subject to the Guam Excess Lands Act to the extent possible.	V2.16.1.15 T2.16.2-69
SE/LA-3	Mitigation for the sociocultural impacts of the acquisition of property and the increase in DoD controlled lands on Guam may include: • Land swap for land of similar value and similar cultural and recreational opportunities; • During the land acquisition process conduct socioeconomic surveys and census of affected landowners, users, ancestral claimants, early in the land acquisition process, in order to identify potential sociocultural impacts; • DoD collaboration with community, GovGuam and UoG and GCC representatives to implement a system of protected garden areas on public lands for the growth and collection of native plants, including medicinal plants; • Continued collaboration between DoD, GovGuam, the University of Guam, and cultural resource specialists to develop public education on the cultural and social value of land on Guam including cultural practices, such as the gathering of medicinal plants and the use of wood for carving, cultural tours, and place-based historical information, and/or • DoD collaboration with community, GovGuam and UoG and GCC representatives to implement guided cultural and historical tours and hikes of relevant locations on acquired land, for visitors and the civilian and military population of Guam.	V2.16.1.15 T2.16.2-69
SE/LA-4	DoD would assist by leading a federal inter-agency effort to identify other federal programs and funding sources for GovGuam: • Obtaining additional support for the UoG Tropical Agricultural Department, and other educational and community agricultural programs in the study of traditional plants, including medicinal plant use, and to develop native plant and seedling nurseries accessible to the public for study and use; • Obtaining additional support for educational and community	V2.16.1.15 T2.16.2-69

Proposed Mitigation Measure		*Reference*
	programs focused on traditional fishing and shellfishing, and related activities; • To improve recreational and cultural activities for the community on GovGuam lands; • Funding of conservation efforts on Guam, and/or • Special projects to improve local agricultural production.	
SE/LA-5	Mitigation for the restriction and/or loss of access to recreational and cultural sites could include: • Implementation of a public access program including set access hours, improved access to sites, that locations would be made safe for entry and use, and maintenance efforts and regular condition assessments of the impact areas, • DoD could collaborate with GovGuam to improve recreational and cultural activities for the community on GovGuam lands • DoD assistance with the identification of potential locations for the relocation of the Guam International Raceway.	V2.16.1.15 T2.16.2-69
SE/LA-6	DoD would assist by leading a federal inter-agency effort to identify other federal programs and funding sources for GovGuam addressing the following: • Assistance for opening public garden spaces on GovGuam land. • Assistance for CLTC to develop a land use plan, written fees collection policies and procedures for commercial licenses • Assistance for GALC to establish rules and regulations for Land Bank properties, written fees collection system and policies and rules and regulations for issuing licenses. • Support for the CLTC agricultural program to address the issues identified in the Chamorro Land Trust Commission Multi-Agency Compliance and Needs Assessment Team First Inspection Report (July - September 2009) • Support for CLTC to provide water lines, roads, sewer lines, power, and land management building on CLTC land. • Support for CLTC and GALC in establishing property boundaries in the subdivisions where the agencies have active leases. • Support and implementation of automation systems to manage CLTC and GALC land inventories, finances, and other data. • Provision of or funding for equipment, training and long-term support for agricultural activities, possibly in a cooperative framework. • Support for the UoG Tropical Agricultural Department, and other educational and community agricultural programs in the study of traditional plants, including medicinal plant use, and to develop native plant and seedling nurseries accessible to the public for study and use; • Support for educational and community programs focused on traditional fishing and shellfishing, and related activities; • Improvement of recreational and cultural activities for the community on GovGuam lands; • Conservation efforts on Guam, and/or • Special projects to improve local agricultural production.	V2.16.1.15 T2.16.2-69
Socioeconomics and General Services: Population (SE/PP)		
SE/PP-1	DoD would decrease the rapid population increase associated with the operations phase by implementing force flow and adaptive program	V2.16.1.15 T2.16.2-69

Proposed Mitigation Measure		*Reference*
	management. *See mitigation measures in General [G] category. This mitigation measure is also applicable to the PHS category.*	V6.17.2.2.7
Socioeconomics and General Services: Public Service and Growth Permitting and Regulatory Agencies (SE/PS)		
SE/PS-1**	DoD would assist by leading a federal inter-agency effort to identify other federal programs and funding sources for GovGuam addressing the following: • Enhancement of GovGuam Tax Revenue Collection efficacy. For example, improved revenue could be used to enhance recruitment and retention of GovGuam workforce and contractual support; • Examination of currently existing caps on benefits such as Medicaid and Medicare, and the non-provision of benefits such as Supplemental Security Income benefits, and the appropriateness of these caps and limits for Guam; • Increase the number of Guam-based offices for the distribution of federal social service support, and to support the work of GovGuam public service agencies; • Review and implementation of programs to assist GovGuam's public agencies in adapting to peaks in service population growth; • Provision of technical assistance for the development and implementation of a system of interpreters and translators available for the interpreting and translating needs of GovGuam public service agencies, to facilitate timely and appropriate provision of services for the English as a Second Language service population; • The development of AmeriCorps, Teach for America, National Health Service Corps programs, and other similar programs on Guam; • Improving the grant-writing capabilities within GovGuam agencies to improve possibilities of attracting federal support programs; • Support for the recruitment of professionals during the construction phases of the proposed action for GovGuam public agency positions; • Support for the use of the Interagency Personnel Act to support identified GovGuam agency personnel requirements, and/or • Provision to GovGuam of technical assistance for, and development and implementation of, comprehensive data collection systems focused on the following topics: o GovGuam public services provided to FAS citizens, in order to facilitate GovGuam access to Compact Impact and other related funding. o GovGuam agency services provided to military individuals, in order to facilitate GovGuam access of TRICARE and other related funding o GovGuam public health agency patient information, records, and services accessed, in order to facilitate appropriate care administered in a timely manner o GovGuam public agency billing systems, in order to facilitate GovGuam collection of payment for services *This mitigation measure is also applicable to the PHS category.*	V2.16.1.15 T2.16.2-69 V5.16.2.5

Proposed Mitigation Measure		*Reference*
SE/PS-2	Continue to support existing DoD programs that contribute and/or donate excess equipment to local agencies. *This mitigation measure is also applicable to the PHS category.*	V2.16.1.15 T2.16.2-69 V5.16.2.5 V6.17.2.2.7
SE/PS-3	DoD would continue to participate in CMTF to address community health needs such as facilitating information sharing between military and civilian health agencies, including health service needs data and health services utilization rates. *This mitigation measure is also applicable to the PHS category.*	V2.16.1.15 T2.16.2-69 V5.16.2.5 V6.17.2.2.7
SE/PS-4	DoD would coordinate with the Governor's Office of Community Affairs to facilitate volunteer opportunities at Guam public service agencies for military personnel and their dependents. *This mitigation measure is also applicable to the PHS category.*	V2.16.1.15 T2.16.2-69 V5.16.2.5 V6.17.2.2.7
*Socioeconomics and General Services: Tinian, CNMI (*SE/T)		
SE/T-1	DoD would assist by leading a federal inter-agency effort to identify other federal programs and funding sources for the CNMI to: • Develop a small museum dedicated to Tinian's history; to support Tinian's tourism industry would further minimize economic impacts on the Tinian tourism industry**;** • Train public safety, emergency response and health personnel in the CNMI; • Enhance the agricultural productivity of land, and/or • Develop a Tinian agricultural and conservation Park.	V3.16.2.5
SE/T-2	To the extent possible, grant liberty to service personnel at the end of training missions.	V3.16.2.5
SE/T-3	DoD would assist with small business outreach and training on Tinian	V3.16.2.5
SE/T-4	DoD would participate in Military Integration Management Committee and Civilian Military Task Force for the purposes of addressing individuals that are displaced if leases on the LBA do require termination.	V3.16.2.5
SE/T-5	DoD would work in collaboration with CNMI officials to ensure that access to tourism, cultural and economic activities are clearly communicated and made as easy as possible**.** *This mitigation measure is also applicable to the PHS category.*	V3.16.2.5
Public Health and Safety (PHS) *Note:* Additional mitigation measures applicable to PHS are identified in the Socioeconomic (SE) and General Services (GS) categories.		
PHS-1	DoD would lead a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam and Tinian in regards to health care, social services, disease control and/or other assistance to help Guam and Tinian upgrade their capacity to care for and help prevent increased incidence of illnesses. **(This measure falls within DoD, GovGuam and/or CNMI Government authority to implement)**	V3.18.2.2.1 V4.2.18.2.8 V18.2.2.10 V4.18.2.2.8 V4.18.2.6 V5.19.2.7 T5.18.2-4 V5.18.2.2.1
Hazardous Materials and Waste – No mitigation measures. See Table of BMPs.		
Environmental Justice and Protection of Children – (EJ).		
EJ-1	Potential impacts to low-income people due to the proposed land acquisition of the Route 15 lands could be reduced by implementation of applicable mitigation measures listed in the Land Use category (LU).	V2.19.2.8
EJ-2	Potential impacts to low-income could be reduced by implementation of applicable mitigation measures listed in the Socioeconomic category (SE).	V2.19.2.8

Proposed Mitigation Measure		*Reference*
EJ-3	Implementation of applicable mitigation measures listed in the Socioeconomic category could reduce the strain on GDPHSS and GDMHSA health services for the poor and uninsured.	V2.19.2.8
EJ-4	DoD would lead a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam and Tinian in regards to health care, social services, disease control and/or other assistance to help Guam and Tinian upgrade their capacity to care for and help prevent increased incidence of illnesses. *This mitigation measure is also applicable to the PHS category.*	V3.19.2.2.3 V3.19.2.7 T3.19.2-5 V2.19.2.8 V2.19.2.2.5
Workforce Housing (WH). See also Utilities and Infrastructure (UI), and General (G) mitigation measures)		
WH-1	*General Conditions: Workforce Housing and Logistics Evaluation Factor and Contract Provision*. During the acquisition process for construction projects, DoD would give preference to potential contractor(s) ("Offerors") who: • submit a comprehensive plan to address housing requirements, • explain methods to minimize impacts to local community, • provide maps and number of living quarters at each location, • provide discussion of how the housing facility meets GovGuam regulations/policies (including any necessary permits), • provide adequate housing to workers in accordance with 29 CFR 1910.142 (and other federal and GovGuam statutes as applicable), • obtain all permits, licenses or other authority required by federal and GovGuam statutes and regulations.	V1.4.15.3.1
WH-2	*Medical Care: Workforce Housing and Logistics Evaluation Factor and Contract Provision*. During acquisition process for construction projects, DoD would give preference to potential contractor(s) ("Offerors") who submit a comprehensive narrative plan to address medical services requirements.	V1.4.15.3.2
WH-3	*Orientation Programs: Workforce Housing and Logistics Evaluation Factor and Contract Provision*. During acquisition process for construction projects, DoD would give preference to potential contractor(s) ("Offerors") who ensure personnel receive orientation training on safety, security, anti-terrorism, cultural awareness, environmental protection, and invasive species.	V1.4.15.3.3
WH-4	*Lodging and Food: Workforce Housing and Logistics Evaluation Factor and Contract Provision.* During acquisition process for construction projects, DoD would give preference to potential contractor(s) ("Offerors") who ensure they would comply with Guam lodging, food, and hygiene regulations.	V1.4.15.3.4
WH-5	*Transportation: Workforce Housing and Logistics Evaluation Factor and Contract Provision.* During acquisition process for construction projects, DoD would give preference to potential contractor(s) ("Offerors") who submit a comprehensive plan to address transportation requirements, including Guam regulations requiring employer provision of transportation to/from the worksite.	V1.4.15.3.5

Proposed Mitigation Measure		*Reference*
WH-6	*Water and Wastewater: Workforce Housing and Logistics Evaluation Factor and Contract Provision*. DoD would give preference to construction contract proposals that identify sufficient available water allocation from GWA for workers for that specific construction contract.	V7.2.4.2
WH-7	Avoid known sinkholes and place a buffer zone of vegetation around them to prevent further erosion or expansion. Erect educational signs and/or fencing where appropriate. Any sinkholes discovered would be evaluated to determine significant impacts and projects would be designed in consideration of these sinkholes as appropriate. **(This measure would be implemented by the developer of the workforce housing facility/facilities)**	V1.4.15.5.1
WH-8	Using a minimum number of equipment at a given time near residences to reduce noise impacts. **(This measure would be implemented by the developer of the workforce housing facility/facilities)**	V1.4.15.5.4
WH-9	Guam Synthesis and Cultural Landscape Report. **(This measure would be implemented by the developer of the workforce housing facility/facilities)**	V1.4.15.5.9
WH-10	Bus workers to/from worksite(s). (See also WH-5 above) **(This measure would be implemented by the DoD construction contractor)**	V1.4.15.5.12
WH-11	Identification and removal of any potential unexploded ordinance (UXO) prior to ground disturbing activities. **(This measure would be implemented by the developer of the workforce housing facility/facilities)**	V1.4.15.5.14
General		
G-1	Force flow reduction. *This mitigation measure is applicable to many of the resource categories (See Section 2.3).*	V 2, 4, 5, 6 & 7
G-2	Adaptive program management. *This mitigation measure is applicable to many of the resource categories (See Volume 7 Section 2.4)*.	V 2, 4, 5, 6 & 7

Note: All proposed mitigation measures are considered within DoD control and would be implemented by DoD unless otherwise noted in **Bold** text. Reference Mitigation Driver (V=Volume, Chapter, and Section or T=Table)

2.3 FORCE FLOW REDUCTION

Force flow is the rate at which the military population, including military personnel, their dependents, and civilian workers for the military, would arrive on Guam. Relocation of military units from Okinawa would be synchronized with the construction schedule for facilities needed to support those units. Force flow would be managed to ensure that military populations would not be relocated to Guam until the requisite facilities were constructed. Managing force flow is a mitigation measure that will be implemented by DoD to reduce or avoid impacts associated with construction related peak population and overall population changes on Guam. There would be no permanently stationed personnel on Tinian; therefore, the force flow reduction mitigation measure does not apply to Tinian. The force flow in Table 2.3-1 below shows the arrival of the military population between the proposed start of construction in 2010 and the targeted completion date of 2014 as discussed in the DEIS. Managing the force flow so that the military population would arrive only after the construction necessary to support them is completed would delay arrival of a majority of the military population beyond 2014. Tying force flow to construction completion would both lower the peak population currently associated with 2014 and decrease the growth rate of short-term population change associated with the proposed action. Table 2.3-1

also presents the estimated annual off-island population increase on Guam that would result from implementation of the proposed action and its 2014 targeted completion date. This same population table is included in Volume 1 of this EIS.

Table 2.3-1. Estimated Total Population Increase on Guam from Off-Island (Direct, Indirect, and Induced)

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Direct DoD Population[1]											
Active Duty Marine Corps	510	1,570	1,570	1,570	10,552	10,552	10,552	10,552	10,552	10,552	10,552
Marine Corps Dependents	537	1,231	1,231	1,231	9,000	9,000	9,000	9,000	9,000	9,000	9,000
Active Duty Navy[2]	0	0	0	0	0	0	0	0	0	0	0
Navy Dependents	0	0	0	0	0	0	0	0	0	0	0
Active Duty Army	0	50	50	50	50	630	630	630	630	630	630
Army Dependents	0	0	0	0	0	950	950	950	950	950	950
Civilian Military Workers	102	244	244	244	1,720	1,836	1,836	1,836	1,836	1,836	1,836
Civilian Military Worker Dependents	97	232	232	232	1,634	1,745	1,745	1,745	1,745	1,745	1,745
Off-Island Construction Workers (DoD Projects)[3]	3,238	8,202	14,217	17,834	18,374	12,140	3,785	0	0	0	0
Dependents of Off-Island Construction Workers (DoD Projects)	1,162	2,583	3,800	3,964	4,721	2,832	1,047	0	0	0	0
Direct DoD Subtotal	**5,646**	**14,112**	**21,344**	**25,125**	**46,052**	**39,685**	**29,545**	**24,713**	**24,713**	**24,713**	**24,713**
Indirect and Induced Population											
Off-Island Workers for Indirect/ Induced Jobs[4]	2,766	7,038	11,773	14,077	16,988	12,940	6,346	4,346	4,346	4,482	4,482
Dependents of Off-Island Workers for Indirect/Induced Jobs	2,627	6,685	11,184	13,373	16,138	12,293	6,028	4,372	4,372	4,413	4,413
Indirect/Induced Subtotal	**5,393**	**13,723**	**22,957**	**27,450**	**33,126**	**25,233**	**12,374**	**8,718**	**8,718**	**8,895**	**8,895**
Total Population	**11,038**	**27,835**	**44,301**	**52,575**	**79,178**	**64,918**	**41,919**	**33,431**	**33,431**	**33,608**	**33,608**

Legend:
[1] DoD population includes military personnel, DoD civilian workers, and dependents from off-island.
[2] The Navy rows do not include increases from the transient presence of aircraft carrier crew with its carrier strike group.
[3,4] Population figures do not include Guam residents who obtain employment as a result of the proposed actions.
* Background on how estimated population numbers were derived is at Vol.1 Page 2-5.

Table 2.3-1 illustrates how the estimated population numbers are linked to the proposed arrival of the military population and/or the construction schedule. Table 2.3-1 reflects the analysis presented in the Draft EIS. It indicates that project-related construction work is expected to begin in 2010, reach its peak in 2014, and end in 2016. It is assumed in this table that arrival of the military population on Guam would be complete by 2014. Since the peak in construction activities and expenditures would coincide

with the completed arrival of Marines and their families, 2014 represents the peak year for population increase. At this peak, the total increase in Guam population from off-island would be an estimated 79,178 people, representing a temporary increase of the total island population by approximately 44%. After the 2014 peak, project-related construction expenditures and the associated construction workforce would decline rapidly as contracts awarded in 2014 are completed in 2015 and 2016. At the completion of construction, and implementation of full military operational capabilities, the population increase from off-island is projected to level off to an estimated 33,608 persons, approximately 19% above the current island population.

During the temporary construction period of the proposed action the population would rapidly increase to a peak, exert maximum stress on Guam's resources and infrastructure, and then afterward would quickly decline. Immediate impacts resulting from the sudden population changes, such as increased demands on existing infrastructure systems and other resources would drop after the off-island construction workers leave the island. However, there would be a requirement to increase infrastructure capacity to respond to the projected long term growth of approximately 33,608 persons. If utility systems were upgraded to meet peak loading demands associated with the construction effort of the proposed action, the level of improvements would far exceed the demand needed to supply the long term estimated population growth noted above. Over-building utility infrastructure to deal with short-term peak needs would result in unnecessary spending, increased rate hikes, and an inefficiency of the utility operation itself as water and wastewater treatment plants are carefully designed to operate at optimum efficiency at a realistic projected flow.

2.3.1 Decreasing Peak Population and Population Change

Some of the impacts listed above could be lessened by delaying or reducing the rate at which the Marines, their dependents, and associated civilian workforce arrive. Extending the arrival of the military population over a greater period of time (e.g. beyond 2014) would lessen the need for various infrastructure upgrades to meet peak loading demands in 2014. Using force flow reduction as a mitigation measure would both lower the overall peak population and decrease the rate of short-term population increase resulting from the proposed action, thereby reducing demands on utilities and many island services.

There are numerous scenarios that could be developed for adjusting force flow. Table 2.3-2 provides one notional example of how the force flow could be reduced. Table 2.3-2 does not represent a current DoN proposal regarding force flow reduction nor should it be viewed as the only possible manner in which Marine Corps force flow to Guam could be managed. The notional scenario is presented only to show the possible mitigative effects on impacts arising out of population growth, and thus likely mitigative effects on impacts to infrastructure and resources, that could occur. Other scenarios, with differing assumptions regarding arrival rates and the ultimate completion of the arrival of the Marine Corps military population would certainly lead to different results. Any actual force flow reduction would be decided in the future and would be dependent upon a number of factors including, but not limited to funding for necessary construction, mutual defense treaty obligations with the Government of Japan, ongoing military operations worldwide, and Congressional direction.

The scenario presented Table 2.3-2 assumes that, consistent with the proposed action, construction of facilities and infrastructure to support the relocation of Marine Corps forces would be largely completed by 2014 and that substantial numbers of the military population would not arrive on Guam until some time thereafter. The purpose of Table 2.3-2 it to highlight the impacts of force flow reduction as a mitigation measure in and of itself. As discussed later in this section, the application of an adaptive program management (APM) process would further mitigate significant impacts by ensuring that the demands on infrastructure created by construction tempo and sequencing did not exceed the existing

infrastructure capacities. If the projected construction tempo were revised, the associated force flow would be adjusted to match the revised construction schedule. The yellow-shaded areas in Table 2.3-2 depict lowered projections of population growth in the years beyond 2014 from those shown in Table 2.3-1. Force flow reductions associated with delaying the complete arrival of the military population beyond 2014 would lower the rate of arrival per year of the entire operations-related population. Force flow reduction in the notional scenario presented below would decrease the current total peak population from 79,187 to 57,593 in 2014. Overall projected population change for this force flow reduction scenario and the projected population change for the proposed action without force flow reduction are illustrated in Figure 2.4-1 in Section 2.2.2.

Table 2.3-2. Notional Force Flow Mitigation Scenario: Estimated Total Population Increase on Guam from Off-Island (Direct, Indirect, and Induced)

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Direct DoD Population[1]											
Active Duty Marine Corps	510	1,570	1,570	1,570	2,468	4,265	6,959	10,552	10,552	10,552	10,552
Marine Corps Dependents	537	1,231	1,231	1,231	2,008	3,562	5,893	9,000	9,000	9,000	9,000
Active Duty Navy[1]	0	0	0	0	0	0	0	0	0	0	0
Navy Dependents	0	0	0	0	0	0	0	0	0	0	0
Active Duty Army	0	50	50	50	50	630	630	630	630	630	630
Army Dependents	0	0	0	0	0	950	950	950	950	950	950
Civilian Military Workers	102	244	244	244	401	820	1,260	1,836	1,836	1,836	1,836
Civilian Military Worker Dependents	97	232	232	232	381	779	1,197	1,745	1,745	1,745	1,745
Off-Island Construction Workers (DoD Projects)[3]	252	4,000	8,079	17,020	17,674	18,983	11,783	0	0	0	0
Dependents of Off-Island Construction Workers (DoD Projects)	50	800	1,616	3,783	4,542	4,428	3,258	0	0	0	0
Direct DoD Subtotal	**1,548**	**8,127**	**13,021**	**24,130**	**27,523**	**34,416**	**31,929**	**24,713**	**24,713**	**24,713**	**24,713**
Indirect and Induced Population											
Off-Island Workers for Indirect/Induced Jobs[4]	110	3,472	6,615	13,519	15,421	12,696	10,411	4,346	4,346	4,482	4,482
Dependents of Off-Island Workers for Indirect/Induced Jobs	85	2,981	5,625	12,843	14,649	12,061	9,890	4,372	4,372	4,413	4,413

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Indirect/Induced Subtotal	**195**	**6,453**	**12,240**	**26,363**	**30,070**	**24,757**	**20,301**	**8,718**	**8,718**	**8,895**	**8,895**
Total Population	**1,742**	**14,580**	**25,262**	**50,492**	**57,593**	**59,173**	**52,230**	**33,431**	**33,431**	**33,608**	**33,608**

Legend:
[1] DoD population includes military personnel, DoD civilian workers, and dependents from off-island.
[2] The Navy rows do not include increases from the transient presence of aircraft carrier crew with its carrier strike group.
[3,4] Population figures do not include Guam residents who obtain employment as a result of the proposed actions.
Shading: Delay force flow population changes from population projections that are the basis for EIS impact analysis (Table 2.3-1).
Shading: This notional force flow scenario also reflects programmed construction spending for years 2010, 2011 and 2012, as of May 2010. The programmed military construction budget is lower than projections used as basis for EIS impact analysis of Table 2.3-1 in the early years. The construction funding impact is projected over subsequent years..

Under the notional scenario presented in Table 2.3-2, the overall population increases more gradually while the construction population grows and shrinks at similar rates exhibited in Table 2.3-1. Table 2.3-2 reflects the projected construction workforce based on programmed construction budgets for years 2010, 2011 and 2012 as of May 2010 (see gray-shaded cells in Table 2.3.2). Unrelated to changes in force flow, the construction would have a slower start than projected in Table 2.3-1 with impacts to subsequent construction years. As presented in the notional scenario, force flow reduction in and of itself does not affect the proposed action's construction schedule. Instead, force flow reduction is a product of the proposed construction schedule. If the construction supporting the relocation of Marine Corps forces is delayed, the implementation of force flow reduction would be stretched further into the future as well. Finally, the estimated population growth and shrinkage rate of off-island construction workers and their dependents on Guam would be unaffected by implementation of the force flow reduction mitigation measure.

2.3.2 Impact Reduction Through Force Flow Management

Some existing infrastructure and/or resources are more sensitive to population level increases than others. Implementation of the force flow mitigation measure would reduce impacts to the following infrastructure limited and population sensitive resources:

- Port Capacity - The force flow mitigation measure would alleviate some of the proposed action's adverse impacts at the port by delaying 1) the need for operations related cargo handling, 2) the need for handling of military population household goods, and 3) the handling of associated cargo to support the military population (i.e., arrival of additional food shipments for the military commissary). The force flow reduction would also have the benefit of freeing up the port's capabilities to accommodate the increase in container ship traffic for construction. Without the demand on port facilities to accommodate construction and operations cargo concurrently, port cargo handling efficiency would increase during the construction phase.
- Wastewater Treatment - Reductions in peak population would reduce demands and burdens on Guam's wastewater treatment capability, which would approach or potentially exceed system design capacities. For example, the NDWWTP's wastewater flow is projected to reach approximately 12.13 MGd during peak population as projected in the Draft EIS. This flow would exceed the plant's design capacity of 12.00 MGd. However, in the notional scenario for force flow reduction mitigation measures presented above, the maximum flow to NDWWTP in 2014 would be reduced to 10.09 MGd, substantially less than the NDWWTP's design capacity.

- Drinking Water Production, Treatment and Distribution – Arrival of Marines could be managed such that demand for potable water associated with peak population would be lowered, thus reducing the demand for potable water production, treatment and distribution. Reducing the peak water demand during construction could relieve stresses on potable water production, particularly with regard to rates of pumping wells or the establishment of new wells. Under the proposed action, DoD would establish new wells to meet projected demand, including peak demand when off-island construction and military populations would overlap. If peak future demand associated with the proposed action is reduced through reductions in force flow, the immediate need for new wells would likewise be lessened.
- Roadways - Impacts to off-base roadways are directly related to population increases. Reducing the total peak population associated with the proposed action by implementing force flow reduction is expected to reduce stresses on Guam's currently deficient roadway system. With implementation of force flow mitigation measures the additive impacts of construction and military operations traffic would be lessened with related reductions in adverse impacts to off-base roadways during the peak population period.
- Water Resources (surface water, stormwater, wetlands) – Force flow may reduce the impacts on surface and nearshore water by reducing the wastewater effluent discharged into the ocean. This measure may also reduce the projected peak demand for and stresses on water-related resources and infrastructure (see discussion above). The stormwater levels and wetlands impacts during construction would not be affected.
- Air Quality – The proposed action involves construction activities that would occur concurrently with operations; both activities would result in increased releases of air pollutants. Reducing force flow would reduce air quality impacts by lowering the amount of air pollutants that would be released at any one time. Specifically, reducing force flow would delay operations and reduce the amount of air emissions from operations that would occur concurrently with construction emissions.
- Noise – In general, it should be noted that noise impacts are often location specific. It is anticipated that with implementation of the force flow mitigation measure there would be no measurable reduction in noise impacts due to construction activities. However, the noise related to airfield or training range operations would be delayed in its initiation. There would also be a less adverse temporary spike in noise impacts associated with reduced on-island peak population traffic.
- Recreational Resources – A reduction in force flow would reduce impacts to recreational resources by lessening the demand for such recreation resources associated with the peak population of the proposed action. Impacts to recreational resources, both within DoD-controlled property and within the civilian community, would be lowered and spread out further until steady state levels took hold because there would be less peak level crowding at parking lots, picnic shelters, restrooms, showers, boat mooring facilities, golf courses, dive spots, etc., due to lowering the estimated peak population.
- Terrestrial and Marine Biological Resources – A reduction in force flow would reduce impacts to terrestrial and marine biological resources associated with decreased recreational use and noise generated (described above). The same amount of habitat would be disturbed by construction activities, and changes in force flow would not have an impact on the construction impacts to terrestrial and marine biological resources.
- Cultural Resources – A reduction in force flow would reduce impacts to cultural resources by reducing the population on-island and associated potential for inadvertent or unauthorized

damage to historic properties. Force flow would not impact the construction impacts to cultural sites.

- Socioeconomics and General Services – The force flow mitigation measure would lessen the severity of the socioeconomic impacts, such as the need for increased public services, social services, and housing. Further, delaying population level increases and lowering the rate of population increase would likely lessen potential increases in the cost of living often associated with temporary construction activity spikes in population. This is especially true for the period between 2013 and 2015 under the notional scenario presented. A reduction in the population growth rate could provide GovGuam and the private sector a longer period of time in which to increase available public services for the temporary construction effort, which may also help alleviate possible shortfalls for the projected long-term population increase.
- Public Health and Safety – The force flow mitigation measure would further reduce any projected disease and traffic incidents because of the lowered peak population. The various procedures and safeguards that are part of BMPs and standard operating procedures would be more effective on the reduced population numbers.
- Environmental Justice and Protection of Children – With force flow reduction as a mitigation measure, impacts to low income or children populations could be reduced due to a reduction in peak population associated with the proposed action. The reduced population numbers would decrease the impacts directly related to public health and safety services, potable water, wastewater, and socioeconomics.

For those resources where there would be minimal additive adverse impact from construction and military operations populations, there would be minimal impact from force flow reduction. Resources that would be minimally affected by the force flow reduction mitigation measure are as follows:

- Land and Submerged Land Use,
- Airspace,
- Visual Resources, and
- Hazardous Material/Waste.

2.4 ADAPTIVE PROGRAM MANAGEMENT

The proposed mitigation measures identified in this EIS would avoid or minimize anticipated impacts associated with the proposed action. However, with a proposed action of this scale the potential exists for a more broad-based adverse impact on infrastructure and resources, particularly during the construction component of the proposed action when populations would peak and exert maximum stress. As stated previously in this chapter, proposed mitigation measures identified in this EIS and selected for implementation in the ROD would be monitored in the post-ROD Mitigation Monitoring Plan. Applying an APM process to the proposed DoD construction is an additional mitigation measure that will be implemented by DoD and would reduce and/or avoid the significant environmental impacts identified in the Final EIS.

2.4.1 Traditional Adaptive Management (Terrestrial/Marine Resources)

The concept of adaptive management has existed since the early 1900s and is rooted in scientific management approaches, pioneered by Frederick Taylor. In its purest form, adaptive management can be thought of as linking learning with policy and implementation. Although the idea of learning from experience and modifying subsequent behavior in light of that experience has long been reported in the literature, the specific idea of adaptive management as a strategy for dealing with environmental impacts can be traced back to the late 1970s.

Traditionally, adaptive management has been associated with implementation of natural resources management actions and/or decisions that affect natural resources. Adaptive management has historically focused on learning and adapting, through partnerships of managers, scientists, and other stakeholders who learn together how to create and maintain sustainable resource systems. Examples of actions historically associated with adaptive management include the control of water releases from a dam, direct manipulation of plant or animal populations through harvesting, stocking or transplanting, and manipulation of ecosystems through physical changes to habitats. Adaptive management recognizes that even with sound assumptions and science, there is always uncertainty with regard to predictions about how resources respond to actions. In the context of natural resources, adaptive management involves decision-making characterized by multiple (often competing) objectives, constrained management authorities and capabilities, dynamic ecological and physical systems, and uncertain responses to management actions. Natural resource managers have been able to successfully use adaptive management over the last three decades to make better resource-based decisions by:

- Exploring ways to meet management objectives.
- Predicting the outcomes of alternatives based on the current state of knowledge.
- Implementing one or more of these alternatives.
- Monitoring impacts of those alternatives.
- Using the results to update knowledge and adjust management actions.

There are many definitions of adaptive management, but the same basic principle applies to all of them: adaptive management is a management approach that involves monitoring outcomes of managed activities and improving the management of those activities based on the monitoring results. The Department of the Interior describes adaptive management as follows (DOI 2009):

> "Adaptive management [is a decision process that] promotes flexible decision making that can be adjusted in the face of uncertainties as outcomes from management actions and other events become better understood. Careful monitoring of these outcomes both advances scientific understanding and helps adjust policies or operations as part of an iterative learning process. Adaptive management also recognizes the importance of natural variability in contributing to ecological resilience and productivity. It is not a 'trial and error' process, but rather emphasizes learning while doing. Adaptive management does not represent an end in itself, but rather a means to more effective decisions and enhanced benefits. Its true measure is in how well it helps meet environmental, social, and economic goals, increases scientific knowledge, and reduces tensions between stakeholders."

2.4.2 Implementing an Adaptive Program Management Process

The APM process would be implemented through creation of a Civil-Military Coordination Council (Council). The Council would monitor environmental impacts, and infrastructure capacities, coordinate discussion among DoD, the Government of Guam, and federal agencies, and provide advice and recommendations to DoD, other federal agencies, and the Government of Guam, on the construction tempo and sequencing, infrastructure improvements, and other related actions in order to avoid and/or reduce significant environmental impacts or overstressing Guam's infrastructure. The APM process would allow DoD to revise construction tempo and adjust sequencing of construction activities to directly influence workforce population levels and indirectly influence induced population growth before significant environmental impacts occurred or infrastructure capabilities were exceeded. The APM process would not be applied to Tinian as there would be no permanently stationed personnel and the scale of construction would be much smaller than on Guam.

An initial operating charter for the Council, establishing its membership, basic structure and function, and schedule to finalize and approve the charter, will be developed cooperatively by DoD, other federal agencies, and the Government of Guam and will be incorporated into the mitigation discussion in the ROD for this proposed action.

Subsequent to the ROD, Council members will meet as necessary to coordinate regarding DoD realignment construction activities and to finalize and approve its operating charter, establishing processes, procedures, and functions necessary for the operation of the Council. DoD is committed to timely completion of the final operating charter and during the development of the charter DoD will not implement its realignment construction program in a manner that causes significant environmental impacts or exceeds existing infrastructure limitations on Guam.

The following discussion provides an introduction to the concept of APM, describes the formation and responsibilities of the proposed Council, and specifies how the Council would apply APM to the proposed action. This section also provides new information regarding the effects of APM resulting from DoD coordination with the above listed agencies following the publication of the Draft EIS in November 2009.

The Council's fundamental function would be to: (1) gather, share, and analyze data; (2) coordinate discussion among DoD, Guam agencies, and federal agencies regarding resources and infrastructure on Guam affected by the military realignment actions; and (3) develop advice and recommendation on how to manage future DoD construction activity and other actions undertaken by Guam or federal agencies associated with the military realignment. The goal in applying an APM process is to mitigate significant environmental impacts by ensuring that existing infrastructure capacities are not exceeded. The use of an APM process and creation of the Council would not create any new authorities or establish limitations on existing authorities. Each participating organization would retain its individual decision making and/or regulatory authority.

Although the proposed framework still is under development, the Council will have participation by DoD, the Government of Guam, and federal agencies, including, but not limited to, DOI (OIA), EPA, NMFS, USDA, USFWS, NPS and DOT. It is envisioned that the Council would have an executive level leadership group and a larger working group to support the Council's functions. It is further envisioned that the Council could establish sub working groups related to specific issues such as wastewater management, roadways, or port management. The larger working group and subgroups would monitor the appropriate indicators, gather the necessary data, and provide recommendations to the Council executive leadership regarding construction tempo, construction sequencing, or other recommend actions. The Council executive leadership would then determine which recommendations would be provided to DoD or other decision makers for consideration.

Should disputes or disagreements arise regarding particular recommendations advanced by the executive level leadership group, it is envisioned that Council members would elevate the matter within their own organization for further coordination and discussion. Efforts to resolve disagreements would start at the local level and then escalate to regional/departmental level and then headquarters level decision makers. Time limits may be set for each level of dispute resolution, allowing for expedited resolution of issues. Efforts to resolve disagreements would not affect underlying agency jurisdiction or regulatory authority.

As members of the Council, the resource agencies will retain their existing processes for elevating disputes. In particular if, during the implementation of the project, EPA anticipates that the pace of the movement of construction workers and military personnel and families, and project related induced

growth will exceed the availability of needed wastewater and/or water supply infrastructure such that unsatisfactory environmental or public health impacts may occur, EPA retains the authority to exercise its responsibility under Section 309 of the Clean Air Act to refer the matter to an appropriate agency in the Executive Office of the President.

In developing advice or recommendations for decision makers, the Council would first focus on known infrastructure limitations and related impacts to resources. Key to these efforts would be identification of action/tipping points, development of data forecasts, implementation of appropriate trend analyses, and identification of appropriate response measures. It is anticipated the larger Council working group would meet quarterly to review/discuss data and trends, and develop recommendations regarding construction tempo and sequencing. The executive level leadership group would meet semi-annually or more frequently if needed. Each agency/department participating in the Council would be expected to fund its own participation.

2.4.3 Slowing Construction Tempo and Altering Construction Sequencing

Adaptive management techniques can be applied to situations other than the management of natural resources. The military construction program proposed on Guam lends itself to an APM approach because of the potential to avoid and reduce impacts to infrastructure and resources.

Existing utilities infrastructure systems on Guam, especially those that affect ground and surface water resources for drinking water and ocean waters for discharge of wastewater, have known limitations and would be most sensitive to the short-term peak increases in population during construction. There is a direct relationship between the amount of construction, the number of people who would be on Guam to support the proposed construction, and demand on utilities, all of which would peak in 2014 under the proposed action. Given the current poor state of the utilities infrastructure on Guam, their non-compliance with existing environmental laws, the long history of compliance waivers, and underlying consent/stipulated orders that govern many existing utility systems, DoD is committed to implementing its construction program to support the proposed military realignment actions on Guam in a manner that would not cause significant environmental impacts or exceed existing infrastructure limitations.

Adaptive program management of the pace and sequencing of construction is a proposed mitigation measure consisting of adjusting program implementation in response to known infrastructure limitations and monitoring and forecasting of impacts on selected resources during construction. With implementation of APM, DoD would slow construction tempo and adjust sequencing of construction activities to directly influence workforce population levels and indirectly influence induced population growth associated with the proposed action before significant environmental impacts took place or infrastructure capabilities were exceeded:

Slowing construction tempo. Construction tempo refers to the overall pace of proposed DoD construction on Guam and regions of Guam (i.e., Apra Harbor, Andersen AFB, and Finegayan). DoD would slow the timing and execution of short term (0 to 3 months), mid-term (3 to 12 months), or long-term (12 to 24 months) construction contract awards in response to known infrastructure limitations and monitoring of data on impacted resources to reduce construction-related population increases and avoid or lessen impacts to environmental resources served by utilities systems (i.e., ground water, surface waters, and ocean waters).

Adjusting construction sequencing. Construction sequencing involves redirecting the sequence of construction to projects that require fewer construction workers (e.g., re-sequencing from horizontal to vertical projects that require fewer workers), thus controlling the workforce population rate of increase. Construction sequencing would also include the regional re-

distribution of construction projects to avoid the concentration of construction activities with the potential to overburden local utilities systems at a particular location.

There are numerous scenarios that could be developed for implementation of APM to construction tempo and sequencing. Table 2.4-1 provides one notional example of how APM could be applied in the context of construction tempo. This notional scenario reflects the application of both an APM process that slows the construction schedule and force flow management. Managing the force flow so that the military population would arrive only after the construction necessary to support them is completed would delay arrival of a majority of the military population beyond 2014. Table 2.4-1 does not represent a current DoN proposal regarding use of APM relative to construction tempo nor should it be viewed as the only possible manner in which military construction tempo on Guam could be managed. The APM notional scenario is presented below only to show the possible mitigative impacts to population growth, and thus likely mitigative impacts to infrastructure and resources, that could occur should adaptive program management be implemented. Other scenarios, with differing assumptions regarding factors that affect construction tempo, would lead to different results. Any actual implementation of APM relative to construction tempo would be decided in the future and would be dependent upon a number of factors including, but not limited to, funding for necessary construction; the implementation of improvements to the Port of Guam; utility systems upgrades for water, wastewater, and power; labor availability on Guam and in the region; material and supply prices; occurrences of natural disasters; Congressional direction; and the monitoring of affected resources. For instance, Table 2.4-1 provides an example of how a decrease in funding for construction in FY10 and FY11 could lower the population numbers compared to current projections noted in Table 2.3-1, with its associated 2014 targeted completion date. As recently identified, the FY10 military construction appropriation and the FY11 military construction budget submission were both lower than initially proposed, likely resulting in a smaller rise of population for those fiscal years, as indicated by the gray shading in Table 2.4-1.

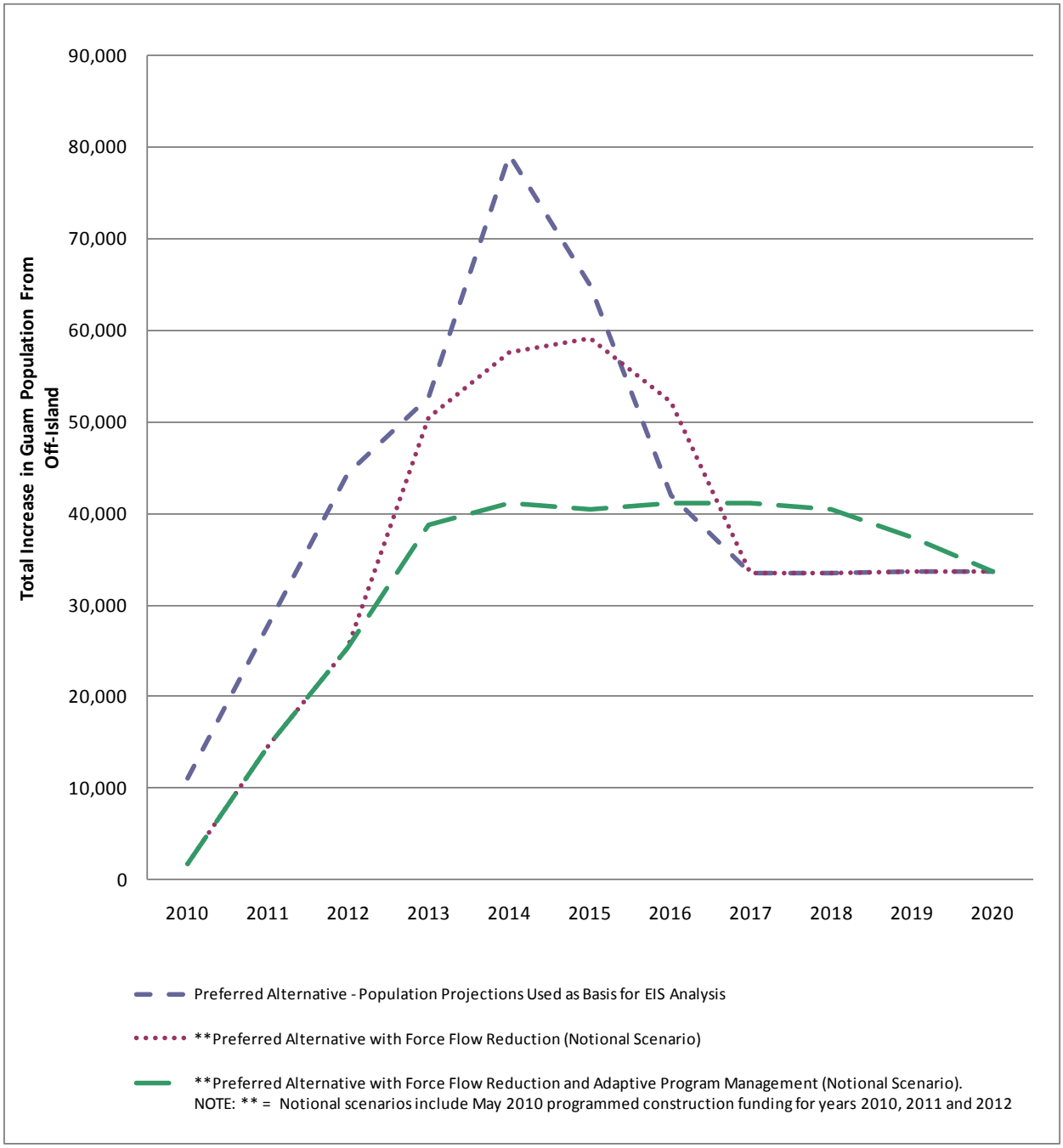
Table 2.4-1. Adaptive Program Management Measure: Slow Construction Tempo. Estimated Total Population Increase on Guam from Off-Island (Direct, Indirect and Induced)

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Direct DoD Population[1]											
Active Duty Marine Corps	510	1,570	1,570	1,570	2,019	2,917	5,163	7,408	9,384	10,027	10,552
Marine Corps Dependents	537	1,231	1,231	1,231	1,620	2,397	4,339	6,281	7,990	8,546	9,000
Active Duty Navy[1]	0	0	0	0	0	0	0	0	0	0	0
Navy Dependents	0	0	0	0	0	0	0	0	0	0	0
Active Duty Army	0	50	50	50	50	630	630	630	630	630	630
Army Dependents	0	0	0	0	0	950	950	950	950	950	950
Civilian Military Workers	102	244	244	244	327	600	966	1,333	1,655	1,751	1,836
Civilian Military Worker Dependents	97	232	232	232	311	570	918	1,266	1,573	1,663	1,745
Off-Island Construction Workers (DoD Projects)[3]	252	4,000	8,079	12,394	12,770	11,330	9,753	8,069	6,340	4,803	0
Dependents of Off-Island Construction Workers (DoD Projects)	50	800	1,616	2,755	3,281	2,643	2,589	2,060	1,518	1,165	0
Direct DoD Subtotal	**1,548**	**8,127**	**13,021**	**18,476**	**20,379**	**22,036**	**25,309**	**27,997**	**30,040**	**29,534**	**24,713**
Indirect and Induced Population											
Off-Island Workers for Indirect/Induced Jobs[4]	110	3,472	6,615	10,352	10,666	9,463	8,146	6,739	5,295	4,012	4,482
Dependents of Off-Island Workers for Indirect/ Induced Jobs	85	2,981	5,625	9,834	10,133	8,990	7,739	6,403	5,031	3,811	4,413
Indirect/Induced Subtotal	**195**	**6,453**	**12,240**	**20,186**	**20,799**	**18,453**	**15,885**	**13,142**	**10,326**	**7,823**	**8,895**
Total Population	**1,742**	**14,580**	**25,262**	**38,662**	**41,178**	**40,490**	**41,194**	**41,139**	**40,366**	**37,357**	**33,608**

Legend:
[1] DoD population includes military personnel, dependents, and DoD civilian workers from off island.
[2] The Navy rows do not include increases from the transient presence of aircraft carrier crew with its carrier strike group (CSG).
[3,4] Population figures do not include Guam residents who obtain employment as a result of the proposed action.
Shading: Construction tempo modification population changes.
Shading: This notional scenario also reflects May 2010 programmed construction spending for years 2010, 2011 and 2012. The programmed military construction budget is lower than projections used as basis for EIS impact analysis of Table 2.3-1 and effects subsequent years' construction budget requests.

Figure 2.4-1 identifies the proposed action, with its target completion date of 2014 and no force flow reduction, as well as the notional scenario in which the APM mitigation measure for construction tempo is implemented along with the corresponding force flow reduction mitigation measure, and the previously addressed force flow reduction notional scenario (without APM). As displayed in the figure, the estimated population of off-island construction workers and their dependents that arrive on Guam is modified and spread out over a period beyond 2014. The result of implementing both the proposed force flow reduction mitigation measure and the use of APM of construction tempo would be that peak population would be reduced from 79,187 to 41,178 in 2014. This reduction associated with slowing construction tempo shows additional population reduction from the peak 57,593 population described for the notional force flow mitigation measure in Section 2.3. Under the notional APM scenario presented below, the full complement of DoD population would not be relocated to Guam until after 2014.

Figure 2.4-1. Population Comparison – Preferred Alternative Projections vs. Force Flow Reduction vs. Adaptive Program Management



Effective APM would require coordinated efforts of multiple agencies, acting through the Council, to advise DoD on measures such as adjusting the construction pace and sequencing. DoD is currently coordinating with these agencies to address utilities concerns following publication of the Draft EIS in November 2009. As a result, updates have been made to the power, water, and wastewater discussions provided in Volume 6 of this EIS and the air quality discussion in Volume 2 of this EIS. In particular, DoD has determined that potential infrastructure limitations associated with a possible shortage of electrical power do not exist and that there is sufficient existing power supply to support the proposed

action (see Volume 6, Chapter 3). Further, DoD has determined that adjusting the construction program based on short-term air quality monitoring data is not feasible. DoD instead proposes the establishment of an air quality monitoring station in northern Guam (see Volume 2, Chapter 5). Consistent with its coordination efforts, DoD and GovGuam have developed two draft memoranda of understanding (MOUs) to provide the framework to address impacts to the GWA water and wastewater systems, co-manage the Northern Guam Lens Aquifer, and address impacts to the Island Wide Power System (see Volume 6, Chapter 3). The MOUs are the basis for establishment of a Utilities Oversight Committee (UOC).

DoD has also agreed to transfer water to meet the off-base water demand associated with the proposed action. DoD would continue to transfer up to 4 MGd (15 mld) to GWA under the current MOU. Under an agreement to be negotiated, DoD would also transfer up to 1.7 MGd (6.4 mld). DoD could implement a number of initiatives to make water available to GWA either by upgrading or improving the condition of existing wells under DoD control or by establishing new wells on DoD lands (see Volume 6, Chapter 6). Through modifications to construction sequencing, DoD would install wells earlier than needed and make the excess water available for transfer to GWA. Approximately 4.7 MGd (17.8 mld) would be required from the Marine Corps water system. Water distribution and transmission lines would be constructed to collect water from the new DoD wells and deliver it to a new pumping station. The pumping station would send water through a new transmission line to the water storage tank that would be constructed at the Marine Corps installation.

Both GWA and DoD have independent island-wide water distribution systems that are capable of moving water throughout the main areas of Guam. This is how water from Fena Reservoir is transferred today from the central Guam transfer point to other areas of the GWA system requiring water. Additional interconnections between these two systems would be constructed to provide enhanced capability for water exchange between the two systems. Where and how these interconnections would be made would be a cooperative effort between DoD and GWA as new wells are sited. This would allow for DoD water that is needed to meet GWA shortfalls during the military relocation to be transferred through the DoD distribution system to the closest interconnection to the GWA system where the water is needed. Maximizing the use of the DoD island-wide water distribution system would minimize the negative impacts that may occur from using the substandard GWA distribution system. Additionally, DoD water storage facilities, including elevated tanks and reservoirs, can be kept at maximum capacity at given times of the year in anticipation of drought conditions and water shortfalls in the GWA system.

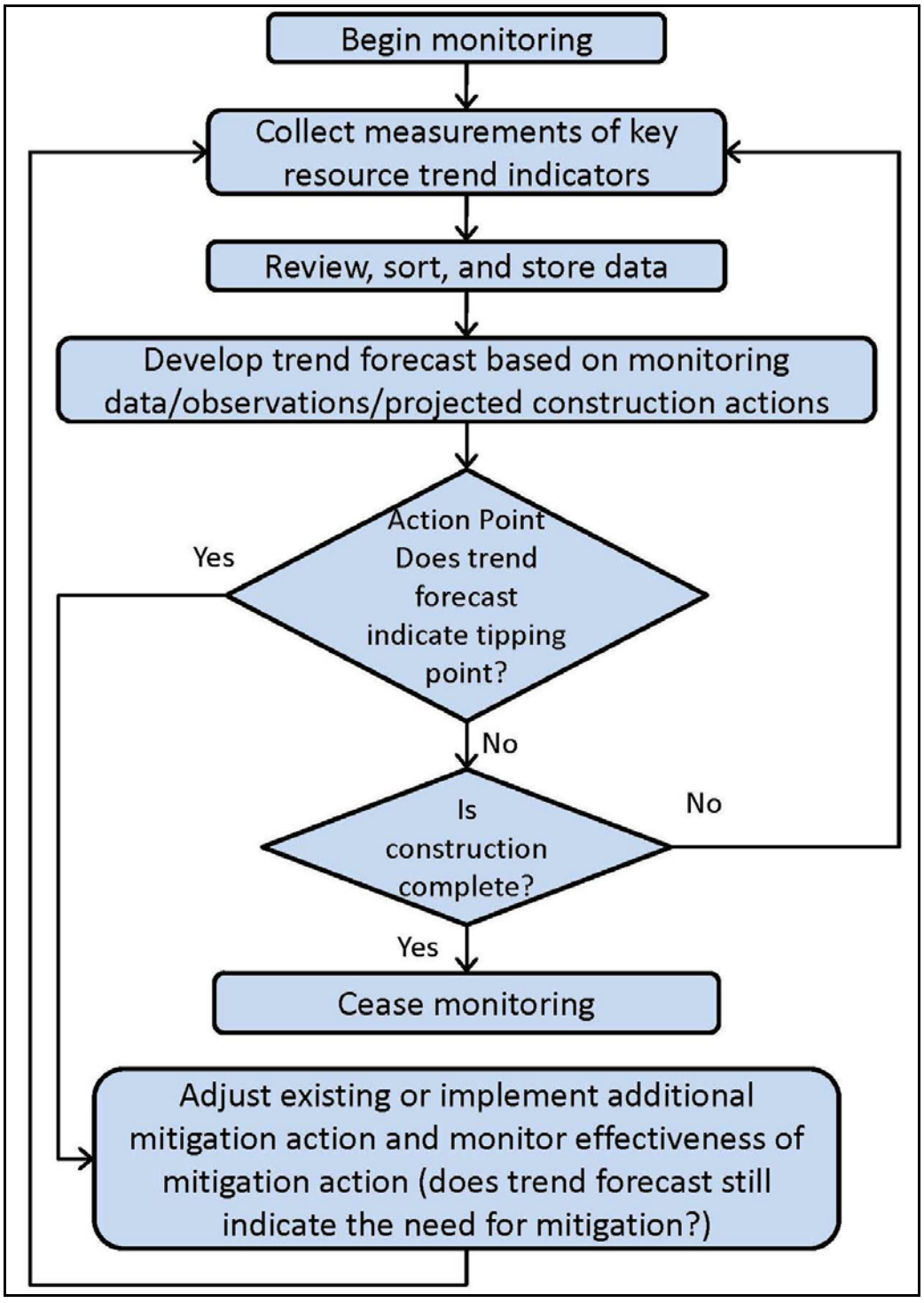
As indicated above, an MOU is being developed between DoD and GWA that establishes a framework of cooperation and information and resource sharing with the goal of providing utility service solutions to meet the projected additional water demand associated with the military relocation. This joint planning and cooperation would ensure that the requirements of both the DoD and civilian community can be met in a manner that is mutually beneficial and maximizes the effectiveness of the overall utility systems. Exchange of water between the DoD and GWA systems would be accomplished through this MOU.

2.4.4 Decision Points in the APM Process

The tipping points developed through the APM process would represent established infrastructure limitations and resource indicator levels that if exceeded, would result in unacceptable impacts on utilities systems and resources. For example, the NDWWTP is currently permitted to 6 MGd for primary treatment. Thus, the tipping point for wastewater infrastructure would be established to flag the point at which construction tempo would be adjusted to prevent exceeding the 6 MGd permit limit or to allow improvements to the primary treatment capacity at the NDWWTP for increased flows in accordance with new permits and consent/orders between the U.S. Government and GWA. The action points would serve as warning level indicators associated with each infrastructure system limitation or resource that would signal the initiation of appropriate actions to avoid unacceptable impacts. The action points would factor appropriate reserves or buffer conditions to ensure that action is taken in sufficient time to prevent adverse impacts associated with tipping points. For example, in the case of the NDWWTP and its current permitted limit of 6 MGd for primary treatment, the NDWWTP currently operates at a daily average of 5.7 MGd. In June 9, 2010 comments to DoD from USEPA, USEPA indicates that the daily averages for the previous six months ranged from 5.59 to 8.24 MGd. An appropriate tipping point would be established by the CMCC. By monitoring data on a regular basis, such as current work force levels and wastewater flows, and by using trend analysis, the CMCC would be able to assess actual per capita usage rates correlated to population, construction work in place, and projected construction awards. When trend analysis forecasted that an action point was being approached or exceeded, DoD, in conjunction with guidance and planning provide by the CMCC, would implement response measures, such as delay of construction awards or changing the sequence of construction, and continue to monitor the effectiveness of the response measures (see Figure 2.4-1).

Another example of how APM could function involves the use of wastewater systems for the construction workforce. As indicated above, the supply of water could be expedited to meet projected workforce demand through modifications to construction sequencing. However, increased use of potable water would increase the generation of wastewater and thereby increase stress on Guam's wastewater infrastructure. The water provided by DoD could therefore be provided on the condition that water supplied to workforce housing developments would meet certain allocation criteria that GWA would control. Water allocations purchased by housing developments in advance would be made available incrementally to workforce housing developments by GWA (e.g., in 2,000-person equivalent increments) and only upon GWA determination that 1) sufficient supply of potable water is available, and 2) sufficient wastewater capacity is available at the impacted wastewater treatment plant. DoD could then make the availability of water allocations at workforce housing one of the requirements for construction contract awards in one of two ways: 1) As a worker requirement provision in requests for proposals, i.e., DoD would only select construction contract proposals that identify sufficient available water allocation from GWA for workers for that specific construction contract; or 2) In the event that GWA communicates a deficiency in its infrastructure identified via regular system monitoring, DoD would delay, or possibly preclude, construction contract award(s) until there is adequate infrastructure capacity. In this way, construction contracts would only be awarded by DoD when sufficient water supply and wastewater capacity are available.

Figure 2.4-2. Monitoring Plan Flow Chart



2.4.5 Impact Reduction by Infrastructure Capacity Area and/or Resource

Some infrastructure capacity and/or resources are more sensitive to population level increases than others and thus more capable of being mitigated by the use of APM techniques focusing on construction tempo and sequencing. Those resources that are sensitive to changes in population increases and mitigation through construction tempo would experience less severe impacts if the construction tempo, and resultant force flow, was slowed (Figure 2.4-1). Slowing construction tempo would reduce the population increase and thus the severity of impacts during construction. Implementation of APM would reduce impacts to the following infrastructure limited and population sensitive resources:

- Port Capacity – APM would alleviate some of the proposed action's adverse impacts at the port by delaying 1) the need for operations related cargo handling, 2) the need for handling of military population household goods, and 3) the handling of associated cargo to support the military population (i.e., arrival of additional food shipments for the military commissary). Adaptive program management would also have the benefit of freeing up the port's capabilities to accommodate the increase in container ship traffic for construction. Without the demand on port facilities to accommodate construction and operations cargo concurrently, port cargo handling efficiency would increase during the construction phase.
- Wastewater Treatment - As indicated above, controlling the peak population associated with the use of APM would reduce demands and burdens on Guam's wastewater treatment capability, which would otherwise approach or potentially exceed system design capacities. For example, under the proposed action the NDWWTP's wastewater flow is projected to reach approximately 12.13 MGd during peak population. This flow would exceed the plant's design capacity of 12.00 MGd. However, in the notional scenario for APM presented above, the maximum flow to NDWWTP in 2014 would be substantially less than the NDWWTP's design capacity.
- Drinking Water Production, Treatment and Distribution – Through implementation of APM, construction tempo would be managed such that demand for potable water associated with peak population would be lowered, thus reducing the demand for potable water production, treatment and distribution. Additionally, as indicated above, through modification of construction sequencing DoD would expedite a number of initiatives to make water available to GWA in advance of need, either by upgrading or improving the condition of existing wells currently under DoD control or by establishing new wells on DoD lands. Coordination of the exchange of water between DoD and GWA would maximize the effectiveness of existing and proposed distribution systems to the mutual benefit of DoD and civilian communities on Guam.
- Roadways - Impacts to off-base roadways are directly related to population increases. Reducing the total peak population associated with the proposed action by implementing APM is expected to reduce stresses on Guam's currently deficient roadway system. With implementation of APM the additive impacts of construction and military operations traffic would be lessened with related reductions in adverse impacts to off-base roadways during the peak population period.
- Geological and Soil Resources – The proposed action involves construction that would result in some degree of erosion. A reduction in the number of concurrent construction projects through APM would reduce concurrent disturbance of soil and topography and therefore lessen the amount of erosion resulting from construction at a given time.

- Water Resources (surface water, stormwater, wetlands) – The proposed action involves construction that would result in erosion and potential for stormwater runoff. The proposed action includes implementation of erosion and stormwater BMPs that would control erosion and runoff before and after construction activities. Slowing the construction tempo would decrease the amount of grading and ground disturbance occurring at one time and further reduce the potential for erosion and stormwater runoff. This measure may also reduce the projected peak demand for and stresses on water-related resources and infrastructure (see utilities discussion below).
- Air Quality – The proposed action involves construction activities that would result in releases of air pollutants. Slowing construction tempo would reduce air quality impacts by lowering the amount of air pollutants that would be released at any one time.
- Noise – There are two potential noise issues associated with the proposed action: noise associated with construction activities and noise associated with long-term operations after construction is complete. Construction noise is directly related to the intensity of construction. The use of heavy equipment at a construction site has a noise impact on nearby citizens and wildlife. Slowing the construction tempo could possibly change the amount of noise experienced at any given time depending on the clustering of construction and relative location of receptors, but could have an undesired effect of prolonging local exposure to that construction-related noise. Likewise, changes in construction tempo would also have a corresponding change in intensity and duration of noise impacts along roadways used by construction vehicles. Operational noise is not directly related to construction tempo or associated short-term population increases; therefore, slowing the construction tempo would not affect operational noise impacts.
- Recreational Resources – Recreational resources both within DoD-controlled property and within the civilian community would be significantly impacted by implementation of the proposed action. Foreseeable impacts from population increases include crowding at parking lots, picnic shelters, restrooms, showers, boat mooring facilities, golf courses, dive spots, etc. Adverse impacts would result from both construction and operations populations; however, impacts would be most pronounced during peak population when these two populations would be additive. Slowing construction tempo would reduce impacts to recreational resources by lessening the peak population associated with the proposed action.
- Terrestrial and Marine Biological Resources – Adjusting the construction pace would not reduce the direct impacts on terrestrial and marine biological resources. However, there may be a reduction in indirect impacts on nearby biological resources if construction is slowed. There may be less construction noise generated in the same location. However, a slower construction schedule could result in noise generated over a longer period of time. The reduced peak population associated with construction could reduce the impacts of recreational use on marine and terrestrial resources.
- Cultural Resources – Adjusting the construction pace would not reduce the direct impacts on historic properties.
- Socioeconomics and General Services– The impacts from the proposed action would peak in the years 2013 to 2015 timeframe and are made significant in large part due to the overlap in the construction and operation phases of the proposed action. Impacts would result from rapid population influx, housing and public service shortages, and cost of living increases, among other factors. Slowing the construction tempo and associated construction workforce and induced population generally would lessen the adverse socioeconomic impacts already

discussed in this EIS. Slowing construction tempo would provide GovGuam and the private sector a longer period of time to increase available public services for the short-term population increase, which may also help alleviate initial shortfalls for the projected long-term population increase.

- Public Health and Safety – Impacts to public health and safety are related to population. The reduced population would likely result in reduced cases of disease, mental illness, and traffic incidents because of the lowered peak population. Slowing the construction tempo would provide GovGuam and the private sector more time to increase available public services (i.e., health care services, social services, and protective services) for the short-term population increase, which may also help alleviate initial shortfalls for the projected long-term population increase. However, because existing Guam public services are considered sub-standard, it is anticipated that Guam public services would still not be able to increase staffing to meet current service ratios and would not be capable of adequately handling potential increases in services (e.g., air quality-related illnesses, water-related illnesses, notifiable diseases, mental illness, and emergency response). Reducing the total peak population associated with the proposed action would reduce the potential for traffic incidents on Guam's roadways. Aircraft mishaps, bird airstrike hazards, explosive safety, and electromagnetic safety are not directly related to construction tempo or associated short-term population increases; therefore, slowing the construction tempo would not affect these potential operational impacts. The proposed action involves construction that would result in the potential to encounter UXO. BMPs would be implemented prior to and during construction activities to ensure that potential impacts from UXO would be minimized. Slowing the construction tempo would decrease the amount of grading and ground disturbance occurring at one time and further reduce the potential for encountering UXO.
- Environmental Justice and Protection of Children – With implementation of APM of construction, disproportionate impacts to low income populations and children could be reduced due to slowing the construction tempo and associated construction workforce resulting in a reduction in peak population associated with the proposed action. Reductions in peak population would reduce demand and burdens on Guam's infrastructure and public health and safety services. The reduced population numbers and monitoring to avoid unacceptable impacts would decrease the significant disproportionate impacts related to socioeconomics, public health and safety, potable water, and wastewater.

For those resources where there would be minimal adverse impact from construction tempo and sequencing, and associated population levels, there would be minimal impact from the APM of construction. Resources that would be minimally affected by the APM of construction mitigation measure are as follows:

- Land and Submerged Land Use
- Airspace
- Visual Resources
- Hazardous Material/Waste.

2.5 LIMITATIONS TO THE ADAPTIVE PROGRAM MANAGEMENT APPROACH FOR THIS ACTION

DoD acknowledges that there are limits on applying APM to construction projects as mitigation. There are well-documented existing infrastructure deficiencies on Guam that make it difficult to differentiate the effects of DoD actions. Adaptive Program Manageemnt is not a substitute for identifying and establishing

mitigation measures for particular impacts. A comprehensive list of mitigation measures, other than APM, proposed in this EIS to avoid or reduce impacts associated with the proposed action are summarized in Volume 7, Section 2.2.

Consistent with draft CEQ guidance on mitigation measures issued February 18, 2010, adaptive management should be included as part of any mitigation measure proposal. As highlighted by the draft CEQ guidance, adopting an adaptive management approach is important to mitigation measures "to minimize the possibility of mitigation failure." Establishing effective mitigation measures during the NEPA environmental review and environmental planning process lessens the potential for significant impacts and minimizes the likelihood of having to respond to unexpected significant impacts later. Following publication of the Draft EIS and receipt of public and agency comments, DoD has identified additional mitigation measures for air quality, natural resources, marine resources, stormwater, potable water, and wastewater. These additional mitigation measures are described in Volumes 2 through 6 and identified in Table 2.2-1 of this volume. As stated earlier in this section, the proposed mitigation measures identified in this EIS and selected for implementation in the ROD would be monitored in the post-ROD Monitoring Plan.

CHAPTER 3. PREFFERED ALTERNATIVES: SUMMARY OF IMPACTS

3.1 INTRODUCTION

Chapter 3 summarizes the combined construction and operational direct and indirect impacts of the preferred alternatives for Guam and Tinian that were presented in previous volumes. These impacts are compared to the recent trends in resources to determine whether the preferred alternatives would adversely impact the overall health of each resource. Many public comments on the Draft EIS referring to cumulative impacts were actually comments on the combined impacts of the proposed actions. The concern of these comments was the impacts described in Volumes 2 through 6 addressed impacts of individual components of the proposed actions and did not address the combined impacts of the proposed actions. The combined impacts of all proposed actions are described in this chapter. This chapter also includes a section on potential secondary impacts due to the preferred alternatives and a section summarizing the Clean Water Act (CWA) Section 404 actions under all alternatives.

Chapter 4 of this volume presents the cumulative impacts analysis, which assesses the combined impacts of the preferred alternatives (presented in this chapter) with the impacts of other past, present, and reasonably foreseeable future actions across Guam and Tinian.

3.2 PREFERRED ALTERNATIVES' DEFINITION

The term "preferred alternatives" is defined as the alternatives that an agency believes would fulfill its statutory mission and responsibilities, giving consideration to economic, environmental, technical and other factors.

Herein, the term preferred alternative refers to all the components of preferred alternatives described in previous volumes for the Marine Corps relocation, Navy transient aircraft carrier wharf, and Army AMDTF, as a whole. The greatest impacts to resources would occur when all of the preferred alternatives occur concurrently. To assess a maximum potential adverse effect, it is assumed that proposed construction actions would occur during a compressed time period. However, it is assumed that all operational activities would commence only upon completion of construction. In other words, there would be no overlap between construction and operation phases of the preferred alternatives. Both the construction and operation impacts are described.

The construction impacts would presumably peak in 2014, therefore, that is the point of reference used to describe the construction impacts under the preferred alternatives for each resource. This is the point of maximum population and ground disturbance with maximum potential impact to resources, and presents the starkest contrast. It is also assumed that the mitigation measures and Best Management Practices (BMPs) that are proposed for construction impacts are completed prior to the operational phase. In other words, the construction impacts are reduced to less than significant once the operational phase begins.

The steady-state level of operations would begin at the conclusion of construction and would continue unchanged for an undetermined amount of time into the future. This operations phase represents the long-term impact of the preferred alternatives in isolation of other reasonably foreseeable future actions.

Relative to the construction phase, the operations phase would generally have less impact on the island resources, especially those resources that are sensitive to population levels.

3.3 PREFERRED ALTERNATIVES' IMPACTS COMPARED TO NO ACTION

3.3.1 Methodology

The methodology for comparing the preferred alternatives' impacts to no action consists of the following steps:

1. Summarize the combined preferred alternatives' impacts from Volumes 2 through 6:
    a. Consolidate the findings of the preferred alternatives' impact analyses by resource area, as presented in previous volumes of the EIS. This was prepared assuming an anticipated construction peak in 2014, a post-construction operational steady-state, the proposed construction actions would occur in a compressed time period, and that all operational activity would commence upon completion of construction. A second assumption is the proposed mitigation for construction impacts would be completed before the operational period commences.
    b. For Guam only: Review the preferred alternatives' findings from Step 1 for each resource and list the highest level of adverse impacts indentified among the volumes. This list represents a summary of the preferred alternatives' impacts for Guam. This summary impact assessment is warranted for Guam's proposed actions because there may be additive impacts associated with the preferred alternatives as a whole that are not apparent in the project-specific analysis of previous volumes.
    c. Tinian is geographically distant from Guam and is not expected to be influenced by Guam's summary impacts. There are far fewer proposed actions on Tinian than Guam and a separate summary of impacts is not warranted. The preferred alternatives' impacts in Volume 3 are essentially a summary of impacts for Tinian. These findings are reiterated in this Chapter.
2. Describe "no action" for each resource. "No action" means the proposed activities would not take place; the resulting environmental effects from taking no action are compared with the effects of allowing the proposed activity or an alternative activity to go forward.
    a. Island-wide resource health trends are described for Tinian and Guam, in the absence of any of the preferred alternatives described in this EIS. There are key natural and anthropogenic (human-influenced) stressors that are triggered by key events or repetitive practices/behaviors over time. A review of stressors often reveals trends in resource success or health that lead to the existing affected environment, as described in resource sections of Volumes 2 through 6. Under no action, each resource is described in terms of its capacity to accommodate additional effects or stress.
    b. The time period designated for describing the resource trends begins at the conclusion of World War II (WWII). WWII was selected because it is the single-most significant event in modern history and had profound environmental impacts on the Mariana Islands. Volume 7, Chapter 1, provides an overview of key events. The resource descriptions are often qualitative and based on best available information. They are intended to provide insight on the current situation on each island that may be influenced by the preferred alternatives. Other past, present, and reasonably foreseeable future actions are further addressed in the cumulative impacts assessment provided in Chapter 4 of this volume.
3. Compare the summary of preferred alternatives' operational impacts described in Steps 1 and 2, to no action described in Step 3, to determine whether the preferred impacts would influence the trends in resource health.

The comparison of the preferred alternative impacts to no action meets, in part, the Council on Environmental Quality (CEQ) guidance on cumulative impacts analysis as described in *Considering Cumulative Effects Under the National Environmental Policy Act (NEPA)* (CEQ 1997) and *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis* (CEQ 2005). One principle in the guidance documents states that "cumulative effects analysis should be conducted within the context of resource, ecosystem, and community thresholds - levels of stress beyond which the desired condition degrades." Thus, "each resource, ecosystem, and human community must be analyzed in terms of its ability to accommodate additional effects, based on its own time and space parameters."

This methodology is applied to each resource and described in the following sections. The findings for Tinian and Guam are discussed under each resource. Tables summarizing the impacts during construction and operation are presented in each resource section.

3.3.2 Geological and Soil Resources

3.3.2.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-3 and 3.3-4 summarize the preferred alternatives' construction and operation impacts to geological and soil resources on Guam and Tinian. The findings from previous volumes are listed. For Guam, the greatest level of impact identified among all the volumes is listed in the last Guam column. The summary of impacts for Tinian's preferred alternatives is listed in the far right column of the tables. It is assumed that all of the proposed construction actions would occur during a compressed time period, and that all operational activity would commence upon completion of construction.

Most impacts on geological and soil resources are less than significant during construction and operation. During site planning in Northern Guam, avoidance of known sinkholes was required to prevent significant impacts to unique geological features. Significant and mitigable impacts are identified for construction and operation, due to the presence of sinkholes. The sinkholes that are deemed dangerous would be fenced off and educational warning signs put in place to warn of potential danger as a proposed mitigation measure for potential impacts during operations. A buffer zone of vegetation would remain around them through construction and operation to prevent further erosion or expansion on Tinian and Guam. A survey by a licensed geologist is required prior to construction to ensure that all sinkholes have been identified. If additional sinkholes are discovered, the significance of these sinkholes would be evaluated and projects would be designed in consideration of these sinkholes as appropriate. With implementation of mitigation, less than significant impacts to sinkholes would occur.

Construction activities on Tinian and Guam would include clearing, grading, and grubbing, demolition of existing road pavement, earthwork, and landscaping. Temporary loss of vegetation would occur; however landscaping would replace it. Ground disturbance would be much less on Tinian than on Guam. With the implementation of best management practices (BMPs), including requirements for stormwater compliance, there would be no significant impacts from soil erosion during construction or operation. Major features of topography or landscape (i.e., hills and mountains) would not changed substantially by the preferred alternatives, and potential structural damage from seismic ground shaking and fault rupture at all locations under the preferred alternatives would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007).

Construction on previously disturbed land, such as Apra Harbor and South Finegayan, would lessen impacts to soil and geological resources. Liquefaction (i.e., conversion of soil into a fluid-like mass during a seismic event) is a risk at Apra Harbor, but impacts due to development would not be significant.

The preferred alternatives would have an overall less than significant impact on geology and soils during construction with implementation of proposed mitigation for sinkholes. For utilities and off-base roadways there would be no impacts during operations.

Operational risks would be limited to geologic hazards. There would be a high risk of liquefaction at Apra Harbor and Naval Base Guam. Structures would be constructed to meet UFC 3-310-04 Seismic Design for Buildings criteria and applicable military requirements for munitions storage facilities to reduce risk of damage to structures from seismic hazards. The risk cannot be reduced to zero; therefore, a less than significant impact would remain.

Table 3.3-1. Summary of Preferred Alternatives' Construction Impacts – Geology and Soils

Resource Category	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Topography	LSI	LSI	LSI	LSI	LSI	LSI	NI	LSI	LSI	LSI
Geology	SI-M	NI	SI-M	NI	SI-M	SI-M	NI	LSI	SI-M	SI-M
Soils	LSI	LSI	LSI	LSI	LSI	LSI	NI	LSI	LSI	LSI
Geologic Hazards	LSI	LSI	LSI	LSI	LSI	LSI	NI	LSI	LSI	NI
Geology and Soils Construction Impact Summary:									**SI-M**	**SI-M**

Legend: SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact

Table 3.3-2. Summary of Preferred Alternatives' Operation Impacts – Geology and Soils

Resource Category	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Topography	NI	NI	NI	LSI	LSI	LSI	LSI	NI	LSI	NI
Geology	SI-M	NI	SI-M	NI	SI-M	SI-M	LSI	NI	SI-M	LSI
Soils	LSI	NI	NI	LSI	LSI	LSI	LSI	NI	LSI	LSI
Geologic Hazards	LSI	LSI	LSI	LSI	LSI	LSI	NI	NI	LSI	LSI
Geology and Soils Operation Impact Summary:									**SI-M**	**LSI**

Legend: SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact

3.3.2.2 No Action

Impacts to geological and soil resources would continue as a byproduct of naturally occurring and anthropogenic activities that result in land disturbance. Soil erosion and changes to topography can be caused by a number of factors including wildlife such as ungulates; wildfires; and even construction projects that did not employ BMPs. Guam has a history of wildfires set by hunters to attract game; the resulting reduction in groundcover from these wildfires increases soil run-off in stormwater and would

continue to occur under no action. Stressors affecting geological and soil resources would continue to occur without implementation of the preferred alternatives.

Historical factors that have contributed to increased erosion and stormwater runoff, loss of vegetation, changes to landscape and topography, diminished slope stability, loss of agriculturally productive soil, or increased vulnerability to a geologic hazard on Guam include:

- Construction practices that do not include the use of BMPs and SOPs and do not adhere to Guam and USEPA regulations;
- Increases in impervious surfaces from construction;
- Illegal burning of savanna and forest by hunters;
- Construction completed on agriculturally productive soil;
- Construction completed in areas with karst geologic features without proper survey by a geologist to avoid sinkholes;
- Construction completed in areas such as Apra Harbor, where there is high risk of liquefaction; and
- Erosion caused by feral ungulates.

These factors contribute to the baseline condition of soil, watersheds, and reefs surrounding the proposed action areas and contribute to the magnitude of impacts to geological and soil resources of current and future actions. Since WWII, this trend has improved with the adoption of federal non-point source discharge (NPDES) regulations, but the increase in erosion and the ongoing effects of historical influences are likely to continue into the future. Continuation of activities contributing to excessive soil erosion would cause a significant impact under no action. Future construction projects would have a less than significant impact because BMPs would be required for erosion and stormwater management. Other measures to address the ongoing problems include ungulate control, planting exposed soils, enforcement of existing policies and laws, and passing new laws to reduce stressors.

Surface runoff and sediment loss from soil erosion are major contributors to the reduction in surface water quality, especially in Southern Guam. A study of the Ugum watershed on Guam indicates that soil erosion from vegetated savanna grassland in the watershed is approximately 70 tons/hectare/year, but can be as high as 547 tons/hectare/year in unvegetated sloping sites known as "badlands" (U.S. Geological Survey [USGS] 2001). Agricultural lands in the Ugum watershed were estimated to have an average soil erosion loss of 45 tons/hectare/year (USGS 2001). Additional problems associated with soil erosion island-wide include loss of soil productivity at the eroded site, reduced water storage capacity in streams and lakes, and loss of wildlife habitat.

Many geological phenomena, such as earthquakes, tsunamis, and volcanic eruptions, originate in areas where tectonic plates meet (USGS 2008). The Marianas are positioned where the Philippine and Pacific Plates converge. Earthquake activity is common on Guam and across the entire Mariana Island chain (Lander, et al. 2002). Seismic activity can trigger landslides, tsunamis, and liquefaction. All of these events are unpredictable and could occur anywhere on Tinian or Guam. Building codes potentially mitigate future hazards that may result from seismic activity.

3.3.2.3 Comparison of Preferred Alternatives to No Action

The preferred alternatives would have a less than significant impact on geology and soils during construction and operation with implementation of proposed mitigation. This assumes adherence to BMPs and stormwater management principles. Under no action, the same principles would apply during construction, and future development would result in less than significant impacts.

The other factors that contribute to island-wide soil erosion would continue, including ungulate removal of vegetation, existing badlands, and exposed soils. The island-wide no action trend of increasing erosion over time due to the factors identified above would continue with significant but mitigable impacts.

The preferred alternatives for Tinian would not significantly impact topography at the specific site of the proposed action and there would be no significant effect on island-wide topography (i.e., hills and mountains). Under no action, there potentially would be localized impacts to topography from planned construction activities, which also would be considered less than significant.

Geologic hazards include earthquake activity on Guam and Tinian, as well as sinkholes and karst features that may limit areas that potentially could be developed on either island. Under the preferred alternatives, geological surveys continue to ensure that construction is not planned in areas where geological hazards could lead to structural problems. Known sinkholes would be avoided and a buffer zone of vegetation would be left around sinkholes as a mitigation measure to prevent further erosion or expansion. A survey by a licensed geologist is required prior to construction to ensure that all sinkholes have been identified. If additional sinkholes are discovered, the significance of these sinkholes would be evaluated and projects would be designed in consideration of these sinkholes as appropriate. There may be impacts in localized areas of construction, but island-wide there would be no operational impact. During preferred alternatives operation or no action, there would continue to be a risk to geological resources. The preferred alternatives would be implemented in accordance with BMPs and regulations; however, under the no action erosion prone areas are likely to persist. All construction is required to meet local seismic design regulations; therefore, the risks are minimized.

3.3.3 Water Resources

3.3.3.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-3 and 3.3-4 summarize the preferred alternatives' construction and operation impacts to water resources on Guam and Tinian. The findings from previous volumes are listed. For Guam, the greatest level of impact identified among all the volumes is listed in the last Guam column. The summary of impacts for Tinian's preferred alternatives is listed in the far right column of the tables. It is assumed that all of the proposed construction actions would occur during a compressed time period, and that all operational activity would commence upon completion of construction. Significant construction-related indirect impacts (construction workforce and induced population) to all water resources were identified. During operations, stormwater would be managed on-site. There is the potential with the overall increases in developed areas and maneuver training that there would be less than significant impacts to groundwater, nearshore and wetland water quality. Wastewater improvements at the NDWWTP on Guam would result in a beneficial impact of improved water quality; however, there would be a significant adverse indirect impact from wastewater to all water resources categories associated with increased population, particularly in the south and central regions of Guam. There may also be an issue associated with leachate impact on groundwater as a result of existing and continued Navy landfill operations. The leachate from the existing Navy sanitary landfill may impact the groundwater at a less than significant level. The landfill is located over aquifers not used for supplying drinking water, thus any leachate that might percolate into the aquifer would not affect regional potable groundwater quality or quantities.

Table 3.3-3. Summary of Preferred Alternatives' Construction Impacts – Water

Resource Category	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Surface Water/ Stormwater	LSI	LSI	LSI	LSI	LSI	LSI	NA	LSI	LSI	LSI
Groundwater	LSI	LSI	LSI	LSI	LSI	LSI	NA	LSI	LSI	LSI
Nearshore Water	SI-M	SI-M	LSI	LSI	LSI	LSI	NA	LSI	SI-M	LSI
Wetlands	LSI	NI	NI	NI	NI	NI	NA	LSI	LSI	NI
Water Resources Construction Impact Summary:									**SI-M**	**LSI**

Legend: SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact, ( ) = Indirect (workforce population and induced) population impact, NA = Not Applicable (no construction)

Table 3.3-4. Summary of Preferred Alternatives' Operation Impacts – Water

Potential Impacts Resource Category	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Surface Water/ Stormwater	LSI	LSI	LSI	NI	LSI	NI (SI)	NI	LSI	LSI (SI)	LSI
Groundwater	LSI	LSI	LSI	NI	LSI	LSI (SI)	LSI	LSI	LSI (SI)	LSI
Nearshore Water	LSI	LSI	LSI	NI	LSI	LSI (SI)	NI	LSI	LSI (SI)	LSI
Wetlands	NI	NI	NI	NI	NI	NI (SI)	NI	NI	NI (SI)	LSI
Water Resources Operation Impact Summary:									**LSI (SI)**	**LSI**

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact, ( ) = Indirect (workforce population and induced) population impact

Surface Water/ Storm Water.

Once constructed, the combined preferred alternatives would add approximately 883 acres (357 ha) of impervious surface area to Guam's existing 12,280 acres (4,970 ha) of developed impervious surface area (see Table 3.3-5), representing an increase of approximately 7% of total development-related impervious surface area on the island. Increases in stormwater would be managed by existing or new stormwater infrastructure; stormwater flow paths would continue to mimic area topography. Stormwater would continue to be managed in accordance with laws, regulations, and plans that would minimize potential impacts to groundwater and nearshore waters to less than significant.

During construction, the preferred alternatives could result in temporary increases in stormwater runoff that would be managed through the implementation of BMPS, and the impacts would be less than significant. Roadway-specific BMPs, as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction for all road

projects. Through the development and implementation of site-specific BMPs, LID measures, and facility-specific plans and procedures, there would be no increased risk from environmental hazards or to human health. A Comprehensive Drainage and Low Impact Development Implementation Study was prepared for the potential Main Cantonment site at Finegayan. The study provides design recommendations for capturing, treating, and routing the 95% exceedance stormwater flows. Conditions of the Construction General Permit would be followed for non-DoD property. By adhering to the provisions of the Construction General Permit and implementing BMPs associated with addressing site- and activity-specific water resource protection needs, there would be a reduction in stormwater pollutant loading potential and thus a reduction in pollution loading potential to the underlying groundwater subbasins.

Table 3.3-5. Guam Impervious Surface Area Island-Wide and on Military Lands: Existing and Preferred Alternatives

	Island Wide*		Military Lands	
	Acres	Percentage	Acres	Percentage
Total land area	134,765	100%	34,435	100%
Existing impervious surface area from development	12,280	9%	3,244	9%
Addition of impervious surface area from Preferred Alternatives	883	<1%	883	3%
Total impervious surface area with Preferred Alternatives	**13,163**	**10%**	**4,127**	**12%**

Note: *Includes military lands
Sources: NOAA 2007, Department of Commerce et al. 2007

Groundwater

While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed per capita, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be at or less than the sustainable yield and would be monitored to ensure sustainable yields are not exceeded. Increased groundwater production potentially could impact cave and pool water levels; potential impacts to these systems could require review and/or permitting by the U.S. Army Corps of Engineers (USACE). There is the potential for leaching of lead and other chemicals from ammunition into groundwater at firing range locations. BMPs would be applied that would reduce these impacts to less than significant. Monitoring groundwater chemistry and overlying sediments would ensure that no harm to existing or beneficial uses and no damage to structures, utilities, or other facilities would result from potential soil settlement or saltwater intrusion. Dredged material dewatering sites would not be located over areas with groundwater used for potable water production; dredge effluent that percolates into the underlying soils would not affect the quality or quantity of groundwater available for drinking.

Nearshore Water

Under the preferred alternatives, there are planned dredging projects in Apra Harbor that would temporarily impact the water quality of nearshore waters. BMPs would limit the impacts to the dredge area. The Army Corps of Engineers Section 404 and 401 permit conditions would require water quality mitigation measures and monitoring during in-water work, such as dredging, to verify the effectiveness of those measures. Non-compliance would result in stopping work until water quality levels meet acceptable levels. These nearshore impacts are considered significant but mitigable.

Ships are required to strictly comply with fuel transfer and ballasting procedures to ensure ballast water does not become contaminated with oil or any other waste. Ships using self-compensating fuel tanks are required to ensure adequate margin is preserved to prevent inadvertent discharges of oil with the

compensating water. Compliance with the relevant laws and procedures would ensure that no significant impact to nearshore water would occur from point-source discharges under the proposed action.

There may be less than significant indirect impacts to wetlands and nearshore waters due to sedimentation on Guam. The use of BMPs, including Low Impact Development (LID), during construction would prevent short- and long-term increases in sediment loading, including sediment loading to Apra Harbor. Construction-related impacts to nearshore water are considered significant but mitigable to less than significant. For further assessment of impacts to nearshore waters and inner and outer Apra Harbor see Section 3.5, *Summary of Clean Water Act Section 404 Actions – All Proposed Actions and Alternatives*.

Wetlands

With the implementation of the proposed mitigation measures to compensate for potential direct and indirect impacts to wetlands resulting in loss of wetland function, there would be no reduction in wetland area or functionality on Guam. For assessment of combined wetlands impacts see Section 3.5, *Summary of Clean Water Act Section 404 Actions – All Proposed Actions and Alternatives*.

Tinian. During construction, water quality impacts on Tinian are anticipated to be similar to those on Guam, but the scale of the proposed construction is much smaller on Tinian and no in-water work is proposed. A direct impact to a potential jurisdictional wetland (Table 3.3-3) from filling would be avoided by adjusting the range layout. There would be less than significant impacts to water resources during operation.

3.3.3.2 No Action

Guam and Tinian

The stressors on water quality include construction-related discharge, sewage overflow, animal waste, sediment erosion, saltwater intrusion into aquifers, leaky septic systems, feral ungulates, human disturbance of soils, erosion, and invasive plants.

Surface Water/Stormwater

The identified stressors impacting surface water availability and quality on Guam and Tinian (e.g., construction-related discharges, sewage overflows, animal waste, and sediment erosion) would continue to exist. These threats to surface water would continue to be monitored by federal and Guam/Tinian agencies, and appropriate regulatory action would continue to occur in order to maximize surface water quality and availability. In time, surface water quality would be expected to slowly improve as point and non-point sources of pollution are identified, and pollution loading to surface waters is reduced.

Groundwater

The identified stressors impacting groundwater availability and quality on Guam and Tinian (e.g., saltwater intrusion and leaky septic systems) would continue to exist. These threats to groundwater availability and quality would continue to be monitored by federal and Guam/Tinian agencies to minimize potential impacts, and appropriate regulatory action would continue to occur in order to protect groundwater resources. Monitoring for saltwater intrusion, coordination among water users, as well as potential protective designations for groundwater resources are expected to ensure there would be a dependable, safe supply of groundwater for Guam/Tinian users. In time, groundwater quality would be expected to slowly improve on Guam as point and non-point sources of pollution are identified, and pollution loading to surface waters is reduced, all within the framework of increasing the understanding of the Northern Guam Lens Aquifer (NGLA).

Nearshore Waters

Numerous sources of pollutants are currently present on Guam and Tinian that stress surface water resources. These sources include municipal and industrial point sources of pollutants, sewer system overflow and failure, agricultural runoff (carrying animal wastes, fertilizers, and pesticides), urban runoff, erosion from stream beds, construction sites, and derelict land, leaks and spills, and landfill leachate. The identified near shore marine water quality concerns for Guam include copper, aluminum, nickel, e*nterococci* bacteria, total residual chlorine, biochemical oxygen demand, and total suspended solids. The identified nearshore water quality concerns for the marine waters of Tinian only include e*nterococci* bacteria at one nearshore location (Unai Chulu). These contaminants can be attributed to one or more of the sources listed above and would persist. Threats to nearshore water quality would continue to be monitored by federal and Guam/Tinian agencies to minimize potential impacts, and appropriate regulatory action would continue to occur to protect nearshore waters. In time, nearshore water quality would be expected to slowly improve as point and non-point sources of pollution are identified and pollution loading to nearshore waters is reduced.

Wetlands

The identified stressors impacting wetlands on Guam and Tinian (e.g., feral ungulates, human disturbance, invasive plants species, sedimentation, and erosion) would continue to occur. These threats to wetland areas are a concern, and are therefore monitored by federal and Guam/Tinian agencies to protect wetland areas. Appropriate regulatory action would continue to occur to protect wetland areas. In time, wetland quality would be expected to slowly improve as point and non-point sources of pollution are identified; however, the extent of wetlands (by acreage) may not significantly increase because the focus is currently on reducing potential future losses.

3.3.3.3 Comparison of Preferred Alternatives to No Action

Under no action, the identified primary threats to surface waters, groundwater, nearshore waters, and wetlands, would continue on Guam and Tinian. Over time, more development and ground disturbance would occur on non-federal lands. Local and federal regulations applied to all development projects would mitigate potential development impacts on wetlands and water.

There would continue to be feral ungulates and invasive plant species that contribute to erosion but the operation of the preferred alternatives would not exacerbate the impacts on water quality due to soil erosion.

During operations, the preferred alternatives would not appreciably alter the existing trends in surface water, ground water, nearshore water, or wetland health.

3.3.4 Air Quality

3.3.4.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-6 and 3.3-7 summarize the preferred alternatives' construction and operation impacts to air quality on Guam and Tinian. The findings from previous volumes are listed. For Guam, the greatest level of impact identified among all the volumes is listed in the last Guam column. The sulfur content of fuels since 1992 has decreased in general although Guam has been granted an exemption from using low sulfur fuel (see Volume 6, Section 7.2). DoD is currently working with relevant stakeholders, including EPA GEPA, GPA, and fuel suppliers, to determine an appropriate strategy for implementing an island wide switch to low sulfur fuel. There are several on-going logistics, economics, contracts, and regulatory issues, which must be resolved before an island wide switch to ultra low sulfur fuel

can be realized. When the island-wide plan is implemented for ultra low sulfur fuel, the actual sulfur content for construction activities and highway diesel vehicles on Guam may be far lower than the level used in the analysis.

The summary of impacts for Tinian's preferred alternatives is listed in the far right column of the table. It is assumed that all of the proposed construction actions would occur during a compressed time period, and that all operational activity would commence upon completion of construction. For air quality, construction data are shown for a range of years and not just the peak construction year.

Table 3.3-6. Summary of Preferred Alternatives' Construction Impacts – Air Quality

Resource Category	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Air Quality	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI
Air Quality Construction Impact Summary:									**LSI**	**LSI**

Legend: LSI = Less than significant impact

Table 3.3-7. Summary of Preferred Alternatives' Operation Impacts – Air Quality

Resource Category	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Air Quality	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI
Air Quality Operation Impact Summary:									**LSI**	**LSI**

Legend: LSI = Less than significant impact

During construction and operation of facilities on Guam and Tinian, air quality impacts would be less than significant. Construction and operation emissions from the preferred alternatives would be below the significance criterion of 250 tons per year (TPY) for air pollutants adopted in the EIS, with an exception for the operational carbon monoxide (CO) emission level that primarily would be generated from on-road vehicle operations. Unlike criteria pollutants, there is no established impact significance threshold for greenhouse gas (GHG) emissions, inclusive of CO_2, therefore, the predicted GHG emissions levels provided in this study only fulfill NEPA disclosure purposes, whereas predicted criteria pollutant emissions are regulated under the NAAQS.

As discussed in Volume 2, Chapter 5, Air Quality, the EIS selected the "major stationary source" definition of 250 TPY or more of any air pollutant subject to regulations under the Clean Air Act [CAA] from the Prevention of Significant Deterioration (PSD) program. The PSD limits are used as the criteria for determining the potential significance of air quality impacts for locations that are in attainment. Neither the PSD permitting program nor the General Conformity Rule (GCR) are applicable to mobile sources and non-major stationary sources in attainment areas. Therefore, the analysis of construction and operational incremental emissions from these sources in attainment areas and the significance criteria selected (250 TPY) are solely for the purpose of informing the public and decision makers about the relative air quality impacts from the preferred alternative and the alternatives under NEPA. However, since the 250 TPY

threshold was selected in the context of the *de minimis* threshold established in the GCR, providing only an indication of a potentially significant impact; a formal impact analysis should be conducted if the threshold may be exceeded.

Based on a more refined CO concentration modeling analysis for on-road vehicle operational impacts as described in Volume 6, no exceedances of the CO National Ambient Air Quality Standards (NAAQS) were predicted at the location with the anticipated highest emissions. Therefore, the preferred alternatives would not result in a significant CO impact, even though the island-wide emissions would exceed 250 TPY.

Sulfur dioxide (SO_2) emissions would also be well below the 100 TPY *de minimis* level used as the threshold for emissions within the two non-attainment areas. Consequently, the preferred alternatives would result in a less than significant impact on air quality.

GHG emissions into the atmosphere are a concern because they contribute to global warming by trapping re-radiated energy. As described in Volumes 2 through 6, GHG emissions in terms of CO_2 equivalents were predicted for the following three source categories:

- Mobile fossil fuel combustion sources including construction equipment,
- Stationary fossil fuel combustion sources, and
- Solid waste landfill.

Within Volumes 2 through 6, the total quantity of GHG emissions are expressed in terms of CO_2 equivalents as well as methane when specifically quantified for landfill operations. Since the change in climate conditions caused from CO_2 equivalent compounds (CO_2 Eq) by the burning of fossil fuels is a global effect, it is required that the air quality impact analysis be assessed cumulatively on a global or regional scale. The total potential CO_2 Eq emissions under the preferred alternatives are presented in the cumulative impacts analysis (Section 4.4 of this Volume).

CO_2 is not a criteria pollutant and the 250 TPY significance threshold is not applicable to CO_2. However, it should be noted that, beginning January 2, 2011, the PSD and Title V permitting regulations will be applicable to GHG emitters (see Section 4.4.1 for details). CO_2 is discussed for all regions of influence (ROI) on Guam and combined with CNMI GHGs at the end of this section because the entire geographic region is a more appropriate scale for evaluation of potential impacts.

A detailed emissions analysis of the preferred alternative and its impact on air quality (evaluating for each individual ROI – North, Central, Apra Harbor, and South) is presented in Volume 9, Appendix I, Section 3.5, Regional Emissions under Preferred Alternatives.

Criteria Pollutants

Construction activities for the Marine Corps relocation would include:

1. The development of airfield, waterfront, ground and other training sites; housing; quality of life facilities; and operational and administrative facilities (Volume 2, Alternative 2);
2. Aircraft carrier berthing and dredging (Volume 4, Alternative 1 [Polaris Point]);
3. The co-location of the Army AMDTF with the U.S. Marine Corps facilities (Volume 5, Alternative 1); and
4. The utilities and off-base roadways in each Guam ROI (Volume 6, Alternative 1).

The annual construction emissions likely would be dominated by the Main Cantonment and roadway activities. The construction criteria pollutant emissions for Guam are summarized in Table 3.3-8; and do not exceed 250 TPY of criteria pollutants in any single year.

Table 3.3-8. Guam Annual Emissions – Preferred Alternatives

Activity	*Year*	*Total Annual Pollutant Emissions (TPY)*						
		SO_2	*CO*	*PM_{10}*	*$PM_{2.5}$*	*NO_x*	*VOC*	*CO_2*
Construction	2011	59.3	85.0	17.3	13.5	86.6	24.5	16654.9
	2012	74.6	111.1	21.3	16.8	109.5	38.4	20889.6
	2013	116.1	156.4	32.4	36.7	167.4	56.5	32659.7
	2014	63.0	118.8	26.3	15.9	97.0	43.3	20419.7
Construction /Operation	2015	138.9	3053.2	99.6	61.0	234.1	248.0	61307.4
	2016	124.6	3016.0	82.0	55.1	210.7	229.0	57289.0
Operation	2017 and on	119.9	2996.9	76.1	53.1	201.0	221.7 – 223.0	56087.5 – 60267.2

Legend: PM =particulate matter; PM_{10}= particle size of 10 micrometers or less; $PM_{2.5}$ = particle size less than 2.5 micrometers; NOx = nitrogen oxides; VOC= volatile organic compounds; CO_2 = carbon dioxide.

Operational activities are limited to 1) airfield, vessel, and ground training and on base vehicle activities associated with the Marine Corps Guam (Volume 2, Alternative 2), 2) aircraft carrier berthing (Volume 4, Alternative 1), and 3) utility and off-base vehicle operations (Volume 6, Alternative 1).

The emissions associated with these operations in any year would be below 250 TPY of criteria pollutants, except for CO at a projected level of approximately 3,000 TPY, as shown in Table 3.3-8. The CO exceedances of 250 TPY primarily would result from off-base vehicle operations and to a lesser extent, on-base vehicle operations.

As discussed in Volume 6 for roadway projects, vehicular CO emissions are of local (microscale) concern with potential impacts concentrated around heavily congested intersections. Although the Guam-wide CO emissions are predicted to exceed 250 TPY under operational conditions, further microscale dispersion modeling performed at the intersections with the highest anticipated levels of emissions (Volume 6) indicated that no exceedances of the CO NAAQS would occur. Therefore, potential CO impacts would be less than significant under the preferred alternatives. Table 3.3-9 lists the intersections with the highest levels of emissions on Guam that were analyzed for CO concentrations. Consequently, overall potential air quality impacts would be less than significant under the preferred alternative.

Table 3.3-9. Intersections Selected for CO Microscale Impact Analysis – Preferred Alternatives

ROI	*Intersections*
North	Route 1/25
	Route 9/Andersen AFB North Gate
Central	Route 1/8
	Route 4/7A
	Route 16/27
Apra Harbor	Route 1/2A
South	Route 5/2A

CAA General Conformity Applicability Analysis

The 1990 amendments to the CAA (CAAA) require federal agencies to ensure that their actions conform to the State Implementation Plan (SIP) in a nonattainment area. The GCR is applicable to the proposed activities in Piti and Tanguisson SO_2 nonattainment areas. Therefore, a subsequent general conformity applicability analysis is required.

The *de minimis* emissions level established by the USEPA is 100 TPY of SO_2, and is applicable to the two non-attainment areas on Guam, Piti and Tanguisson. If the sum of direct and indirect emissions of a pollutant is above the *de minimis* level, a formal, general conformity determination is required for that pollutant. The net increase in SO_2 emissions due to the components of the preferred alternatives located within the two SO_2 non-attainment areas was predicted for operational and construction activities. As summarized in Tables 3.3-10 and 3.3-11, annual SO_2 emissions under the preferred alternatives would not exceed the *de minimis* criterion of 100 TPY of SO_2 in either the Tanguisson or the Piti non-attainment areas; thus a formal, conformity determination is not required. The record of non-applicability is included in this Final EIS.

Table 3.3-10. Preferred Alternative Total Annual SO_2 Emissions – Tanguisson Non-attainment Area

Activity	*Year*	*SO_2 (TPY)*
Construction	2011	2.1
	2012	3.2
	2013	4.1
	2014	4.1
Construction/Operation	2015	11.4
	2016	9.8
Operation	2017 and on	8.3
de minimis level		***100***

Legend: SO_2= sulfur dioxide, TPY = tons per year

Table 3.3-11. Preferred Alternative Total Annual SO_2 Emissions – Piti Non-attainment Area

Activity	*Year*	*SO_2 (TPY)*
Construction	2011	0.4
	2012	0.4
	2013	0.4
	2014	0.4
Construction/Operation	2015	1.0
	2016	1.0
Operation	2017 and on	0.9
de minimis level		***100***

Legend: SO_2= sulfur dioxide, TPY = tons per year

Greenhouse Gases

The predicted construction CO_2 emissions range from about 16,655 to 32,660 TPY from 2011 to 2014 (see Table 3.3-8) and the predicted operational CO_2 emissions range from about 54,664 to 58,844 TPY from 2017 on (Table 3.3-8). Climate change assessment and a detailed estimate of CO_2 Eq is provided in the cumulative impacts analysis in Section 4.4 of this volume.

Since the preferred alternatives would mostly involve the relocation of the military operations (i.e., training exercises) already occurring in the West Pacific region, energy consumption from activities in the region is unlikely to change significantly; the predicted net increase in CO_2 emissions (Table 3.3-8) is considered overly conservative and provided only for NEPA disclosure. Therefore, overall global GHG emissions are likely to remain near the current levels on a regional scale; and are particularly applicable under the operational conditions resulting in an insignificant impact to global climate change.

Tinian

On Tinian, all air emissions would be far below the significance threshold of 250 TPY for air pollutants subject to regulations under the CAA for both construction and operation as shown in Table 3.3-12. Therefore, air quality impacts are considered less than significant for all areas under Alternative 1.

Table 3.3-12. Tinian Training Activity Annual Emissions – Alternative 1

Activity	*Pollutant (TPY)*						
	SO_2	*CO*	*PM_{10}*	*$PM_{2.5}$*	*NO_x*	*VOC*	*CO_2*
Construction	0.3	1.1	0.1	0.1	0.7	0.3	108.7
Operation	**Barge**						
	0.2	0.8	0.1	0.1	4.2	0.1	NA
	Vehicle						
	0.0	0.0	0.1	0.0	0.0	0.0	2.0
	Total						
	0.2	0.8	0.2	0.1	4.2	0.1	2.0

Legend: CO = carbon monoxide, CO_2= carbon dioxide, NO_x= nitrogen oxides, SO_2= sulfur dioxide, PM_{10}= particulate matter less than 10 microns in diameter, $PM_{2.5}$ = particulate matter less than 2.5 microns in diameter, VOC= volatile organic compound, TPY= tons per year, NA = Not applicable

MSAT Analysis

Mobile source air toxics (MSAT) are hazardous air pollutants, seven of which have been identified by the USEPA as mobile source pollutants of concern. These seven pollutants are: napthalene, acrolein, benzene, 1-3 butadiene, formaldehyde, polycyclic organic matter (POM) and diesel PM plus diesel exhaust organic gases (DPM+DEOG). As part of the National Environmental Policy Act (NEPA) process, MSATs require review and evaluation as they could affect the quality of the human environment.

An initial MSAT analysis for this project indicated that it would have a low potential for MSAT effects. However, USEPA requested that an MSAT analysis based on the methodology described in the research report "Analyzing, Documenting, and Communicating the Impacts of Mobile Source Air Toxic Emissions in the NEPA Process" prepared for the American Association of State Highway and Transportation Officials (AASHTO) (ICF International 2007) be performed. Given the unusual scale of the proposed relocation as compared to other DoD actions and to accommodate USEPA's request as part of the NEPA disclosure process, this additional MSAT analysis was performed (Parsons Brinkerhoff 2010) using the methodology based on the AASHTO report, and is summarized in this section and detailed in Volume 9 Appendix I, Attachment B.

MSAT levels are predicted to increase under the preferred alternatives compared to the no-action alternative. However, based on the MSAT analyses performed, there would be no significant carcinogenic or non-carcinogenic impacts at any of the locations. In addition, given future reductions in overall MSAT levels due to USEPA-mandated regulations, projected MSAT levels, even with the predicted VMT increases under the build alternatives, are expected to be lower.

3.3.4.2 No Action

The future traffic growth would likely result in an increase in mobile source emissions on Guam. However, the improvement of mobile source engine emissions in the future, per CAA requirements, would contribute to a reduction of the overall mobile source emissions. Therefore, the air quality conditions affected by mobile source operations under no action would likely remain the same or improve slightly, as compared to the existing conditions.

Under no action, there could be new construction of small-scale projects on-island that would not occur concurrently, and continued operation of existing stationary sources. Air pollutant emissions would essentially remain the same as they are now, or improve slightly if a cleaner fuel becomes available on Guam in the future.

GovGuam has not collected ambient air quality data since 1991. Therefore, no existing ambient air quality data are available to represent current air quality conditions, with respect to the criteria pollutants for which the NAAQS were established. Historical data are available for 1972 through 1991, when ambient air quality data were collected at a number of sites through a USEPA-sponsored monitoring program. The monitored pollutants were total suspended particles (TSP), SO_2, nitrogen dioxide (NO_2), and nitrogen monoxide (NO). In 1991, PM_{10} was monitored in addition to TSP.

Prior to 1991, TSP was monitored at 20 sites, SO_2 at 14 sites, NO_2 at five sites, and NO at one site. In 1991, PM_{10} was monitored at four sites. In addition to the historical monitoring identified above, the GPA established a network of five stations to measure SO_2 at locations that are not downwind, or close to any major electrical generating units during normal trade wind conditions. Data were collected from the fall of 1999 through the summer of 2000. All of the observed SO_2 concentrations were below the 24-hour NAAQS.

Because there are no comprehensive ambient background air quality levels from recent monitoring available for Guam, the existing background air quality conditions around Guam can be defined based on the current ambient air quality attainment status in effect for Guam:

- Attainment for all criteria pollutants, except for SO_2.
- Two SO_2 nonattainment areas within a 2.1 mi (3.5 km) radius around Piti and Tanguisson power plants.

Except for power generating facilities, there are no significant sources of air emissions on Tinian. However, military training vessels, on-road vehicles, and open burnings are sources of emissions that contribute to the existing ambient air quality background conditions on Tinian. While there are no air monitoring stations on Tinian, it can be assumed that ambient air quality is good, has remained constant in recent years, and is in compliance with air quality standards. These assumptions are based on the small number of emission sources on the island, and the island is currently designated as an attainment area for all criteria pollutants. Air quality conditions on Tinian, under no action, would be expected to remain the same as compared to the existing condition.

3.3.4.3 Comparison of Preferred Alternatives to No Action

Under the Guam preferred alternatives, there would be less than significant effects on criteria pollutants from all construction and operation components including those in existing nonattainment areas. The GHG effects would also be considered less than significant. Under no action, the existing nonattainment conditions would persist for some years into the future until the power plants are upgraded. The air quality impacts from construction and operation of the preferred alternative on Tinian would be less than significant, and there would be no impact from no action. The good air quality of Tinian would continue into the future with or without the preferred alternatives.

3.3.5 Noise

3.3.5.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-13 and 3.3-14 summarize the preferred alternatives' construction and operation impacts of noise on Guam and Tinian as presented in previous volumes. For Guam, the greatest level of impact

identified among all the volumes is listed in the last Guam column. The summary of impacts for Tinian's preferred alternatives is listed in the far right column of the tables. It is assumed that all of the proposed construction actions would occur during a compressed time period, and that all operational activity would commence upon completion of construction.

There would be adverse impacts associated with construction of the preferred alternatives on Guam and Tinian. The impacts would be temporary. Temporary noise barriers are proposed to mitigate construction noise, where practicable.

Table 3.3-13. Summary of Preferred Alternatives' Construction Impacts – Noise

Resource Category	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Construction	SI-M	LSI	LSI	LSI	LSI	LSI	NI	LSI	SI-M	LSI
Noise Construction Impact Summary:									**SI-M**	**LSI**

Legend: SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact; NI = No impact.

Table 3.3-14. Summary of Preferred Alternatives' Operation Impacts – Noise

Resource Category	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Wastew ater*	*Solid Waste*	*Off-base Road-ways*		*Training*
Airfield Operations	LSI	NA	NA	NA	NA	NA	NA	NA	LSI	LSI
Aviation Training	LSI	NA	NA	NA	NA	NA	NA	NA	LSI	LSI
Ground-based Training	SI	NA	NA	NA	NA	NA	NA	NA	SI	LSI
Other Operations	NA	LSI	LSI	NI	NI	NI	NA	NA	LSI	NA
Utilities and Off-base Roadways	SI-M*	NA	SI-M*	NI	NI	NI	LSI	SI-M*	SI-M	NI
Noise Operation Impact Summary:									**SI**	**LSI**

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact; NA = not applicable; *North and Central Guam

Aviation operations would raise noise levels locally, but only as the aircraft fly overhead. Noise levels associated with the preferred alternatives would increase locally by one or two decibels (dB) at the day-night noise level (DNL) around the Andersen AFB airfield.

Operational noise generated by the Route 15 ranges would result in a significant impact on the community beyond DoD property. The Route 15 training ranges would result in noise levels that are considered incompatible with residential use. Proposed mitigation measures include maintaining existing foliage,

which would serve as a noise buffer, and the construction of noise barriers. The most effective measure would be constructing berms at the Route 15 training range locations, which would reduce noise levels by 10-15 dB. Although construction of berms at the Route 15 training range locations would reduce the noise levels, noise levels would not be reduced to a less than significant impact for all sensitive receptors. Construction of berms to reduce noise levels at the Route 15 training range locations is assumed in the summary of impacts.

Hand grenade range operations at Andersen South would result in areas exposed to noise levels considered incompatible with residential use and impacts would be considered significant. Mitigation measures to avoid this significant impact are not proposed because engineered controls aimed to reduce the low frequency sound generated from hand grenades is not feasible. Should innovative and new technologies become available and are applicable to Guam in the future they would be considered as mitigation measures.

Operational noise due to roadways could be mitigated by soundwalls that meet FHWA and DPW feasibility and reasonableness criteria. Roadway noise would be a significant impact in the north and central areas of Guam. Noise walls are a potential mitigation that would reduce the severity of roadway noise, but they would have adverse impacts on views.

With the exception of traffic associated with increased population, Guam island-wide noise impacts would not occur for construction or operation because noise is generated at a source and then diminishes the farther the receptor is away from the source. Receptors in the northern part of Guam would not hear noise generated in the south and vice versa; as a result, there would be no island-wide noise impacts.

The construction and operational impacts on Tinian would be less than significant due to the distance of the proposed ranges to residential receptors in the southern portion of Tinian.

3.3.5.2 No Action

Unlike some other potential impacts, most human activities generating noise are localized and do not affect the entire islands of Guam or Tinian. Traffic could be considered an exception; while individual vehicle noise is localized, island-wide population increases would be accompanied by increased numbers of motor vehicles on the roadway network, with some resulting island-wide increases in ambient noise. The sources of noise that influence ambient noise include the commercial airport and Andersen Air Force Base airfield, industrial facilities, military training range activities, and traffic. Most of the noise impacts are temporary. Industrial noise, such as noise emitted during power generation, would expose sensitive receptors, such as workers in an industrial environment, for longer periods of time but is subject to Occupational Safety and Health Administration (OSHA) regulations to protect the hearing of sensitive receptors. There is no island-wide noise level monitoring and historic trends in noise are not documented island-wide. Ambient noise levels would generally increase with an increase in noise generating activities and the assumption is there has been an increase in noise levels island-wide over time with the increase in industrial activity, airfield activity and traffic.

Regionally, northern Guam would continue to experience noise from Andersen AFB aircraft, Northwest field training, small arms firing at NCTS Finegayan, traffic, and construction projects as they are undertaken. In central Guam, A. P. Won Pat Guam International Airport (IAP) operations, construction activities, and traffic would continue to create noise. Near Apra Harbor, industrial activities, construction and traffic would continue to be the major noise sources. In southern Guam, Naval Munitions Site (NMS) activities, construction and traffic would continue to generate noise. The Guam 2030 Transportation Plan would improve off-base roadways, but significant noise impacts are not anticipated once construction is complete. Large population and traffic increases and significant noise impacts would not be anticipated.

On Tinian, the major noise generators would continue to be Tinian Airport operations, current military activities, and traffic. Air operations conducted by the military during World War II from Tinian may represent the loudest period in Tinian's history, but the noise impacts were temporary.

3.3.5.3 Comparison of Preferred Alternatives to No Action

Significant, direct, and long-term noise impacts to residential receptors would result from the firing range alternatives proposed near Andersen South along Route 15. Construction noise under the preferred, or no-action, would not be a long-term impaction because construction activities would be temporary in nature and localized. Construction noise impacts would be short-term, ceasing when the construction project is completed. An impact would only emerge when multiple construction activities occur in a compressed time period, are immediately adjacent to one another, and in proximity to sensitive receptors. Construction would be localized and would occur predominately during daylight hours, with no noise impact island-wide.

Long-term noise impacts would be related to the increased traffic on the Guam roadway network. Traffic noise would be most evident in northern and central Guam, around Apra Harbor, and even less in southern Guam. Overall, the island would experience an increase in traffic noise due to the increased number of motor vehicles on the island.

3.3.6 Airspace

3.3.6.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-15 and 3.3-16 summarize the preferred alternatives' construction and operation impacts to airspace over Guam and Tinian. The findings from previous volumes are listed. For Guam, the greatest level of impact identified among all the volumes is listed in the last Guam column. The summary of impacts for Tinian's preferred alternatives is listed in the far right column of the tables. Airspace impacts would not occur during construction, and are only applicable to operations.

Table 3.3-15. Summary of Preferred Alternatives' Construction Impacts – Airspace

Resource Category	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Air Space	NI	NI	NA	NI	NI	NI	NI	NI	NI	NA
Airspace Construction Impact Summary:									**NI**	**NA**

Legend: NI = No impact; NA= Not applicable

Table 3.3-16. Summary of Preferred Alternatives' Operation Impacts – Airspace

Resource Category	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Airspace	LSI	NI	NI	NI	NI	NI	NI	NI	LSI	NI
Airspace Operation Impact Summary:									**LSI**	**NI**

Legend: LSI = Less than significant impact, NI = No impact

The preferred alternatives for Guam and Tinian would have less than significant impacts on airspace. There would be a 46% increase in airfield operations at Andersen AFB; however, there would be no resultant interference with local general aviation flights, no new airspace requirements, and no measureable change in airspace management procedures.

A new Special Use Airspace (SUA) in the vicinity of Northwest Field would be required for training, but would not require any changes to existing arrivals or departures from the IAP. There would be no en route low-altitude airways. The impact of this airspace action on air traffic control and airspace users is anticipated to be minimal and less than significant.

For the proposed ground firing range on the east coast of Guam that has .50 caliber machine gun training capability, SUA would have to be established to overlay the Surface Danger Zone (SDZ) footprint. It would require a slight reduction in airspace surrounding the IAP. There would be no significant reduction in the amount of navigable airspace available for the IAP, and no change to en route airways. Additionally, there would be no restrictions on access to and no effect on the use of the airport or airfield available for public use; nor would there be any effect on airport or airfield arrival or departure traffic flows due to the increase in military aircraft assigned to Guam. Establishment of any Special Use Airspace would be a Federal Aviation Administration (FAA) action, and the DoD would provide a formal aeronautical proposal for establishment of Restricted Airspace over the proposed ground firing ranges on the eastern side of Guam. Any modification of approach or departure procedures at Guam International Airport would be accomplished as part of the FAA's establishment of Restricted Airspace.

There would be an increase in aircraft operations in the north and south portions of Tinian, but it would be within the capacity of existing airspace use. There would be no new SUA, and no impacts to existing arrival and departure patterns from either the Tinian or Saipan airports. There are no en route low-altitude airways, and no Instrument Flight Rule procedures would have to change. Approach and departure patterns associated with the airports and airfields would not be restricted, nor would they be required to change.

Established aviation procedures, rules governing flight operations in both controlled and uncontrolled navigable airspace, and existing SUA make future adverse effects on public health and safety extremely unlikely. Aircrews for military participants and nonparticipating aircraft would be responsible for using "see and avoid" techniques to avoid hazards. There would be no difference in the effects identified for the preferred alternatives discussed in each volume.

3.3.6.2 No Action

Because there are multiple and sometimes competing demands, the FAA considers all aviation airspace requirements in relation to airport operations, federal airways, jet routes, military flight training activities, and other special needs to determine how the National Airspace System can best be structured to satisfy all user requirements. Significant impacts are avoided prior to FAA approval.

No additional military or civilian airspace requirements have been identified outside of the preferred alternatives. There is a periodic review of the Mariana Island Range Complex (MIRC) airspace requirements that would address future airspace needs should the training mission requirements change.

Since WWII, Guam and Tinian air traffic has fluctuated due to tourism levels for civilian aviation and military mission requirements (world events) for military aviation. These fluctuations are within the capacity and capability of the FAA airspace system.

3.3.6.3 Comparison of Preferred Alternatives to No Action

Preferred alternatives and no action would both result in less than significant impacts to airspace. All future proposals would be subject to the same FAA approval process that is aimed at avoiding significant airspace impacts.

3.3.7 Land and Submerged Land Use

3.3.7.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-17 and 3.3-18 summarize the preferred alternatives' construction and operation impacts to land ownership and use on Guam and Tinian. The findings from previous volumes are listed.

The land use impact analysis is generally based on operational impacts. The exceptions are 1) off-base roadways where a slightly different methodology was applied (Volume 6) and 2) proposed actions that involve temporary upland placement of dredged materials (Volumes 2 and 4). For Volumes 3, 5 and most of 6, the assumption is that land use impacts are long-term, although they would be initiated in the short-term construction phase. The construction staging and disturbed area would be situated on previously disturbed land or within the project footprint. The construction phase impacts for land ownership and use are described as not applicable for Volumes 3, 5 and 6 (utilities) and no impact for Volumes 2, 4 and 6 with the exception of off-base roadways, which would result in a significant but mitigable impact.

For Guam, the greatest level of impact identified among all the volumes is listed in the last Guam column. The summary of impacts for Tinian's preferred alternatives is listed in the far right column of the tables.

Table 3.3-17. Summary of Preferred Alternatives' Construction Impacts – Land Ownership/Use

Resource Category	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Land Ownership	NI	NI	NA	NA	NA	NA	NA	NA	NA	NA
Land Use	NI	NI	NA	NA	NA	NA	NA	SI-M	SI-M	NA
Land Ownership/Use Construction Impact Summary:									**SI-M**	**NA**

Legend: SI-M = Significant impact mitigable to less than significant, NI = No impact, NA= Not applicable

Table 3.3-18. Summary of Preferred Alternatives' Operation Impacts – Land Ownership/Use

Resource Category	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Land Ownership										
Land	SI	NI	NI	NI	NI	LSI	NI	SI-M	SI	LSI
Submerged Land	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Land Use										
DoD land	LSI	NI	NI	NI	NI	NI	NI	NI	LSI	SI
DoD submerged lands	BI	NI	NI	NI	NI	NI	NI	NI	BI	NI
Non-DoD land	SI	NI	NI	NI	NI	NI	NI	SI-M	SI	NI
Non-DoD submerged lands	SI	NI	NI	NI	NI	NI	NI	NI	SI	NI
Land Ownership Summary:									**SI**	**LSI**
Land Use Summary:									**SI**	**SI**

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact, BI= beneficial impact

Land ownership and use impacts are assumed to occur over the long-term or operational phase, except roadway construction on Guam would have a significant mitigable adverse impact on roadway use. The Traffic Management Plan (TMP) would identify and provide alternate traffic routes, construction materials hauling routes, bus stops, transit routes and operation hours, pedestrian routes, as well as residential and commercial access routes to be used during the construction period. The TMP would mitigate construction phase impacts to less than significant.

There would be a significant impact due to forced sale of land to the federal government for main cantonment and firing ranges on Guam. As described in the approach to analysis in Volumes 2 through 6, it is assumed landowners are not interested in selling their land. Although there may be landowners who are interested in selling their land, the assumption of significant impact remains until negotiations are complete. There would also be relocations and land acquisition, or long-term leases for roadway improvements.

Firing range land use within DoD property boundaries is incompatible with adjacent land uses in the vicinity, due to noise. Significant impacts to land use consistency were identified due to increased noise generated by a grenade range at Andersen South and the Route 15 firing range complex. The grenade range impacts are not mitigable to a less than significant impact. Proposed mitigation for Route 15 ranges includes noise berms and foliage that would reduce noise impacts for most sensitive receptors. There would also be significant impacts associated with incompatibility of noise generated by the Route 15 training range with future residential development in the adjacent community.

Less than significant impacts on land use are anticipated from LCAC noise generated at Apra Harbor. Less than significant impacts are anticipated from aviation training at Orote Peninsula, NWF and NMS.

Access to GovGuam submerged lands, and natural and cultural resources in the range areas, would be restricted during training resulting in a significant impact to land use; however, no submerged lands would be acquired at Guam or Tinian. A beneficial land use impact was identified under submerged land use because an existing firing range at NCTS Finegayan would no longer be used, and the associated surface danger zone over submerged land would be eliminated.

There is no change in land ownership or lease covenant proposed on Tinian. On Tinian, many and possibly all of the agricultural/grazing permits within the Lease Back Area (LBA) would be terminated, thereby causing a significant impact on consistency with the Farmland Protection Policy Act (FPPA) of 1981. FPPA applies to designated prime and important farmlands, which do not include the lease areas. The DoD has determined that the Guam and CNMI Military Relocation is exempt from FPPA regulations because the action is undertaken by a federal agency for national defense purposes (section 1547(b) of the Act, 7 U.S.C. 4208(b)). Current permits within the LBA account for 2,552 ac (1,032 ha) of the 11,956 ac (4,838 ha) of the agricultural-designated land on Tinian (including grazing land, crop land, plantation orchard and mixed agricultural). In total that represents approximately 21% of the agricultural lands on the island. The project description was updated in the Final EIS to reflect the DoD's commitment to retain as many of the leases as possible. The leases are subject to termination at military discretion. Access to the SDZs for harvesting or recreation is permitted during non-training periods. The decrease in public access to the Military Lease Area (MLA) would be an adverse impact, but is considered less than significant because it is federally controlled land. No significant impact on agricultural productivity was identified on Guam.

3.3.7.2 No Action

DoD land ownership in 1950 was estimated at 58% of Guam (Rogers 1995). DoD land control has decreased over the past three decades as a result of the Guam Excess Land Act of 1994, and Base Closure and Realignment (BRAC) recommendations. Figure 8.1-3 of Volume 2 shows the military land use in the 1960s compared to current landholdings. The former Naval Air Station Agana was closed in 1995, and the DoD transferred or released ownership of it to GovGuam and other government agencies as a result of BRAC. In 1997, BRAC realigned Naval Base Guam, which included the release of surplus/excess DoD military property determined to be excessive in the Guam Land Use Plan. Areas east of Route 15 in proximity to the proposed firing range complex were released. The previous Naval Facility at Ritidian Point was transferred to the U.S. Fish and Wildlife Service (USFWS). Other DoD parcels also have been, or are currently in the process of being transferred to GovGuam. In addition, the Navy outleased the Former Navy Ship Repair Facility located within the Apra Harbor Naval Base to GovGuam for utilization as a commercial shipyard facility. The trend has been to release federal lands. Outside of the preferred alternatives, there are no other planned land acquisitions identified for military use on Guam. Submerged lands ownership has not changed substantially since 1975. As lands were released through BRAC, adjacent submerged lands were not released. There are a few exceptions, such as DoD releasing nearshore submerged lands at Ritidian Point.

Ideally, community plans, zoning, and building codes direct land development and use on Guam and Tinian. Historically, there has been limited success. There was an economic development boom in the 1980s when community plans were not implemented according to a master plan, and the result was spot zoning and mixed uses (e.g., a "massage parlor" [prostitution] proliferation in Tamuning). In the early 1990s many zoning variances and permits were issued without long-range land use planning. Senators passed laws to rezone individual properties to bypass the permit process (Rogers 1995).

Community plans do not accelerate development, they guide land development in accordance with community values. The *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) addressed the EIS preferred alternatives based on preliminary notional plans, including development of the

NCTS Finegayan area, but has not been adopted by the legislature. The proposed military land use would be consistent with this plan. Once the EIS record of decision (ROD) is published, the community plan may have to be revisited to capture the final development decisions.

The *North and Central Guam Land Use Plan* designates uses of lands that were once designated agricultural, but there are other areas reserved for agricultural use. As pressure for development increases and the interest in farming (by younger generations) decreases there is continued pressure to develop agricultural lands; community plans and zoning served to retain sufficient lands for agricultural use. The general trend on Guam is a decrease in agricultural land use, as development increases.

There is a substantial amount of development identified in the *North and Central Guam Land Use Plan* for residential communities, village centers, and resorts/hotels; this plan is a guidance document and does not specify when the growth would occur. Any development would result in a loss of open space, however there is open space reserved in the *North and Central Guam Land Use Plan*.

Apra Harbor would continue to be an active Navy commercial harbor requiring infrastructure improvements to address existing deficiencies, new missions, and increased efficiency. These improvements are consistent with existing facilities.

After WWI, Tinian became a protectorate of Japan and was used to produce sugarcane. During WWII, the island was transformed into a military base first by the Japanese, and the local population was relocated. The U.S. expanded the military base primarily in the northern part of the island. After WWII, population migrated back to Tinian. In the 1970s, gambling was permitted on-island, and the Tinian Dynasty Hotel and Casino opened. It is the only casino on-island. The military leasing of land began in 1975 and some lands were ceded back to the CNMI. In the 1990s, there was a tuna transshipment industry on island. The amount of MLA on Tinian has remained relatively constant since 1975 and is likely to remain the same in the near future. There are also federal submerged lands along the coast of the leased areas; no change is anticipated to submerged land ownership.

There are two resorts planned for Tinian that could significantly impact agricultural lands. The CNMI government controls land use. The Department of Public Lands is required to designate some Tinian public lands for homestead villages. There are proposals to create additional homestead villages. A master plan is currently being prepared for Tinian that would presumably ensure the planned land uses are consistent with community values, and would result in consistent zoning.

3.3.7.3 Comparison of Preferred Alternatives to No Action

The impact of the proposed increase in federal land reverses the recent trend established through BRAC to reduce DoD lands on Guam. The preferred alternatives would re-acquire a portion of the lands south of NCTS Finegayan and the areas east of Route 15. The comments received during the scoping period did not support an increase in federal land on-island; an increase is considered to be an adverse impact. The impacts of the proposed island-wide increase in federal land are addressed in the Land Acquisition Impact Study portion of the Socioeconomic Impact Assessment Study in Volume 9, Appendix F, and in the Land Acquisition Impact section of the Socioeconomic and General Services chapter 16 of Volume 2.

From the individual land owner and business owner perspective, the forced sale of property to the federal government would occur under the no action for roadway and utility improvements; however, the number of land owners affected would be fewer than under the preferred alternative.

The removal of the SDZ on the west coast of NCTS Finegayan has a beneficial impact due to the popular SCUBA sites that are located near the submerged lands. Under no action, the SDZ would remain, and

submerged land access would be limited to non-training days. Under no action, there would not be any new public area restrictions to land or submerged land.

The preferred alternative land uses are generally consistent and compatible with adjacent land uses and land use plans. As the notional plans under the preferred alternative become more refined, the community land use plans could be revised to include a greater land use buffer from the federally-controlled boundaries. Also, under no action, community plans that included the expansion of the federally-controlled land would have to be revised. Under no action, gradual declines in agricultural land use continue on Guam, but the preferred alternatives would not contribute to that decline except for an agricultural lease at Andersen South.

The preferred alternative on Tinian would have an impact on agricultural/grazing leases. There are planned resorts that could also impact agricultural land use under no action.

3.3.8 Recreational Resources

3.3.8.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-19 and 3.3-20 summarize the preferred alternatives' construction and operation impacts to recreational resources on Guam and Tinian. The impacts to recreational use are mostly long-term impacts, although there are short-term significant impacts during construction-related activities that impede access to recreational resources. The findings from previous volumes are listed. For Guam, the greatest level of impact identified among all the volumes is listed in the last Guam column. The summary of impacts for Tinian's preferred alternatives is listed in the far right column of the tables.

Table 3.3-19. Summary of Preferred Alternatives' Construction Impacts – Recreation

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Access to recreational resource	SI	LSI	NI	NI	NI	NI	NI	SI-M	SI	LSI
Recreational Resource Use:										
Reduction of recreational opportunities	SI	LSI	NI	NI	NI	NI	NI	NI	SI	LSI
Conflicts between different recreational uses	LSI	NI	NI	NI	NI	NI	NI	NI	LSI	LSI
Substantial deterioration to recreational resources	NI	NI	NI	NI	NI	NI	NI	NI	NI	LSI
Recreational Resources Construction Impact Summary:									**SI**	**LSI**

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact

Table 3.3-20. Summary of Preferred Alternatives' Operation Impacts – Recreation

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Access to recreational resource	SI	SI-M	NI	NI	NI	LSI (SI)	NI	BI	SI (SI)	LSI
Recreational Resource Use:										
Reduction of recreational opportunities	SI	SI-M	LSI	NI	NI	LSI (SI)	NI	NI	SI (SI)	LSI
Conflicts between different recreational uses	LSI	SI-M	LSI	NI	NI	LSI (SI)	NI	NI	SI-M (SI)	LSI
Substantial deterioration to recreational resources	LSI	SI-M	LSI	NI	NI	LSI (SI)	NI	BI	SI-M (SI)	LSI
Recreational Resources Operation Impact Summary:									**SI (SI)**	**LSI**

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact, BI = Beneficial impact, ( ) = Indirect (workforce population and induced) population impact

Implementation of preferred alternatives would result in a new, permanent population comprised of the Marines, Army personnel, civilian workers, dependents, and a temporary population formed by construction personnel on Guam. All of these people would become potential users of Guam's recreational resources and would contribute to an increase in the number of users of the existing DoD, federal, and public recreational resources on Guam. The constant increase in the number of visitors to public parks, despite the absence of the proposed actions, suggests the parks and other public recreation sites are likely to be significantly impacted when the Marines, their dependents, and temporary construction population arrive in Guam. The transient population associated with the aircraft carrier could temporarily add to the impact; however, shuttle bus service would alleviate impacts on access.

Loss of public access and use of recreational resources such as the Guam International Raceway, Marbo Cave (spelunking and offshore fishing), Pagat Trail and associated trails, and *suruhana* activities during construction and operation are significant.

The increased number of users of the recreational resources (refer to Appendix G: EIS Resource Technical Appendix, Recreational Resources) would result in increased competition for the available opportunities at different recreational resources. Most of the popular recreational resources attract a constant flow of off-island and resident (including military and dependents) users. The degree of impact on each recreational resource is likely to be higher on weekends and holidays as well as during vacation months from July through March (except for January) when the island receives a greater number of off-island visitors. To meet the quality of life (QOL) requirements of relocating the Marines, their dependents, and civilian employees, a wide range of recreational facilities are proposed at the Main Cantonment site by the Marine Corps Community Service (MCCS). The planned QOL facilities are expected to relieve potential impacts

to the existing recreational resources on DoD, federal, and public properties by providing viable recreational use options to the potential users. By providing comparable and alternate recreational resources, impacts to recreational resources on Guam would be alleviated, thereby benefitting the residents and off-island tourists. The implementation of preferred alternatives would result in the loss of some recreational resources in the lands adjacent to Route 15, which would be acquired for training activities and ranges. Currently, mitigation measures are proposed in Volume 2 Chapter 9 (Recreational Resources) to partially restore recreational resources that would otherwise be lost.

Impacts to marine recreational resources would likely be temporary during the proposed wharf construction involving dredging at Polaris Point, which is anticipated to be eight to 12 months. The transient aircraft carrier wharf would cause notable impacts on the existing Morale, Welfare and Recreation (MWR) facilities and marine recreational activities within Apra Harbor. Other potentially affected areas include popular tourist regions such as Tumon/Tamuning villages and MWR facilities on other DoD installations. The surge in recreational users, which mostly would be visiting sailors, would increase competition for the available opportunities at existing facilities (e.g., gym usage) and could potentially cause conflicts among recreational uses. Although there are significant impacts associated with the visiting aircraft carrier, the population is transient, and the impacts could be mitigated to less than significant.

Proposed mitigation measures to reduce impacts to recreation include:

- Preparation of a Recreational Carrying Capacity Analysis Management Plan that addresses recreational use, demand, preference, conflicts, and conditions.
- DoD would offer resources in the form of time and donation or use of equipment to assist the volunteer conservation officer (VCO) at Andersen AFB.
- Collaboration with the Guam Division of Aquatic and Wildlife Resources (GDAWR) to establish outreach programs and docent programs for the five marine preserves and other environmentally sensitive areas on Guam.
- The Marine Corps could provide for improvements and maintenance of Tanguisson Beach, along with management of the coastline to the north of Hilaan that contains significant natural, cultural, scenic, and recreational resources.
- Establishment of outdoor recreation areas on NCTS Finegayan. This would also mitigate impacts to biological resources.
- To compensate for potentially significant impacts to beach and ocean recreational resources of the proposed actions on Guam, DoD is proposing to improve Hoover Beach at the Seaman Service Club Organization in Piti. The existing beach pilings, shelter, and bathroom are proposed to be improved. Available recreational activities include kayaking, snorkeling, and beach combing.

3.3.8.2 No Action

Since the completion of the 1990 Guam Comprehensive Outdoor Recreation Plan (GCORP) by GovGuam, Department of Parks and Recreation, some outdoor recreational activities have kept pace with population shifts while other activities have become more popular. The following outdoor recreational activities have become more popular since 1990 (GCORP 2006):

- Walking at the Paseo in Hagatna and along Tumon Beach
- Kayaking, particularly within Tumon Bay
- Baseball, particularly organized teams
- Basketball, particularly organized teams
- Football, particularly organized teams

- Soccer, particularly organized teams
- Swimming (pool), particularly organized teams
- Golf, particularly for youth
- Skateboarding

Even if the proposed relocation of the Marines to the island of Guam were not to occur, it is likely the effects described in Table 3.3-20 (Summary of Preferred Alternatives Operation Impacts - Recreation) would still occur on a smaller scale. This is due to the fact that Guam would continue to receive tourists. In addition, the local civilian and military population would continue to use the public recreational resources. The impacts to the public recreational resources would continue to be centered on the need for improved facilities, more facilities, more funding, and better facility management (GCORP 2006). Seventeen organizations involving various sports associations, civic, and private organizations participated in a survey conducted by the GovGuam, Department of Parks and Recreation, which is included in the 2006 GCORP. Specific comments included:

- Need for better facilities
    - Need for better maintenance and cleanliness of the facilities
        - "The bathrooms are disgusting"
        - Need to privatize facility maintenance
        - Implement the Adopt-a-Park program
    - Need to air condition the Dededo Sports Complex
- Need for more facilities
    - Need for a lifeguard tower at Matapang Beach
    - Need for public track and field facilities
    - Need for more sports facilities in the South (Guam)
- Need for more funding
    - Need for more funding of events
    - Need for a deposit for use of facilities
    - Need for facility fees
        - Need to extend Guam Visitors Bureau (GVB) grants beyond just non-profit organizations
- Need for better facility management
    - Need for consistent government support of sports
        - "DPR (Department of Park and Recreation) is short-sighted."
        - Need to empower lifeguards
        - Need to privatize lifeguards
        - Need for smarter management
        - Need for more sports partnerships with federation
- Need for better communication system
    - Need for a government sports liaison
    - Need to educate public about safety
    - Need for radio coordination with emergency personnel

- Need for a flag system
- Need for 911 emergency phone boxes

- Need for more access to facilities
  - Issue keys to organizations

3.3.8.3 Comparison of Preferred Alternatives to No Action

Under the preferred alternatives, impacts to recreational resources would be largely long-term and singularly affecting the use aspect of each recreational resource. The proposed action would accelerate the deterioration of recreational resources. The new permanent population resulting from the implementation of the preferred alternatives would result in users competing for the available recreational opportunities (e.g., longer wait for service/enjoyment at recreational resource). Other impacts include conflicts between uses (e.g., surfers and body boarders competing for waves; pedestrians, bicyclists, and equestrians competing for the use of a trail), and increased deterioration of recreational resources resulting from frequent use by more persons. The preferred alternatives would adversely affect the access aspect of recreational resources, short term or long term with the exception of lands to be acquired along Route 15 for training purposes. Resources there (e.g., Pagat Trails and a series of trails linked to them, *suruhana* activities, offshore fishing, and spelunking at Marbo Caves) would be inaccessible during training for health and safety reasons. This impact is mitigable through establishment of an ecological restoration area and permitting access when there is no live-fire training.

Under no action, the most notable difference from the preferred alternative would be that the aforementioned loss of use at Route 15 lands would not occur. It is likely future developments would limit recreational uses on Guam, but impacts to recreational resources would be more gradual than under the preferred alternatives. Impacts to the recreational resources would occur to a lesser degree under no action. Nevertheless, it is recommended that a recreational resource carrying capacity study be conducted and a recreational resource management plan completed to decelerate deterioration to Guam's recreational resources.

3.3.9 Terrestrial Biological Resources

3.3.9.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-21 and 3.3-22 summarize the potential construction and operation impacts to terrestrial biological resources on Guam and Tinian with implementation of the preferred alternatives. The summary is based on the findings from previous volumes, which are listed in the tables.

Table 3.3-21. Summary of Preferred Alternatives' Construction Impacts – Terrestrial Biological Resources

Resource Category	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Wast e-water*	*Solid Waste*	*Off-base Roads*		*Training*
Vegetation	SI	NI	SI	NI	LSI	LSI	NI	LSI	SI	LSI
Wildlife	LSI	SI-M	SI	NI	LSI	LSI	NI	LSI	SI	SI-M
Special-Status Species	SI	SI-M	SI	NI	SI (SI-M)	LSI	NI	SI	SI (SI-M)	SI-M
Terrestrial Biological Resources Construction Impact Summary									**SI (SI-M)**	**SI-M**

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact, ( ) = Indirect (workforce population and induced) population impact.

Table 3.3-22. Summary of Preferred Alternatives' Operation Impacts – Terrestrial Biological Resources

Resource Category	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste-water*	*Solid Waste*	*Off-base Roads*		*Training*
Vegetation	LSI	NI	LSI	NI	NI	NI	NI	LSI	LSI	LSI
Wildlife	LSI	LSI	LSI	NI	NI	NI	NI	LSI	LSI	SI-M
Special-Status Species	SI-M	SI-M	SI-M	NI	NI	NI	NI	SI-M	SI-M	SI-M
Terrestrial Biological Resources Operation Impact Summary									**SI-M**	**SI-M**

Legend: SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

A summary of direct impacts for all preferred alternatives in this EIS for vegetation communities on Guam and Tinian is shown in Table 3.3-23. There are no reliable estimates for the amount of primary limestone forest remaining on Guam - the vegetation type that is the most threatened from historical losses and that is prime habitat for many of the threatened and endangered species. Other vegetation types are not rapidly being lost on Guam, although ravine forest in most areas is being degraded by invasive plant species.

Table 3.3-23. Potential Direct Impacts to Guam and Tinian Vegetation Communities with Implementation of the Preferred Alternatives

Island	*Limestone Forest, Primary (ac [ha])*	*Limestone Forest, Disturbed (ac [ha])*	*Scrub/Shrub Tangantangan (ac [ha])*	*Ravine Forest (ac [ha])*	*Savanna (ac [ha])*
Guam	28 (11)	1,549 (627)	482 (195)	4.3 (1.7)	20 (8.1)
Tinian	0	173 (70)*	68 (27)	0	0

Note: *Tinian forest is classified as mixed introduced forest.

The preferred alternatives would significantly impact terrestrial biological resources on Guam and Tinian during construction activities - due primarily to the removal of habitat. A determination of impact under NEPA and the Endangered Species Act (ESA) (in parentheses) is provided below for each species in the project area. Volumes where these species are evaluated are listed in brackets.

Guam

ESA- and Guam-listed Species:

- Mariana fruit bat – significant impact, (may affect, is likely to adversely affect); the impact under NEPA would be mitigated to less than significant. [V2, V5 V6]
- Micronesian kingfisher - significant impact to habitat (may affect, is likely to adversely affect).[V2, V5, V6]
- Mariana crow - significant impact (may affect, is likely to adversely affect); the impacts under NEPA would be mitigated to less than significant.[V2, V5, V6]
- Guam rail - less than significant impact to habitat (may affect but is not likely to adversely affect). [V2, V5, V6]
- Mariana common moorhen – less than significant impact (may affect but is not likely to adversely affect). [V4]
- Mariana swiftlet – less than significant impact (may affect but is not likely to adversely affect). [V2]
- Green sea turtle – less than significant impact (may affect but is not likely to adversely affect). [V4]
- Hawksbill sea turtle – less than significant impact (may affect but is not likely to adversely affect). [V4]
- Fire tree (*Serianthes nelsonii*) – less than significant impact (may affect but is not likely to adversely affect). [V2, V5, V6]

ESA Candidate and Guam-listed Species:

- Guam tree snail - significant impact mitigated to less than significant. [V2]
- Humped tree snail - significant impact mitigated to less than significant. [V2]
- Fragile tree snail - significant impact mitigated to less than significant. [V2]

ESA Candidate Species (not Guam-listed):

- Mariana eight-spot butterfly - significant impact mitigated to less than significant. [V2]

Guam-Listed Only Species:

- Micronesian starling - less than significant impact. [V2, V5, V6]
- Pacific slender-toed gecko –significant impact mitigated to less than significant. [V2]
- Moth skink - less than significant impact. [V2]
- *Heritiera longipetiolata* - significant impact mitigated to less than significant. [V2]

Other Indirect Impacts on All Special-status Species

Other indirect effects on all species would occur as a result of the proposed construction. Movement of construction personnel, equipment, and supplies could result in the movement and spread of invasive plant and animal species to Guam, within Guam, and to other locations from Guam. Invasive species would affect special-status species or degrade habitat and therefore would result in potential indirect impacts from actions proposed. Invasive species impacts for construction would be similar to those for operations but shorter-term. Special-status species impacts would be significant but numerous proposed mitigation measures, such as preparation and implementation of the MBP and Hazard Analysis and Critical Control Points (HACCP) planning, as specified under proposed mitigation in Section 10.2.2.6, would be implemented to reduce impacts to less than significant.

There would be impacts to wildlife in those areas where public access is restricted, because no hunting would be allowed to control the ungulate population. An ungulate management plan will be finalized by the DoN for DoD lands on Guam to include specific management and control of ungulates that would reduce the impacts to less than significant.

Tinian

ESA- and CNMI-Listed Species:

- Mariana fruit bat – less than significant impact (may affect, but is not likely to adversely affect).
- Micronesian megapode - significant impact mitigated to less than significant (may affect, but is not likely to adversely affect).
- Mariana common moorhen - significant impact mitigated to less than significant (may affect but is not likely to adversely affect).
- Mariana swiftlet – less than significant impact (may affect, but is not likely to adversely affect).
- Green sea turtle and hawksbill sea turtle - less than significant impacts (may affect, but is not likely to adversely affect).

ESA Candidate Species:

- Humped tree snail – no impact.

CNMI-Listed Only Species:

- Micronesian gecko – less than significant impact.

A summary of direct impacts for all preferred alternatives for special-status species habitat is shown in Table 3.3-24. The table includes an estimate of island-wide acreages. The loss ranges from 1% to 6% and is due to clearing of vegetation of special-status species habitat required by the proposed construction projects. Because most species are currently very restricted in range (such as the Mariana crow with only two individuals known left on Guam, as well as the Micronesian kingfisher and Guam rail that exist only in captivity) only habitat would be affected; not individual species. An exception is the fruit bat, which, although the main colony on Andersen AFB is thought to have fewer than 50 individuals, disperses throughout forested areas on Andersen AFB to feed at night. All fruit bats throughout the Mariana Islands have been determined to be a single population; the best estimate of the total number of individuals remaining is several thousand. During operation, there would be noise impacts from training that may significantly impact the endangered Mariana fruit bat, Micronesian kingfisher, and Mariana crow, either at present, if they re-occupy, or are re-introduced to recovery habitat in the future.

Table 3.3-24. Potential Direct Impacts on Special-Status Species Habitat – Preferred Alternatives

Loss	*Overlay Refuge* (ac [ha])*	*Recovery Habitat (ac [ha])**			
		Bat and Kingfisher	*Crow*	*Rail*	*Serianthes Tree*
Island Total = No Action	21,690 (8,778)	28,655 (11,596)	27,124 (10,977)	49,564 (20,058)	11,722 (4,744)
Loss due to Preferred Alternatives Construction	1,469 (594)	1,559 (631)	1,557 (630)	1,268 (513)	643 (260)
% Loss on Island Due to Preferred Alternatives	6.7%	5.4%	5.7%	2.6%	5.5%

*Note: *Each habitat category and species habitat is considered independently of others and is not additive.*

In addition to loss of habitat from clearing, additional habitat would be impacted by noise and disturbance from operations, including general facility operation and from aircraft takeoff and landings. The Mariana fruit bat would be indirectly affected by noise, lighting, or human activity at Andersen AFB because it is

present, or potentially present, in operational areas. The amount of recovery habitat indirectly affected, using a 492 ft (150 m) distance would be 602 ac (109 ha). Other birds and fruit bats are not currently present (or rarely present) in other project areas, therefore most or all impacts would be at some future time when the species returned to the area.

Other potential direct impacts to the Guam-listed Pacific slender-toed gecko and *Heritiera longipetiolata* tree would be mitigated to less than significant. Indirect impacts that would be mitigated to less than significant include potential feral pig and deer damage, threats to listed species from uncontrolled pets, invasive species damage, and potential wildfires caused by training. Of greatest concern is the potential for unintentional introduction of the BTS from Guam to other islands throughout the Pacific. Preferred alternatives would vastly increase the movement of personnel, aircraft, equipment and supplies from Guam to other locations, thereby increasing the likelihood of introducing this species if no precautions are taken. This concern would be addressed using various measures, as summarized in Section 7.2.

A Micronesia Biosecurity Plan (MBP) is being developed to address potential invasive species impacts associated with this EIS as well as to provide a plan for a comprehensive regional approach. The MBP will include risk assessments for invasive species throughout Micronesia and procedures to avoid, minimize, and mitigate these risks. It is being developed in conjunction with experts within other Federal agencies including the National Invasive Species Council (NISC), U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS), the US. Geological Survey, Biological Resources Discipline (USGS-BRD), and the Smithsonian Environmental Research Center (SERC). It will include brown treesnake (BTS) control measures to prevent BTS movement off Guam and management within Guam. For actions being proposed in this EIS, the Navy will implement specific biosecurity measures to supplement existing practices on Guam and Tinian. These would include BTS control to address potential unintentional transport off Guam, including inspection requirements and procedures. For additional information on the MBP and existing and interim measures for invasive species control, please refer to Volume 2, Chapter 10, Section 10.2.2.6.

3.3.9.2 No Action

Sambar deer and feral pigs were introduced to Guam in the 1770s and late 1600s respectively. The introduced ungulates significantly impact native forests by consuming seeds, fruits and foliage and trampling plants. Feral pigs cause damage by wallowing and rooting. WWII physically destroyed extensive areas of habitat as do periodic tropical storms. About 50 years ago, the BTS was inadvertently introduced to Guam, and shortly thereafter became the primary cause of the elimination of 9 out of every 12 native forest birds. The BTS has also severely impacted native reptiles on the island. There is a high risk under both no action and the preferred alternative of the BTS being accidentally transported to other Pacific islands; but under no action, there may be less attention and focus on the problem. Post WWII, tangantangan was planted to reduce erosion and they have spread to the point of replacing indigenous plants in some areas.

Under no action, existing stressors that degrade habitat quality would remain, and the present declining trends in the health of terrestrial biological resources would continue. Stressors include non-native, invasive plants, animals and diseases, wildfires, and poaching. Introduction of some non-native species and diseases to Guam and Tinian has had a devastating effect on the native plants and animals.

Under no action, limestone forest areas would continue to degrade via invasive plants, in particular the canopy tree *Vitex*. The BTS, ungulates, and other invasive plants and animals would continue to degrade and/or prevent the recovery of the natural flora and fauna in the project areas. Poaching, which presently

occurs on military lands, would continue because many of the military lands, particularly the Navy lands, are not fenced.

On Tinian, disturbance of native forests from livestock occurred during Spanish occupation of Tinian (Fosberg 1960). Subsequent Japanese occupation cleared additional forested lands for sugarcane production. During WWII, the sugarcane plantations and most remaining native vegetation were destroyed by military campaigns and construction (Baker [1946] as cited in USFWS [2005]). As reported in USFWS (2005), after the war the DoD may have seeded the island with tangantangan, a non-native invasive tree, to reduce erosion. Based on the most recent vegetation mapping, it is estimated that only 2.6% of the island is still dominated by native limestone vegetation.

Existing Plans and Procedures

Under no action, existing DoD and non-DoD conservation measures would continue. Ongoing efforts to manage terrestrial resources on military lands would continue in accordance with the Joint Region Integrated Natural Resource Management Plans (INRMP), which include measures mandated by Biological Opinions and voluntary DoD conservation measures that are not regulatory requirements. The INRMPs is required to be updated every five years.

There are environmental restrictions and requirements for training operations that are included in the COMNAV Marianas Training Handbook (COMNAV Marianas Instruction 3500.4, June 2000). The Instruction contains guidance for developing an Environmental Protection Annex in support of a major military exercise plan, training requirements, BTS control and interdiction, monitoring and monitoring reports, emergency procedures, environmental monitor checklists, and an environmental awareness pocket card. There are also stand-alone BTS Interdiction and Control Plans that are implemented by the military services.

The USFWS has published recovery plans for the ESA-listed species present on Guam and in the CNMI. As funds become available, local and federal agencies conduct projects to further the recovery of listed species.

GovGuam agencies captive-breed endangered birds (Guam rail, Mariana crow, and Micronesian kingfisher), control predators and invasive species (mainly snakes and cats) in support of released birds, and promote the recovery of habitat for other species of concern. Education programs are given to school and community groups encouraging the preservation of Guam's natural resources. The Government also works to prevent the introduction of invasive species to Guam by providing technical assistance for import permits and aiding the development of policies and action groups to prevent the introduction of invasive species. Other work involves monitoring of native species populations on Guam, providing information, guiding management activities, and reviewing development project plans.

A Micronesia Biosecurity Plan (MBP) is being prepared that covers basic principles that would be applicable even under no action. The DoN and GovGuam would decide whether to implement the MBP if there were no Marine Corps relocation.

ESA-listed Threatened and Endangered Species Population Trends

The threatened Mariana fruit Bat (fanihi), a subspecies of a bat found in other areas of Micronesia, formerly resided throughout the Mariana Islands, and in forested areas on Guam that previously occupied most of the island. Mariana fruit bat populations have declined over the years, especially in the southern islands. In 1958, a maximum of 3,000 bats were believed to be on Guam. Fewer than 1,000 bats were believed to exist in 1972, and less than 100 bats from 1974 to 1977. During an intensive island-wide

survey in 1978, it was concluded that fewer than 50 fruit bats survived. The most recent counts indicate that fewer than 50 bats remain on Guam.

The Mariana fruit bat was first listed as endangered only on Guam, in the belief that bats on Guam formed a separate population from those in the CNMI. Recent studies have indicated that the bats move from one island to another, linking these colonies as a single population. In 2005, the Mariana fruit bat was listed as threatened throughout its range. Mariana fruit bats have been used as food since humans first arrived on the islands; the consumption of bats represents a significant cultural tradition. Although hunting of bats has been illegal under federal and local law in both Guam and the CNMI since the 1970s, hunting remains a chronic threat.

The kingfisher population on Guam was federally listed as an endangered species in 1984, but by 1988 it was close to becoming extinct along with the majority of Guam's other avifauna as a direct result of predation by the introduced BTS. Kingfishers were last reported in southern Guam in the 1970s. A USFWS survey conducted in 1981 estimated the total population remaining in northern Guam to be 3,023. Surveys in 1984/1985 indicated the kingfisher population probably had fewer than 50 individuals. The remaining kingfishers were brought into captivity, with plans for their eventual reintroduction back into the forests of Guam. The captive population reached 100 individuals in 2008. Research and management efforts continue to eventually reestablish a wild population either on Guam or one of the islands of the CNMI.

Historically on Guam, the endangered Mariana crow has been found throughout forested areas, and was considered common into the early 1960s. A USFWS survey estimated only 357 crows in 1981, mostly in the northern cliffline forests. The last born Guam crow was observed in 2000. Currently, two crows that were translocated from Rota, as eggs and/or chicks, are found on Guam. Although predation by introduced BTS is now widely accepted as being responsible for this dramatic decline, other factors such as infertility, predation by rats and monitor lizards, and mobbing by introduced drongos, may cumulatively be preventing recovery.

The endangered Guam rail is a flightless bird previously found more frequently in scrubby second growth or mixed forest than in uniform tracts of mature forest. Before the 1970s, the Guam rail occurred island-wide and was distributed in all habitats except wetlands. The population declined severely from 1969-1973, and the rail disappeared from southern Guam in the mid 1970s. In an attempt to save the species, 21 birds were caught in the wild in the mid-1980s and placed in captive breeding, both in the continental U.S. and on Guam. The Guam rail only occurs in the wild as a small population introduced onto Rota by GDAWR; it occurs only in captivity on Guam.

Although the Tinian monarch is no longer ESA listed, the species is currently being monitored in accordance with the post-delisting monitoring plan. The Tinian monarch is an endemic species found only on Tinian that nests in limestone forest, secondary forest, and tangantangan forest habitats. It was federally delisted in 2004 (USFWS 2004). The population of this species has been in decline recently. The monarch currently inhabits approximately 62% of the land area on Tinian, of which approximately 70% is secondary and tangantangan vegetation, and less than 3% is native limestone forest.

Habitat Trends

The USFWS (2008) estimated recovery or suitable habitat available in 2004 on Guam, and habitat loss for endangered species from past actions at Andersen AFB from 2004 to 2008. These losses are:

- Mariana fruit bat – 5.5 % removed from a 2004 baseline habitat available of 12,026 ac (4,867 ha).

- Micronesian kingfisher – 5.6 % removed from a 2004 baseline habitat available of 12,026 ac (4,867 ha).
- Mariana crow – 6.5 % removed from a 2004 baseline habitat available of 10,774 ac (4,360 ha).
- Guam rail – 2.1 % removed from a 2004 baseline habitat available of 12,172 ac (4,926 ha).

3.3.9.3 Comparison of Preferred Alternatives to No Action

The preferred alternatives would contribute to the trend in degradation of terrestrial biological resources, primarily through a loss of habitat. Unless other stressors are controlled, the listed species would not recover. There are many acres of suitable habitat on non-federally controlled land; however, acreage on non-federally controlled land is not large enough alone to achieve recovery goals that are outlined in approved recovery plans. The majority of the recovery habitat for the Mariana crow and the Guam Micronesian kingfisher is located on DoD lands. Land would become a limiting factor if too much recovery habitat is lost. Habitat on DoD lands in conjunction with non-federal lands is necessary to ensure enough physical space with appropriate vegetation types to ensure foraging, breeding, and sheltering of listed species are available once threats are controlled or abated.

The proposed mitigation for preferred alternatives' impacts to ESA-listed species, as summarized in the volumes of this EIS, will be described in detail in the Biological Opinion and incorporated into future INRMP updates. The non-DoD efforts to halt or reverse the trend would continue under no action, but would increase under preferred alternatives. While there has been some success, it is unlikely under no action conditions and funding levels, that the trend in resource health would be halted or reversed in the near future.

3.3.10 Marine Biological Resources

3.3.10.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-25 and 3.3-26 summarize the preferred alternatives' construction and operation impacts to marine biological resources on Guam and Tinian. The findings from previous volumes are listed in the tables. For Guam, the greatest level of impact identified among all the volumes is listed in the last Guam column. The summary of impacts for Tinian's preferred alternatives is listed in the far right column of the tables.

Table 3.3-25. Summary of Preferred Alternatives' Construction Impacts – Marine Biological Resources

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste-water*	*Solid-Waste*	*Off-base Road-ways*		*Training*
Marine Flora, Invertebrates, and associated EFH	LSI	SI	NI	LSI	LSI	LSI	NI	LSI	SI	LSI
EFH	LSI	SI	NI	LSI	LSI	LSI	NI	LSI	SI	LSI
Special-Status Species	SI	SI	NI	LSI	LSI	LSI	NI	LSI	SI	LSI
Non-Native Species	SI-M	SI-M	NI	LSI	LSI	LSI	NI	LSI	SI-M	LSI
Marine Biological Resources Construction Impact Summary:									**SI**	**LSI**

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact

Table 3.3-26. Summary of Preferred Alternatives' Operational Impacts – Marine Biological Resources

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste-water*	*Solid-Waste*	*Off-base Road-ways*		*Training*
Marine Flora, Invertebrates and Associated EFH	NI	LSI	NI	LSI	NI	LSI/BI	LSI	LSI	LSI	LSI
EFH	LSI	LSI	NI	LSI	NI	LSI/BI	LSI	LSI	LSI	LSI
Special-Status Species	LSI (SI-M)	LSI	NI	LSI	NI	LSI/BI	LSI	LSI	LSI (SI-M)	LSI
Non-Native Species	SI-M	LSI	NI	LSI	NI	LSI	LSI	LSI	SI-M	LSI
Marine Biological Resources Operation Impact Summary:									**SI-M (SI-M)**	**LSI**

Legend: SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact, BI = Preferred Alternatives would result in a net beneficial localized impact near the wastewater discharge because there would be an improvement in terms of Guam Water Quality Criteria (GWQC) for multiple constituents from NDWWTP upgrades. The summary impacts to marine biological resources would be significant but mitigable to less than significant.

Construction Impacts

Under the preferred alternatives, in-water and land–based construction related to proposed Marine Corps actions would result in significant adverse impacts on some marine biological resources in Inner and Outer Apra Harbor. The adverse impacts are related to the following: (1) permanent removal of coral reef habitat by dredging, with an adverse effect on Essential Fish Habitat (EFH) and Management Unit Species (MUS) present within the coral reef habitat; (2) long-term adverse impacts from removal of live hard/bottom EFH. Although anticipated to recover in time, the size of the area, context and intensity, and cumulative effects elevates this impact "above minimal," with an adverse effect on those EFH habitats and MUS present; (3)

initial adverse indirect impacts from cumulative sediment deposition levels within 40 ft (12 m) of the direct impact areas based on oceanic sediment deposition modeling, and; (4) noise effects above NMFS established levels on ESA-listed sea turtles from pile driving activities within Inner and Outer Apra Harbor.

Other impacts would be short-term, periodic and localized; therefore minimal, with implementation of the BMPs summarized in Chapter 2. These impacts in Apra Harbor are due to increased sediment in the water column (> 40 ft. [12 m]) outside the dredged area, various noise sources that are expected to have minimal effect, soft bottom community dredge and fill operations, increased frequency of construction-related tug and barge traffic, and increased potential for non-native species introduction.

Land-based construction activities in Guam have the potential to impact coastal water quality. Impacts would be less than significant with implementation of BMPs. Impacts to fish, sea turtles, and infaunal or epifaunal organisms in or on the soft sediment, would be short-term and localized. The impacts would be less than significant.

Introduction of non-native invasive species in the marine environment during in-water construction could have a significant impact. This would be mitigated to less than significant through implementation of the MBP and further minimized and avoided through existing Navy hull and ballast water management. The construction of the Navy's new aircraft carrier berthing in Outer Apra Harbor would result in significant direct impacts to marine biological resources. After all efforts to minimize and avoid the impacts of the aircraft carrier project, there would still be unavoidable adverse impacts associated with dredging coral reef ecosystems, pile driving and fill operations in Outer Apra Harbor. Sessile reef species, some crustacean MUS, site-attached reef fish, pelagic egg/larval stages of bottomfish, and pelagic MUS may also be affected.

Various compensatory mitigation proposals are being considered, including watershed management projects and artificial reef construction. BMPs and mitigation measures proposed for in-water and land-based construction that are in Chapter 2.

There could be significant noise-related impacts to ESA-listed sea turtles from the pile driving component of the Outer and Inner Apra Harbor wharf improvement projects. A take is not anticipated because turtle occurrence in the inner harbor is extremely rare, but due to the turbidity of the water in the project area, observers may not see sea turtles approaching the area. Consequently, turtles could be exposed to noise levels that exceed NOAA's criterion for Level B Take, and therefore the action may affect, and is likely to adversely affect ESA-listed sea turtles.

There would be less than significant direct, indirect and cumulative impacts from turbidity, decreased water quality, and other disturbances from dredging activities to ESA-listed sea turtles (foraging, resting, nesting or swimming), EFH FEP MUS, and soft bottom community during vessel movements (Outer and Inner Apra Harbor), dredging, and in-water construction activities of wharves (pile driving) and LCAC and AAV operations facilities within Inner Apra Harbor. See Table 11.2-11 in Volume 2 for EFHA summary. A beneficial mid-term impact to water quality may be seen from the removal of the fine benthic sediment within Inner Apra Harbor.

As identified in the 10 April 2008 Federal Register, 40 CFR Part 230, the final U.S. Army Corps of Engineers (USACE) compensatory mitigation rule, permit applicants are required to mitigate to no net loss of ecological services and function. Compensatory mitigation for the direct dredging removal of coral, and coral reef habitat associated with the aircraft carrier berthing would be implemented by the DoD through USACE Section 10/404 permitting.

Operational Impacts

Impacts would be less than significant from direct and indirect effects associated with an increase in non-recreational Apra Harbor ship traffic. Marine flora, invertebrates, and essential fish habitat (EFH) would experience long-term, localized, infrequent minor impacts from the increased noise, re-suspension of sediment during vessel movements, and the potential for increased discharges of pollutants into the water column. Introduction of non-native invasive species in the marine environment during in-water operation activities could have a significant impact. This would be mitigated to less than significant through implementation of the MBP and further minimized and avoided through existing Navy hull and ballast water management. Less than significant indirect long-term population-level impacts or reduction in the quality and/or quantity of EFH were identified associated with recreational activities, including recreational fishing, diving, and boating. Existing Navy policies and plans (e.g. INRMPs) helped avoid and minimize potential adverse impacts. Future DoD educational programs and mitigation measures will help minimized indirect population-level impacts. Potential impacts from increased flows to wastewater treatment plants, particularly in central and southern Guam where WWTPs are in disrepair. The Navy anticipates short-term, localized more than minimal impacts to marine biological resources near these outfalls, however a beneficial long-term impact when GWA brings their WWTPs into compliance as directed by the USEPA Stipulated Order.

There would be long-term indirect impacts to EFH (coral and coral reef ecosystems) and significant impacts to special status species from increased recreational activities at Haputo ERA and Andersen AFB. This is mitigable to less than significant through increased efforts toward ERA regulations enforcement at Haputo and Orote, and enforcement of other ESA, MMPA, and EFH requirements and policies.

There would be short-term, periodic, and localized minimal impacts on sea turtle behavior during increased operation activities and vessel movements in Apra Harbor that would be less than significant with continued implementation of BMPs and Navy vessel policies.

Significant impacts, mitigated to less than significant from the potential introduction of non-native species would be expected since the DoD would adopt appropriate measures recommended by the MBP working groups during the MBP development to reduce the likelihood of introduction and spread of invasive marine organisms. Some example measures may include clarifying biosecurity requirements for all Navy vessels (including chartered Military Sealift Command [MSC] ships), improving hull husbandry documentation, and incorporating mandatory BMPs, including specific criteria to ensure low levels of biofouling and ballast water management, into contractual agreements with vessels chartered to support the military build-up. Avoidance and minimization measures include the fact that vessels operating within Apra Harbor would comply with U.S. Coast Guard (USCG) and Navy requirements and practices for ballast water and hull management.

Wastewater treatment plant upgrades at NDWWTP (and other WWTPs per USEPA SO and Guam WRMP) would result in long-term, localized net beneficial impacts to marine biological resources from improved water quality over existing conditions, although still exceeding Guam water quality criteria (GWQC) standards for some constituents. These impacts are considered to be beneficial.

Construction and improvements of roadways around Apra Harbor and other coastal areas, especially associated bridge work, may indirectly impact biological resources through increased runoff or pollutants discharged into marine waters or carried downstream and discharged. Implementation and proper management of permit-required construction BMPs would reduce these potential impacts to less than significant.

When considered in conjunction with all other preferred alternatives, the overall operational impacts to marine biological resources are considered significant, however mitigable to less than significant. Specifically, indirect impacts to special-status species from increased recreational boating in Apra Harbor and around Guam.

The Navy anticipates that the Government of Guam and federal resource agencies on Guam will enforce laws to protect coral reefs and sensitive marine habitats from increased recreational stress and behavior inconsistent with local resource management plans. Therefore, the proposed action and indirect induced growth would have no adverse effects to EFH.

As identified in Volume 2, Chapters 9 and 14, Recreational Resources and Marine Transportation, the proposed mitigation measures and BMPs would help alleviate these "growth-related" impacts to marine biological resources. The summary of operational impacts to marine biological resources would be significant, but mitigable to less than significant, with the exception of wastewater impacts in central and south Guam, which are not considered to be mitigable to less than significant.

Tinian

Due to increased barge traffic through Tinian Harbor supporting the proposed action, and increased runoff created from land-based construction and operation activities, the marine environment may experience elevated turbidity levels and increased levels of vessel noise. These impacts are anticipated to be short-term and localized, therefore minimal, resulting in less than significant impacts. Construction-related BMPs would be required and managed appropriately during construction to provide protection of coastal waters. Positive impacts to sea turtles and EFH may be seen from restricted access to coastal areas (specifically, nesting beaches and coral areas of special significance) on Tinian.

3.3.10.2 No Action

Guam

Stressors on marine biology include anthropogenic (human-induced) and natural events (i.e., storms and bleaching). Declining health of a resource is typically a response to an increased human population and associated industrial and commercial operations that affect the natural environment. Examples of stressors include overfishing, increased pollutants released directly to the marine environment or indirectly from land, point and non-point source discharges of stormwater and wastewater treatment plant outfalls, invasive species, recreational activities, diseases, coral bleaching, and storms. Other anthropogenic sources of stress on the marine environment include deliberate damage to marine resources by the human population on Guam, including military personnel; examples include destructive fishing methods such as dynamite fishing and deliberate collection of corals and live rock for aquarium use.

Other future construction on Guam may also impact marine resources. The land use plan for North and Central Guam designates areas for resort and high density development that would require utility upgrades. Under no action, the marine biological impacts could be as described for the preferred alternatives, but the impacts would be gradual over a longer period of time.

The *State of Coral Reef Systems in Guam* (Burdick et al. 2008) is the source of information provided below on Guam's coral reef health and trends, unless stated otherwise. The article provides background on resource trends and stressors data from 2004 to 2007.

Under no action, current trends would continue. The vitality of many of Guam's reefs has declined over the past 40 years. The average live coral cover on the fore reef slopes was approximately 50% in the 1960s, but by the 1990s had dwindled to less than 25% live coral cover, with only a few sites having over 50% live cover. The health of Guam's coral reefs varies significantly across the island. In general, reefs in

the northern part of the island and southern reefs at sufficient distances from rivers are relatively healthy, while large sections of reef in the south, particularly those near river mouths are in poor to fair condition. Currently harvested fish greater than 10 inches (>25 cm) are uncommon to rare on Guam, and while their numbers are slightly higher on northern reefs, abundance of medium and large sized fish is still very low compared to other islands in the Mariana Archipelago. The ability of some reefs on Guam to recover from their current degraded state and from acute disturbance events, such as crown-of thorns starfish outbreaks, storms and bleaching events, is likely hindered by poor water quality, low herbivorous fish abundance (due to fishing pressure on target stocks), and low coral recruitment.

In the past, Guam's reefs have recovered after drastic declines. However, continued degradation of water quality, crown-of-thorns starfish outbreaks, low abundance of target fish species, and other persistent stressors currently affecting Guam's reefs, have made the reefs less resilient.

Generally, Guam's reefs have been spared from severe and widespread coral mortality associated with large-scale bleaching events; however, observations in 2006 and 2007 suggest that bleaching events on Guam's reefs may become more frequent and severe in the coming decades. There were bleaching events in 1994, 1996, 2006, and 2007 from which the impacts are difficult to assess but appear to have coincided with elevations in sea surface temperature. Baseline surveys in 2006 and 2007 suggest that disease may be causing at least partial mortality in a significant number of colonies on Guam's reefs. White Syndrome may be the most prevalent disease, and the source of greatest tissue mortality.

Large offshore waves associated with storm-driven winds can cause physical damage to a reef. Storm surge and wave inundation can increase local sea levels by more than 40% of an offshore, significant wave height. Stormwater laden with sediments, nutrients, debris and other anthropogenic inputs, can be detrimental to coral reef ecosystems.

Sedimentation of nearshore habitats, primarily a result of severe upland erosion, is one of the most significant threats to Guam's reefs. It is most prevalent in southern Guam, where steep slopes, underlying volcanic rock, barren areas, and areas with compromised vegetation contribute large quantities of the mostly lateritic, clay-like soils to coastal waters. The excess sediment flows into coastal waters where it combines with organic matter in sea water to form "marine snow," often falling to the seafloor and smothering corals and other sessile organisms.

The southern reefs are subject to more anthropogenic activities than the northern reefs. In the south, there has been an increase in wildland arson, clearing and grading of forested land, inappropriate road construction methods, recreational off-road vehicle use, as well as grazing by feral ungulates. These sources of disturbance have all accelerated rates of sedimentation and appear to have exceeded the sediment tolerance of coral communities in these areas resulting in highly-degraded reef systems.

Wildfires set by poachers are believed to be the main cause of soil erosion. Despite being illegal, intentionally-set fires continue to burn vast areas of southern Guam. An average of over 700 fires has been reported annually between 1979 and 2006, burning over 115,000 ac (46,558 ha) during this period. The devastating effects of illegally-set wildfires in southern Guam are exacerbated by the drought-like conditions associated with El Niño events.

Coastal pollution also contributes to the decline of reefs. Three of Guam's sewage treatment outfall pipes continue to discharge within 660 ft (200 m) of the shallow reef crest, in depths of 66-83 ft (20-25 m) and in areas where corals are found. Stormwater leakage into aging sewer lines during heavy rains forces the sewage treatment plants to divert untreated wastewater directly into the ocean outfall pipes. Additionally, since Super Typhoon Pongsona impacted Guam in 2003, effluent from the Hagatna sewage treatment plant has been partly discharging into a shallow coral reef area, due to a break in the outfall line.

Nonpoint source pollutants in the north often infiltrate basal groundwater which discharges into springs along the sea-shore and subtidally on the reefs. Pollutants include nutrients from septic tank systems, sewage spills, livestock and agricultural areas, as well as chemical discharge from urban runoff, farms and illegal dumping. Algal blooms in Tumon Bay are attributed to fertilizers applied to landscaping. The DoD recently completed restoration of five sites contaminated with toxic chemicals from operations dating to WWII on Guam, and continues to assess and restore another 15 sites that are mostly situated on or near shorelines.

SCUBA diving, snorkeling, and related water activities continue to be very popular for both tourists and residents; some of the more popular sites have already exceeded their annual threshold, above which coral cover loss and coral colony damage levels may increase more rapidly. Popular dive sites are often adversely impacted when numerous inexperienced divers visit the site within a short period. Broken pieces of coral, and colonies damaged by kicking, grabbing, and standing are often observed in these areas. Other impacts, such as trampling of coral and other benthic organisms, increased turbidity, and alterations of fish behavior from fish feeding, are also regularly observed. These behaviors and associated damage are also routinely observed at popular boat diving sites, such as Blue Hole, Hap's Reef, Finger Reef, and Western Shoals.

Guam's coral reef fisheries are economically and culturally important, and target a large number of reef fish and invertebrates. Reef-related fishing methods currently used on Guam include hook and line, cast net (talaya), spear fishing with snorkel and SCUBA, gill net (tekken), surround net, trolling, drag net (chenchulu), hooks and gaffs, jigging, spincasting, and bottom fishing. Despite improvement in gear and technology, Guam's fishery catches have declined over the last few decades. A recent re-estimation of small-scale fishery catches for Guam suggests that catches have declined up to 86% since 1950.

Two fishing methods used on Guam have raised particular concern: the use of SCUBA and artificial light for night spear fishing, and the use of monofilament gill nets. These methods have been banned or heavily restricted in most of the region - including the CNMI. Abandoned gill nets also cause physical damage to the reef; DAWR regularly removes nets from nearshore reefs.

Ship groundings on Guam's reefs are inevitable due to the frequency of typhoons affecting the island. For example, the October 2004 grounding of a foreign longliner at Western Shoals, a popular dive site, caused substantial damage to an area of high coral cover.

While not a major threat, marine debris continues to impact Guam's reefs. Several monitoring, assessment, and research activities have been conducted on Guam since 2004. These activities measure several aspects of Guam's reef community that are important to coral reef management, such as benthic habitat, water quality, biological communities associated with coral reefs (e.g., fishes and macroinvertebrates) and socio-economic information (Burdick et al. 2008).

Maintenance and construction dredging occurs infrequently in Outer Apra Harbor. The shipping channel is at sufficient depth and has not been subject to dredging. Historically, Guam has served as a port of call since the 16th century, first catering to the ships of Spain, and after the Spanish-American War, to American interests. By the beginning of the 20th century, the U.S. had established the island as its western Pacific coaling and shipping station. Except for the two-year occupation of Guam by the Japanese during World War II, the U.S. Naval Administration ran the port until 1951, when command was transferred to the Department of Commerce.

As described in Volume 2, Section 2.11, the Glass Breakwater project was constructed in 1944 with 2 million cubic yards (1.5 million cubic meters [m^3]) of soil and coral extracted from adjacent Cabras Island. This completely altered the barrier reef system by restricting the exchange of water between Apra Harbor

and the open ocean. With an average height of approximately 15 ft (4.6 m) above mean sea level, the Glass Breakwater is the largest artificial substrate in the Marianas.

Table 3.3-27 lists key dredging events in Outer Apra Harbor that impacted coral reefs. Maintenance dredging events in Outer Apra Harbor have not been identified. Maintenance dredging events also occur periodically in Inner Apra Harbor. The combined area of coral reef and lagoon in nearshore waters is estimated to be 26,685 ac (10,800 ha). There is a similar area offshore beyond the territorial boundary (Burdick et al. 2008).

Table 3.3-27. Outer Apra Harbor Construction Dredge Events

Year	*Owner*	*Location*	*Dredge Depth (ft)*	*Coral Loss Area (acres estimate)*
1945	Navy	Creation of Inner Apra Harbor, Glass Breakwater and navigation channel[1]	ND	> 50
ND	PAG	Pier 3,4,5,6[2]	34-38	ND
1966	PAG	Hotel[2]	34	12
ND	PAG	Fuel Pier -Golf[2]	50	ND
ND	PAG	Fuel Pier -F-1[2]	70	ND
1989	Navy	Kilo Wharf[5]	45	7.4
2009	Navy	Kilo Wharf[3]	47	5
2008	Navy	Alpha/Bravo Wharf[4]	40	7
2010-2012	PAG	Commercial Port Modernization: F-6 and F-7 (new) [2]	51	ND
2012	Navy	Navy aircraft carrier (Proposed Action)	51.5	25

Notes:
[1] HEA and Supporting Studies (Volume 9, Appendix E of this EIS);
[2] Port Authority of Guam 2009;
[3] NAVFAC Pacific 2007;
[4] NAVFAC Pacific 2006;
[5] NAVFAC Pacific 1983.
ND = no data

Despite alterations to Apra Harbor since the liberation of Guam during WWII, the outer harbor "…holds a vibrant and thriving marine community including well-developed reefs with some of the highest coral cover on Guam, and a diverse biota of algae, invertebrates, and fish. In this regard, the harbor is unlike most other major ports, which tend to become greatly degraded for marine life" (Paulay et al. 1997). The outer harbor also supports diverse populations of macro-invertebrates, finfish, and moderate numbers of the threatened green sea turtle.

Tinian

The stressors affecting Tinian's marine resources are similar to those described for Guam, and include both anthropogenic and natural events such as storms and bleaching. Stresses on the marine environment increase as a function of an increased human population and effects of associated industrial and commercial operations on the natural environment; therefore, although anthropogenic stressors are active on Tinian, there is less pressure on the reefs due to relatively less population and land development. Stressors may include overfishing, increased pollutants, point and non-point source discharges from stormwater and wastewater treatment plant (WWTP) outfalls, invasive species, recreational activities, diseases, coral bleaching, and storms, which have all contributed to the degradation of marine biological resources. There also are two resort developments proposed for Tinian that would have the potential to impact marine biological resources.

Existing Plans and Procedures

Under no action, existing DoD and non-DoD conservation measures would continue. Ongoing efforts to manage marine resources on military submerged lands would continue in accordance with Air Force and Navy INRMPs - which include measures mandated by Biological Opinions and permit conditions, and voluntary DoD conservation measures that are not regulatory requirements. The INRMPs are updated every five years.

Guam and Tinian both have government agencies responsible for coastal management that draft and implement plans and programs to address historical impacts and prevent future impacts. GovGuam has marine preserves and DoD has coastal reserves that include the Haputo and Orote ERAs. Federal agencies such as the National Oceanic and Atmospheric Administration (NOAA) and National Marine Fisheries Service (NMFS) fund a variety of projects, including reef assessments that are implemented as funding becomes available.

There are environmental restrictions and requirements for training operations included in the COMNAV Marianas Training Handbook (COMNAV Marianas Instruction 3500.4, June 2000). The instruction contains guidance for developing an Environmental Protection Annex in support of major military exercises, training requirements, BTS control and interdiction, monitoring and monitoring reports, emergency procedures, environmental monitor checklists, and an environmental awareness pocket card.

Erosion control measures are required for construction and are regulated by federal and local laws. These measures, if enforced, reduce the sediment and pollutant discharge into coastal waters.

A biosecurity plan is currently being prepared that covers basic principles that would be applicable even if the preferred alternatives were not implemented. GovGuam would decide whether to implement the plan if there were no preferred alternatives constructed.

Special–status Species

USFWS and/or NMFS ESA-listed and candidate species and marine mammals not listed under ESA are considered special-status species. The species relevant to the EIS are green and hawksbill sea turtles, common bottlenose dolphin, and spinner dolphin. The baseline condition of these resources is described in Volume 2, Section 2.11.

Threats to green sea turtles include direct harvesting of eggs or adults, beach cleaning and replenishment, recreational activities, debris, incidental take from fishing, and foraging habitat (e.g. seagrass) degradation. The survival status in the Pacific Region continues to decline, except for populations in the Hawaiian Islands.

The hawksbill sea turtle is subject to similar threats as the green sea turtle, although this species is not commonly taken for human consumption. The population on Guam is almost extirpated; there was one sighting in 1991. No nesting turtles have been recorded in the CNMI. There are however, historic reports of hawksbill nesting activity on beaches in northern and central (Apra Harbor) Guam (NAVFAC Pacific 2005).The spinner dolphin is expected to regularly occur all around Guam, except in Apra Harbor where there are few occurrences of this species. Spinner dolphins are behaviorally sensitive and avoid areas that have a large amount of anthropogenic usage.

3.3.10.3 Comparison of Preferred Alternatives to No Action

There would be additional military transient and commercial ship traffic under the preferred alternatives, but standard operating procedures would minimize the impact to special status species. A key assumption is that the construction BMPs and proposed compensatory mitigation measures are implemented resulting

in less than significant operation impacts from these non-recreational vessels. The habitat equivalency analysis (Volume 9, Appendix E) prepared for the aircraft carrier berthing estimates that if artificial reefs are the compensatory mitigation, there would be a replacement of 85% of natural reef functions and services within ten years of deployment (on average - some specific areas may recover faster, others more slowly). There would also be a delay in the recovery under watershed management compensatory mitigation projects. The operational phase impact assessment assumes 100% restoration. There would likely be future dredging projects that result in coral loss, but none have been identified that are of the magnitude described for the preferred alternatives. These impacts would also require compensatory mitigation.

During operation, the preferred alternatives would have a direct significant impact on marine biological resources, mitigated to less than significant. The preferred alternatives would not add to the long-term degradation of marine resources. Two areas of concern for long-term localized impacts are at WWTP outfalls, and increased use of sensitive marine protected areas/ecological reserve areas, both of which are considered less than significant indirect impacts based on interim actions by GWA, USEPA and other GovGuam and Federal resource agencies. There would continue to be anthropogenic and natural impacts that degrade the marine environment and historical events to recover from that are unrelated to the preferred alternatives. Conservation measures and plans for federally-controlled and GovGuam submerged lands would continue to minimize and reverse the impacts on marine biology, as funding becomes available.

3.3.11 Cultural Resources

3.3.11.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-28 and 3.3-29 summarize the preferred alternatives' construction and operation impacts to cultural resources on Guam and Tinian. The findings from previous volumes are listed. For Guam, the greatest level of impact identified among all the volumes is listed in the last Guam column. The summary of impacts for Tinian's preferred alternatives is listed in the far right column of the tables. The overall summary of impacts during peak construction is significant but mitigable for both islands. During operation, the overall cultural impact of the preferred alternatives is significant and mitigable for both islands. Mitigations for impacts to modern Chamorro culture and practices are discussed under Socioeconomics/General Services.

It is assumed that all of the proposed construction actions would occur in a compressed time period, and that all operational activity would commence upon completion of construction.

Table 3.3-28. Summary of Preferred Alternatives' Construction Impacts – Cultural Resources

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Archaeological Resources	SI-M	NI	SI-M	SI-M	SI-M	NI	NI	LSI	SI-M	SI-M
Architectural Resources	NI	NI	NI	NI	NI	NI	NI	LSI	LSI	NI
Submerged Resources or Objects	NI	NI	NI	NI	NI	NI	NI	LSI	LSI	NI
Traditional Cultural Properties	NI	NI	NI	NI	NI	NI	NI	LSI	SI-M	NI
Cultural Resources Construction Impact Summary:									**SI-M**	**SI-M**

Legend: SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact

Table 3.3-29. Summary of Preferred Alternatives' Operation Impacts – Cultural Resources

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road -ways*		*Training*
Archaeological Resources	SI-M	NI	SI-M	NI	NI	NI	NI	LSI	SI-M	LSI
Architectural Resources	NI	NI	NI	NI	NI	NI	NI	LSI	LSI	NI
Submerged Resources or Objects	NI	NI	NI	NI	NI	NI	NI	LSI	LSI	NI
Traditional Cultural Properties	SI-M	NI	SI-M	NI	NI	NI	NI	LSI	SI-M	LSI
Cultural Resources Operation Impact Summary:									**SI-M**	**LSI**

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact

During construction on Guam, there are potential significant adverse direct impacts to approximately 31 historic properties on Guam, and 9 on Tinian; all such impacts would be mitigated to less than significant through mitigation. The proposed mitigation measures would be conducted in accordance with Section 106 consultation with the State Historic Preservation Office (SHPO) that would require avoidance, survey, monitoring during construction, data recovery, public education, and/or historic property awareness training of DoD personnel.

There would be significant adverse indirect impacts to three traditional cultural properties; all impacts would be mitigated to less than significant through public education, development of access procedures,

and implementation of preservation plans. Impacts under NEPA to natural resources of cultural concern, such as those collected by healers or traditional artisans, would be avoided if possible. However, in places where they cannot be avoided, DoD would work with consulting parties to provide access to these resources. There would be no adverse impacts to architectural or submerged historic properties during construction or operation for either island.

Impacts during operation would include accidental or inadvertent damageto archaeological historic properties. In general, historic properties on DoD-managed lands receive protection from cultural resource management plans and various DoD laws and regulations. However, accidental damage may occur and would be mitigated through historic property awareness training of personnel working and living in the area to avoid impacts to historic properties.

Direct impacts within the surface danger zones to historic properties from firing ranges (Guam and Tinian) are unlikely. Almost all munitions would be contained within the impact area, which includes large earthen berms. Potential effects of munitions rounds/fragments to features or artifacts in the SDZ would be negligible and less than significant. Indirect impacts to sites would include restricting public access to some historic properties during operations. Initially, the preferred alternatives would have a greater burden on the SHPO than the no action, due to the number of DoD management plans that would require consultation. However, in the long run, there would be a far less burden on SHPO with the preferred alternatives because the DoD would continue to manage large tracts of land on Guam and could afford the historic properties on those lands a higher level of protection than if they were not under DoD protection.

3.3.11.2 No Action

Potential impacts to historic properties include accidental or intentional damage, intentional and inadvertent disturbance from construction activities, and deterioration resulting from erosion. Many WWII l historic sites were established on Guam and Tinian, but the war itself resulted in the loss of cultural sites. The trend since the conclusion of WWII is a decline in cultural resources due to the impacts listed.

Currently, over 1,000 archaeological sites have been identified on Guam, with others yet to be identified. Many of these sites are still relatively intact, although past construction activity has resulted in the destruction of other archaeological sites. Data that were recovered through the excavation of these sites remains accessible. Likewise, future intentional removal of archaeological sites through construction can be mitigated through data recovery if the historic properties are eligible under criterion D. Removal of buildings that are historic properties can also be mitigated through detailed recordation. These potential impacts to historic properties would be significant and mitigable in the future. However, the absence of the preferred alternatives could also result in a decrease in significant off-installation (private) impacts to cultural resources.

There are local and federal laws and regulations to protect historic properties. For example, under no action, there are fines for vandalism. There are challenges to law enforcement due to the large number of sites to manage island-wide. These potential impacts continue to be significant, but mitigable into the future.

In the absence of the preferred alternative, there is a potential for significant but mitigable impact on cultural resources. Cultural resources would continue to decline in the future. In the absence of the preferred alternative the public would have access to all cultural resources as they do now..

3.3.11.3 Comparison of Preferred Alternatives to No Action

Some historic properties would be lost during construction of the preferred alternatives; however, once the proposed mitigation is implemented for this loss, impacts would be reduced to a less than significant level.

During operation, there could continue to be loss due to inadvertent or accidental damage to the preserved archaeological sites, but overall the impact to historic properties on DoD land would be less than significant due to site management. Under no-action, in the absence of any aspect of the preferred alternatives, there would continue to be potential for direct significant impacts to historic properties on non-DoD land due to construction activities, vandalism, erosion, and plant overgrowth of above ground features. . Direct impacts would be significant but mitigable, if proposed mitigation measures similar to those proposed for the EIS are applied.

3.3.12 Visual Resources

3.3.12.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-30 and 3.3-31 summarize the preferred alternatives' operation impacts to visual resources on Guam and Tinian. The visual impacts are considered long-term impacts; therefore, the short-term construction phase impacts are not applicable. The findings from previous volumes are listed. For Guam, the greatest level of impact identified among all the volumes is listed in the last Guam column. The summary of impacts for Tinian's preferred alternatives is listed in the far right column of the tables. During operation, the overall impact to the visual resources under the preferred alternatives would be significant but mitigable to less than significant for both islands.

Table 3.3-30. Summary of Preferred Alternatives' Construction Impacts –Visual Resources

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-Base Road-ways*		*Training*
Visual	NI	NI	LSI	NI	NI	NI	NI	SI-M	SI-M	SI-M
Visual Resources Construction Impact Summary:									**SI-M**	**SI-M**

Legend: SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact

Table 3.3-31. Summary of Preferred Alternatives' Operation Impacts – Visual Resources

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Andersen AFB	LSI	NA	NI	NA	NA	NA	NA	NA	LSI	NA
NCTS Finegayan	SI-M	NA	SI-M	NA	NA	NA	NA	NA	SI-M	NA
Non-DoD lands (North)	SI-M	NA	NA	NA	NA	NA	NA	NA	SI-M	NA
Andersen South	SI-M	NA	NA	NA	NA	NA	NA	NA	SI-M	NA
Non-DoD lands (Central)	SI-M	NA	NA	NA	NA	NA	NA	NA	SI-M	NA
Barrigada	LSI	NA	NI	NA	NA	NA	NA	NA	LSI	NA
Apra Harbor	LSI	LSI	NA	NA	NA	NA	NA	NA	LSI	NA
Naval Base Guam	LSI	NA	NI	NA	NA	NA	NA	NA	LSI	NA
South	LSI	NA	NA	NA	NA	NA	NA	NA	LSI	NA

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Views along Highway 3 adjacent to/near Finegayan	SI-M	NA	NA	NA	LSI	NI	NA	NA	SI-M	NA
Views from Route 2, Route 2a, and nearby Afilieje Beach Park	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
Existing visual quality changes to a more urban visual character	NA	NA	NA	NA	NA	NA	NA	SI-M	SI-M	NA
Removal of vegetation in residential areas, changing the visual character	NA	NA	NA	NA	NA	NA	NA	LSI	LSI	NA
Views from Mount Lasso	NA	NA	NA	NA	NA	NA	NA	NA	NA	SI-M
Views along Broadway	NA	NA	NA	NA	NA	NA	NA	NA	NA	SI-M
Views along 8th Avenue	NA	NA	NA	NA	NA	NA	NA	NA	NA	SI-M
Visual Resources Operation Impact Summary:									**SI-M**	**SI-M**

Legend: SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact, NA= Not applicable

It is assumed that all of the proposed construction actions would occur in a compressed time period, and that all operational activity would commence upon completion of construction.

Impacts to visual resources would result from altering the views or scenic quality associated with particularly significant and/or publicly recognized vistas, viewsheds, overlooks, or features; substantially changing the light, glare, or shadows within a given area; and substantially affecting sensitive receptors. Since the preferred alternatives would result in different levels of impacts in different areas, Table 3.3-31 is subdivided by location, with the exception of roadways, which uses a general impact description.

The military buildup would result in substantial changes to the visual environment at specific locations in Guam. For instance, off-base roadways and intersections widened by the Guam Roadway Network (GRN) projects would add an increased urban character to the views of the roadways. Those traveling on the roadway would likely find the wider pavement sections very noticeable. Pedestrians and those living or working adjacent to the roadway or intersection would likely find the changes very noticeable as well. However, it is not anticipated that these viewers would be highly sensitive to the individual changes given the cumulative nature of the roadway visual quality changes. Potable water supply, storage, and treatment would also introduce new features into the landscape. The height of the current DoD landfill at Apra Harbor would be nearly doubled under the preferred alternative for solid waste, causing significant effects to nearby and distant public viewpoints and sensitive receptors. These effects would be reduced to a level of less than significant with implementation of appropriate mitigation measures, including notable grading

and re-vegetation. Impacts to the visual environment from the preferred alternatives would primarily be considered less than significant; in cases where impacts were deemed to be significant, the proposed mitigation measures would reduce their impacts to less than significant. The proposed mitigation measures would include compliance with design guidelines for all buildings, in keeping with the Guam archetype, by implementing a landscape plan focused on retention of mature specimen trees during construction, establishing a variety of vegetation in keeping with Guam's native flora, and using native flora to create a natural-appearing "screen" between public roadways and buildup areas. In addition, a landscape plan could be developed and implemented and mature specimen trees could be retained during construction (where possible). To maintain the existing visual appearance, land clearing and grading should be minimized to the extent possible on lands proposed for ranges uses.

3.3.12.2 No Action

Urban development is likely the most notable cause of change in visual environments; the degree and nature of the proposed development as well as where a project is proposed, correspond with the resulting visual environment. For example, a single-family subdivision proposed on a hillside, where the view of the hillside was enjoyed from the existing scenic points or designated viewing areas, the resulting visual environment may mean that the existing views would be altered as seen from the existing viewing points. Natural disasters such as typhoons and earthquakes contribute to the degradation of the appearance of existing developments. Some developments are abandoned and fall into disrepair with adverse impact on visual resources. During strong economic conditions there is a tendency for increased development or property improvement. Conversely, during hard economic times buildings are not maintained or are abandoned. The visual resources trend over time is not linear, but is influenced by critical events. In general, there is a trend toward degradation of visual resources. As such, even if the proposed relocation of the Marines and their dependents would not occur, there is likelihood that changes to the existing visual environments may occur throughout the island of Guam.

Of all the DoD properties on Guam, Andersen AFB would likely experience some change in its visual environment, with the implementation of the planned ISR/Strike Town and other associated structures. There are no developments proposed on NCTS Finegayan, Former FAA parcel, Andersen South, Navy/Air Force Barrigada; as a result the existing conditions would remain under this Alternative. Under no action, a notable change at Apra Harbor would be that the proposed build-up of the existing landfill - up to 100 ft (30 m) - would no longer occur; thereby eliminating an adverse impact to the existing visual resource. No changes are expected at the NMS in South Guam.

There are several medium- (approximately 150 units) to large-scale single-family subdivisions (approximately 400 units) and some construction proposed on private properties, in Yigo and Central Guam; as well as condominium and resort developments in Tumon/Tamuning that would presumably result in an altered visual environment, from semi-rural to urban and/or suburban to urban. Over time, the visual environment in these areas would become less natural in appearance. There are no developments proposed in South Guam, no change to the existing visual condition is expected.

<u>Tinian</u>

There are new resorts planned for Tinian; preliminary plans suggest the resorts would add urban attributes to the existing semi-rural environment on Tinian in the form of tall and/or large structures. Without the preferred alternatives on Tinian, the viewshed from the overlook at Mount Lasso, which would have been affected the most from the preferred alternative developments, would remain in its existing condition.

3.3.12.3 Comparison of Preferred Alternatives to No Action

Under no action for both islands, there is always the potential for development of large, massive facilities in areas that are currently open space. The preferred alternative on Guam also assumes development of other large facilities not proposed in this EIS. These effects are additive across each island. The impacts are considered less than significant because valued viewsheds would not be lost. In addition, development on non-federal land would occur in accordance with master plans and zoning codes, and presumably would be consistent with community development goals that specifically set aside areas for open space. Although there would be some changes to the landscape, the preferred alternatives would have no island-wide impact on the visual environment. With the implementation of the proposed mitigation measures as previously identified, summary impacts would be less than significant.

3.3.13 Marine Transportation

3.3.13.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-32 and 3.3-33 summarize the preferred alternatives' construction and operation impacts to marine transportation resources on Guam and Tinian. For the purposes of this assessment, marine transportation consists of the movement of military and commercial vessels into and out of port. The findings from previous volumes are listed. For Guam, the greatest level of impact identified among all the volumes is listed in the last Guam column. The summary of impacts for Tinian's preferred alternatives is listed in the far right column of the tables. The overall summary of marine transportation impacts during peak construction is less than significant for Guam and no impact for Tinian. During operation, the overall summary of marine transportation impacts for the preferred alternative are less than significant for Guam and no impact for Tinian.

It is assumed that all of the proposed construction actions would occur in a compressed time period, and that all operational activity would commence upon completion of construction.

Table 3.3-32. Summary of Preferred Alternatives' Construction Impacts – Marine Transportation

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Marine Transportation	LSI	LSI	NI	NI	NI	LSI	NA	NA	LSI	LSI
Marine Transportation Construction Impact Summary:									**LSI**	**LSI**

Legend: LSI = Less than significant impact, NI = No impact , NA = Not applicable

Table 3.3-33. Summary of Preferred Alternatives' Operation Impacts – Marine Transportation

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Marine Transportation	LSI	LSI	NI	LSI	NI	NI	NI	NA	LSI	NI
Marine Transportation Operation Impact Summary:									**LSI**	**NI**

Legend: LSI = Less than significant impact, NI = No impact, NA = Not applicable

Impacts to marine transportation would occur at Apra Harbor. The preferred alternatives would result in an increased number of vessels visiting the Harbor primarily during the period of 2010 through 2018. To facilitate the berthing of the escort combatant ships, it would be necessary to dredge Sierra Wharf to remove approximately 327,000 cy (250,000 m^3) of sediment. It has not been determined whether the dredged material would be disposed of in the proposed ocean dredged material disposal site offshore of Guam, or at an upland disposal site on DoD land on Guam. It is anticipated that a total of approximately 127 trips would be needed to the ocean disposal site to transport the dredged material from Sierra Wharf. This activity would result in less than significant impacts to marine transportation.

Under the preferred alternatives for a transient aircraft carrier wharf, there would be a cumulative total of up to 63 visit days per year. Approximately 150 trips for a tug and scow to the ocean disposal site would be conducted to transport the dredged material from Polaris Point over a six- to nine-month period. The proposed activities that would have less than significant impact on navigation are: 1) dredging that would be conducted in or adjacent to the main channel, 2) relocation of the buoys, 3) relocation of the range lights for Outer Apra Harbor, 4) a security barrier installed around the aircraft carrier, 5) restrictions on navigation during aircraft carrier transits into and out of Apra Harbor in accordance with security requirements, and 6) installation of floating security barriers around the aircraft carrier while it is at the wharf. This activity would not result in significant impacts to marine transportation.

To minimize the impacts of the proposed dredging on the maritime community, a Notice to Mariners would be published prior to the start of the dredging to identify the location and duration of dredging, and temporary navigational aids may be deployed. The impacts on Navy ship traffic would be addressed through scheduling and communications between Port Operations and the contractors.

The projected average number of containers to be handled each year during the period 2008 through 2018 is 153,636. This quantity is about twice the average number of containers handled during the period of 1995 through 2008 (86,558). The average number of container ships that visited the Port of Guam each year over the period of 1995 through 2008 is 124. The maximum number of containers to be handled during the period of 2008 through 2018 is 190,000 (in the year 2015). If the number of containers per ship remains the same as during the period of 1995 through 2008 (average of 706 containers per ship), there would be approximately 269 container ships visiting the Port of Guam during 2015.

The projected average tonnage of break-bulk cargo to be handled each year during the period of 2008 through 2018 (180,409) is about 45 percent more than the tonnage of break-bulk cargo that was handled during the period of 2003 through 2008 (125,565). The average number of break-bulk cargo ships that visited the Port of Guam each year over the period of 1995 through 2008 is 290. The maximum tonnage of break-bulk cargo to be handled during the period of 2008 through 2018 is 291,400 (in the year 2012). If

the tonnage of break-bulk cargo carried by each ship remains the same as during the period of 2003 through 2008 (average of 548 tons per ship), there would be approximately 532 break-bulk ships visiting the Port of Guam during 2012.

Preferred alternatives on Guam would have less than significant impacts because the annual number of vessels visiting the Port of Guam has decreased by 1,902 vessels during the period of 1995 to 2008. With implementation of the preferred alternatives, the peak years for shipment of containers and break-bulk cargo to the Port of Guam do not coincide. The peak year for the shipment of break-bulk cargo is 2012 while the peak year for shipment of containers is 2015. In 2015, the number of vessels shipping break-bulk cargo would reduce from the peak of 532 (in 2012) to 262. It is expected that the addition of up to 269 container vessels (2015), up to 532 break-bulk vessels (2012), and 277 trips to the ocean disposal site to transport the dredged material from Sierra Wharf and the new wharf at Polaris Point, would result in less than a significant impact on marine transportation in Apra Harbor.

There is no construction or modification of existing Tinian Harbor facilities under the preferred alternative. If equipment is moved by barge, one single barge would be able to carry the equipment necessary to support the estimated 200 to 400-Marine training evolution. The movement of this barge once per month would result in less than significant impact to marine transportation in Tinian Harbor. Impact to roadways would be less than significant due to modified access to the MLA during training.

3.3.13.2 No Action

Under no action, the number of military vessels visiting Guam would not change from current conditions. The aircraft carrier would continue to visit Apra Harbor at Kilo Wharf with great impacts to ordnance operations. There would be security restrictions, including security barriers, at Kilo Wharf that would restrict navigation at the entrance to Outer Apra Harbor. As new ships and military missions change, there is the potential for an increase in military marine traffic. The number of non-military vessels visiting the Port of Guam would continue to vary with the economy, but would not be expected to change greatly. Therefore, no action would result in no impacts on marine transportation in Apra Harbor. There have been plans to improve the commercial port prior to the discussions on the military build-up. Improvements are being funded prior to the build-up construction and would have occurred without the build-up; however, the timing of the improvements may have been different without the proposed build-up.

The Inner Tinian Harbor was built in 1944 by U.S. Navy Engineers. The harbor was the center for fish transshipment in the 1990s. The number of vessels (military and non-military) visiting the Tinian Harbor varies with the economy. The Tinian Dynasty Hotel & Casino operates Tinian shipping and the ferry service between Saipan and Tinian. Currently there are only one to two trips per day, which is a decrease over the peak six trips per day in the 1970s. Marine transportation would continue to decline, or remain at about the current level, unless there are increases in tourism, military mission, or other industry. As described in Volume 7 Chapter 4, Cumulative Impact Assessment, there are two large-scale, planned resorts for Tinian. Construction of these projects may increase ship traffic at Tinian's port. There may be an increase in ferry traffic due to the additional tourists drawn to the island to visit these two new resorts. There may also be an increase in military use of Tinian in the future that would contribute to the marine traffic. The port needs improvements which may be provided as part of future projects that involve an increase in use.

3.3.13.3 Comparison of Preferred Alternatives to No Action

The total number of commercial (non-fishing) vessels visiting the Port of Guam has decreased substantially from 1995 (763 vessels) to 2008 (436 vessels). Assuming a channel occupancy time of one hour for passage of a vessel into and out of the harbor, channel occupancy has declined from 17 to 9.7

percent. Even after allowing for military vessels (including priority vessels, such as aircraft carriers) and weather interruptions, the harbor's navigation channels appear to have a substantial capacity for additional vessels. Because the annual number of vessels visiting the Port of Guam has decreased by 1,902 vessels over the period of 1995 to 2008, it is expected that the addition of up to 269 container vessels (2015); up to 532 break-bulk vessels (2012); and 277 trips to the ocean disposal site to transport the dredged material from Sierra Wharf and the new wharf at Polaris Point would result in a less than significant impact on marine transportation in Apra Harbor.

Under the preferred alternatives, after construction, it is anticipated that the number of commercial vessels visiting the Port of Guam would be greater than under no action, to support the additional on-island population. The impact would be less than significant because the harbor has the capacity to handle the additional vessel traffic.

Less than significant impacts on Tinian marine transportation are anticipated under the preferred alternatives. However, no action may include new resort construction and operations that could result in an increase in harbor traffic.

3.3.14 Utilities and Roadways

3.3.14.1 Summary of Preferred Alternatives' Impacts

The utility and off-base roadway analysis in Volume 6, Chapter 2 is an analysis of the combined impacts of the preferred alternatives on utilities and off-base roadways and is summarized in this section of Volume 7. This section of Volume 7 differs from the other Volume 7 discussions of utilities and off-base roadways in that it focuses on the overall capacity of and impacts *to* existing utilities and roadways infrastructure relative to the new demand under the preferred alternatives, instead of focusing on the impacts on environmental resources *from* the individual utility and roadways infrastructure projects proposed to meet the additional demand. Impacts on environmental resources from the individual utility and roadways infrastructure projects are addressed in the individual resource chapters in Volume 6 and are summarized in the other sections throughout this chapter of Volume 7. The utilities and off-base roadway impacts analysis in this EIS are island-wide and based on the total proposed population increase on Guam associated with the Marine Corps, Navy and Army preferred alternatives, including associated workforce and induced populations.

Volume 6 details action alternatives to upgrade utility systems and improve roadways to meet future demands associated with the proposed military relocation. Proposed utilities systems action alternatives include installation of new supply wells and systems for potable water, improvements to the Northern District Wastewater Treatment Plant (NDWWTP), improvements to GPA power systems, and use of landfills. Roadways proposed actions include eight off-base roadway projects. Additionally, Volume 6 proposes mitigation measures for utilities and roadway infrastructure impacts. The mitigation measures are listed in Chapter 2 of this volume. The summary analysis presented in this section assumes implementation of the utilities and roadways preferred alternatives detailed in Volume 6.

Utility infrastructure is subject to impacts from the direct DoD population that would live and work at the new military relocation facilities (referred to as "direct impacts"). Utility infrastructure is also subject to indirect impacts from the off-base construction workforce and induced populations (referred to as "indirect impacts"). Additional indirect impacts of workforce housing are addressed in Section 3.4 of this volume. The population increases during operation are largely due to the Marine Corps preferred alternatives. The population and utility impacts associated with the Marine Corps proposed action are greater than the other two Navy and Army proposed actions.

The population during the peak construction period would have the greatest demand on utilities, therefore, utilities and roadways impacts presented in this section represent peak year impacts. The preferred alternatives include utilities and roadways repairs, upgrades and improvements, which are designed to address peak year demands, as detailed in Volume 6. This analysis is based on implementation of these utilities and roadways infrastructure components. Tables 3.3-34 and 3.3-35 summarize the preferred alternatives' direct and indirect impacts to utilities and off-base roadways on Guam and Tinian. The impacts in the table represent the greatest impact assessed for each utility and for roadways associated with the peak construction period.

Table 3.3-34. Summary of Preferred Alternatives' Impacts – Utilities and Roadways

Resource Categories	*Guam*	*Tinian*
	Volume 6	*Volume 3*
	Military Relocation	*Training*
Utilities		
Power	LSI (LSI)	LSI
Water	LSI (SI)	LSI
Wastewater	SI-M (SI)	LSI
Solid Waste	LSI (LSI)	LSI
Utilities Summary of Impact	**SI-M (SI)**	**LSI**
Off-base Roadways Impacts	**SI-M**	**LSI**
On-base Roadways Impacts	**SI-M**	**LSI**

Legend: SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact, ( ) = Indirect (workforce population and induced) population impact

As indicated in Table 3.3-34, less than significant impacts would occur on Tinian. On Guam, significant but mitigable direct impacts would occur, and significant indirect impacts would occur. The utilities and roadways impacts resulting from implementation of the preferred alternatives are summarized below.

Guam

Power

Existing and proposed power systems would be adequate to support the military relocation. The preferred alternative would result in less than significant direct and indirect impacts. Table 3.3-35 summarizes the impacts from Volume 6 Chapter 3 of impacts to power systems resulting from implementation of the preferred alternatives under the military relocation. See Volume 6 Chapter 3 for more details.

Table 3.3-35. Summary Impacts for Power

Potentially Affected Resource	*Power Basic Alternative*
Power	LSI (LSI)

Legend: LSI = Less than significant impact; ( ) = Indirect (workforce population and induced) population impact

Water

Direct impacts to potable water systems from the preferred alternatives would be less than significant because DoD would install a new water system to meet its water needs. Indirect impacts to the Guam Water Authority (GWA) system would be significant as a result of the following:

- The existing GWA water supply would be inadequate to meet the water demands from the workforce housing and induced population. This would be mitigated by DoD providing excess water capacity to GWA.

- The existing GWA system for transmitting bulk water to areas of Guam, and distributing water to customers, would be inadequate to meet the water demands from the workforce housing and induced population. This would be partially mitigated by DoD constructing new transmission lines and interconnects to deliver bulk water to the GWA system where demands are greatest. However, mitigation of the GWA distribution system servicing customers is the responsibility of GWA and would not be undertaken by DoD.

Direct and indirect impacts to the Northern Guam Lens Aquifer would be less than significant as the sustainable yield of the aquifer is sufficient to support the DoD, construction workforce, and induced populations.

Indirect impacts associated with GWA's inadequate distribution system cannot be mitigated by DoD and some customers may experience inadequate water service during the construction phase.

Table 3.3-36 summarizes the impacts to water systems resulting from implementation of the preferred alternatives under the military relocation as identified in Volume 6, Chapter 3. See Volume 6 Chapter 3 for more details.

Table 3.3-36. Summary of Impacts for Water

Potentially Affected Resource	*Preferred Alternative*
DoD Water System (direct impact)	LSI
GWA Water System (indirect impact)	SI-M
Supply	SI-M
Transmission	SI-M
Distribution	SI
NGLA (combined direct and indirect impact)	LSI

Legend: DoD = Department of Defense; GWA = Guam Waterworks Authority; LSI = less than significant impact; NGLA = Northern Guam Lens Aquifer; SI-M = Significant impact mitigable to less than significant

Wastewater

DoD proposes to utilize the GWA owned and operated NDWWTP, to treat the wastewater from the direct DoD population in the area. The NDWWTP currently does not have sufficient capacity or treatment capability to treat the increased wastewater flows from the DoD population, resulting in a significant impact to the plant. DoD proposes to initially repair and upgrade the existing primary treatment capability at the plant, then upgrade the plant to secondary treatment capability. This would result in improved water quality and long-term beneficial impacts. DoD also proposes to utilize the existing Navy Apra Harbor Wastewater Treatment Plant, which has sufficient capacity to treat the increased wastewater flows from the DoD population in the surrounding area.

Less than significant and significant indirect impacts to the GWA owned and operated Hagatna Wastewater Treatment Plant (WWTP) would result from increased wastewater from the construction workforce and induced populations. The plant has insufficient capacity to treat the wastewater. This results in periodic effluent permit violations which would be more frequent with increased flows.

There would be less than significant indirect impacts to other GWA owned and operated wastewater treatment plants from increased wastewater from the construction workforce and induced populations. This is because the relative increase in flow to these plants would be negligible. There would be significant indirect impacts to GWA wastewater collection systems from increased wastewater from the construction

workforce and induced populations because these wastewater collection systems are currently inadequate to handle the flows they receive today.

Table 3.3-37 summarizes the impacts from Volume 6 Chapter 3 of impacts to wastewater systems resulting from implementation of the preferred alternatives under the military relocation. See Volume 6 Chapter 3 for more details.

Table 3.3-37. Summary Impacts for Wastewater

Potentially Affected Resource	*Preferred Alternative*
NDWWTP Treatment Capacity (direct impact)	SI-M/BI
NDWWTP Effluent (Discharge) Quality (direct impact, short/intermediate term)	BI/BI
Apra Harbor WWTP Treatment Capacity (direct impact)	LSI
Apra Harbor WWTP Effluent (Discharge) Quality (direct impact)	LSI
Hagatna WWTP Treatment Capacity (indirect impact)	LSI
Hagatna WWTP Effluent (Discharge) Quality (indirect impact)	LSI
Southern Guam WWTPs (indirect impact)	LSI
GWA Collection Systems (indirect impact)	SI

Legend: BI = Beneficial impact; GWA = Guam Waterworks Authority; LSI = Less than significant impact; NDWWTP = Northern District Wastewater Treatment Plant; SI = Significant impact; SI-M = Significant impact mitigable to less than significant; WWTP = Wastewater Treatment Plant.

Solid Waste

Construction and operation of the preferred alternatives would result in less than significant direct and indirect impacts, assuming the short-term use of existing landfills and the future use of the new Layon landfill. Table 3.3-38 summarizes the impacts from Volume 6 Chapter 3 of impacts to solid waste systems resulting from implementation of the preferred alternatives under the military relocation. See Volume 6 Chapter 3 for analysis of impacts to solid waste management systems resulting from implementation of the preferred alternatives.

Table 3.3-38. Summary Impacts for Solid Waste

Potentially Affected Resource	*Preferred Alternative*
Construction & Demolition Debris Disposal Capacity at Landfills	LSI (LSI)
Solid Waste Disposal Capacity at Landfills	LSI (LSI)

Legend: LSI = Less-than-significant impact, ( ) = Indirect (workforce population and induced) population impact

Roadways

The impacts to roadways on Guam would be significant and mitigation is identified, but the mitigation may not be adequate to reduce impacts to less than significant. As of February 2010, eight off-base projects had been identified as having funding or reasonable expectation of being funded and these projects are considered part of the preferred alternatives. Additional traffic analysis was completed for 17

roadways and 42 intersections, assuming that only a limited number of these projects would be funded. These projects are either DAR-certified or determined to be DAR-eligible at this time (see Volume 1, Section 1.1.4 Project Location, Funding, and Setting). These additional projects are considered mitigation measures. The evaluation of the unfunded road projects for DAR eligibility and certification is continuing and the DoD, FHWA, and GovGuam continue to work cooperatively to develop a funding plan for the off-base roadway and intersection capacity projects.

Under the preferred alternatives, roadways improvements would be distributed across the island and implementation of these roadway projects would impact Guam-wide roadway conditions. The off-base roadways impacts would be significant for the north and central regions of Guam, as described in Volume 6, Chapter 4. The impacts to the Apra Harbor and South areas of Guam would be less than significant.

Due to the increase in traffic resulting from the preferred alternatives, the on-Base roadways impact would be significant but mitigable at Andersen AFB and at the Navy base. The traffic impact is less than significant at Andersen South, Barrigada, and NMS. Mitigation measures for Andersen AFB and Apra Harbor include road widening, restriping, or installation of traffic signals and other traffic control devices to help improve traffic operations.

Tinian

On Tinian, there would be less than significant impacts to utilities and roadways resulting from the preferred alternatives and no mitigation (improvements) are proposed. No supporting utility infrastructure facilities are proposed for the Tinian firing ranges. All training would be considered "expeditionary," in that the Marines would bring all necessary equipment to the ranges, set up temporary tents on-site, and remove all equipment following completion of the training activities. The only proposed use of on-island utilities would be for wastewater and use of the municipal water supply. A contract, portable toilet service would be used for human waste. Portable toilets would be contracted from a local company and the wastewater would be disposed in accordance with all applicable laws and regulations, as a requirement of the contract. The contractor would be directed to take the wastewater to the existing DoD septic tank/leach field system.

Potable water usage would be restricted to what could be delivered in trucks from the municipal water supply. It is not expected to exceed the available capacity of the municipal water system. Bottled potable water would be delivered to the construction workers during the construction period. Range fire-fighting would be performed by local fire fighting services, as augmented for a range fire-fighting role. Portable generators or solar-battery systems would be used to operate any equipment needed at the bivouac site. Water service would be provided via a water truck during operations. Estimated potable water consumption would be one gallon per person, per day, for drinking; additional water would be consumed for cleaning, bathing, etc. Solid waste would be collected and returned with the military unit, pending establishment of a certified landfill on Tinian. Solid waste would otherwise be back-hauled to Guam, and the DoD would not dispose of solid waste at the open dump operated by the CNMI Department of Public Works.

3.3.14.2 No Action

Guam

The following is a brief summary of information provided in the Affected Environment section of Volume 6, Chapter 3.

Power

Power demand forecasts, including all current and foreseeable projects, indicate that there is currently and would continue to be sufficient power generation capacity. The Guam Power Authority's Integrated Resource Plan indicates the need for a new base load power plant in 2017, however the assumptions for that need may or may not be realized. Alternative power sources (wind, solar, and geothermal) are forecast to be implemented in 2015.

Water

The baseline condition of the GWA water system is described in GWA's WRMP and in various other reports prepared for GWA and USEPA Region 9. The overall condition of the water system infrastructure (wells, reservoirs, treatment systems, storage tanks, and distribution lines and pump stations) is identified as poor in the WRMP and substandard in EPA reports, with substantial corrosion of infrastructure and failed or bypassed systems due to lack of maintenance or capital improvements. Problems with the GWA infrastructure result from the effects of natural disasters, poor or deferred maintenance, lack of upgrades and capital improvements, and vandalism. According to the WRMP, the water system infrastructure does not meet the basic flow and pressure requirements for all customers, and did not consistently comply with regulatory requirements. A 2003 Stipulated Order was issued to force correction of GWA's Safe Drinking Water Act violations and deficiencies, but compliance with the Order has been limited due to funding constraints. The condition of the GWA water systems and a history of compliance are outlined in Volume 6, Chapter 3.

Under the no-action scenario, current capacities of DoD water systems are adequate to meet current DoD demands for the foreseeable future. However, the projected off-base water demand for the Guam civilian population throughout 2010-2019, not including the effects of the military relocation, exceeds the current Guam Water Authority (GWA) water system capacity. Some of the currently planned improvements and expansion to the GWA water system would be required under no action to meet the terms of a 2003 Stipulated Order to GWA address potable water deficiencies. Should Ground Water Under Direct Influence (GWUDI) treatment become a future requirement, GWA would be faced with installing additional water treatment to be in compliance with Safe Drinking Water Act requirements.

Wastewater

As indicated above, GWA's wastewater infrastructure (treatment plants, collection piping, and pump stations) are identified as poor in the WRMP and substandard in EPA reports from a legacy of deferred maintenance and capital improvements. This, coupled with natural disasters (such as typhoons and flooding), has resulted in frequent sewage overflows at pump stations and collection piping, collapse of collection piping, and failure of treatment plant equipment. A lack of GWA resources, particularly restrictions on fees that can be collected from the public for sewer services and a poor bond rating for loans, has severely limited GWA's ability to adequately maintain and update their wastewater treatment system. As a result, GWA has experienced frequent violations of its National Pollution Discharge Elimination System (NPDES) permit conditions, including the inability to adequately treat wastewater and exceedances of the allowed pollutant levels in plant discharges. A 2003 Stipulated Order was issued by USEPA to force correction of GWA's Clean Water Act violations and deficiencies, but compliance with the Order has been limited due to funding constraints. The condition of the GWA wastewater systems and a history of compliance are outlined in Volume 6, Chapter 3.

Under no action, current NDWWTP would continue to require upgrades and maintenance to meet the terms of a 2003 Stipulated Order to GWA addressing wastewater deficiencies. Also, USEPA will not likely grant the secondary treatment waiver for the NDWWTP or the Hagatna WWTP. Thus, in the near

future, GWA may be required to upgrade these treatment plants to secondary treatment in addition to making repairs and upgrades to the existing primary treatment processes.

Solid Waste

Solid waste from DoD is presently disposed of at the Navy sanitary landfill or the Air Force landfill at Andersen AFB. Solid waste from non-DoD sources is disposed of at GovGuam facilities. The GovGuam Ordot landfill will be closed only after the new landfill is opened, and access roads will be upgraded by GovGuam to accommodate the transport of waste to the new disposal site.

The new GovGuam solid waste landfill is funded and currently under construction; it is scheduled to be completed and operational by July 2011. DoD would switch its use from its current landfills at Apra Harbor and Andersen AFB for municipal solid waste when this new landfill is completed. Solid waste that cannot be accepted by the new GovGuam landfill would continue to be disposed at the DoD landfill at Apra Harbor. The new GovGuam landfill is anticipated to be fully compliant with current municipal solid waste regulations and would have a life span of over 30 years, including the estimated impacts of the proposed DoD relocation.

Roadways

The *2030 Guam Transportation Plan* (Plan; GovGuam 2008) identified roadway improvement projects that would address roadway deficiencies on Guam; however, it does not address all of the roadway improvements identified in this EIS. The need for some of the projects identified in the Plan would be accelerated by the military build-up. The rate of improvements identified in the Plan is tied to the availability of funding. The condition of roadways on Guam has deteriorated, but the roadways are operational.

Tinian

Volume 3, Chapter 15 describes the island-wide utilities on Tinian. Power capacity has not been exceeded and demand may decrease in the future if the Dynasty Hotel closes. Currently, the quantity of water production from municipal wells easily meets the current average daily water demand. There is currently no centralized wastewater treatment system on Tinian. Most residents utilize personal septic tanks with leach fields or cesspools. The Tinian Dynasty Hotel and Casino has its own tertiary treatment plant. The IBB has its own septic tank/leach field system. DoD installed a septic tank/leach field in 1998-1999 in support of the "Tandem Thrust" training exercise (CNMI Division of Water Quality [DEQ] 1999). That exercise involved approximately 2,000 people for one week. Portable toilets are also used on Tinian and are provided by an on-island rental company. All municipal solid waste (including septage) is currently received at an open dumpsite located approximately 0.5 mile (mi) (0.8 kilometer [km]) north of San Jose, and west of 8th Avenue. The disposal site is operated as an open burning dump. Current practice is for waste pumped from septic tanks, cesspools, or portable sanitation devices to be discharged at an area adjacent to the existing open dumpsite as there is no separate disposal facility for this waste. The existing municipal solid waste dumpsite does not comply with the Resource Conservation and Recovery Act Subtitle D regulations for municipal solid waste landfills (40 Code of Federal Regulations Part 258). A new landfill and WWTP are anticipated to be constructed without implementation of the preferred alternatives. Periodically, roadways are repaired but repairs may lag due to insufficient funds.

3.3.14.3 Comparison of Preferred Alternatives to No Action

Although the preferred alternatives include utilities upgrades on Guam that would improve existing conditions, implementation of the preferred alternatives would increase demand on existing overburdened and deficient utilities on the island, particularly during peak construction. Increased demand on Guam's

utilities would result directly from military personnel and their families and also indirectly from construction workforce and induced populations. Significant direct and indirect impacts would occur to potable and wastewater systems on Guam. Although the significant direct impacts would be mitigable to less than significant, significant indirect impacts on Guam's water and wastewater utilities would not be mitigable to less than significant.

Roadway improvements are required on Guam either under the preferred alternatives or with no action. Although the preferred alternatives include off-Base roadways improvements, impacts to off-Base roadways resulting from the preferred alternatives would be significant. If roadways on Guam were allowed to deteriorate to the point of being closed in the near-term, the effect would be significant but mitigable. Proposed mitigation consists of roadway restoration. The evaluation of the unfunded road projects for DAR eligibility and certification is continuing and the DoD, FHWA, and GovGuam continue to work together to develop a funding plan for off-base roadway and intersection capacity projects.

Less than significant impacts would occur to utilities and roadways on Tinian; there would be no appreciable difference between the no action and the preferred alternatives on Tinian.

3.3.15 Socioeconomics and General Services

3.3.15.1 Summary of Preferred Alternatives' Impacts

Overall, socioeconomic impacts of the preferred alternatives would be island-wide in nature. Implementation of the proposed actions of the Marine Corps, Navy, and Army would result in both beneficial and adverse impacts. The significance of impacts would be increased by the suddenness of the activity, and the peaks in activity during the 2013-2015 timeframe, due to the overlap in the construction and operation phases of the preferred alternatives.

During the peak, many public services offered by GovGuam would need to increase professional staff to service the new population. Most of these agencies would need to rapidly expand their services and staff during the 2013-2014 peak (raising issues of availability of qualified workers), then cut back them back as construction ends. Agencies that deal with permitting and regulating growth are affected more by the initial requests for permits and then subsequent inspections and monitoring. For the agencies involved in development permitting, impacts on workloads would tend to be slightly earlier than for other agencies.

The peak growth period would be followed by a period of a population decline on Guam when construction ends, as a large part of the population influx due to construction work would likely leave the island at this time (although population levels would still represent an increase over pre-action levels). While quality of life might improve and public service agencies may be more equipped to handle this more manageable post-construction population "steady state," the ensuing dip in economic impact could result in an island-wide economic slowdown given the peak spending during the build-up period.

There would likely be sociocultural impacts. Crime and social order impacts would be felt because of the large increase in population, especially during the construction phase. There is potential for cultural conflict, especially in the opening years of the proposed action.

Federal regulations regarding land acquisition mitigate for the economic impacts experienced by individual landowners and occupants due to land acquisition. However, due to the extent the proposed land acquisition would mean an increase in federally owned or controlled land on Guam, and a reduction in access to lands of sociocultural and recreational importance, the overall socioeconomic impacts of land acquisition would be significant.

Table 3.3-39 and Table 3.3-40 provide a summary of the significance of implementing the proposed actions addressed in Volumes 2 through 6 for construction and operation phases, respectively. While the

relocation of the Marines to Guam and the related facilities and infrastructure would be the largest of the proposed actions, there are incremental impacts to socioeconomic factors from the transient aircraft carrier visits and Army proposed actions on Guam. The socioeconomic analysis included the combined direct and indirect impacts for Volumes 2, 3, 4 and 5. Volume 6 distinguishes between direct and indirect (workforce housing and induced population) impacts and identifies levels of significance for each.

Table 3.3-39. Summary of Preferred Alternatives' Construction Impacts – Socioeconomics and General Services

Resource Categories	*Guam*						*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*		*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Utilities*	*Off-base Road-ways*		*Training*
Population Impacts	SI/BI	LSI	SI/BI	SI/BI	SI-M	SI	NI
Economic Impacts	BI	BI	BI	BI	BI/LSI	LSI	SI
Public Service Impacts	SI	LSI	SI	SI	SI (BI)	SI (BI)	SI
Sociocultural Impacts	SI	SI	NI	NI	NI	SI	SI
Utility Rate Payer Impacts	NA	NA	NA	NA	LSI (SI)	SI (SI)	NA
Socioeconomics and General Services Construction Impact Summary:						**SI (SI)**	**SI**

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact, BI = Beneficial impact, NA = not applicable, ( ) = Indirect (workforce population and induced) population impact; SI/BI = Population increases have inherently mixed impacts (both beneficial and adverse), because population growth fuels economic expansion but sudden growth also strains government services and the social fabric.

Table 3.3-40. Summary of Preferred Alternatives' Operation Impacts – Socioeconomics and General Services

Resource Categories	*Guam*						*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*		*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Utilities*	*Off-base Road-ways*		*Training*
Population Impacts	SI/BI	LSI	LSI	SI/BI	NI	SI	NI
Economic Impacts	BI	BI	LSI	BI	NI	BI	SI
Public Service Impacts	SI	LSI	LSI	SI	NI	SI	LSI
Sociocultural Impacts	SI	SI	NI	NI	NI	SI	SI
Land Acquisition Impacts	SI	NA	NA	NA	NA	SI	NA
Utility Rate Payer Impacts	NA	NA	NA	LSI (SI)	NA	LSI (SI)	NA
Socioeconomics and General Services Operation Impact Summary:						**SI (SI)**	**SI**

Legend: SI = Significant impact, LSI = Less than significant impact, NI = No impact, BI = Beneficial impact; NA = not applicable; ( ) = Indirect (workforce population and induced) population impact; SI/BI = Population increases have inherently mixed impacts (both beneficial and adverse), because population growth fuels economic expansion but sudden growth also strains government services and the social fabric.

3.3.15.2 No Action

Guam

Historic Baseline

Guam's socioeconomic history has been heavily influenced by Spanish rule, Pre-WWII American occupation and the battles of WWII. Pre-European contact, Chamorro families were organized into matrilineal clans. Wealth was held largely in land and currency consisted of polished turtle shell pieces. The economy was based on subsistence fishing, and farming (Rogers 1995).

Chamorro society was altered during the Spanish Era (1521-1898), which began with Magellan's arrival in 1521 (permanent Spanish settlement began in 1668). The Spaniards compelled most Chamorro to live on Guam and Rota and prohibited the sailing of traditional *Proa* canoes. Fishing was limited to the coastal areas, while subsistence farming continued. The prime source of income in the 1840s was derived from the whaling industry, which declined in the late 1840s. During this time, under the Laws of the Indies, all lands technically belonged to the Spanish Crown. The Spanish granted Chamorros legal equality with all Spanish subjects in 1681, and in 1771 the governor made land available to all families for agricultural purposes. While this meant that much land remained in Chamorro families, this ownership became concentrated in the hands of more wealthy and influential families, descendants of Chamorro nobility that had married into Spanish families. The Catholic Church became a major landowner. Inheritance patterns also changed from matrilineal to patrilineal systems (Rogers 1995).

The Spanish Crown lands were seized by the United States during the Spanish-American War (1898). American sovereignty over Guam under international law officially began on April 11, 1899 when the Treaty of Paris was proclaimed law after being signed and ratified by both the U.S. and Spanish governments. Under American occupation, the economy was still subsistence-based. Some Chamorros worked as day laborers on large farms. Chamorro remained the predominant language in villages but English replaced Spanish in schools and government. Employment in government grew with the expanding bureaucracy. There were two civilian labor rates, one for Americans, and a lower one for Chamorros. (Rogers 1995). WWI had little social impact on the society. Government efforts to encourage more agriculture did not succeed and influenza killed 6% of the island population (Rogers 1995).

Volume 2, Chapter 16, Section 16.1.2 details recent socioeconomic trends on Guam (between 1950 and 2010). Guam's population rose in the 1950s and 1960s, plateaued between 1970 and 1990 and has since declined. This trend is expected to continue. The military population was highest in 1950 and lessened through the 1980s with an increase from the later 1980s through 1990s. This increase was attributable to cold war military spending and the closing of U.S. bases in the Philippines. Super typhoon Karen in the 1960s left many Guam residents homeless. Pan American clipper service from Japan sparked tourism businesses and support services. The economy stagnated in the 1970s to early 1980s, partly due to the 1973 oil embargo. During the 1980s, corresponding to the reduction in military population, military lands were released, including Naval Station Agana. Tourism peaked between 1995 and 1997 but ended with the Japanese financial crisis in 1997. Super typhoon Pongsona and the September 11 terrorist attacks affected the tourism market that was on the verge of recovery. In 2005, tourism was the second largest private industry.

Socioeconomics under No Action Alternative

Unlike most of the resources in this EIS, socioeconomic systems would not remain at baseline conditions if the preferred alternatives are not implemented. Economies and population levels change due to other reasons. Furthermore, the announcement of the intended relocation has already had socioeconomic

consequences, such that a decision not to follow through on the military relocation would have short-term effects associated with a reversal of those consequences.

Population under No Action Alternative

Project related population in-migration and associated demographic and household characteristic impacts would not occur. Overall Guam population could be expected to develop according to baseline trends which show Guam's population continuing to increase but at slower rates than the recent past. The 2010 Census will provide an update on population trends for Guam.

Guam Economy under No Action Alternative

In the short term, a decision not to implement the preferred alternatives would deflate any current speculative activity attributable to the preferred alternatives. Real estate values in particular would likely drop, thereby hurting investors, but increasing the affordability of housing. The contrast between the business community's expectations and no action would likely produce a period of pessimism about Guam's economic future.

Long term, the island's prospects would remain linked to international economic conditions and the health of its tourism industry. Conceivably, a smaller military profile might remove some barriers to growing the potential Chinese tourism market. Growth would resume, though probably with the same volatility experienced in recent decades.

Guam Public Services under No Action Alternative

The public service agencies would not face pressure to expand professional staffing; agencies involved in planning and regulating growth would not experience such a sharp increase in workload. Agencies that are required to implement major infrastructure developments – such as the ports and highways – would have substantially more time to implement long-term plans, rather than having to achieve much of their objectives over the next few years.

From a broad viewpoint, no action and the elimination of prospective long-term revenues expected from the preferred alternatives, GovGuam agencies would continue to face the difficult financial condition they have faced in recent years. At least for the foreseeable future, this would negatively impact the various service agencies because of budget cuts, and would probably represent the most important overall consequence for GovGuam.

Sociocultural Issues under No Action Alternative

To the extent that Guam experiences job losses, crime rates may rise in the short term. The political attention given to some contentious issues linked to public perceptions and concerns of the proposed action would likely recede. Military-civilian relations would likely remain at the current generally positive level.

The incentive for increased in-migration from the FAS would decrease, reducing potential sociocultural impacts. However, current incentives for providing support for those populations – both on Guam and the Micronesian states themselves – would be lessened, with detrimental implications for those populations.

Land Acquisition under No Action Alternative

Under no action, no land acquisition would occur. There would be no potential for effects on individuals, the community at large, or GovGuam.

Utility Rates under No Action Alternative

There would be no need for greater funding contributions from DoD for upgrades in wastewater treatment systems on Guam if the preferred alternatives are not implemented, i.e., no action is taken. Under no action, the lack of an increased demand for water would not put pressure on further developing the sole source aquifer in northern Guam. Similarly, no action would not increase demand for power. Existing Guam power plants would not benefit from any expansion in the rate payer base to help finance the maintenance, refurbishing or improvement of air quality aspects that currently exist. Some utility rate increases are already planned that would occur with or without the proposed actions.

Roadway Construction under No Action Alternative

Under no action, only roadway projects needed for organic growth on Guam would be constructed. Intensive construction activities would not result; therefore, there would be no potential for effects on neighborhoods and businesses. No action may also result in impacts from property acquisition and relocation associated with GovGuam planned projects, as opposed to DoD's planned projects. The proposed mitigation by GovGuam can be identified and implemented to reduce potential impacts to a less than significant level.

Tinian

Volume 3, Chapter 16, Section 16.1 provides an overview of recent socioeconomic trends for CNMI in general and Tinian in particular.

From a historical perspective, the island of Tinian is most well known as the forward base from where nuclear attacks on Japan were launched in 1945. Most residents moved from Tinian following the close of the war. In recent years the airstrip has become an attraction for Tinian's small tourism industry. However, Tinian has remained a quiet and lightly populated island.

The leasing of land (the MLA) from the CNMI by the federal government has been an economic factor since January 6, 1983. The lease agreement is effective for 50 years (until year 2028), with a 50 year renewal option. The CNMI and DoD have a leaseback agreement for a portion of the public lands (LBA lands) leased to the military. The CNMI government issues permits for the leaseback lands on Tinian for scattered small agricultural and grazing operations. The military has also ceded some lands in and around the West Field back to the local government of Tinian to build and operate the civilian airport. The portion of the MLA that is utilized by the military is called the Exclusive Military Use Area and is open to the public only during times when military training is not occurring. The LBA, on the other hand, is a joint use area at all times and military and civilian activities on this land must be compatible. The various military services have conducted sporadic training exercises on Tinian. While there is no permanent residential population on the military's land, it is usually available for resident food-gathering and recreation, and for tour business access to beaches and historical sites.

Tinian's economy is dominated by one existing casino, a small tourism trade centered on the island's role in WWII, and marine activities such as diving. In the early 1990s the island had a tuna transshipment and freezer facility, but this facility closed late in the decade when its owner entered bankruptcy. Agriculture on the island is primarily of a subsistence nature, though there is some small cash cropping of vegetables. Cattle-ranching has been promoted as a growth industry on Tinian but remains in its early stages. Both cattle ranching and tourism are dependent on access to the MLA. Household income on Tinian is derived mainly from CNMI government employment and a small retail trade sector. Casino gaming revenues enter the economy through tax revenues to the local government. The existing casino has been staffed almost

entirely with foreign guest workers, as longtime Tinian residents are more likely to seek work in the higher-paying government sector.

The Tinian casino and resort economy is reliant upon the Asian market. In the late 1970s, the people of Tinian decided to permit gambling on the island through construction of up to five casinos. The Tinian Dynasty Hotel and Casino, the only casino operating on Tinian, is at risk of closure for two reasons. The first is because a large percentage of its Chinese customer base is no longer visiting the casino. The second is because the availability of a foreign labor workforce is now threatened by re-federalization. Few of the current military personnel on Guam have spent rest and relaxation time on Tinian. The visitor population declined approximately 30% from 2005 to 2008. Insufficient transportation infrastructure is noted as a barrier to further tourism development throughout Tinian, and as a factor in the Tinian Dynasty's low occupancy rate and financial performance. The recent reduction in air travel and corresponding slump in tourist numbers on all the CNMI islands has led to less revenue going to any island. That, coupled with rising fuel and food prices, has made living on Tinian economically difficult for residents.

Under the no-action alternative, military training on a smaller scale would continue in the MLA, consistent with the existing Marianas Integrated Range Complex guidelines. No additional ranges or infrastructure would be built. Access to the MLA, for any social or economic reasons, would remain the same as at present. Wages would still rise to federal minimums. Federalization of the CNMI's immigration would restrict access to willing foreign laborers by the end of the transition period in 2014. Also, the global finance collapse appears likely to threaten future casino investment. Therefore, even without the development of additional ranges in the military lease area, Tinian's economy would still experience a contraction like the rest of the CNMI. However, the disappointment of expectations Tinian residents have long held about the benefits from a full-fledged military base may be especially acute if no action at all is taken, resulting in significant impacts to military-civilian relations.

3.3.15.3 Comparison of Preferred Alternatives to No Action

The proposed military relocation represents a large infusion of people, spending, and capital improvement projects within a short time period, and in a small place. Socioeconomic impacts would be felt island-wide and by all island inhabitants. Military spending for facilities and infrastructure would generate economic and social consequences that would peak in the middle of the next decade. Impacts over the longer term would return to current conditions, with the exception of a larger presence of the permanent military, and associated induced population, than has existed on Guam in recent years.

The next sections summarize the socioeconomic impacts that would occur, divided by the socioeconomic sub-categories population, economic, public service, sociocultural, land acquisition and roadway construction. The tables below provide a summary of the socioeconomic impacts identified on Guam in Volumes 2, 4, 5 and 6 with one exception. Volume 6, Chapter 17 utilizes a different methodology in determining the economic impacts of roadway construction which is consistent with FHWA methodology. The roadway construction impacts presented below have been normalized to be consistent with the impact methodology used in the other volumes of this EIS. This methodology is described in Chapter 2 of the Socioeconomic Impact Assessment Study (SIAS), located in Volume 9 Appendix F.

<u>Population Impacts - Guam</u>

Table 3.3-41 presents an estimate of the annual population increase of off-island people that would result from implementation of the preferred alternatives.

Table 3.3-41. Estimated Total Population Increase on Guam from Off-Island (Direct, Indirect and Induced)

Populations	*Construction*	*Operation*
Direct DoD Population[1]		
Active Duty Marine Corps	10,552	10,552
Marine Corps Dependents	9,000	9,000
Active Duty Navy[2]	0	0
Navy Dependents	0	0
Active Duty Army	50	630
Army Dependents	0	950
Civilian Military Workers	1,720	1,836
Civilian Military Worker Dependents	1,634	1,745
Off-Island Construction Workers (DoD Projects)[3]	18,374	0
Dependents of Off-Island Construction Workers (DoD Projects)	4,721	0
Direct DoD Subtotal	**46,052**	**24,713**
Indirect and Induced Population		
Off-Island Workers for Indirect/ Induced Jobs[3]	16,988	4,482
Dependents of Off-Island Workers for Indirect/Induced Jobs	16,138	4,413
Indirect/Induced Subtotal	**33,126**	**8,895**
Total Population	**79,178**	**33,608**

Notes:
[1] DoD population includes military personnel, dependents, and DoD civilian workers from off island.
[2] The Navy rows do not include increases from the transient presence of an aircraft carrier strike group (CSG).
[3] Population figures do not include Guam residents who obtain employment as a result of the proposed action.

The initial influx of military, military related, construction, and indirect/induced total population in 2010 is estimated to be approximately 11,000 people. This annual amount would be expected to grow substantially through the mid-decade, and peak at approximately 79,000 people. Following the completion of the majority of the relocation construction program, the population would decline from this peak, but would result in an increase over the current presence of DoD population on Guam by approximately 33,000 total people.

This rapid and substantial increase in population on Guam would create opportunities and problems. In the short term, there could be significant negative impacts caused by rapid population growth that would have to be managed by the government, as well as by responses from the private market sector. Over the longer term, it is probable that the larger "steady state" of DoD population would be accommodated on Guam, and that there would be beneficial effects from the stable presence of the military, their families, and related population.

Economic Impacts - Guam

Civilian Labor Force Demand

Labor force demand refers to the jobs and workers needed to fill them. This analysis includes civilian jobs only, including federal civilian workers, and other jobs from spin-off economic growth.

Table 3.3-42 demonstrates that the preferred alternatives would generate the summary of impacts of 43,278 workers at the 2014 peak, and would decline to about 6,930 after construction abates by 2017. This many jobs would be considered a significant beneficial impact on Guam. However, this rapid swing in the number of civilian jobs, suggests a sudden decline in economic activity. For many people on Guam, the end of construction would be a welcome return to normalcy; but some businesses would have to cut back, and many workers would have to out-migrate due to job loss.

Table 3.3-42. Impact on Civilian Labor Force Demand – Summary Impacts

Impact	*Construction*	*Operation*
Direct	33,871	5,355
Indirect	9,407	1,576
Total	**43,278**	**6,930**

Additional analysis suggests Guam residents would capture up to 2,700 of the direct on-site construction jobs plus about 3,200 of all other types of jobs during the construction peak of 2012 - 2014. In the later post-construction period, it is estimated that Guam residents would capture about 2,660 of the permanent jobs. These jobs do not currently exist on Guam and represent a beneficial value added effect as a result of the preferred alternatives.

Civilian Labor Force Income

Civilian labor force income refers to the cumulative gross (before deductions for taxes) wages and salaries earned by the civilian labor force. Table 3.3-43 demonstrates that the peak year figure would exceed $1.5 billion, falling back to about $278 million after construction ends in 2017. This clearly would represent a positive impact on Guam.

Table 3.3-43. Impact on Civilian Labor Force Income (Millions of 2008 $) – Summary Impacts

Impact	*Construction*	*Operation*
Direct	$1,095	$217
Indirect	$416	$60
Total	**$1,510**	**$278**

Civilian Housing Demand

The housing unit demand (required number of homes) in this section represents an estimate of the number of units that would be required for the in-migrating Guam civilian population. It excludes temporary, foreign construction workers entering on an H-2B work visa, people assumed to live in the barracks-style dormitory housing provided by contractors (as required by law), and active-duty military personnel, who are assumed all to be housed on base (or on board ship for the Navy action).

Table 3.3-44 demonstrates that the preferred alternative's summary of impacts on housing demand would be a demand for 11,893 new units in the peak year of 2014, falling to just 3,205 after construction ends in 2017.

Table 3.3-44. Demand for New Civilian Housing Units – Summary Effects

Impact	*Construction*	*Operation*
Direct	7,856	1,720
Indirect	4,037	1,485
Total	**11,893**	**3,205**

Civilian Housing Supply

Guam has an excess of vacant, available housing (about 2,800 units) to absorb some of the estimated housing demand. This housing is likely to accommodate private-sector housing demands in 2010. However, the excess capacity is projected to be less than demand in 2011; therefore, new private-market housing supply must be available in 2011, and new housing would have to be built through 2014.

Once the construction period is past its peak in 2015, and if this new housing is provided, the need for new housing construction would diminish to zero, and excess capacity would grow to approximately 8,688. These estimates are shown in Table 3.3-45.

Table 3.3-45. Demand and Supply Needed for New Civilian Housing Units – Summary Impacts

Demand	*Construction*	*Operation*
Combined Action Total Impact	11,893	3,205
Annual Change in Demand	2,452	0
Available Housing Supply (vacant, likely available)	2,787	2,787
Annual Construction Needed to Eliminate Housing Deficit	2,452	0
Over-Supply Future: Surplus Units if Supply Increases to Eliminate Deficit	0	8,688

The housing unit estimates summarized in Table 3.3-45 include the housing surplus in subsequent years; they assume the market will provide all the needed construction-period housing, and that no alternative uses (such as conversion to commercial use) are found for them.

The estimates in Table 3.3-45 are theoretical and are intended to suggest the amount of housing construction required to satisfy increased demand. The table estimates are not intended to imply that construction of new housing would fully respond to the demand, and eliminate a housing deficit. If it did, the result would be an over-supply of housing following the construction period. This sort of over-supply would drive housing prices down for residents, but would likely mean substantial losses for developers and landlords, as well as problems associated with maintenance of large numbers of unoccupied units.

The most likely outcome is a partial response of housing construction in relation to the demand. Nevertheless, this substantial increase in demand for housing, the probable response in supply of houses, and then a decline in demand, would be significant summary impacts of implementing the preferred alternatives.

Effects on Tourism

The summary of impacts on the island's primary private-sector industry would likely be mixed. Hotels would benefit considerably due to prospective increases in occupancy associated with more military-related business travel, visiting friends and family, construction supervisors, etc. Nonetheless, the general service sector could undergo a period of difficulty due to a loss of labor to higher-paying jobs and pressure for increased wages; thereby, impairing competition with inexpensive Asian destinations. Ocean-oriented tourism activities would be affected by increased use by others, and population expansion would increase competition for limited marine resources.

Selected Local GovGuam Revenues

Table 3.3-46 demonstrates that the approximate combined revenues accruing to GovGuam from its three primary sources: 1) gross receipts taxes; 2) corporate income taxes; and 3) personal income taxes could be as high as $423 million in 2014; declining to a stable figure of $104 million after construction ends in 2017.

Table 3.3-46. Impact on Selected GovGuam Tax Receipts (Millions of 2008 $) – Summary Impacts

Impact	*Construction*	*Operation*
Direct	$312.6	$69.4
Indirect	$110.7	$34.8
Summary Total	**$423.3**	**$104.3**

Generally, taxes are collected quarterly or annually and there may be a time lag between when government revenues from these sources are available and when they are needed to pay for services and infrastructure. Infrastructure costs would be heavily front-loaded in the timeframe. Revenue impacts would be significant and beneficial to GovGuam; and subject to the issues of timing and the peaks and valleys associated with construction ramp-up and decline.

Gross Island Product (GIP)

GIP for Guam represents the total market value of all final goods and services produced in a given year. It is equal to total consumer, investment, and government spending, plus the value of exports, minus the value of imports.

Table 3.3-47 shows the total effects could be as high as $1,080 million (nearly $1.1 billion) in 2014, declining to a stable figure of $187 million in 2017.

Table 3.3-47. Impact on Gross Island Product (Millions of 2008 $) – Summary Impacts

Impact	*Construction*	*Operation*
Direct	$544	$100
Indirect	$536	$87
Summary Total	**$1,080**	**$187**

Public Service Impacts - Guam

Public Education Service Impacts

The focus of public service analysis is to calculate the required number of key professional staff, based on service population impacts derived from analysis, as determined by surveys of all the GovGuam agencies discussed here and below (refer to Volume 9 Appendix F SIAS). For public education services, such as the Guam Public School System (GPSS) elementary, intermediate, and high schools, as well as the UOG and Guam Community College (GCC), this refers to teachers or non-adjunct faculty members.

Table 3.3-48 summarizes the combined requirements for these five educational programs due to all of the preferred alternatives from Volumes 2 through 6. It indicates a requirement for 619 teachers/faculty at the 2014 construction peak, and a more stable 148 total additional teacher/faculty for the steady-state operational phase.

Table 3.3-48. Additional Combined Public Education Professional Staff Required – Summary Impacts

Impact	*Construction*	*Operation*
Direct	448	118
Indirect	172	30
Total	**619**	**148**

Additional analysis indicates that the construction and operational phase requirements for the individual agencies are as indicated on Table 3.3-49.

Table 3.3-49. Professional Staff Requirements for Individual Public Education Service Agencies

Agency	*Construction Additional Staff Requirement*	*Steady-State(Operation) Additional Staff Requirement*
GPSS Elementary	290	67
GPSS Intermediate	123	29
GPSS High School	119	28
GCC	31	9
UOG	56	15

Public Health and Social Service Impacts

Based on estimated increases in service population, key professional staff requirements attributable to the preferred alternatives were calculated for Guam Memorial Hospital Authority (GMHA) – both physicians and "nurses and allied health professionals," the Department of Public Health and Social Services' Bureau of Primary Care (DPHSS BPC) medical providers and nursing staff, Bureau of Communicable Disease Control (CDC) communicable disease prevention specialists, Bureau of Family Health and Nursing Services (BFHNS) nursing personnel, the Department of Mental Health and Substance Abuse (DMHSA) mental health professionals, and the Department of Integrated Services for Individuals with Disabilities (DISID) social workers and counselors. Table 3.3-50 summarizes the impacts on all of these agencies due to the preferred alternatives. It indicates a requirement for 245 additional professionals at the 2014 construction peak, and a more stable 56 total professionals for the steady-state operational phase.

Table 3.3-50. Additional Combined Public Health and Social Service Professional Staff Required – Summary Impacts

Impact	*Construction*	*Operation*
Direct	190	44
Indirect	55	13
Total	**245**	**56**

Additional analysis indicates that the construction peak and post-construction steady-state operational phase requirements for the individual agencies are as follows (Table 3.3-51).

Table 3.3-51. Total Additional Professional Staff Requirements for Individual Public Health and Social Service Agencies

Agency	*Construction*	*Operation Additional Staff Requirement*
GMHA Physicians	19	2
GMHA Nurses, Allied Health Professionals	121	13
DPHSS BPC	19	7
DPHSS CDC	14	6
DPHSS BFHNS	10	4
DMHSA	56	22
DISID	6	2

Public Safety Service Impacts

Based on estimated increases in service population, key professional staff requirements attributable to the preferred alternative were calculated for the Guam Police Department (GPD) sworn police officers, Guam Fire Department (GFD) uniformed personnel, Department of Corrections (DoC) custody and security personnel, and the Department of Youth Affairs (DYA) youth service professionals.

Table 3.3-52 summarizes the combined requirements for all such agencies due to the total preferred alternatives action. It indicates a requirement for 318 additional professionals at the 2014 construction peak, and a more stable 116 total professionals for the steady-state operational phase.

Table 3.3-52. Additional Combined Public Safety Professional Staff Required – Summary Impacts

Impact	*2014*	*2020*
Direct	254	98
Indirect	64	18
Total	**318**	**116**

Additional analysis indicates that the construction and operational phase requirements for the individual agencies are as follows (Table 3.3-53).

Table 3.3-53. Professional Staff Requirements for Individual Public Safety Service Agencies

Agency	*Construction staff Requirement*	*Operational Additional Staff Requirement*
GPD	141	60
GFD	77	12
DoC	54	16
DYA	44	28

Other Selected General Services Impacts

The other services selected for analysis were the Guam Department of Parks and Recreation (GDPR), the Guam Public Library System (GPLS), and the Guam Judiciary.

Table 3.3-54 summarizes the combined requirements for these agencies due to the preferred alternatives. It indicates a requirement for 56 additional professionals at the 2014 construction peak, and a more stable 23 total professionals for the steady-state operational phase.

Table 3.3-54. Combined Additional Professional Staff Required for Other Selected General Service Agencies – Summary Impacts

Impact	*2014*	*2020*
Direct	44	19
Indirect	12	4
Total	**56**	**23**

Additional analysis indicates that the construction and operational phase requirements for the individual agencies are as follows (Table 3.3-55).

Table 3.3-55. Additional Professional Staff Requirements for Other Selected General Service Agencies

Agency	*Construction Staff Requirement*	*Operation Additional Staff Requirement*
GDPR	41	17
GPLS	13	5
Judiciary	3	1

Note: Totals may differ slightly from table above due to rounding.

Growth Permitting and Regulatory Agency Impacts

These agencies' work loads are driven by permit requests, generally in advance of actual population growth, as well as by associated monitoring and enforcement actions. The agencies analyzed were the Department of Public Works (DPW) building permits and inspection function, Department of Land

Management (DLM), Guam Environmental Protection Agency (GEPA), the Bureau of Statistics and Plans' (BSP) Coastal Management Program (CMP), GPA, GWA, GFD, GDPR's Historic Preservation Office (HPO), and the DPHSS Division of Environmental Health (DPHSS DEH). In addition, staffing implications for the Guam Department of Labor's (DoL) Alien Labor Processing and Certification Division (ALPCD) were calculated based on the estimated number of temporary foreign worker H-2B visa petitions to be processed.

Table 3.3-56 summarizes the combined requirements for all growth permitting agencies, due to the preferred alternatives. It indicates the peak construction year for increased number of required FTEs is 2012. At 2012, the requirement for additional permitting related FTEs would be 104; this requirement would decline to a more stable 23 total FTEs for the steady-state operational phase.

Table 3.3-56. Additional Combined Professional Staff (FTE) Required for Development Permitting Agencies

Alterative	*2010*	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Preferred Alternatives	78	95	104	94	73	45	37	23	23	23	23

Note: This table does not distinguish between "direct" and "indirect" impacts as shown in previous tables, because that distinction is less appropriate for this analysis, as growth-related permit reviews occur in advance of the expected actual growth.

Additional analysis indicates that the construction and operational phase requirements for the individual agencies are as listed in Table 3.3-57.

Table 3.3-57. Additional Professional Staff Requirements for Permitting Agencies

Agency	*Construction Years*	*Construction Additional Staff Requirement*	*Steady-State(Operation) Additional Staff Requirement*
DPW	2011	11	1
DLM	2012	14	8
GEPA	2012	29	4
BSP CMP	2013	10	4
GPA	2010-2012	4	1
GWA	2011-2012	7	1
GFD	2011	14	2
GDPR HPO*	2010-2012	4	1
DPHSS DEH	2014	5	2
GDoL ALPCD	2012	16	0

Note: Totals may differ slightly from table above due to variation in peak years.
* The Programmatic Agreement in progress (further described in the Cultural Resources chapter) helps the SHPO with staffing issues by streamlining the Section 106 process. Because staffing requirements to meet federal regulations would be reduced by this agreement, freeing up current staff to work on non-federal projects, the staffing requirements noted in this table may not be as high.

Sociocultural Impacts - Guam

There would likely be impacts on crime and social order, especially during the construction phase, because of the large increase in population. While there is particular concern on Guam, due to media reports about Marine Corps personnel accused of rape and other crimes in Okinawa, the available evidence suggests that military crime rates have been generally low relative to other populations, including civilian populations.

"Community cohesion" refers to positive or negative interactions between individuals or groups. Community cohesion allows people to maintain connections to, and a sense of identification with, their communities. Because of the large influx of populations of different cultural background, including populations from the FAS and military populations, there is potential for cultural conflict, especially in the

opening years of the proposed action. There is potential to mitigate for these conflicts in the long term with cultural awareness and military-civilian outreach programming.

Finally, more non-Chamorro and local voters would potentially affect ongoing and future issues undergoing votes.

Land Acquisition Impacts - Guam

Land acquisition would have both economic and sociocultural impacts on individuals, the community and GovGuam.

While federal regulations regarding land acquisition automatically mitigate for the economic impacts experienced by individual landowners and occupants due to land acquisition, an increase in federally owned or controlled land on Guam, and a reduction in access to lands of sociocultural and recreational importance and possible impacts to the social fabric of the community would result in significant impacts.

Roadway Construction Impacts - Guam

Roadway Construction Effects on Neighborhoods and Businesses

At a neighborhood level, roadway construction can also affect local community cohesion. Because most of the roadway improvements would occur within the existing rights of way (ROW), they would not constitute any new physical or psychological barriers that would divide, disrupt, or isolate neighborhoods, individuals, or community focal points in the corridor. At certain locations, roadway improvements would require the acquisition of additional ROW; however, these would primarily occur adjacent to the existing ROW. Therefore, community cohesion effects would be minimal.

Roadway Construction Effects on Property Acquisition and Relocation

Acquisition of residential, nonresidential, and military property would be required. Residential and nonresidential units would require relocation. Federal and state laws require consistent and fair treatment of landowners (of the property to be acquired), including just compensation for their property. The Uniform Relocation Assistance and Real Property Acquisition Act of 1970, as amended would be followed.

Roadway Construction Effects on Specific Public Services and Facilities

No adverse effects on public services and facilities are anticipated at the site-specific level.

Summary - Guam

As previously illustrated in text and tables, the socioeconomic impacts of the preferred alternatives would be felt on an island-wide basis and would be characterized by a sharp increase in activity and impacts (both positive and negative) in the 2012-2015 timeframe. Overall, the socioeconomic quality of life on Guam would be substantially impacted for several years. Eventually however, a large part of the population that came in for construction work would leave the island.

Summary impacts would include those associated with rapid population influx due to job opportunities (including large populations from the FAS of Micronesia). These include: shortages in housing and working facilities, public services, and qualified workers, as well as increases in the cost of living.

The Marine Corps component of the action would produce the largest and most significant impacts, due to its relatively greater magnitude. The other components of this action, when combined with the Marine Corps component, would produce an overall impact greater than its separate pieces. Particularly important examples include:

- The decline in overall economic activity following the various components' construction periods.
- The challenges in providing housing for the potential growth in private-sector employees. For example, the housing market would have little problem accommodating the Army action alone; however, the Marine Corps action would strain capacity during the boom period.

While differing in magnitude, each component's construction phase would produce the same types of impacts, summing to significant summary impacts. These would include an increase in economic activity, jobs, GIP, and tax revenue.

During the operational phase, the summary impacts would be characterized by a larger Guam population than now exists, although not so large as would have to be accommodated during the 2012-2015 boom period. Economic growth, job numbers, tax revenue, and requirements for housing and public services would all follow this trend. Each action component would contribute to these impacts relative to its size.

In addition the different characteristics of each action component would have different types of impacts, combining in unique ways during the operation phase.

- The Marine Corps component would continue to impact the island most significantly, increasing the island's permanent military population, and creating the potential for more crime and social disorder, as well as concern about loss of Chamorro and local political autonomy.
- The Aircraft Carrier Berthing component, on the other hand, would increase the military presence on the island in a less permanent, more cyclical manner – producing surges of sailors arriving on Guam for periods of shore leave. Thus, this component would influence civilian-military relations in a slightly different manner, especially as periods of shore leave would produce surges of populations on Guam that would be unfamiliar with the local culture.

Over the long term, Guam's economy and quality of life should be significantly enhanced by the preferred alternatives.

Summary - Tinian

Economic impacts to Tinian would be significant due termination of agricultural leases and loss of access to chili peppers in the training areas and within associated SDZs. There would be some increases in employment due to the construction and operational jobs related to the proposed action. Tinian may also see some benefits that are not noted in Volume 3 – increased population and improved economic conditions in the region could spur increased tourism to Tinian.

Public services on Tinian would not be impacted as population is not expected to increase. Sociocultural issues may be significantly impacted under the No Action Alternative as civilian-military relations may be impaired by a failure of the military to meet long-held expectations of holding a presence on the island.

Table 3.3-58 summarizes the impacts on socioeconomics and general services of all components of the preferred alternatives on Guam and Tinian. However, because socioeconomic impacts are island-wide in nature, the discussion is primarily generic rather than specific to alternatives.

Table 3.3-58. Summary of Preferred Alternatives' Impacts, Guam and Tinian

Resource	*Guam*		*Tinian*	
	Preferred Alternatives	*No Action*	*Preferred Alternatives*	*No Action*
Population Impact	SI/BI	NI	NI	NI
Economic Impact (Overall)	BI	NI	SI	NI
Labor Force	BI	NI	BI	NI
Labor Force Income	BI	NI	NI	NI
Standard of Living	BI	NI	NI	NI
Housing	SI	NI	NI	NI
Local Government Revenue	BI	NI	NI	NI
Local Business Opportunities	BI	NI	NI	NI
Tourism	BI	NI	LSI	NI
Gross Island Product	BI	NI	NI	NI
Utility Rate Payer	LSI (SI)	NI	NA	NA
Loss of agricultural Grazing land in Tinian LBA	NA	NA	SI	NA
Public Service Impact (Overall)	SI	NI	SI	NI
Public Education Services	SI	NI	NI	NI
Public Health and Social Services	SI	NI	NI	NI
Public Safety Services	SI	NI	SI	NI
Other Selected General Services	SI	NI	NI	NI
Growth Permitting and Regulatory Agencies	SI	NI	NI	NI
Sociocultural Impact (Overall)	SI	NI	SI	SI
Crime and Social Order	SI	NI	NI	NI
Chamorro Issues	SI	NI	NA	NA
Community Cohesion	SI	NI	SI	SI
Land Acquisition Impact	SI	NI	NA	NA
Roadway Construction Impacts				
Effects on Neighborhoods and Businesses	SI-M	NI	NI	NI
Property Acquisition and Relocation	SI-M	NI	LSI	NI
Site-Specific Public Services and Facilities Impacts	LSI	NI	NI	NI
Summary of Impacts	**SI(SI)**	**NI**	**SI**	**SI**

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact, BI = Beneficial impact, NA = not applicable, ( ) = Indirect (workforce population and induced) population impact; SI/BI = Population increases have inherently mixed impacts (both beneficial and adverse), because population growth fuels economic expansion but sudden growth also strains government services and the social fabric.

3.3.16 Hazardous Materials and Waste

3.3.16.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-59 and 3.3-60 summarize the preferred alternatives' construction and operation potential impacts to soils, water, air, and biota that hazardous materials and hazardous waste would have on Guam and Tinian. The findings from previous volumes are listed. It is assumed that all of the proposed construction actions would occur during a compressed time period, and that all operational activity would commence upon completion of construction.

Table 3.3-59. Summary of Preferred Alternatives' Construction Impacts – Hazardous Materials and Waste

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Soils	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI
Waters (Ground & Surface)	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI
Air	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI
Biota	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI
Hazardous Materials and Waste Construction Impact Summary:									**LSI**	**LSI**

Legend: LSI = Less than significant impact

Table 3.3-60. Summary of Preferred Alternatives' Operation Impacts – Hazardous Materials and Waste

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Soils	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI
Waters (Ground &Surface)	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI
Air	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI
Biota	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI
Hazardous Materials and Waste Operation Impact Summary:									**LSI**	**LSI**

Legend: LSI = Less than significant impact

Guam

The preferred alternative for Guam includes the transport of all necessary supplies, materials, equipment, and expendable and non-expendable resources necessary to perform the Marine Corps, Navy, and AMDTF missions. Without any proposed DoD mission expansion, currently the Defense Reutilization and Marketing Office (DRMO) successfully arranges for the disposal of approximately 594,494 pounds (lbs) (269,658 kilograms [kg]) of hazardous waste annually from DoD Guam operations.

If PCBs, ACM and/or LBP are encountered during demolition, licensed contractors would be used for these projects and comply with all relevant local and federal regulations.

The DRMO, through its contractors, manages, stores, ships, and disposes of hazardous substances (i.e., hazardous materials, toxic substances, and hazardous waste) associated with all DoD installations and operations in Guam. DRMO maintains all required hazardous substances documentation. Furthermore, DRMO contracts with licensed firms for the disposal of these hazardous substances at permitted facilities, typically off-island. However, in the case of asbestos-containing materials (ACM), these materials are disposed of at federal facilities on Guam.

It is expected that the DoD preferred alternatives would result in increased transportation, handling, use, and disposal of hazardous materials and hazardous waste (i.e., an estimated increase of 50% for both).

Potential DoD-related impacts (i.e., to soils, waters, air, and biota) as a result of increases in the use of these substances on Guam from the preferred alternatives would be less than significant.

It is anticipated that the largest increases of hazardous materials would occur primarily from the use of petroleum, oil, and lubricants (POL). Potential hazardous waste increases would include herbicides, pesticides, solvents, corrosive or toxic liquids, paints, and aerosols. Despite expected DoD-related increases in hazardous materials and hazardous wastes, less than significant summary impacts would occur. This conclusion is predicated on the implementation of BMPs and standard operating procedures (SOPs) as discussed in Volumes 2 through 7 and that related plans, procedures, protocol, and permits are updated as necessary. These updates would occur in response to increased demands upon DRMO regarding hazardous substance transportation, handling, storage, usage, and disposal.

The various controls (i.e., BMPs and SOPs) in place to prevent unintended spills, leaks, or releases of these substances (see Volume 7, Chapter 2) include, but are not limited to:

- Spill prevention control and countermeasures plans
- Waste management plans
- Facility response plans
- Stormwater pollution prevention plans
- Hazardous material management plans (e.g., asbestos management plans and lead-based paint management plans, etc.)
- Mandatory personnel hazardous material and hazardous waste training
- Waste minimization plans
- Waste labeling, storage, packaging, staging, and transportation procedures
- DoD waste regulations
- Minimize the use of contaminated sites for new construction. When new projects are planned on sites where contamination and/or MEC has been identified, ensure that the risk of human exposure to contaminated media is minimized through the use of a site-specific health and safety plan, engineering and administrative controls, and appropriate PPE. In addition, as appropriate conduct Phase I and II Environmental Site Assessments prior to construction activities and ensure that designs consider and address contaminated sites as appropriate.
- Ensure that site planning and activities are conducted in accordance with Naval Ordnance Safety and Security Activity (NOSSA) Instruction 8020.15B Explosives Safety Review, Oversight, and Verification of Munitions Responses (DoN 2010).

Furthermore, the preferred alternative's potential increase in hazardous substances would produce less than significant secondary or external effects on Guam's hazardous substance management issues.

Tinian

The CNMI Department of Environmental Quality (DEQ) Hazardous and Solid Waste Management Branch regulates hazardous waste generated within the CNMI. In 1984, the CNMI DEQ adopted the federal hazardous waste regulations under RCRA and the hazardous and solid waste amendments. The CNMI does not have any hazardous waste regulations that are more stringent than USEPA regulations.

When DoD hazardous waste is generated, it is transported to Guam in accordance with DOT regulations to DRMO facilities. Once on Guam, the DRMO arranges for the subsequent transfer and disposal of the hazardous waste off-island at licensed hazardous waste facilities. In the case of ACM, these materials are disposed of at federal facilities on Guam.

For similar reasons described for Guam, the Tinian preferred alternative would result in less than significant summary impacts.

3.3.16.2 No Action

Generally speaking, the trend in hazardous material use is associated with increases in population and industrial activity.

Guam

There are few historical data for Guam on hazardous material, toxic substance, and hazardous waste handling; collectively referred to as hazardous substances. World War II established a high baseline of environmental releases; but overall, the trend in hazardous substance use is associated with increases in population and industrial activity. During the 1970s, there were numerous local and federal environmental regulations enacted to protect human health and the environment and to closely control and regulate the transport, storage, use and disposal of hazardous substances. While the trend in use of hazardous substances is expected to increase over time, regulations currently in place minimize the risk of release to the environment as well as the risk to human health. This trend would continue at a more gradual rate of increase. The impacts are largely related to human activities, but natural events such as typhoons and earthquakes can result in inadvertent releases of regulated hazardous substances.

From 2000 to 2008, the population of Guam rose approximately 1.6% on an average annual basis. This growth in population, and subsequent commercial development, resulted in an increased demand for the transportation, handling, use, and disposal of hazardous substances. The types of Guam businesses that require hazardous substance management and disposal include: ports, airports, hotels, power generation facilities, hospitals, automobile repair facilities, automobile junkyards, gas stations/fueling facilities, underground storage tanks (USTs), dry cleaners, industrial/commercial operations, etc.

These non-DoD generated hazardous substances would be managed in a similar fashion to DoD-generated hazardous substances (i.e., generally disposed of at permitted off-island facilities except, for ACM). In December 1998, the GEPA created its Hazardous Waste Management Program. This Program specifies requirements regarding hazardous substance permitting, collection and treatment, storage, and disposal. In addition, the program requires various inspection, compliance monitoring, enforcement, and corrective actions for hazardous waste-related activities and sites. Furthermore, Guam's *Hasso Guam! Household Hazardous Waste Collection Program*, a component of the Hazardous Waste Management Program, has been successful in collecting and disposing of various hazardous substances. For example, thousands of lead acid car batteries, and thousands of gallons of used paint, have been collected for safe disposal. In addition, under GEPA's Hazardous Waste Management Program, generators of hazardous waste are required to submit annual reports to the GEPA that document the generated hazardous substance quantities, waste codes, disposal facility information, and other pertinent information.

Under no action, the DoD proposed mission expansion on Guam would not occur. However, existing DoD-related hazardous substance management activities would continue. Because of the growth in Guam's population, and the subsequent growth in commercialization, increased quantities of hazardous substances would be required to be managed, even absent the preferred alternatives. The current non-DoD Guam hazardous substance infrastructure is subject to similar hazardous substance management requirements, as implemented by the DoD. Consequently, no action would result in less than significant hazardous substance impacts.

Tinian

For reasons previously described for Guam, the no action alternative on Tinian would result in less than significant impacts.

3.3.16.3 Comparison of Preferred Alternatives to No Action

No action and the preferred alternatives for both Guam and Tinian would result in less than significant impacts to soils, surface water, groundwater, air, or biota, with respect to hazardous materials and hazardous waste. Neither of the scenarios can be classified as having "no impact" because with all operations using hazardous substances, there is a possibility for inadvertent leaks, spills, or releases. Therefore, all the alternatives discussed for Guam and Tinian have been assigned a less than significant summary of impacts. Most of these controls, except the DoD-specific regulations, are also applicable to civilian actions. Prior to the enactment of hazardous waste regulations in Guam or Tinian, wastes were not always managed responsibly and resulted in impacts to the environment. Subsequently, adopted regulations have served to control the number of unauthorized spills, leaks, or release occurrences on Guam and Tinian.

Despite expected increases in hazardous substances, less than significant summary impacts would occur, if the controls discussed above are appropriately implemented. In summary, less than significant impacts (i.e., primary or secondary/external effects) are expected on Guam or Tinian, related to DoD or non-DoD operations relative to the hazardous substances management and disposal.

3.3.17 Public Health and Safety

3.3.17.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-61 and 3.3-62 summarize the preferred alternatives' construction and operation impacts to public health and safety on Guam and Tinian. A text summary follows the tables. The public health and safety analysis included the combined direct and indirect impacts for Volumes 2, 3, 4 and 5. Volume 6 distinguishes between direct and indirect (workforce housing and induced population) impacts and identifies levels of significance for each. For Guam, the greatest level of impact identified among all the volumes is listed in the last Guam column. The summary of impacts for Tinian's preferred alternatives is listed in the far right column of the tables. It is assumed that all of the proposed construction actions would occur during a compressed time period, and that all operational activity would commence upon completion of construction.

Table 3.3-61. Summary of Preferred Alternatives' Construction Impacts – Public Health and Safety

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Operational Safety	NI	NA	NA	NA	NA	NA	NA	NA	NI	NI
Aircraft Mishaps	NI	NA	NA	NA	NA	NA	NA	NA	NI	NI
Explosive Safety	NI	NA	NA	NA	NA	NA	NA	NA	NI	NI
Electromagnetic Safety	NI	NA	NA	NA	NA	NA	NA	NA	NI	NI
Noise	LSI	LSI	NA	NA	NA	NA	NA	NI	LSI	LSI
Water Quality	SI	SI	SI	NA	NA	NA	NA	NI	SI	NI
Air Quality	LSI	LSI	LSI	NA	NA	NA	NA	NI	LSI	LSI
Health Care Services	SI	LSI	SI	NA	NA	NA	NA	NI	SI	NI
Notifiable Diseases	SI	LSI	SI	LSI	LSI	LSI	LSI	NI	SI	NI
Mental Illness	SI	LSI	LSI	NI	NI	NI	NI	NI	SI	NI
Hazardous Substances	NI	NI	NI	NA	NA	NA	NA	LSI	LSI	NI
Traffic Incidents	LSI	NI	NI	LSI	LSI	LSI	LSI	LSI	LSI	NI
Unexploded ordnance (UXO)	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI
Radiological Substances	NA	NI	NA	NA	NA	NA	NA	NA	NI	NI
Public Services (includes protective services)	SI	LSI	NI	NA	NA	NA	NA	NI	SI	NI
Public Health and Safety Construction Impact Summary:									**SI**	**LSI**

Legend: SI = Significant impact, LSI = Less than significant impact, NI = No impact, NA = Not applicable.

Table 3.3-62. Summary of Preferred Alternatives' Operation Impacts – Public Health and Safety

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste-water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Operational Safety	NI	NA	NA	NA	NA	NA	NA	NA	NI	LSI
Aircraft Mishaps	NI	NA	NA	NA	NA	NA	NA	NA	NI	LSI
Explosive Safety	NI	NA	NA	NA	NA	NA	NA	NA	NI	LSI
Electromagnetic Safety	NI	NA	NA	NA	NA	NA	NA	NA	NI	NA
Noise	SI	LSI	NA	NA	NA	NA	NA	NA	SI	LSI
Water Quality	SI	SI	SI	NA	LSI (SI)	NA	NA	LSI	SI (SI)	NI
Air Quality	LSI	LSI	LSI	LSI	NA	NA	NA	LSI	LSI	LSI
Health Care Services	SI	LSI	SI	LSI (LSI)	LSI (SI)	LSI (SI)	NI	NA	SI (SI)	NI
Notifiable Diseases	SI	LSI	SI	SI (SI)	SI (SI)	SI (SI)	NI	NA	SI (SI)	NI
Mental Illness	SI	LSI	LSI	NI	NI	NI	NI	NA	SI	NI
Hazardous Substances	NI	NI	NI	NA	NA	NA	NA	LSI	LSI	NI
Traffic Incidents	LSI	LSI	NI	LSI (LSI)	LSI (LSI)	LSI (LSI)	LSI (LSI)	LSI	LSI (LSI)	NI
UXO	LSI	LSI	LSI	NA	NA	NA	NA	LSI	LSI	LSI
Radiological Substances	NA	NI	NA	NA	NA	NA	NA	NA	NI	NA
Public Services (includes protective services)	SI	LSI	NI	NA	NA	NA	NA	NA	SI	NI
Public Health and Safety Operation Impact Summary:									**SI (SI)**	**LSI**

Legend: SI = Significant impact, LSI = Less than significant impact, NI = No impact, ( ) = Indirect (workforce population and induced) population impact

The preferred alternatives would have no impact on public health and safety related to operational safety, aircraft mishaps, explosive safety, or electromagnetic safety. Potential noise and air quality impacts on public health and safety resulting from construction and operations of the preferred alternatives would be less than significant.

Existing water supply distribution and wastewater treatment inadequacies could be exacerbated by the influx of construction workers and other induced population resulting in an increase in illness. The Guam Water Authority (GWA) water system infrastructure does not meet the basic flow and pressure requirements for all customers. These conditions can result in microbiological and other contaminants entering the distribution system potentially resulting in illness. GWA water distribution system problems also exist, which may result in customers receiving inadequate supply/service. The DoD acknowledges the existing sub-standard conditions of the potable water and wastewater treatment systems on Guam and the

interest to have DoD fund improvements to these systems. DoD's ability to fund infrastructure improvements is limited by federal law. However, to minimize adverse impacts associated with the proposed military relocation program, the DoD is leading a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam. The DoD cannot repair GWA distribution system problems but would attempt to identify ways to address them via the federal interagency task force.

While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield and monitoring of groundwater chemistry would ensure no harm to existing or beneficial use. However, since it is doubtful that GWA could fund and implement required upgrades to the water system in time for the proposed DoD buildup, it is anticipated that public health and safety impacts from increased demand on potable water and potential water-related illnesses would be significant.

Air emissions of the preferred alternatives would be less than significant. Air pollution can harm individuals when it accumulates in the air in high enough concentrations. Sensitive populations include children, older adults, people who are active outdoors, and people with heart or lung diseases, such as asthma. Because air emission increases would be less than significant, it is anticipated that Guam Clinics and hospital would have adequate staffing to handle air quality-related illnesses; therefore, less than significant impacts to health care services are anticipated.

The population increase with the construction workforce and other induced population would have a potentially significant effect on health care service providers on Guam. During operations, when Guam's population decreases there would continue to be impacts from water- and air-related illness. There is no population increase proposed for Tinian; therefore, there would be no population-related impacts to health and health care services on Tinian.

A potential increase in disease occurrences due to the addition of approximately 21,262 personnel and dependents and 18,374 construction employees (peak construction force in 2014) are anticipated. A natural annual increase of 1.4% in the Guam population is also anticipated, resulting in a population of approximately 201,095 by the year 2019. With the increase in military and dependent personnel, the total Guam population would be approximately 222,357 in 2019. Using the average per capita rates for notifiable diseases on Guam, the potential increase in disease occurrences was estimated based on the natural increase in population and the anticipated arrival of military personnel and their dependants. The construction workforce visiting Guam from other countries to support construction requirements (peak construction force of 18,374 in 2014) would have the potential to contribute notifiable disease incidents during the construction period (2010 to 2016). The largest potential increase in disease occurrences is that of STDs (8% increase/77 new cases annually).

A potential increase in mental illness occurrences due to the addition of 21,262 personnel and dependents, the construction workforce, as well as the natural population increase, would be anticipated. Based on the average per capita rates for mental illness on Guam, the potential increase in mental illness occurrences was estimated based on the natural increase in population as well as the anticipated military personnel moving to Guam. Based on the anticipated 2019 population of Guam, the annual number of mental illness cases could increase by 20 to a total of 247 cases and this is considered a significant impact.

There is no population increase proposed for Tinian; therefore, there would be no population-related disease or mental illness impacts on Tinian. Public health and safety impacts related to hazardous substances would be less than significant.

It is estimated that the annual number of traffic accidents and fatalities could increase based on projected population increases but the impacts are less than significant. Several common factors appear to contribute to liberty incidents including: young personnel, late nights, impaired driving, and alcohol/drugs. Some of the actions that would be implemented to reduce traffic incidents during liberty include:

- Increase awareness training regarding the consequences of drugs and alcohol use;
- Declare specific off-base bars/clubs off-limits;
- Increase Shore Patrol activity; and
- Provide free shuttle bus runs to/from town.

On Guam, any ground disturbance has the potential to disturb UXO; however, there are established SOPs that would be implemented prior to and during construction, which would mitigate the impact to less than significant at the project sites. There would be no impact to public health and safety from radiological substances.

It is anticipated that the GPD and GFD would not be able to increase staffing to meet current service ratios unless the federal inter-agency task force succeeds in finding funding and/or other assistance to help upgrade deficiencies; therefore, significant impacts to police and fire service are anticipated. There is no population increase proposed for Tinian; therefore, there would be no impacts on police or fire services on Tinian.

The DoD acknowledges the existing sub-standard conditions of infrastructure, health care services and protective services on Guam and the interest to have DoD fund improvements to these services. DoD's ability to fund these services is limited by federal law. However, to minimize adverse impacts associated with the proposed military relocation program, the DoD is leading a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam.

3.3.17.2 No Action

The trends in public health and safety are a function of changes in population and operation, or industries that involve dangerous materials (e.g., hazardous substances, live ammunition, electromagnetic energy, radiological substances). The socioeconomics section describes changes in population over time. As of the most recent U.S. Census of 2000, Guam's population was 154,805. In 2008, the U.S. Census Bureau provided a more recent estimate of Guam's population of 175,877. The island's population has grown significantly since becoming a U.S. Territory. From 1950 to 2000, Guam's population grew at an average rate of 21% per decade (about 2.1% annually). However, the Census Bureau projects that this growth would taper off, possibly due to outmigration rates observed around 2002; this is the same year as the estimates used in Table 3.3-64.

From 1970 to 2000, the population on Tinian increased, but it declined in subsequent years. The two new planned resorts would provide construction and operation employment that may lead to increases in the Tinian population, but in the near-term, population is expected to continue to decline. With the declining population, there would be an anticipated decrease in traffic accidents and notifiable disease incidents. There would be no increased electromagnetic energy risks, radiological risks, or expectations of aircraft mishaps.

Operational Safety

There are industries and operations in the civilian community on Guam and Tinian with inherent risks of accidents (e.g., law enforcement, heavy equipment operations and repair, manufacturing). The accident trends are expected to remain constant.

Aircraft Mishaps

On Guam and Tinian, no action would continue to include a risk of aircraft mishaps at the commercial and military airfields. The risk would increase with increased air traffic via an increase in tourism; the economy would continue to go through cycles of prosperity.

Explosive Safety

Ammunition is used by the civilian population either for recreation (e.g., target practice, hunting) or law enforcement on both islands; the trend in use is expected to remain the same. The military would continue to use ammunition on both islands, but only Guam has storage facilities that generate explosive safety arcs. The quantity of military ammunition stored is driven by mission requirements. The quantity of ammunition used by the civilian population is small relative to the military, and is likely to slowly increase with population growth.

Notifiable Diseases, Mental Health, Traffic Incidents

The increase in population growth on Guam would result in a proportionate increase in notifiable diseases, mental health issues, and traffic incidents. The Tinian health and public services are sub-standard due to lack of funding. This trend is likely to continue in the absence of economic development.

UXO

There are UXOs on non-federal lands in Guam as a result of WWII. The amount of UXO would not change appreciably over time. Earthmoving activities could disturb the UXO; excavation for building foundations, roads, underground utilities, and other infrastructure could encounter unexploded military munitions. Construction on Guam requires a health and safety plan; a response to inadvertent discovery of UXO would be included. The appropriate response would be to cease construction, clear the area, call the police, and call DoD explosive safety personnel. If UXO are uncovered during any other activity, the appropriate response would be to call the police.

Tinian was an active battlefield during WWII. As a result of the occupation and defense of the island by Japanese forces, and the assault by Allied/American forces to take the island, unexploded military munitions remain. The risks are similar to those described for Guam.

Radiological Substances

Hospitals and medical clinics use radiology as a diagnostic tool; transport, handling, and disposal of radiological substances are heavily regulated. Presumably, changes in population would result in the proportional changes in the medical use of radiological substances.

3.3.17.3 Comparison of Preferred Alternatives to No Action

On Guam, the potential increase in disease occurrences, mental illness, and traffic incidents, would be very low relative to no action, as shown in Tables 3.3-63 and 3.3-64.

Table 3.3-63. Potential Disease Occurrence Increase, Guam

Disease	*Average Rate*	*Annual Average 1997-2006*	*Preferred Alternative*	*No Action Increase(b)*	*Difference (a)*
AIDS	1/32,678	5	7	6	1
Cholera	1/163,389	1	1	1	0
Dengue	1/163,389	1	1	1	0
Hepatitis C	1/52,706	3.1	4	4	0
Malaria	1/163,389	1	1	1	0
Measles	1/90,772	1.8	2	2	0
Rubella	1/2,768,033	0.2	<1	<1	0
Typhoid Fever	1/233,412	0.7	<1	<1	0
STDs	1/243	671	915	838	77
TB	1/2,416	67.5	95	79	16

Notes: AIDS= Acquired Immune Deficiency Syndrome, STD= Sexually Transmitted Disease, TB= Tuberculosis,
(a) Difference between preferred alternative increase in average number of diseases per year and the no-action alternative increase. (b) Based on natural increase in population.

Table 3.3-64. Potential Traffic Accident Increase, Guam

Accidents	*Average Rate*	*Annual Average 2001-2005*	*Preferred Alternative Increase*	*No Action Increase(b)*	*Difference (a)*
Accidents	1/26	6,651	8,894	8,044	850
Fatalities	1/9,717	18	24	22	2

Notes: (a) Difference between Alternative 2, increase in average number of traffic accidents and fatalities per year and the No Action increase. (b) Based on natural increase in population.

In the absence of the preferred alternative, there are no other notable increases in health and safety risk anticipated on Guam. Under no action, there would continue to be a minor increase in population, and associated increases in disease and traffic incidents. The increases in population on Guam would also result in an increased need for public services (i.e., health care professionals, police, firefighters); anticipated personnel increases for these services would allow current service levels to be maintained. The trend would be the same as it has been in recent history.

On Tinian, there is no appreciable difference between the preferred alternatives and no action, with respect to health and safety issues. The increase in population due to the planned resorts may have a less than significant impact on the Tinian population, but the preferred alternatives would not.

The risk of a radiological or aircraft incident would be higher under the preferred alternative on Guam, as a result of aircraft carrier berthing on the island, and because more military aircraft would be in operation.

Under no action on Tinian, there would be no aircraft carrier berthing actions and the number of aircraft operations would be smaller (limited to minimal civilian and military aircraft operations).

The preferred alternatives on both Guam and Tinian would result in construction, and there would be an increased risk of uncovering UXO; but with appropriate health and safety plans, the risks would be less than significant. Under no action, although there is no significant construction planned, there is always a risk on Guam and Tinian of discovering UXO; therefore, UXO would continue to be a risk resulting in a less than significant impact.

Construction and operational activities associated with the preferred alternative would have the potential to increase noise levels and pollutant emissions, which could result in health impacts to individuals on Guam. The anticipated increases in noise and pollutants are considered less than significant. Because Guam clinics and hospital would increase staffing to meet current health care service ratios and would be capable

of handling a potential increase in air quality- and noise-related illnesses, less than significant impacts would be anticipated from construction and operational activities. The potential impacts of increased noise and pollution on Tinian would be less, due to less construction and fewer operational activities proposed on the island.

3.3.18 Environmental Justice and the Protection of Children

3.3.18.1 Summary of Preferred Alternatives' Impacts

Anticipated disproportionately high and adverse effects in terms of Environmental Justice and Protection of Children, relate to socioeconomics and public health and social services. The populations of interest are low income, racial minority, and children.

If a resource area did not have significant impacts, or impacts were mitigable to less than significant, as analyzed in each individual chapter in Volumes 2 through 6, then it was not further analyzed in the Environmental Justice and Protection of Children chapters. These resources are: geology and soils, water resources, air quality, airspace, biological resources, cultural resources, visual, marine transportation, and hazardous materials and waste.

Construction-related noise and traffic are reduced with implementation of noise and traffic reduction BMPs and proposed mitigation measures, as described in the noise chapter of each volume, Volume 6 for traffic, and as summarized in Volume 7 Chapter 2. Construction would not result in disproportionately high and adverse effects on populations of interest.

Table 3.3-65. Summary of Preferred Alternatives' Construction Impacts – Environmental Justice and the Protection of Children

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Wastewater*	*Solid Waste*	*Off-base Road-ways*		*Training*
Marine Biology	NA	NI	NA	NA	NA	NA	NA	NA	NI	NA
Traffic	NA	NA	NA	NI	NI	NI	NI	NI	NI	NA
Noise	NI	NI	NI	NI	NI	NI	NI	NI	NI	NA
Socio-economics	SI	NI	SI	NI	NI	NI	NI	NA	SI	NA
Public Health/ Public Safety	SI/NI	NI/NI	SI/NI	NI	NI	NI	NI	NI	SI/NI	NI
Environmental Justice Construction Impact Summary:									**SI**	**NI**

Legend: SI = Significant impact, NI = No impact on the entire island, NA = Not Applicable, SI/NI= different impact for public health and public safety.

Proposed roadway improvements would be a beneficial impact to low-income populations living near proposed roadway projects, particularly over the long-term operation of the preferred alternatives. Potentially significant impacts to public health care services and socioeconomics could result in disproportionately high and adverse effects on low-income populations and children of low-income families. These impacts could potentially be reduced with implementation of proposed mitigation measures identified in Volume 2, Chapter 16.

The DoD acknowledges the existing sub-standard conditions of social services on Guam and the interest to have DoD fund improvements to these services. DoD's ability to fund these services is limited by federal law. However, to minimize adverse impacts on public health care and protective services associated with the proposed military relocation program, the DoD is leading a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam.

Significant impacts to low-income groups could occur on Tinian. Tinian ranchers would be disproportionately impacted by the proposed actions because their grazing rights in the leased land areas would end. Local workers who currently collect and sell wild chili-peppers in the leased area (most of whom are presumably part of the low-income population of the island) would also be disproportionately impacted because their access to these resources would be restricted.

Table 3.3-66. Summary of Preferred Alternatives' Operation Impacts – Environmental Justice and the Protection of Children

Resource Categories	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary of Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Off-base Road-ways*		*Training*
Marine Biology	NA	NI	NA	NA	NA	NA	NA	NA	NI	NA
Traffic	NA	NA	NA	NA	NA	NA	NA	BI	BI	NA
Noise	NI	NA	NA	NI	NA	NA	NA	NA	NI	NA
Land Use	NI	NA	NA	NI	NA	NA	NA	NA	NI	SI
Recreational Resources	NI	NA	NA	NI	NA	NA	NA	NA	NI	NI
Socio-economics	SI	NI	NI	NI	NI (SI)	NI (SI)	NI	NA	SI (SI)	SI
Public Health/Public Safety	SI/NI	NI/NI	SI/NI	NI/NI	NI (SI)/ NI (SI)	NI (SI)/ NI(NI)	NI/NI	NI/NI	SI (NI)	NI
Environmental Justice Operation Impact Summary:									**SI (SI)**	**SI**

Legend: BI = Beneficial impact, SI = Significant impact, NI = No impact on the entire island, NA = Not applicable; ( ) = Indirect (workforce population and induced) population ; SI/NI= different impact for public health and public safety..

3.3.18.2 No Action

As discussed in Volume 2, U.S. Census (2000) statistics indicate that overall, the population on Guam has a higher percentage of racial minorities, low-income populations, and children, than the continental U.S. While Guam's demographic, social, and economic profile generally contrasts with that of the continental U.S., it is similar to that of other islands in the Pacific. The island has been occupied by foreign nations throughout its history, and its economic struggle has been a historical trend. If the preferred alternatives are not implemented, the potential impacts associated with them would not occur. Much of the island's population would likely continue to struggle with poverty and access to basic quality community services.

The island-wide population would not experience the long-term benefits from roadway infrastructure improvements. Existing inadequate roads and utilities would likely continue to deteriorate, having an adverse and disproportionate impact on disadvantaged residents of Guam.

No land would be acquired by the federal government, and cultural resources that would have had restricted access under the preferred alternative, would remain accessible to Chamorros. Recreational resources, such as the Guam International Raceway and Pagat Trail, would remain accessible to the public. No action would facilitate the continued existence and accessibility of several cultural and historic resources that are valued by residents of Guam.

Tinian's population when compared to a village on Guam with a similar demographic profile (Dededo), and the U.S. population as a whole, has a high percentage of racial minorities and households living in poverty. The trend is expected to remain the same or worsen in the absence of economic development.

3.3.18.3 Comparison of Preferred Alternatives to No Action

The summary impacts of the preferred alternatives would be both beneficial and adverse. The island of Guam is unique in that a majority of the population of Guam meets the criteria for being an Asian Pacific minority group in the context of the overall U.S. population. The majority of residents on Guam are Chamorros, who were the first known cultural group to inhabit the island. Even though Guam has been occupied by several western nations throughout history, the Chamorros have a long and rich cultural history on the island that continues to exist today. Chamorro cultural and historical resources can be found throughout the land, and are valued by the Chamorros as part of their culture and heritage. Because of international agreements that require the proposed action to focus on Guam, and not other locations within the U.S., the evaluation of environmental justice was on whether there are disproportionate adverse effects within the context of alternatives for facility location on Guam. Because of this, it would be impossible for there to be a disproportionate effect from an identified adverse impact based solely on the impact affecting a minority population. Therefore, the analysis for environmental justice on Guam considered whether there is a disproportionate adverse effect on a low-income population or children.

The existing condition of public health care and social services on Guam are sub-standard. Because of this, the population growth associated with the preferred alternative would adversely affect public health care services for low-income people and children of low-income families.

The current roadway infrastructure on Guam is in poor condition. Under no action, roadway infrastructure may improve, but probably over a much longer period of time. Roadway improvements, as part of the preferred alternatives, would have a beneficial impact on low-income residents living near the roadway projects. No action would include some of the roadway improvements described under the preferred alternatives, but the project schedule would be gradual and would extend beyond 2014. The island residents would benefit from roadway improvements island-wide in the long-term.

3.3.19 Summary of Preferred Alternatives' Impacts

Table 3.3-67 summarizes the post-construction operational impacts for each of the resources, as described in Sections 3.3.2 to 3.3.18. These findings are used in the cumulative impact assessment of Chapter 4. The preferred alternatives have potential to significantly impact fifteen resource areas on Guam, and five on Tinian, as indicated by **bold** typeface in the table.

Table 3.3-67. Summary of Operation Phase Impacts of Preferred Alternatives

Resource	*Guam*	*Tinian*
Geological and Soil Resources	**SI-M**	LSI
Water Resources	LSI (SI)	LSI
Air Quality	LSI	LSI
Noise	**SI**	LSI
Airspace	LSI	NI
Land/Submerged Land Ownership	**SI**	LSI
Land/Submerged Land Use	**SI**	**SI**
Recreational Resources	**SI (SI)**	LSI
Terrestrial Biological Resources	**SI-M**	**SI-M**
Marine Biological Resources	**SI-M (SI-M)**	LSI
Cultural Resources	**SI-M**	LSI
Visual Resources	**SI-M**	**SI-M**
Marine Transportation	LSI	NI
Utilities	**SI-M (SI)**	LSI
Off-base Roadways	**SI**	LSI
On-base Roadways	**SI-M**	LSI
Socioeconomics and General Services	**SI (SI)**	**SI**
Hazardous Materials and Waste	LSI	LSI
Public Health and Safety	**SI (SI)**	LSI
Environmental Justice and the Protection of Children	**SI (SI)**	**SI**

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact, ( ) = Indirect (workforce population and induced) population impacts, **bold** = significant impacts

3.4 ADDITIONAL SECONDARY EFFECTS

The Guam military relocation and buildup would have direct, indirect, and cumulative effects on the natural and built environment of Guam and Tinian. Indirect impacts resulting from induced population and workforce population are identified earlier in this chapter. This section addresses additional indirect effects that are also referred to as "secondary effects." CEQ regulations and guidelines define secondary effects as follows:

> "Secondary (Indirect) Effects: Effects which are caused by the action and later in time, or farther removed in distance, but are still reasonably foreseeable. Indirect effects may include growth inducing effects and other effects related to induced changes in the pattern of land use, population density or growth rate and related effects on air and water on other natural systems, including ecosystems" (40 CFR 1508.8 [b]).

The military relocation, including short term construction-related and longer term expanded facilities and military activities, would have consequences beyond the direct footprints of the proposed construction projects and extend in time beyond the construction period.

There are few secondary impacts identified for Tinian and they are related to socioeconomics. There would be construction job opportunities for Tinian residents on Guam to support the proposed actions. This would likely be a beneficial economic impact for the families of those workers, assuming some wages are sent to Tinian. There would be no anticipated labor drain on Tinian because there are few existing job opportunities on the island. Tinian's tourism may benefit from the increase in population on Guam associated with the proposed action. Agricultural activities would presumably increase outside the military lease areas to replace the agricultural activities lost when permits are terminated. Additional agricultural homesteads may be required.

A Compatibility Sustainability Study (CSS) is being prepared as a joint effort between GovGuam and the military. The program is managed by the Office of the Governor and is funded through a grant provided by DoD and the Office of Economic Adjustment. The CSS would likely address many of the secondary impacts anticipated under the preferred alternatives. The primary goal of the CSS is to reduce potential conflicts that could occur between military installations and the Guam community, while sustaining economic vitality, accommodating a targeted job development, protecting public health and safety, and maintaining the military mission. The CSS will examine existing land use, growth trends, and development potential. Recommendations and strategies will be developed to promote compatible land use planning. A series of community meetings will be held to collect public input into the process. More information is available online at the following address: http://www.one.guam.gov/. Key resources areas that are likely to be affected by secondary effects on Guam are described below.

3.4.1 Socioeconomics and General Services

Forecasts of economic activities prepared for this EIS include estimates of direct and indirect (secondary) population and employment growth as a consequence of the proposed military buildup. Estimates of indirect employment growth provide a reasonable indicator of secondary effects; new employment opportunities would also create wealth and disposable income that would stimulate spending on new business establishments, employee and family housing, as well as the continual purchasing of other goods and services. This spending and potential development would, in turn, have consequences on land use, and potentially other natural and built environmental systems.

The demand for civilian labor is projected to total up to 7,500 workers in 2010. At the peak of the construction and buildup, total civilian labor is projected to range between 43,000 and 44,000 in 2014. Following this peak, the demand for civilian labor related to the preferred alternatives would return to about 7,000 or so workers, into the foreseeable future. Of this total civilian labor force, approximately 25 to 30% would consist of indirect or secondary jobs. Thus, over 1,500 jobs would be the normal secondary effect of the buildup program and up to over 9,000 jobs would be considered an indirect consequence of the buildup program during the peak of the construction period.

The socioeconomic growth in the civilian sector may require additional education, medical care, police, and fire facilities. The Navy acknowledges that there is the potential for effects on social services, such as educational and medical facilities, due to the added demand on services from DoD military and civilian populations as well as demand from others coming to Guam as a result of potential induced growth that may result from the DoD proposed actions. Additionally, those potential impacts, resulting in increased demands on Guam social services, would also be affected by a possible shift in trained personnel from public and private facilities on Guam to the DoD facilities on Guam. Based upon a proposed 2014 completion date for the Marine Corps realignment effort, efforts have been made to quantify those impacts in the Final EIS. These estimates were prepared using the best available information, but were influenced by several variables, such as possible shifts of trained personnel from public and private facilities on Guam to DoD facilities, that cannot be ascertained at this time. Thus, the quantification of impacts presented in the Final EIS is less than certain. Because DoD may consider a modified timing and sequencing for the relocation of troops through force flow reduction, the quantification of socioeconomic impacts noted in the Final EIS may not occur. Because of difficulties in quantifying such impacts in normal circumstances, much less under a under force flow reduction mitigation scenario, those social service needs on Guam are best addressed by the independent, ongoing, work of the Office of Economic Adjustment in support of the Economic Adjustment Committee's (EAC) development of a Guam infrastructure plan for those social services.

3.4.2 Land Use Planning

A secondary impact of the preferred alternatives would be the need for additional land use planning and zone changes on Guam to reflect the increase in federal land area and changes in land use on federally-controlled land. These plans may have to include a buffer of open space outside the perimeter of federally-controlled lands to avoid impacts on civilian land use. GovGuam's BSP and DLM may have to hire more staff and fund additional land use planning documents.

Most of the secondary growth caused by the military expansion would likely occur in the northern and central part of Guam. The BSP anticipated these secondary effects, and in March 2009, completed the "*North and Central Land Use Plan*" (Plan). The Plan has not been adopted by the legislature. Once adopted, it would likely lead to changes in zoning codes. It was prepared through a public and stakeholder involvement program that intended to capture the vision of the community for future land use development. Implementation of the Plan would promote the quality of life that makes north and central Guam a desirable place to work, live, and visit. While the Plan considered the impacts of the Marine Corps relocation and other proposed actions on Guam, it did not have the advantage of the most current site plans that are presented in this EIS. The ongoing CSS planning effort will address these secondary impacts.

The zoning codes and building codes may have to be updated to include design and building height, and massing criteria to ensure the new civilian development is compatible with surrounding uses, and does not block important scenic views.

3.4.3 Natural Resources

Guam has a fragile, natural environment that has been substantially altered by natural and man-made events. The natural systems that provide functionally viable and valuable forest, coastal, and marine ecosystems, potentially would be impacted by secondary growth. A secondary impact of the buildup on federal lands would be the increased pressure to restore, protect, and preserve natural resources on non-federal lands. Local legislation may have to be more aggressive in providing environmental protection and enforcement. Local and federal agencies may also have to be more aggressive in applying for and obtaining grants and discretionary funds to support the local natural resource managers. Additional funds could be required for watershed management studies, managing geographic information system (GIS) databases, pilot studies, natural resource monitoring, and public education. Labor and facilities would be required to support the Micronesia Biosecurity Plan (described in Chapter 2) that is being developed. Insufficient budget and staff to enforce environmental management programs could be an adverse secondary impact.

3.4.4 Water Quality

The preferred alternatives would implement stormwater management and erosion control BMPs (Chapter 2) and meet regulatory requirements. The potential impacts of the preferred alternatives' construction and operation to surface water are described throughout this EIS. The increase in development on non-federal lands that may result from the increased military presence would require additional oversight by local agencies to ensure that BMPs are implemented and violations are reported and corrected in a timely manner. Additional staffing may be required for reviewing permits, inspections, collecting/testing water quality samples, and reporting of violations and corrective actions. This may be considered an adverse secondary impact on the agencies, but no long-term secondary impact to water resource health was identified.

3.4.5 Utilities

In response to comments from EPA, Guam agencies, and the legislature, DoD provided more detailed analysis of the indirect (workforce housing and induced) population increases. Workforce housing indirect impact is addressed below in Section 3.4.10. Assuming there would be increases in civilian populations and development on Guam, there would also be additional demand on utilities. Legislation may be warranted to set renewable energy programs and goals for the island and provide incentives. This may require additional staffing and budget, or an increase in user fees, resulting in adverse secondary impacts.

Protection of groundwater is a major priority and would be managed to avoid any adverse effects from secondary growth. The Guam Northern Lens Aquifer provides approximately 80% of the island's potable water supply. As much of the development created by secondary growth would be focused in this region, protection of groundwater resources in the Sole Source Aquifer area would be paramount. Demand-side programs may have to be developed to encourage water conservation, similar to the BMPs proposed for the preferred alternatives on federally-controlled land.

3.4.6 Emergency Preparedness

Disaster and emergency preparedness plans would have to be updated. Plans for providing emergency utilities, shelter, and food, based on the anticipated increases in the civilian population, would have to be updated. The secondary impacts can be mitigated to less than significant through planning.

3.4.7 Transportation

Commercial airports and harbors would benefit economically due to the secondary impact of increases in traffic. Policies and procedures may have to be revisited to ensure maximum efficiency and safety. Traffic flow patterns of people or goods through the facilities may require planning updates and additional staffing, but income-generating enterprises are accustomed to responding to economic cycles. The secondary impact would not be adverse.

3.4.8 Recreation, Cultural and Tourist Activities

The anticipated increase in civilians and tourists on Guam could put additional pressure on the use of recreational sites and visits to cultural sites, both of which are typical tourist and local population activities. The GDPR would require staffing and budget to prepare and implement a recreation plan. Additional dive/snorkeling sites and other recreational facilities may have to be constructed and maintained.

Secondary impacts associated with a larger population on Guam might include increased vandalism of recreational and cultural sites; not necessarily from the military and their dependents.

3.4.9 Cultural Ties to the Land

Volume 2, Section 1.1.2.4 describes the sociocultural value of land to Chamorros. Contemporary land issues on Guam with most relevance to the proposed action are federal land ownership and land access, with the cultural value of land underpinning both these issues.

Many members of the native Chamorro population of Guam and their elected or self appointed representatives feel that their culture is bearing an unfair burden of impact from the proposed action, especially in the continued loss of public and private land ownership and access to these lands. Importantly, these lands are sources of various attributes and resources with cultural significance.

Both land and submerged lands, and the resources that are available on or in those areas, have been identified as a source of health and sustenance for the Chamorro people. Volume 2, Chapter 12 Cultural

Resources identifies various plants traditionally used for medicinal purposes by the *suruhanu*, who are "spirit counselors" or "medicine men" of the native Chamorro culture, whose knowledge was passed down from previous generations (usually orally). Land on Guam also provides the value of cultural heritage and existence to the native Chamorro community. The inheritance of family properties is a continuing aspect of Chamorro culture that remains evident in the current land tenure system on the island.

Regardless of actual legal ownership designations, land on Guam also represents to native Chamorros a sense of place. The island of Guam is often referred to by them as *Tano y Chamorru* or the land of the Chamorro, a reference not to land ownership in the Western sense, but to spiritual ties that a people feel for their cultural birthplace – in other words, where they belong.

The land of the ancient Chamorro is still inhabited by the spirits of the ancestors today, and these *taotaomo'na* are believed to protect and watch over the people and the land. This land is also believed to be inhabited by *aniti* or spirits of the deceased who can bring misfortune if one disrespects the ancestors or the dead. Banyan trees or *tronkon nunu* are particularly avoided in the jungle, especially after dark, and permission to disturb these areas must be asked of the spirits who inhabit them. For those who fail to do so, "It is believed that the *taotaomo'na* that inhabit the space will cause them harm or make them fall ill if they do not show proper respect for the land." (Mendiola 2010) To disturb the land and its native jungle without spiritual permission therefore, is to disturb not only the resting place of the ancestors and the spirits of one's own deceased, but the very body of the gods Puntan and Fu`una who left this land and its resources to the Chamorro people.

The proposed action would have an adverse impact on the land and the Chamorro culture. The cultural ties to the land are also identified in Volume 7, Chapter 4 as a cumulative impact.

3.4.10 Workforce Housing

Analysis in Volumes 2 through 6 of the EIS and presented earlier in this chapter identifies the environmental impacts from the construction worker population associated with the proposed action. Volume 1, Section 4.15 identifies housing proposals for the construction workforce on Guam as an indirect impact of the proposed action and provides assessment of environmental impacts that would result from nine workforce housing proposals. This assessment includes figures illustrating the locations of the housing areas. The assessment identifies mitigation measures that could avoid or reduce impacts; these measures are listed in Volume 7, Chapter 2, Table 2.2-1 under the Workforce Housing category. Workforce housing is not proposed by and would not be constructed by DoD; however, DoD has influence over some mitigation measures associated with workforce housing through provisions in the acquisition process for projects included in the proposed action, as indicated in Volume 1, Section 4.15 and Section 2.4 of this volume. The assessment of workforce housing in Volume 1 is based on information in permit applications from private developers to GovGuam regulatory authorities. Several applications have been approved and one workforce housing project is under construction, as of the preparation of this EIS. The following is a summary of potential impacts from workforce housing identified in the assessment in Volume 1, Section 4.15:

Less than significant impacts. The following resources would have a less than significant impact (see Volumes 2 through 6 and the earlier assessment in this chapter for discussion of impacts from construction workforce population): geological and soil resources, water resources, air quality, noise, land and submerged land use (based on the assumption that any workforce housing development must satisfy GovGuam zoning and land use conditions and be approved by GovGuam in order to proceed), terrestrial biological resources, visual resources, socioeconomics and general services, public health and safety, and hazardous materials and waste.

Recreational Resources. Recreational resources in northern and central Guam would experience negative effects (e.g., crowding, deterioration of resources, competition for use/space, and etc.) associated with simply having more users on their resources. This includes effects to National Park Service units associated with the War in the Pacific National Historic Park. Increased visitation associated with direct, indirect, and induced population increases would affect park resources, values, facilities, and other users. Similar to the Marines and their dependents, heavier user presence is expected on weekends and holidays since workers would be working otherwise.

Marine Biological Resources. Indirect negative effects from increased recreational activities (high speed water craft/boating, fishing, tidal harvesting, diving, etc.) in the nearshore environment may be seen islandwide. Significant impacts to special-status species, such as sea turtles, and the coral reef ecosystems may occur from increased use of this resource by construction workers; the magnitude of impacts is directly related to the increase in recreational use. Damage to reefs may be long-term if caused by anchors, reef-walkers, or reckless dive or snorkel activities, resulting in an adverse effect on EFH.

Cultural Resources. Significant adverse impacts to archaeological sites could result from construction at the workforce housing sites, particularly impacts associated with ground excavation and soil removal. Vandalism of archaeological sites from the workforce population could be of particular concern with Area 1 workforce housing because of the site's location near the coast area, which has a high probability of containing archaeological sites. The workforce housing may remove natural resources of cultural concern (See Chapter 4, Cumulative Impacts). Mitigation measures may reduce cultural impacts.

Utilities. Currently, the water systems of GWA are considered barely adequate to meet current demands (see Volume 6 for detailed utilities analysis). Some of GWA's groundwater extraction wells have experienced increasing salinity and pumping from these wells has been ceased to allow the aquifer to locally relax and restore the fresh water/salt water separation. DoD has its own water system, which currently has excess water production capacity. As discussed in Section 4.3.2., above, DoD has been meeting with GWA and is establishing a memorandum of agreement for the transfer of the excess water to GWA via current and proposed interconnections between the two systems.

Areas 1 and 2 of the currently proposed workforce housing facilities would use the Northern District Wastewater Treatment Plant (NDWWTP).The other proposed locations would use the Hagatña Wastewater Treatment Plant (WWTP). Effluent from the NDWWTP is currently not meeting all NPDES permit requirements. Average daily influent is also very close to permitted limits, with peak daily influent exceeding permitted limits. Thus, the addition of workforce housing would exacerbate this exceedance and potentially cause exceeding the actual average daily influent. However, the original physical design capacity of the NDWWTP is 12 million gallons per day (MGd) average daily influent and 27 MGd peak daily influent. Current physical capacity has been estimated at approximately 7.96 MGd. Thus with permit modifications, the NDWWTP should be able to handle the increased demand from workforce housing even prior to implementation of the preferred wastewater alternative. Sewer collection systems serving the NDWWTP are aged and reportedly in poor shape. Thus, sewer upgrades and system expansions would be needed to serve the proposed workforce housing facilities. The Hagatña WWTP has recently been refurbished, but is still operating without meeting the requirements of its NPDES permit. The capacity of the Hagatña WWTP is adequate to handle the additional demand from the currently proposed workforce housing facilities; however, permit modifications are needed to allow for higher peak flows as the plant is currently exceeding those permitted levels. The effluent pump also requires repair as it is not operational. This can cause effluent backup during certain tidal conditions. The sewer collection system serving this area are aged and reportedly in poor shape. Thus sewer upgrades and system expansions would be needed to serve the proposed workforce housing facilities.

The financial and technical capabilities of GWA are deemed marginal and may not allow GWA to successfully prepare the infrastructure to provide adequate water and wastewater service to some of the proposed workforce housing facilities. For these reasons, the impacts of workforce housing on the water utility are assessed as significant. The GWA distribution system is not in good shape and may not be able to adequately deliver this additional water. Depending on the location of the selected workforce facilities, the localized GWA distribution system may require new installations, upgrades, and/or repair. DoD does not know enough specifics of the GWA water system to evaluate in detail which workforce housing facility locations would face the largest challenges in providing adequate water service.

Roadways. Impacts to roadways are addressed in Volume 6 and earlier in this chapter. There would be impacts to roadways and traffic from workforce housing, although these impacts would be minimized by GovGuam's requirements for employers to provide transportation to and from worksites and contract requirements imposed by the DoD. Table 4.15-3 in Volume 1 identifies the expected travel routes between the various workforce housing sites and NCTS Finegayan, where most of the proposed construction activity would occur. Areas 1 and 2 are located in the North Region, where the majority of the workforce is expected to be housed, allowing for a relatively short commute to Finegayan.

Environmental Justice and the Protection of Children. The proposed workforce housing would be located on an island with high percentages of minority and low income population and children as compared with the U.S. population. Potentially significant impacts related to workforce housing that may result in disproportionately high and adverse impacts to low-income populations include socioeconomics, potable water, and wastewater impacts. Potentially significant health and safety risks associated with socioeconomics, potable water, and wastewater impacts may also disproportionately affect children.

3.5 SUMMARY OF CLEAN WATER ACT SECTION 404 ACTIONS - ALL PROPOSED ACTIONS AND ALTERNATIVES

The summary of impacts on wetlands and jurisdictional waters of the U.S. for the preferred alternatives is contained in the Water Resources sections in Volumes 2 through 6 of this EIS by geographic locations and action proponent. A summary of all potential impacts to wetlands and jurisdictional waters of the U.S. is provided in this section.

Secondary effects could include 1) degradation of natural conveyance functions of waters of the U.S., 2) alteration of sediment mobilization, transport, and deposition processes, and 3) habitat fragmentation and degradation of ecosystem processes.

There are potential direct effects under some alternatives, due to filling of wetlands and the potential for increased turbidity from nearby construction. Most of the land-based construction is proposed in the north and central areas of Guam, which have far fewer wetlands and streams than the Apra Harbor and south Guam areas. BMPs and proposed mitigation measures to minimize and avoid impacts are summarized in Volume 7, Chapter 2. Table 3.5-1 summarizes the potential impacts for all alternatives, and the preferred alternatives are indicated by **bold** typeface. Figure 3.5-1 identifies the locations of these potential impacts for the preferred alternative only.

Three actions would occur at Apra Harbor: 1) Inner Apra Harbor wharf improvements and dredging, 2) Inner Apra Harbor ramps for the Landing Craft Air Cushion (LCAC) laydown area, and 3) new berthing for a transient aircraft carrier at the entrance to Inner Apra Harbor. Indirect temporary impacts to wetlands are anticipated during construction of GRN projects numbered 3 and 35, and a replacement water main.

Potential impacts to coastal caves due to the fresh water level fluctuations in the aquifer were identified as potential impacts to jurisdictional waters, but there are insufficient data to assess potential impacts. The

impacts would be associated with all alternatives. In the Draft EIS, potential wetlands were identified on Tinian within the preferred alternative footprint. These wetlands were not field verified or delineated and may not be jurisdictional wetlands. Field studies will confirm the location of the wetlands and the final design of the ranges would avoid impacts to the wetlands.

Table 3.5-1. Clean Water Act Section 404 Actions: Summary of Potential Impacts for All Alternatives

Volume	*Alternative*	*Component (Figure 3.5-1 ID#)*	*Type and Area (ac/ha) of Impact*				*Impacted Feature*
			Direct	*Indirect*	*Temp.*	*Perm.*	
Marine Corps – Guam (Vol. 2)	**All**	**LCAC Ramps (2)**	**0.02 ac (<0.01 ha) fill**			●	**Inner Apra Harbor**
	All	**Dredging –Sierra Wharf (1)**	**327,000 cy (250,000 m^3)**	**ND**	●	**-**	**Inner Apra Harbor**
	NMS Option A (improved)	NMS Access Road	No impacts				
	NMS Option B (unimproved)	**NMS Access Road**	**No impacts**				
	Main Cantonment Alt. 2	**No impacts**					
	Main Cantonment Alt. 3, 8	AF Barrigada	2.4 ac (1.0 ha) fill	-	-	●	Palustrine wetlands
Marine Corps Training-Tinian (Vol. 3)	**1**	**No impacts**					
	2	No impacts					
	3	No impacts					
Navy –Aircraft Carrier Wharf (Vol. 4)	**Polaris Point (Alt. 1)**	**Dredging (3)**	**608,000 cy (466,000 m^3)** **53 ac (21.5 ha) dredge footprint area**	**46 ac (18.7 ha) 200 m coral buffer**	**-**	**25 ac (10 ha) coral loss (2-dimensional)** **33 ac (13 ha) coral loss (3-dimensional)**	**Outer Apra Harbor**
	All	**Wharf Pilings & Riprap (3)**	**3.6 ac (1.4 ha) fill**	**-**	**-**	●	**Outer Apra Harbor**
	Former SRF (Alt. 2)	Dredging	479,000 cy (366,000 m^3) 44 ac (17.9 ha) dredge footprint area	47 ac (19.1 ha) 200 m coral buffer	●	24 ac (10 ha) coral loss (2-dimensional) 32 ac (13 ha) coral loss (3-dimensional)	Outer Apra Harbor

Volume	*Alternative*	*Component (Figure 3.5-1 ID#)*	*Type and Area (ac/ha) of Impact*				*Impacted Feature*
			Direct	*Indirect*	*Temp.*	*Perm.*	
Army (Vol. 5)	**1**	**No impacts**					
	2	No impacts					
	3	AF Barrigada	2.4 ac (1.0 ha) fill	-	-	●	Palustrine wetlands
Related Actions (Vol. 6)	**Power Interim 1**	**No impacts**					
	Power Interim 2	No Impacts					
	Power, Interim 3	No impacts					
	Water Basic Alt. 1	**Water main line (6)**	**-**	**ND**	●	**-**	**Palustrine wetlands**
	Water Basic Alt. 2	Water main line	-	ND	●	-	Palustrine wetlands
	Wastewater Basic Alt. 1a	**No impacts**					
	Wastewater Basic Alt. 1b	No impacts					
	Solid Waste	**No impacts**					
Related Actions (Vol. 6)	**Marine Corps-Guam All**	**Agana Bridge-GRN # 3 (5)**	**0.13/ 0.05**	**ND**	●	●	**Agana River between Agana Bridge and the river terminus (260-ft stream length) at West Hagatna Beach.**
		Antantano Bridge - GRN # 35 (4)	**0.12/ 0.05**	**ND**	●	●	**Antantano River between Antantano Bridge and river terminus (1,600-ft streambed length) at Inner Apra Harbor.**
		Aguada Bridge - GRN # 35 (4)	**0.09/ 0.04**	**ND**	●	●	**Aguada River between Aguada Bridge and river terminus (1,150-ft streambed length) at Sasa Bay**
		Asan Bridge # 2 - GRN # 35 (4)	**0.18/ 0.07**	**ND**	●	●	**Asan River between Asan Bridge # 1 and river terminus (320-ft streambed length) at Asan Bay.**
		Asan Bridge # 2 - GRN # 35 (4)	**0.16/ 0.06**	**ND**	●	●	**Asan drainage between culvert and drainage terminus (99 ft streambed length) at Asan Bay.**
		Fonte Bridge-	**0.27/ 0.11**	**ND**	●	●	**Fonte River between Anantano**

Volume	*Alternative*	*Component (Figure 3.5-1 ID#)*	*Type and Area (ac/ha) of Impact*				*Impacted Feature*
			Direct	*Indirect*	*Temp.*	*Perm.*	
		GRN # 35 (4)					**Bridge and river terminus (290-ft streambed length) at East Hagatna Beach.**
		Laguas Bridge -GRN # 35 (4)	**0.13/ 0.05**	**ND**	●	●	**Laguas River between Laguas Bridge and river terminus (800-ft streambed length) at Sasa Bay / Sasa Bay Marine Preserve.**
		Sasa Bridge-GRN # 35 (4)	**0.14/ 0.06**	**ND**	●	●	**Sasa River between Sasa Bridge and river terminus (1,600-ft streambed length) at Sasa Bay / Sasa Bay Marine Preserve.**

Legend: **Bold** = Preferred alternatives, ND = Not determined; temporary impacts not quantified; - = No impact; ● = impact; (2) = Figure 3.5-1 Location number.

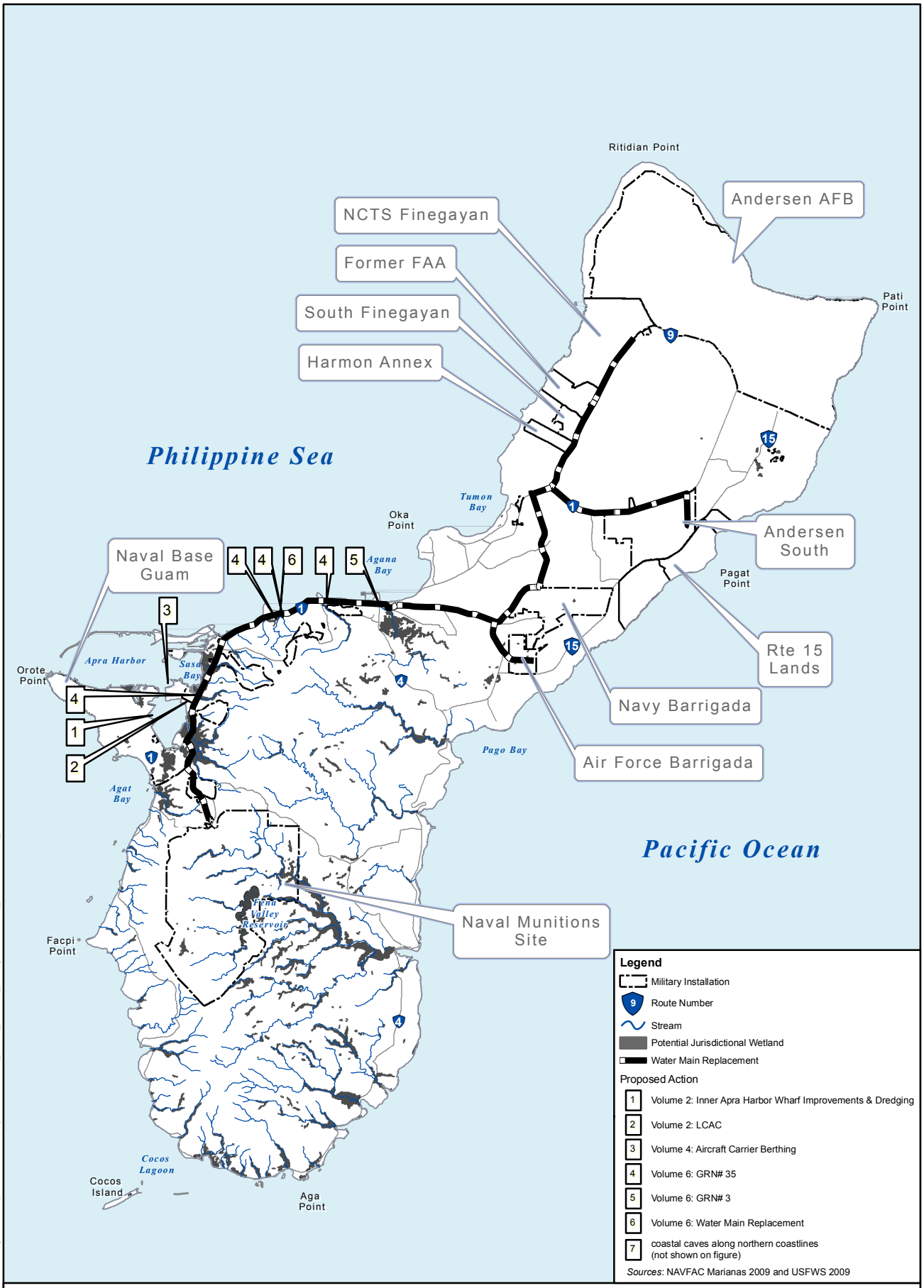


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Figure 3.5-1
Proposed Actions with Potential to Impact Wetlands and Jurisdictional Waters

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CHAPTER 4. CUMULATIVE IMPACTS

After release of the Draft EIS, changes were made to this chapter to address comments that were received from members of the public and government agencies. These changes include: 1) the Council on Environmental Quality (CEQ) cumulative impact guidance used in the Draft EIS has been supplemented with methodology contained in *Defining Cumulative Impact, Approach and Guidance* (California Department of Transportation, EPA, and FHWA 2005), as recommended by the EPA; 2) the cumulative project list was updated based on information provided in comments and additional information received following publication of the Draft EIS; 3) there is additional text describing the cumulative impact assessment findings, by resource, in this chapter; and 4) global warming and climate change analyses were expanded and consolidated in this chapter.

Many of the public comments on the Draft EIS that referred to "cumulative impacts" were actually comments regarding the summary of impacts for all of the proposed actions. The concern was that the impacts described in Volumes 2 through 6 did not address the impacts of the proposed action in its entirety. That summary analysis for the preferred alternatives continues to be in Volume 7, Chapter 3, *Preferred Alternatives: Summary of Impacts* and has been updated accordingly. Revisions to that chapter resulting from public and agency comments have been further considered and integrated into the cumulative impacts analysis contained in this chapter in accordance with the guidance and methodology described below.

Because climate change is a global problem, the climate change impacts resulting from the preferred alternatives, along with the projected impacts of climate change on Guam and Tinian, are assessed in Section 4.4., Climate Change and Global Warming.

4.1 CONSISTENCY WITH CUMULATIVE IMPACTS ANALYSIS GUIDANCE

Defining Cumulative Impact, Approach and Guidance (California Department of Transportation, EPA, and FHWA 2005) identifies eight steps for a cumulative impact analysis. This EIS is consistent with the guidance; some of the steps were completed in greater detail in earlier volumes and chapters of this EIS (e.g., descriptions of existing conditions). In such instances, this chapter attempts to refer the reader to earlier sections of the EIS for more detailed discussion and additional information regarding each resource area. The following is a list of the steps taken for this cumulative impacts analysis:

1. **Identify resources to consider in the cumulative impact analysis.** Volumes 1 through 6 address the proposed action's impacts on the following resources: geological and soils, water, air quality, noise, airspace, land and submerged land use, recreation, terrestrial biological resources, marine biological resources, cultural resources, visual resources, marine transportation, utilities, off-base roadways, socioeconomic and general services, hazardous materials and wastes, public health and safety, and environmental justice and protection of children. Due to the magnitude of the proposed action, all of these environmental resources addressed earlier in this EIS are considered in this cumulative impact analysis.
2. **Define the study area for each resource.** In Volume 7, the study area is island-wide (Guam and Tinian) for each resource. The cumulative impacts study area extends 164 ft (50 m) from the coastline of each island into marine waters. Guam and Tinian are sufficiently distant from one another that additive impacts between the islands are not anticipated. Cumulative impacts

to Guam are addressed in Section 4.3.5.1 and cumulative impacts to Tinian are addressed in Section 4.3.5.2.

3. **Describe the current health and historical context for each resource.** Volume 7 begins with an overview of key events in the history of Guam and Tinian that have influenced the islands' environmental resources. The trends in, and factors affecting, resource health island-wide (i.e., human behavior and natural events) have played a role in the existing conditions (or affected environment) of each resource described in previous EIS volumes. The trend information is summarized and augmented in Section 4.3.5 of this chapter. Additionally, the trends are assessed in conjunction with recently completed and present projects on Guam and Tinian. For the purposes of this analysis, recently completed projects are projects that have been completed in the past six years. Tables 4.3-3 and 4.3-4 in Volume 7, Section 4.3 are lists of cumulative projects considered in the cumulative impact analysis for Guam and Tinian, respectively. These tables contain recently completed, present, and reasonably foreseeable projects.

4. **Describe direct and indirect impacts of the proposed project that might contribute to a cumulative impact.** The individual impacts of the proposed actions are described in Volumes 2 through 6. The summary of the preferred alternatives' combined impacts are described in Volume 7, Chapter 3. The results are brought forward into this chapter for the discussion of cumulative impacts.

5. **Identify other reasonably foreseeable future actions that affect each resource.** As described under Step 3, Tables 4.3-3 and 4.3-4 in Volume 7 list cumulative projects considered in the cumulative impact analysis for Guam and Tinian, respectively. These tables include the reasonably foreseeable future projects on each island. Reasonably foreseeable projects are anticipated to be completed by 2019. Step 5 considers the potential cumulative impacts resulting from reasonably foreseeable projects.

6. **Assess potential cumulative impacts.** The cumulative impact analysis was primarily qualitative due to the absence of detail for most of the reasonably foreseeable future projects on Guam and Tinian. The assessment discussion indicates whether the proposed actions could have an additive cumulative impact, when considered in conjunction with the listed cumulative projects, and describes the anticipated extent of the preferred alternatives' contribution to the cumulative impact expected to result from past, present, and reasonably foreseeable future actions.

7. **Report the results.** The cumulative impact assessment results are presented for each resource in Section 4.3.5 and summarized in Tables 4.3-3 and 4.3-5. Additionally, the climate change cumulative impact assessment is reported in Section 4.4, Climate Change and Global Warming.

8. **Assess the need for mitigation.** Navy policy is to avoid impacts when possible and reduce impacts when avoidance is not possible. Mitigation measures to avoid or reduce impacts are listed in Volume 7, Chapter 2. In addition to avoiding or reducing impacts resulting from the proposed action, these mitigation measures would avoid or reduce cumulative impacts. No additional mitigation measures for cumulative impacts are proposed.

4.2 CUMULATIVE IMPACT METHODOLOGY: STEPS 5 THROUGH 7

No universally accepted framework for cumulative effect analysis exists. The cumulative impacts methodology applied in this chapter is consistent with the objectives of the National Environmental Policy Act (NEPA) of 1969 and CEQ regulations (40 Code of Federal Regulations [CFR] §§ 1500-1508) that provide the implementing procedures for NEPA. The CEQ regulations define "cumulative effects" as:

> ".. . the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of 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." (40 CFR 1508.7).

As mentioned in Section 4.1, some of the data for the cumulative impact analysis was presented in previous volumes or chapters of this EIS. The relevant information is referenced in this cumulative impact analysis chapter. The following approach was applied for implementing Steps 5 through 7:

1. Develop a list of recently completed, present, and reasonably foreseeable future actions, referred to as "cumulative projects," within a designated timeframe (2004-2019) beginning six years before implementation of the proposed action and ending five years after the completion of construction (see Tables 4.3-1 and 4.3-2).
2. Screen the projects to develop a list of cumulative projects to be used in the assessment of cumulative impacts (see Tables 4.3-3 and 4.3-5). Projects were eliminated from the analysis if:
    a. They are located outside the geographic boundary of Guam and Tinian (e.g., undersea cables and the Marianas Trench Monument designation).
    b. They are proposed beyond the cumulative project timeline (2019).
    c. There is insufficient, readily available data on project magnitude, location, or description such that potential impacts from the project cannot be ascertained.
    d. The project was categorically excluded (CATEX) under NEPA. 40 CFR 1508.4 defines categorical exclusion as "…a category of actions which do not individually or cumulatively have a significant effect on the human environment, and which have been found to have no such effect in procedures adopted by a federal agency in implementation of these regulations (Sec. 1507.3) and for which, therefore, neither an environmental assessment nor an environmental impact statement is required."
    e. The project would have *de minimus* impact on the environment (e.g., maintenance and repair of existing facilities or construction of minor or accessory structures within a built environment).
    f. The project is a plan or policy not a physical action or development.
3. Identify the resources that may be affected by the project (Tables 4.3-3 and 4.3-5) for each of the projects on the screened cumulative project list for Guam and Tinian.
4. Evaluate the direct and indirect impacts of the preferred alternatives in combination with the impacts of other projects.

5. If a cumulative impact is identified, assess the extent to which the preferred alternatives would contribute to the cumulative impact.
6. Report the results of the cumulative impact assessment for each resource to meet the requirements of Step 7.

4.3 RECENTLY COMPLETED, PRESENT, AND REASONABLY FORESEEABLE FUTURE ACTIONS

The Recently Completed, Present, and Reasonably Foreseeable Future Actions, herein referred to as the "cumulative projects list," were developed via Navy and Air Force planners, and the Guam Land Use Commission (GLUC) database. Tables 4.3-1 and 4.3-2 list projects that were identified on Guam and Tinian, respectively, based on readily available information. The status of these would change and proposals for new projects would continue to be developed. Both tables are divided by region and not all projects listed are discussed in detail. Project locations for the four regions on Guam are shown on Figures 4.3-1, 4.3-2, 4.3-3, and 4.3-4. Project locations on Tinian are shown on Figure 4.3-5.

The most substantial projects on Guam from the cumulative projects list include the Commercial Port Modernization Program, the Establishment and Operation of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Capability Project on Andersen Air Force Base (AFB), and Guam and the Mariana Islands Range Complex (MIRC) improvements. Each of these projects either had master plans or NEPA documents prepared describing the proposed actions. A brief description of these projects is provided below.

Table 4.3-1. Recently Completed, Present and Reasonably Foreseeable Projects on Guam

#	*Lead Agency or Proponent*	*Point of Contact at Lead Agency*	*Project Name/ Location*	*Area of Interest*	*Construction Year(s)*	*Status*	*Description (include purpose, scope, known issues)*	*Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)*	*Reason for Dismissal*
GUAM									
Guam – General Actions (not mapped)									
1	Core Tech	Ironwood Estates	Residential construction, Machanao (private)	Guam	2007-2008	Construction complete	Ironwood Estates, 108-lot subdivision, low income rentals.	RC	Retain
2	Commander Navy Region Marianas (CNM)	Navy	Joint Basing	Guam	2009	In progress	Consolidation of support services at the Navy and Air Force base under the Dept of the Navy effective Oct 1, 2009.	P	No cumulative impacts are anticipated
3	Secretary of Commerce, Secretary of Interior, National Oceanic and Atmospheric Administration	Unknown	Marianas Trench National Marine Monument	Guam, CNMI	2009	Established	Establishment of the Marianas Trench Marine National Monument by proclamation of the President of the United States on January 6, 2009. 95,222 square miles (mi^2) for both Guam and the CNMI.	P	Outside the geographical region of influence. Policy, not development
4	Commander Navy Region (COMNAV) Pacific	Nora Macariola-See Naval Facilities Engineering Command (NAVFAC) Pacific	MIRC EIS/OEIS	Guam, CNMI	2011	FEIS May 2010	Covers proposed action and alternatives for continued use of the Mariana Islands Range Complex.	RF	Retain
5	Department of Public Works (DPW)	GovGuam	2030 Guam Transportation Plan projects	Guam	To Be Determined (TBD)	The plan guides federally-funded transportation projects from 2010 - 2030.	The plan involves significant repairs and upgrades of Guam's transportation network. The project would be funded through grants from the U.S. Department of Transportation, Federal Highway Administration and other funding sources.	RF	Plan or policy, not development
6	DPW	GovGuam	Territorial Transportation Improvement Plan (TTIP)	Guam	2008-2011	Constructed	Adjunct to the2030 Guam Transportation Plan. Short-term federally-funded transportation projects (65). Projects are largely safety projects and capacity improvements to address immediate short-term needs.	P	Categorical Exclusion
7	Guam Department of Corrections	Guam Department of Corrections	Territorial Prison	Guam	TBD	Organizing funding	New Territorial prison to house 1,000 inmates. Site to be determined.	RF	Retain
8	Unknown	Unknown	CAME Alternative Energy	Guam	TBD	Unknown	To develop an energy supply for the CAME that is renewable, sustainable, environmental-friendly and economical. To evaluate the potential for development of a geothermal power system within the CAME based on the scientific findings of exploitable geothermal formations and the economics of distributing the energy generating. - Comprehensive Economic Development Study (January 2009)	Unknown	Too speculative
9*	CNM	Navy	Marianas Communications Backbone, Guam/CNMI various locations	Guam, CNMI	TBD	Unknown	Data backbone (microwave and data link backbone, electronic warfare (portable) staging site.	Unknown	CATEX anticipated with no significant impacts.
10	U.S. Fish and Wildlife Service (USFWS)	USFWS	Five year review of species under the federal Endangered Species Act	Guam, CNMI	TBD	Public Comment ended June 30, 2008	The Pacific Region of the USFWS is initiating 5-year reviews of 70 species protected under the federal Endangered Species Act. One of the species under review is the Micronesian Megapode (*Megapodius laperouse*) which is endangered with a current range of the Mariana Islands.	Unknown	Plan or policy, not development
11	U.S. Army	U.S. Army	Theater Internment Facility	Guam	TBD	Unknown	Construct a Theater Internment Facility (TIF)	Unknown	Insufficient project information

#	*Lead Agency or Proponent*	*Point of Contact at Lead Agency*	*Project Name/ Location*	*Area of Interest*	*Construction Year(s)*	*Status*	*Description (include purpose, scope, known issues)*	*Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)*	*Reason for Dismissal*
12	Guam Power Authority	Guam Power Authority	60 MW Power Plant	Guam	TBD	Unknown	Establish a new 60 MW power plant on Guam.	RF	Retain
Guam - Offshore (not mapped)									
13	PIPE Networks	Bevan Slattery, CEO	"Project Runway" Australia – Guam submarine cable (private)	Guam-Offshore	2009-2010	Pending	Submarine cable link from Australia to Guam.	RC	Outside the geographical region of influence
14	USEPA	USEPA	Designation of Ocean Dredged Material Disposal Site EIS, Guam (offshore)	11-nautical miles west of Apra Harbor	2010	Notice of Availability of Draft EIS published in August 2009	USEPA designation of offshore disposal site for dredged materials.	P	Outside the geographical region of influence
Guam - North									
N-1	Guam Air National Guard	Unknown	GUANG Operations and Training Facility	Guam-North	2003	Unknown	254th Air Base Group, Guam Air National Guard at Andersen Air Force Base. The project would involve the construction of a 10,400-ft^2 Operations & Training facility and the associated 97-stall parking lot within the existing Guam Air National Guard installation.	RC	Impacts are included in EIS affected environment
N-2	Air Force	Air Force	Shopette Construction	Guam-North	2004	Unknown	The AAFES shopette is located, together with the existing gas station, a store, administrative area, an automated car wash building, additional 35 parking spaces and site access roads encompassing 79,000 ft^{2}of pavement surrounding the building, within an approximately 2.4 ac site.	RC	Impacts are included in EIS affected environment
N-3	Air Force	Air Force	AT/FP Perimeter Fence and Road Construction and Main Gate Relocation at Andersen AFB	Guam-North	2010-2011	Construction initiated	Construct a perimeter 8.2-ft (2.5m) tall chain-link fence in the western portion of Andersen AFB along Routes 9 and 3a. The perimeter fence was proposed in two phases, the eastern portion of which is complete. Total length is 35,440 ft (10,802 m). The project includes a gravel access road adjacent to the perimeter fence. The fence and the roadway extend from Potts Junction to the northern cliff line. The length of the roadway is 43,980 ft (13405 ac) and the width is 13ft (4m). Total area of disturbance is estimated at 16 ac (64,423 m^2). The main entrance gate to Andersen AFB would be reconfigured and expanded at the existing location with utility service improvements. The area of disturbance is estimated at 5.47 ac (22.2 m^2).	RC: Phase 1of fencing is complete; other components are future (RF).	Retain
N-4	Unknown	Air Force	Unknown	Guam-North	2007	Unknown	Removal and Control of Vegetation at Runway, in accordance with AICUZ Program.	RC	*De minimus* impacts
N-5*	Fleet Area Control and Surveillance Facility (FACSFAC) Range Control	Navy	FACSFAC, Andersen AFB	Guam-North	2010	Unknown	Training Operations Center (FACSFAC/Range Control), CVW-5 liaison office.	RF	*De minimus* impacts
N-6	36 WG of the Pacific Air Forces (PACAF)	Air Force	Beddown of Training and Support Initiatives at NWF	Guam-North	2006 to 2011	Finding of No Significant Impact (FONSI) (signed 6-20-06)	Relocate a Rapid Engineer Deployable Heavy Operations Repair Squadron Engineer (REDHORSE) of mobile engineering forces, the PACAF Commando Warrior training program, and a Combat Communication Squadron and its training program at the same location. This includes an additional 400 personnel, utility and infrastructure improvements, and construction of field training areas, offices, classrooms, and warehouses to be based at Northwest Field, Andersen AFB.	P	Retain

#	*Lead Agency or Proponent*	*Point of Contact at Lead Agency*	*Project Name/ Location*	*Area of Interest*	*Construction Year(s)*	*Status*	*Description (include purpose, scope, known issues)*	*Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)*	*Reason for Dismissal*
N-7	36 WG of the Pacific Air Forces (PACAF)	Air Force	ISR Strike Capability, Andersen AFB	Guam-North	2007 to 2016	ROD (signed 01-12-07)	Base four unmanned aerial reconnaissance aircraft and 12 refueling aircraft at Andersen AFB and accommodate 48 fighter and six bomber aircraft on a rotational basis. An additional 2,400 personnel would be based at Andersen AFB.	P	Retain
N-8	Base Corp.	Unknown	Paradise Estates, Yigo	Guam-North	2007-2008	Phase III Under construction	Paradise Estates residential homes, 400-lot subdivision. Villa Pacita residential homes, near AAFB back gate.	P	Retain
N-9	Air Force	Air Force	Andersen AFB water supply system construction	Guam-North	Unknown	Unknown	Construction of an on-base water supply system on the Andersen AFB.	RF	Retain
N-10	36 WG of the PACAF	Air Force/ Navy	Unknown	Guam-North	TBD	Unknown	Additional FY10-FY15 MILCON Projects: War Readiness Materials Storage Warehouse, Education/Library Complex, Permanent Party Enlisted Dorm, Consolidate Youth Programs, Postal Service Center.	RF	Retain
N-11	36 WG of the PACAF	Air Force	Unknown	Guam-North	TBD	Unknown	Repair AEF FOL South Runway (Phase 1). Additional FY12 Projects: repair AEF FOL South Runway (Phase 2).	RC	*De minimus* impacts.
N-12	Air Force/U.S. Army Corps of Engineers (USACE)	Air Force	Enhancement of Tarague and Sirena Beaches	Guam-North	TBD	Unknown	Air Force, USACE File No. POH-2007-45, to install 31 anchors for marker buoys to serve as a perimeter safe zone for swimming and reef walking activities, in accordance with Wing Command, 36 SVS; Wing Safety, enhancement of passive recreational opportunities at Tarague Beach; and installation of two navigation poles at the Tarague and Sirena Beaches, Andersen Air Force Base, Guam.	RC	*De minimus* impacts.
N-13	36 WG of the PACAF	Air Force	Munitions Storage Igloos Andersen AFB Guam	Guam-North		Two phases: Phase 1 operational since 2008 and Phase 2 NEPA EA prepared. FONSI pending.	New munitions igloos are required to enable the 36 WG's existing mission and ongoing military operations. Phase 1 to construct 12 munitions igloos is complete at Munitions Storage Area 1 (MSA 1). Phase II would construct 48 additional munitions igloos to meet the same purpose and need.	P	Retain
N-14	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Conditional Use Request	Guam-North	TBD	Conditionally Approved by the GLUC	Conditional Use Permits for a variety of commercial, retail and residential projects.	RF	Insufficient information, but retain because these projects are in the northern area of Guam, in proximity to preferred alternatives
N-15	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Subdivision Variance Request	Guam-North	TBD	Pending Approval by the GLUC	Subdivision Variance Requests for a variety of residential, commercial, and light industrial projects. Variances include deletion or reduction of easements.	RF	
N-16	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Tentative Subdivision Approval	Guam-North	TBD	Pending Approval by the GLUC	Tentative Subdivision Approvals for a combined 131 subdivision lots.	RF	
N-17	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Wetland Permit	Guam-North	TBD	Conditionally Approved by the GLUC	Permits to impact wetlands.	RF	Retain
N-18	GLUC	Terry Perez, Guam Coastal	Zone Change Request	Guam-North	TBD	Conditionally Approved or Pending Approval	A wide variety of zone change requests that are conditionally approved or pending approval by the GLUC. Proposed uses include	RF	Insufficient data

#	*Lead Agency or Proponent*	*Point of Contact at Lead Agency*	*Project Name/ Location*	*Area of Interest*	*Construction Year(s)*	*Status*	*Description (include purpose, scope, known issues)*	*Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)*	*Reason for Dismissal*
		Management Program, Bureau of Statistics and Plans				by the GLUC	residential, commercial, recreational, and one landfill.		
N-19	Private Development	Vantage Group	Villa Pacita Estates	Guam-North	TBD	Under construction	Private housing division along Rte. 15 in Yigo on the west side of Mt. Santa Rosa.	P	Retain
N-20	Archdiocese of Guam	Unknown	Catholic High School	Guam-North	TBD	Task force assessing prospect as of Nov. 2008	New construction of private Catholic high school on the north side of Guam.	RF	Insufficient data
N-21	Younex Enterprises LLC	Guam Land Use Commission	Ukudu Workforce Village	Guam - North	2010-2011	GLUC approved permit 10/29/09	New workforce housing to support military build-up on Guam. 18,000 person capacity.	P	Retain
N-22	Air Force	US Air Force Headquarters	Create Broad Area Maritime Surveillance (BAMS) capability	Guam-North	TBD	Feasibility being assessed	The BAMS is an information hub that would operate in direct collaboration with other manned and unmanned airborne space-based platforms. BAMS operate at greater than 40,000 ft, above the weather and most air traffic, to conduct open ocean and littoral surveillance of targets as small as submarine periscopes. Information on the infrastructure required is not available.	RF	Retain
N-23	Pacific International Guam Inc.	Guam Land Use Commission	Workforce Housing	Guam - North	2010-2011	GLUC approval pending	New workforce housing to support military build-up on Guam. 1,176 person capacity.	RF	Retain
N-24	Air Force	Air Force	Milky Way Site for MUTES	Guam-North	TBD	NEPA review being initiated	Communications facility near Northwest Field under consideration.	RF	Insufficient data
N-25	Army	Army	Regional hub node	Guam-North	2010	CATEX anticipated with no significant impacts.	Upgrade to existing communications facility.	RF	CATEX anticipated with no significant impacts.
Guam - Central									
C-1	Federal Highway Administration (FHWA)	Unknown	Route 15 Construction	Guam-Central	2005	Unknown	Reconstruction/rehabilitation of the Route 15 existing two-lane roadway and construction of roadway appurtenances for a complete and useable safe facility, in the municipalities of Mangilao and Yigo.	RC	May not be required if actions proposed in this EIS are implemented.
C-2	Home Depot	Various	Home Depot and Garden Center (private), Tamuning (Airport Road)	Guam-Central	2007	Operational	New Home Depot and Garden Center on Airport Road (Tamuning).	RC	Retain
C-3	Private Development	Access Development Company	Talo Verde Estates	Guam-Central	2007-2009	Operational	Luxury housing community; Single family dwellings (62) and Townhouses (82).	RC	Retain
C-4	TBD	Unknown	Residential construction, Tamuning (private)	Guam-Central	2007-2009	Unknown	700-unit condominium (Near Nikko Hotel), units to be complete by 2010.	P	Retain
C-5	Private Development	Access Development Company	Talo Vista Tower	Guam-Central	2010-2012	Construction pending	236 unit condominium; obtained GLUC approval (Nov 2007).	P	Retain
C-6	Core Tech International	Guam Land Use Commission	Workforce Housing	Guam-Central	2010-2011	GLUC permit pending	New workforce housing to support military build-up on Guam. 856 person capacity.	RF	Retain
C-7	Private Development	Access Development Company	Ypao Resort	Guam-Central	2010-2012	Pending	700 units full-service resort condominium; under GLUC review.	RF	Retain
C-8	Private Development	Younex International Corp	Emerald Ocean View Park	Guam-Central	2008-2011	Under construction	260 luxury condo unit - 20 villas, two 18-story towers and two 15-story towers.	P	Retain

#	*Lead Agency or Proponent*	*Point of Contact at Lead Agency*	*Project Name/ Location*	*Area of Interest*	*Construction Year(s)*	*Status*	*Description (include purpose, scope, known issues)*	*Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)*	*Reason for Dismissal*
C-9	Unknown	Unknown	Veterans Clinic	Guam-Central	2009	Under construction	The Veterans Clinic would be located just outside of the Naval Hospital along Route 7.	P	Retain
C-10	CNM	Navy	Defense Access Road	Guam-Central	Unknown	U.S. Gov is committing $1B per U.S./Japan pact signed by Secretary of State Hillary Clinton on February 17, 2009	The proposed highway would cut across largely undeveloped hills and valleys of Chalan Pago, Yona and Piti, starting from the area in Chalan Pago where Routes 10 and 4 meet.	Unknown	Project replaced by EIS proposed action roadway improvements
C-11	CNM	Navy	Joint Region Headquarters & Operations Center (P-572)	Guam-Central	2010	Contract awarded	Renovate and adapt existing Buildings 200, 202, and 205 currently used as DoDEA high schools for joint use by Navy and JGPO.	P	*De minimus* impacts
C-12	Private Development	Tanota Partners (Ysrael family)	Hotel Construction Bayview 5 Luxury Project, Tumon Bay	Guam-Central	2010	Under construction	Construction of 400-room, 28-story hotel in Tumon Bay.	P	Retain
C-13	BUMED	Unknown	Bureau of Medicine Naval Replacement Hospital Project	Guam-Central	2010-2012	Environmental Assessment (EA) under review	Naval Replacement Hospital at Nimitz Hill. The existing one would be demolished. The site of the new hospital is located within the Naval Hospital Complex at Agana Heights.	P	Retain.
C-14	Private Development	Access Development Company	Hemlani Apartments	Guam-Central	TBD	Planning	300 unit apartments (behind Acanta Mall, Tumon Bay).	RF	Retain
C-15	Guam International Airport Authority (GIAA)	GovGuam	Project Airport Guam	Guam-Central	2009 -2029	Construction initiated for some projects	Various upgrades to airport property, main terminal, industrial park, airfield, and south ramp.	RF	Retain
C-16	GovGuam and the U.S. Navy	GovGuam	Reforestation of Masso Reservoir	Guam-Central	TBD	Completed within 3 years (by 2012)	The reforestation plan was developed as a mitigation project for coral reef loss in Apra Harbor.	RF	Retain
C-17	Private Development	Ino Corp. Development	Ino Corp Development	Guam-Central	TBD	Pending	396 unit resort condo and commercial spaces; approved Mar 2008 by GLUC.	RF	Retain
C-18	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Conditional Use Request	Guam-Central	TBD	Conditionally Approved or Pending Approval by the GLUC	Conditional Use Permits for a variety of commercial, retail and residential projects.	RF	Retain
C-19	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	PUD - Amendment	Guam-Central	TBD	Approved by the GLUC in 2005	A PUD Amendment for a project in Agana with civic, commercial and recreational use.	RF	Retain
C-20	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Seashore Clearance Request	Guam-Central	TBD	Conditionally Approved or Pending Approval by the GLUC	Seashore Clearance Requests for a variety of commercial, residential and recreational projects.	RF	Retain
C-21	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Subdivision Variance Request	Guam-Central	TBD	Approved, Conditionally Approved or Pending Approval by the GLUC	Subdivision Variance Requests for a variety of residential, commercial, and light industrial projects. Variances include deletion or reduction of easements.	RF	Retain

#	*Lead Agency or Proponent*	*Point of Contact at Lead Agency*	*Project Name/ Location*	*Area of Interest*	*Construction Year(s)*	*Status*	*Description (include purpose, scope, known issues)*	*Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)*	*Reason for Dismissal*
C-22	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Tentative Development Plan Application	Guam-Central	TBD	Conditionally Approved or Pending Approval by the GLUC	Tentative Development Plans for a variety of residential, commercial and recreational projects that are conditionally approved or pending approval by the GLUC. Combined totals: 43 apartments, 960 condos, and 1 single family dwelling.	RF	Retain
C-23	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Tentative Subdivision Approval	Guam-Central	TBD	Conditionally Approved or Pending Approval by the GLUC	Tentative Subdivision Approvals for a combined 417 subdivision lots.	RF	Retain
C-24	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Wetland Permit	Guam-Central	TBD	Pending Approval by the GLUC	Permits to impact wetlands.	RF	Retain
C-25	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Zone Change Request	Guam-Central	TBD	Approved, Conditionally Approved or Pending Approval by the GLUC	A wide variety of zone change requests that are conditionally approved or pending approval by the GLUC. Proposed uses include residential, commercial, recreational, and one landfill.	RF	Retain
C-26	Unknown	Unknown	Guam Greyhound Casino	Guam-Central	TBD	Unknown	Approved on the Nov. 2008 voting ballot and failed. Guam Greyhound is currently closed.	Unknown	No longer viable.
C-27	Unknown	Unknown	Unknown	Guam-Central	TBD	Unknown	Subdivision on Ypao Road, in construction.	RF	Insufficient data, but in proximity to proposed firing ranges. Retain
C-28	PACAF A7P (Air Force)	Navy	Upgrade JP-8 Receipt Pipeline	Guam-Central	2013	Planning and Programming Phase	Infrastructure improvements to fuel pumps and pipelines that extend from the Sasa Valley Fuel Farm to Andersen AFB. Project includes a new 15.7 mile pipeline that is parallel and adjacent to existing pipeline and located within an existing 10-foot wide easement.	RF	*De minimus* impacts.
C-29	Chugach World Services	Guam Land Use Commission	Workforce Housing	Guam-Central	2010-2011	GLUC permit pending	New workforce housing to support military build-up on Guam. 696 person capacity.	RF	Retain
C-30	S.K Construction Inc.	Guam Land Use Commission	Workforce Housing	Guam-Central	2010-2011	GLUC permit pending	New workforce housing to support military build-up on Guam. 350 person capacity.	RF	Retain
C-31	Black Construction Corp	Guam Land Use Commission	Workforce Housing	Guam-Central	2010-2011	GLUC permit approved 2/25/10.	New workforce housing to support military build-up on Guam. 1,200 person capacity.	RF	Retain
C-32	DDT Konstract	Guam Land Use Commission	Workforce Housing	Guam-Central	2010-2011	GLUC permit pending	New workforce housing to support military build-up on Guam. 390 person capacity.	RF	Retain
C-33	Bob Salas	Guam Land Use Commission	Workforce Housing	Guam-Central	2010-2011	GLUC permit pending	New workforce housing to support military build-up on Guam. 64 person capacity.	RF	Retain
C-34	Bascon Corp	Guam Land Use Commission	Workforce Housing	Guam-Central	2010-2011	GLUC permit pending	New workforce housing to support military build-up on Guam. 30 person capacity.	RF	Retain
Guam - Apra Harbor									
AH-1	CNM	Navy	Kilo Wharf Improvements (P-451)	Guam-Apra Harbor	2005	Operational	Construct concrete ordnance container handling pad for handling, loading, and unloading of containerized ordnance on Orote Plateau, with an access road from Orote Point road to the container holding yard and the new facilities proposed under P-425 and P-447. Replace fenders, renovate Gate House and service buildings, upgrade fire	RC	Retain

#	Lead Agency or Proponent	Point of Contact at Lead Agency	Project Name/ Location	Area of Interest	Construction Year(s)	Status	Description (include purpose, scope, known issues)	Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)	Reason for Dismissal
							protection, lighting, and steam utilities at Kilo Wharf.		
AH-2	CNM	Navy	Alpha/Bravo Wharves Improvements (P-431)	Guam-Apra Harbor	2008	Operational	Extension of Bravo Wharf and construction dredging to meet requirements for new class of submarines. Project includes utility upgrades at Alpha and Bravo Wharves.	RC	Included in affected environment of EIS.
AH-3	CNM	Navy	Open Ammo Storage, Orote Point (P-447)	Guam-Apra Harbor	2007	Draft EA currently in progress as of May 2008	Construct eight 9,350 ft^2 open ammunition storage pads for temporary storage of one million pounds net explosive weight (NEW) C/D 1.1 on Orote Plateau. Each pad can accommodate 20 standard shipping containers stacked two high. Includes paved access, earthen berms, lightning protection, security fencing, and video surveillance.	RF	Included in AH-4.
AH-4	CNM	Navy	Orote Magazines (P-425)	Guam-Apra Harbor	2012	Draft EA currently in progress as of May 2008	Construct 17 non-propagation wall magazines for storage of 2M lbs NEW C/D 1.1 on Orote Plateau. Provides sufficient capacity for one full cargo ship. Includes security fencing, utility extensions, access road, and vegetation clearing.	RF	Retain
AH-5	CNM	Navy	Electrical Distribution System Hardening, Main Base (P-494) Phase 4	Guam-Apra Harbor	2008	FONSI	Improve Navy's power infrastructure by increasing capacity of Orote Substation to increase backup generation capacity and placing two miles of overhead power lines underground.	RC	*De minimus* impacts
AH-6	CNM	Navy	Potable Water System Recapitalization, Phase 1 (P-532), multiple locations	Guam-Apra Harbor	2008	Under construction	Replace existing water lines with larger size lines, provide miscellaneous water mains and line connections, construction of a concrete enclosure for the Fena Lake Pump Station, and install pressure reducing valves for waterlines feeding Sasa Valley, X-Ray Wharf, and Polaris Point.	P	CATEX.
AH-7	CNM	Navy	Construct New BEQ, Main Base (P-469R/P-484)	Guam-Apra Harbor	2009-2010	EA FONSI Prepared	Construct new Bachelor Enlisted Quarters (BEQ) at Guam Naval Base for enlisted personnel; includes three and four story buildings with reinforced concrete walls, flooring and foundation, containing 376 modules.	P	Adverse impacts (explosive safety) were mitigated through design. No cumulative impacts
AH-8	Port Authority of Guam (PAG)	GovGuam	Modernization Program: Port Reconfiguration, Maintenance and Repair	Guam-Apra Harbor	2011-2013	NEPA document being prepared	Phase 1 A: productivity and efficiency improvements such as new equipment, systems, and buildings, and terminal modernization and new yard capacity. Includes demolition of buildings, new utilities, paving, lighting, cargo handling equipment, stormwater outfalls into Apra Harbor and security systems.	RF	Retain
AH-9	Port Authority of Guam (PAG)	GovGuam	Modernization Program: Port Reconfiguration, Maintenance and Repair	Guam-Apra Harbor	> 2019	Un-programmed	Phase 1B: structural refurbishment of existing docks (F4, F5, F6), modernization of terminal areas to the west and acquisition of cranes. Phase 2: Hotel Wharf Improvements (more recent version of AH-19 project)	Unknown	Beyond cumulative impact analysis time period
AH-10	CNM	Navy	Kilo Wharf Extension (P-502)	Guam-Apra Harbor	2010	Construction completion anticipated by summer of 2010.	Construct new facilities at Kilo Wharf to meet DoD technical design standards to ensure safe and efficient ordnance loading/offloading for the Auxiliary Dry Cargo/Ammunition Ship (T-AKE). Project involves extension of wharf and construction of associated facilities.	P	Retain
AH-11	CNM	Navy	X-Ray Wharf Improvements (P-518)	Guam-Apra Harbor	2013	Programmed, unfunded	Waterfront improvements to accommodate the new T-AKE supply ship and utility upgrades to meet wharf requirements. Includes construction and dredging at the southern portion of Inner Apra Harbor to -35 ft.	RF	Retain
AH-12	CNM	Navy	Consolidated Port and Harbor Security Operations Facility (P-473), Polaris Point	Guam-Apra Harbor	2010	Pending approval, EA required	A new consolidated waterfront operations complex (37,900 ft^2) at Sumay Cove, equipment storage facility at Polaris Point, and installation of two surface approach radar systems. 37,900 ft^2.	Unknown	Cancelled

#	*Lead Agency or Proponent*	*Point of Contact at Lead Agency*	*Project Name/ Location*	*Area of Interest*	*Construction Year(s)*	*Status*	*Description (include purpose, scope, known issues)*	*Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)*	*Reason for Dismissal*
AH-13	CNM	Navy	Harden Electrical System – Phase 2 (P-495)	Guam-Apra Harbor	2010	Un-programmed	Project would harden Navy's electrical distribution system by replacing the existing overhead primary and secondary electrical distribution with an underground installation for increased system reliability during frequent typhoons.	RF	CATEX
AH-14	CNM	Navy	Consolidated Submarine Learning Center (SLC) and Commander Submarine Squadron (CSS) Headquarters Facility	Guam-Apra Harbor	2010	Pending site approval	Construct a new two-story consolidated SLC and CCS headquarters facility. The SLC would house valuable equipment that would allow multiple undersea warfare training scenarios. The CSS facility would include administrative spaces, conference room, emergency control center and classified material storage. Built on fill.	RF	CATEX
AH-15	CNM	Navy	Construct Torpedo Exercise Support Building (P-528)	Guam-Apra Harbor	2010	Pending site approval	Construct one-story torpedo exercise support facility (8,000 ft^2) on fill.	RF	CATEX
AH-16*	MARFORPAC	Marine Corps	Amphibious Training, Dadi Beach (Marine Corps Proj. 10)	Guam-Apra Harbor	2014+	Unknown	Amphibious Assault Vehicle (AAV) training. Beach improvements: one concrete revetment at each beach, remove non-native vegetation, no in-water improvements.	RF	Retain
AH-17*	MARFORPAC	Marine Corps	Amphibious Training, Tipalao Beach (Marine Corps Proj. 11)	Guam-Apra Harbor	2014+	Unknown	AAV training. Beach improvements: one concrete revetment at each beach, remove non-native vegetation, no in-water improvements.	RF	Retain
AH-18*	MARFORPAC	Marine Corps	Amphibious Training, Boat Ramp and Overland Route	Guam-Apra Harbor	2014+	Unknown	One concrete boat ramp in southern end of Inner Apra Harbor, for one AAV craft at a time, overland paved route to Tipalao includes steep descent to Tipalao Beach. Site improvements associated with amphibious training include a new ramp at the southernmost point of Inner Apra Harbor. Overland route would be along the wetland area between the inner harbor and Dadi Beach.	RF	Retain
AH-19	PAG	GovGuam	Master Plan for Deep Draft Wharf and Fill Improvements at Apra Harbor	Guam-Apra Harbor	Unknown	Final EIS prepared February 2009. No ROD was issued. Project is postponed.	Construct new wharf east of Hotel Wharf to accommodate deep-draft container vessels and cruise ships. Dredging and filling of GovGuam submerged lands required.	Unknown	Beyond the timeframe for the cumulative impact analysis and no longer a reasonably foreseeable project.
AH-20*	CNM	Navy	Target Support Building and TSV Wharf Upgrades, Navy Base	Guam-Apra Harbor	TBD	Unknown	Surface, sub-surface and aerial target facility, underwater tracking range (portable acoustic range), TSV.	Unknown	Cancelled
AH-21	CNM	Navy	Mitigation for Kilo Wharf Extension	Guam-Apra Harbor	TBD	Trees have been planted	Afforestation of 500 acres (202 ha) in Cetti Bay Watershed.	P	Retain
AH-22	Army	Army	Stationing and Operation of Joint High Speed Vessels (JHSV)	Guam-Apra Harbor (not mapped - wharf location unknown)	TBD	Draft Programmatic EIS anticipated in June 2010	Stationing and operation of up to 12 Army JHSVs at military port facilities in the United States and abroad. The proposed stationing of JHSVs may occur at the following military port locations: Virginia Tidewater area; San Diego, Calif. area; Seattle-Tacoma, Wash. area; Pearl Harbor, Hawaii area; and Guam.	RF	Retain

#	*Lead Agency or Proponent*	*Point of Contact at Lead Agency*	*Project Name/ Location*	*Area of Interest*	*Construction Year(s)*	*Status*	*Description (include purpose, scope, known issues)*	*Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)*	*Reason for Dismissal*
Guam - South									
S-1	USFWS	USFWS	Draft Safe Harbor Agreement, Cocos Island	Guam-South	2008	The draft agreement and proposed permit was published in the *Federal Register* on January 10, 2008	Cocos Island Resort and the Guam Department of Agriculture have applied for an enhancement of survival permit and a proposed Safe Harbor Agreement for the benefit of the ko'ko'. Implementation of the proposed agreement would provide for voluntary habitat restoration, maintenance, and activities to enhance the habitat and recovery of the Guam rail on 83.1 ac of Cocos Island partly owned by Cocos Island Resort, and the Guam Department of Parks and Recreation.	P	Retain
S-2	DPW	GovGuam	New Landfill, Dandan	Guam-South	TBD	Design complete	Development of a municipal solid waste landfill facility. Project involves construction and operation of integrated solid waste facility and transfer stations. It would provide for waste management through diversion, recycling, composting, and processing.	RF	Retain
S-3	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Conditional Use Request	Guam-South	TBD	Pending or Conditionally Approved by the GLUC	Conditional Use Permits for a variety of commercial, retail and residential projects.	RF	Insufficient information on location or magnitude
S-4	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Seashore Clearance Request	Guam-South	TBD	Conditionally Approved or Pending Approval by the GLUC	Seashore Clearance Requests for a variety of commercial, residential and recreational projects.	RF	Insufficient information on location or magnitude
S-5	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Seashore Permit Application	Guam-South	TBD	Application was entertained by the ARC on 2/2/2006	Seashore permit for the construction of a rock revetment.	RF	Insufficient information on location or magnitude
S-6	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Tentative Subdivision Approval	Guam-South	TBD	Conditionally Approved or Pending Approval by the GLUC	Tentative subdivision approvals for a combined 98 subdivision lots.	RF	Insufficient information on location or magnitude
S-7	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Wetland Permit	Guam-South	TBD	Conditionally Approved by the GLUC	Permits to impact wetlands.	RF	Retain
S-8	GLUC	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Zone Change Request	Guam-South	TBD	Conditionally Approved or Pending Approval by the GLUC	A wide variety of zone change requests that are conditionally approved or pending approval by the GLUC. Proposed uses include residential, commercial, recreational, and one landfill.	RF	Insufficient information on location or magnitude

#	*Lead Agency or Proponent*	*Point of Contact at Lead Agency*	*Project Name/ Location*	*Area of Interest*	*Construction Year(s)*	*Status*	*Description (include purpose, scope, known issues)*	*Timeframe: Recently Completed (RC) Present (P); Reasonably Foreseeable (RF)*	*Reason for Dismissal*

Legend: **Bold:** Projects are shown on Guam figures. RC = Recently completed, P = Present, RF = Reasonably foreseeable

Sources:

1) ***** Identified in the Training Concept Plan (Marine Forces Pacific 2009), but siting would need to be revisited after the Record of Decision (ROD) is issued for this EIS.
2) Projects included from the GLUC database (accessed 2/25/09) and organized by GLUC Request Type (e.g., Zone Variance, Seashore Clearance, Tentative Development Plan, etc.) provided in fourth column. They were/would be permitted between 2000 and 2019.
3) Navy projects last updated 9/09 by Navy
4) Air Force Projects updated 10/09 by Air Force
5) Additional projects added and project status updated based on agency review of the Draft EIS.

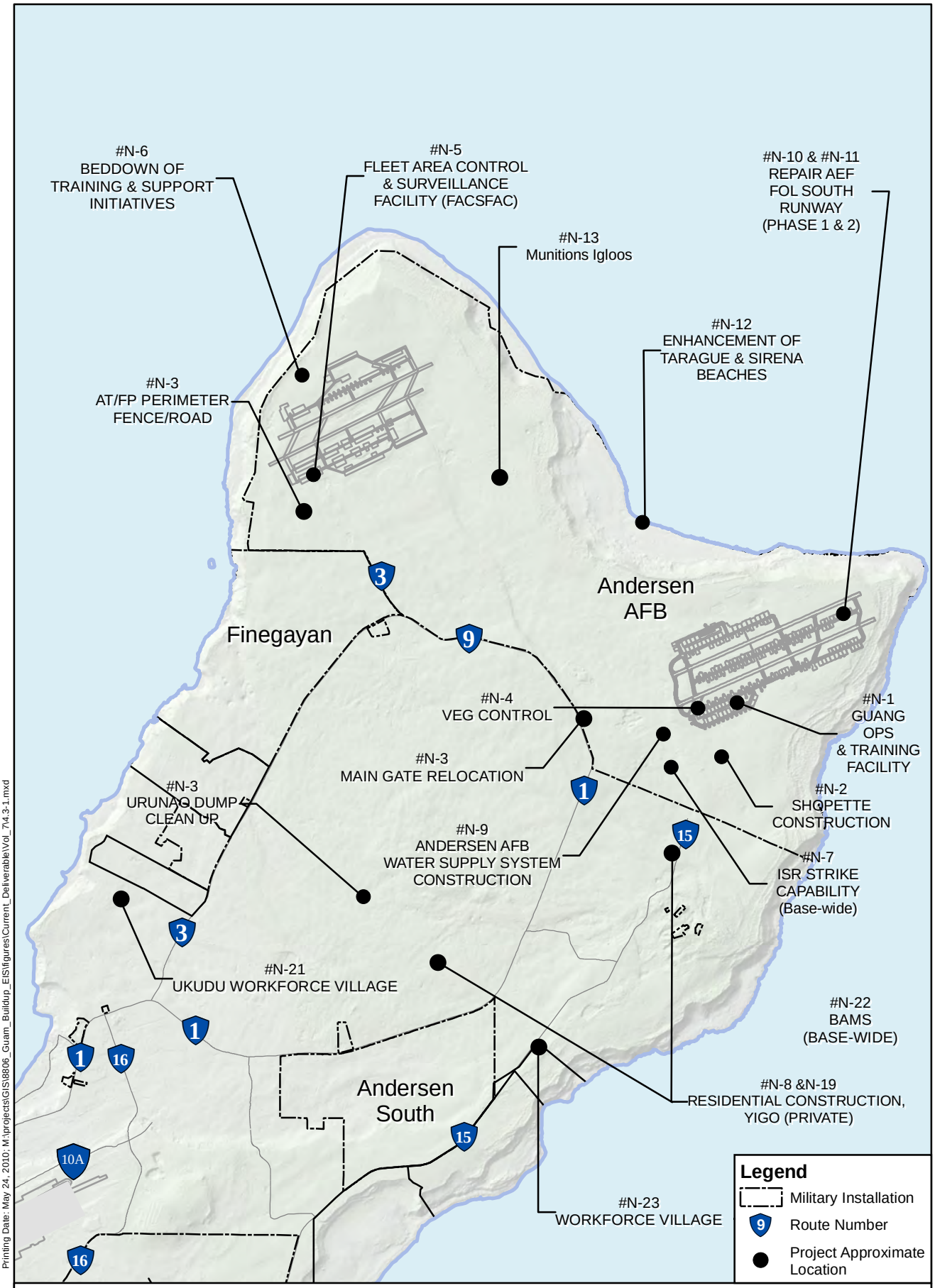

Figure 4.3-1
Anticipated Locations of some Recently Completed, Present and Reasonably Foreseeable Projects on Guam (North)

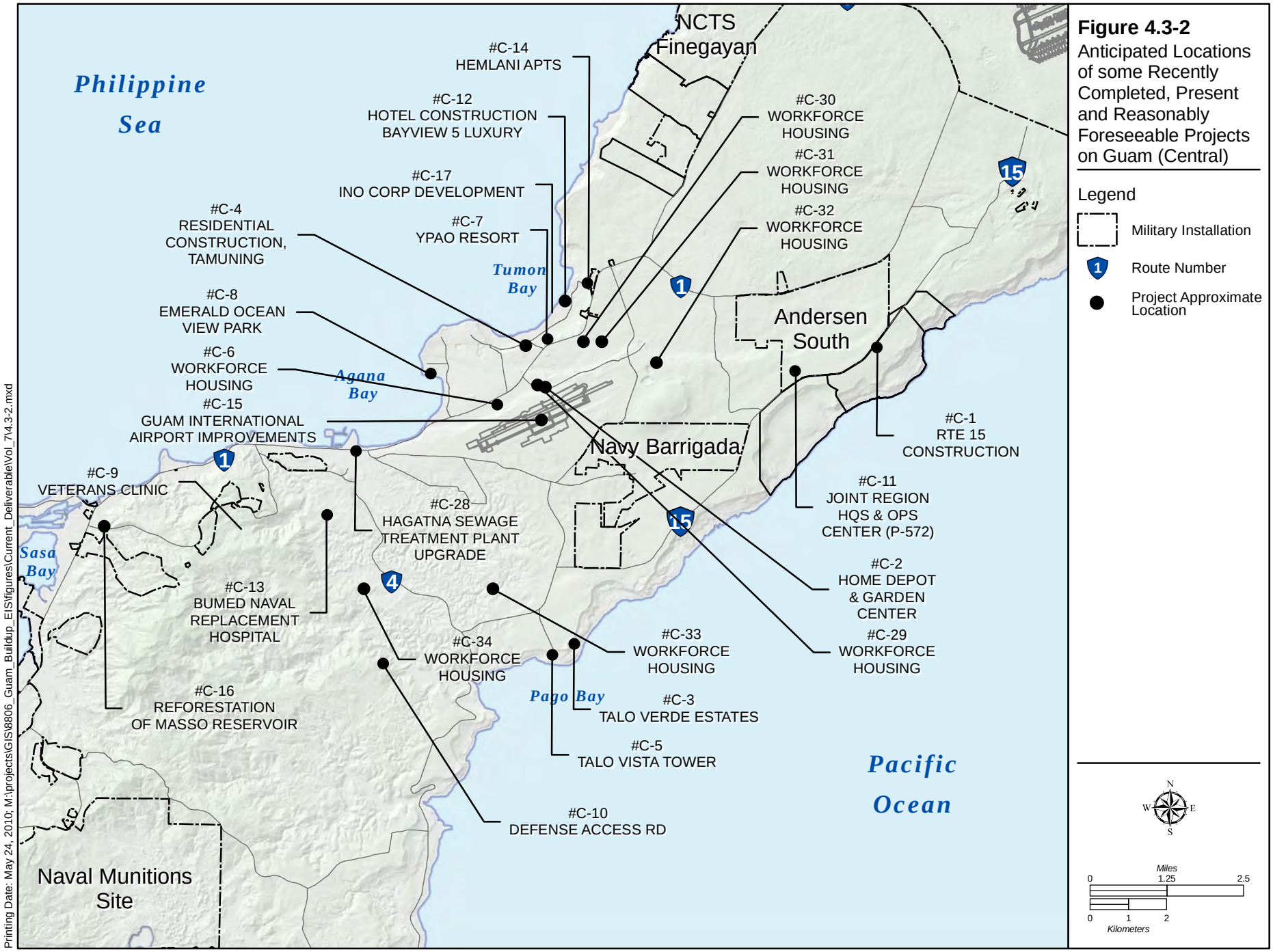

Figure 4.3-2
Anticipated Locations of some Recently Completed, Present and Reasonably Foreseeable Projects on Guam (Central)

Legend

- Military Installation
- Route Number
- Project Approximate Location

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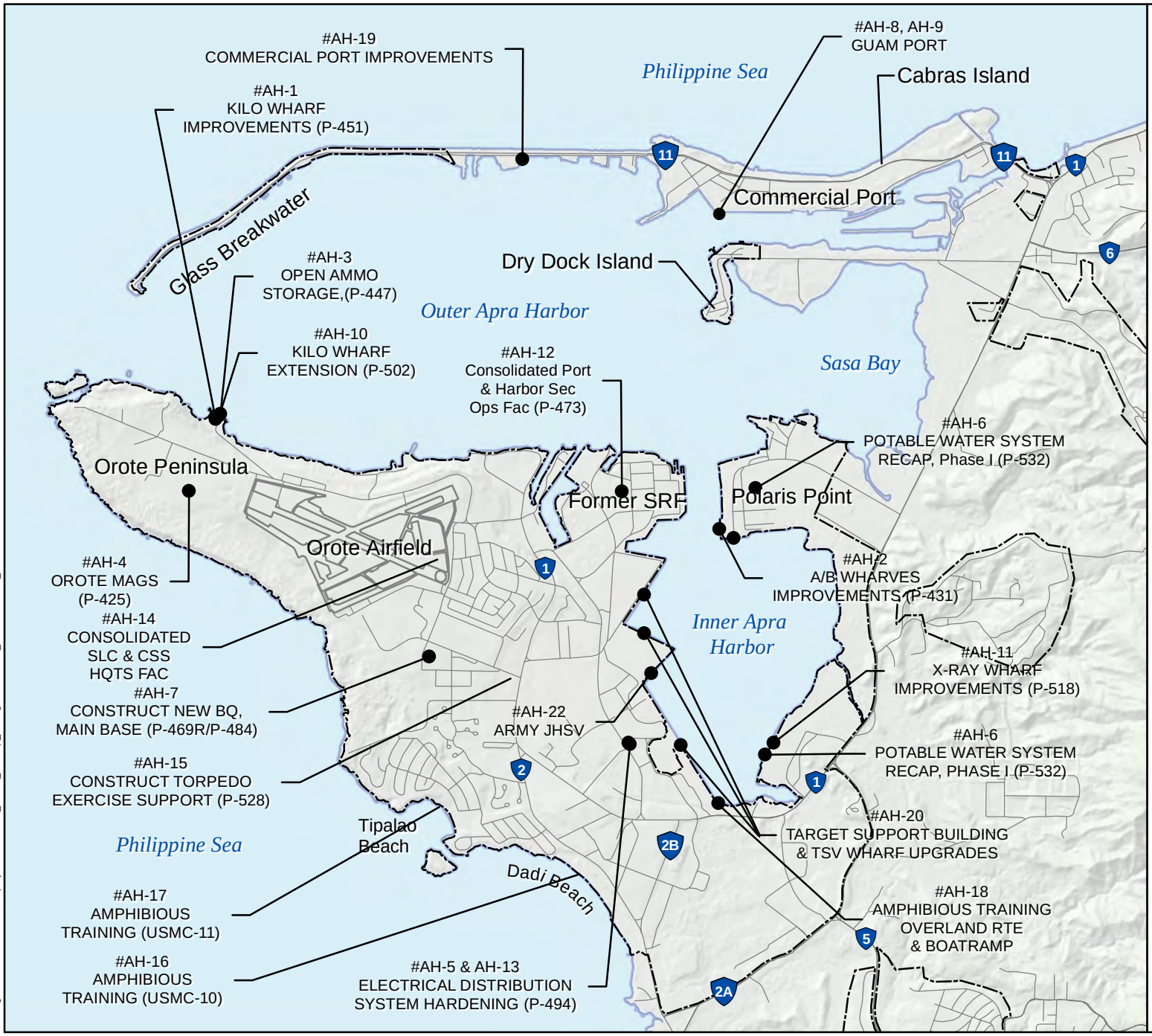

Figure 4.3-3
Anticipated Locations of some Recently, Completed, Present and Reasonably Foreseeable Projects on Guam (Apra)

Legend

- Military Installation
- Route Number
- Project Approximate Location

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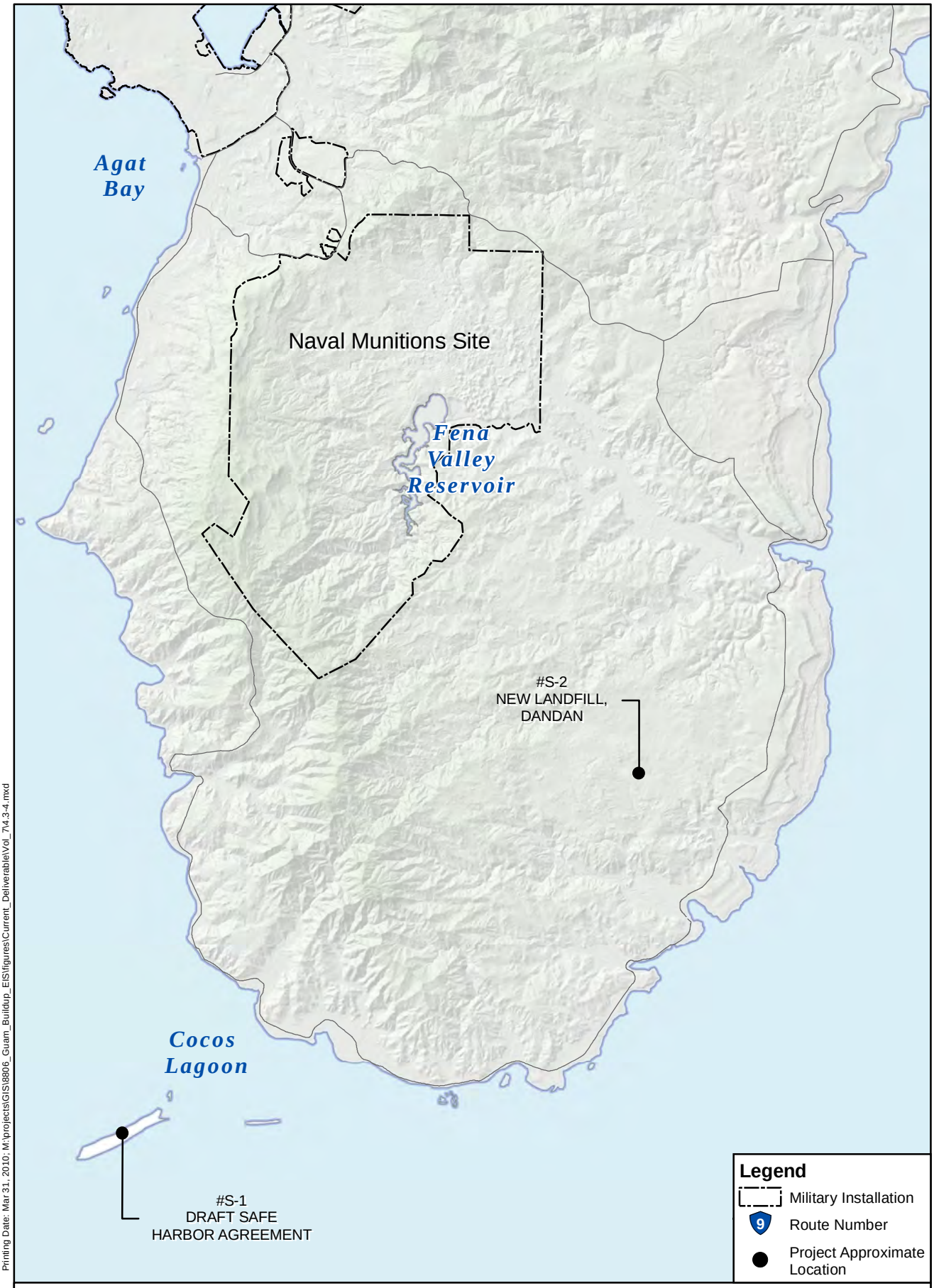

Figure 4.3-4
Anticipated Locations of some Recently Completed, Present and Reasonably Foreseeable Projects on Guam (South)

Table 4.3-2. Recently Completed, Present and Reasonably Foreseeable Projects in Tinian

#	*Lead Agency or Proponent*	*Point of Contact at Lead Agency*	*Project Name/ Location*	*Area of Interest*	*Construction Year(s)*	*Status*	*Description (include purpose, scope, known issues)*	*Timeframe: Recently Completed (RC), Present (P),Reasonably Foreseeable (RF)*	*Potential Impacts*
CNMI-Tinian									
T-2*	Marine Corps Proj. 13B	Marine Corps	1,500/3,000 Man Base Camp, Phase 2 (Marine Corps Proj. 13B)	MLA	2014+	Unknown	Additional construction to accommodate up to 3,000 personnel.	RF	Retain
T-3*	Marine Corps Proj. 14	Marine Corps	Ammunition Storage (Marine Corps Proj. 14)	MLA	2014+	Unknown	Ammunition storage facility. Includes six igloo magazines, a segregation facility, operations building, security systems, and a road network.	RF	
T-4*	Marine Corps Proj. 15	Marine Corps	Automated Multipurpose Range (Marine Corps Proj. 15)	MLA	2014+	Unknown	Automated multipurpose range. Includes range support building, ammunitions storage, range observations tower, general instruction building, covered mess, covered bleachers, field range latrines, and 788 target emplacements.	RF	
T-5*	Marine Corps Proj. 16	Marine Corps	Combined Arms Live Fire Training Area (Marine Corps Proj. 16)	MLA	2014+	Unknown	1.5 x 3 mile area for live-fire and maneuver training, including stationary and automated targets. Supports up to .50 caliber ammunition.	RF	
T-6*	Marine Corps Proj. 17	Marine Corps	Company Level Live-Fire and Movement Range (Marine Corps Proj. 17)	MLA	2014+	Unknown	2,000 x 4,000-ft area for live-fire and movement training. Supports up to 7.62-mm infantry weapons.	RF	
T-7*	Marine Corps Proj. 18	Marine Corps	Mortar and Artillery Ranges (Marine Corps Proj. 18)	MLA	2014+	Unknown	Areas for mortar and artillery firing points.	RF	
T-8*	Marine Corps Proj. 19	Marine Corps	North Field Helicopter Operations (Marine Corps Proj. 19)	MLA	2014+	Unknown	Paved area at North Field for helicopter landings, weekly aviation training. Includes fire protection and bermed area for fuel bladder.	RF	
T-9*	Marine Corps Proj. 20	Marine Corps	Small Arms and Machine Gun Ranges (Marine Corps Proj. 20)	MLA	2014+	Unknown	6 pistol and rifle firing ranges, including stationary/automated targets, standard set of range support facilities.	RF	
T-10*	Marine Corps Proj. 21	Marine Corps	Stationary Target Range (Marine Corps Proj. 21)	MLA	2014+	Unknown	100 x 300-foot area for tank/fighting vehicle training. one firing point, central dubbed impact area.	RF	
T-11*	Marine Corps Proj. 22	Marine Corps	Waterfront Upgrades (Marine Corps Proj. 22)	MLA	2014+	Unknown	Breakwater repair, pier face structures repair, loading ramp, holding yard for customs, storage/transfer area, harbor dredging. Includes demolishing finger pier.	RF	
T-12*	Marine Corps Proj. 23	Marine Corps	Infrastructure Upgrades (Marine Corps Proj. 23)	MLA	2014+	Unknown	Roadway improvements, electrical distribution changes, fire protection facilities, and access to Unai Dankulo.	RF	
T-13*	Marine Corps Proj. 24	Marine Corps	Voice of America Relocation (Marine Corps Proj. 24)	Saipan and MLA	2014+	Unknown	Relocate Voice of America facility to northern portion of Saipan.	Unknown	Cancelled
T-14	Commonwealth Ports Authority (CPA)	Unknown	Harbor Rehabilitation Project	Port	Ongoing	Ongoing	Power Builders International is presently upgrading dock surfaces, bulkheads, and bollards.	P	*De minimus* impacts

#	*Lead Agency or Proponent*	*Point of Contact at Lead Agency*	*Project Name/ Location*	*Area of Interest*	*Construction Year(s)*	*Status*	*Description (include purpose, scope, known issues)*	*Timeframe: Recently Completed (RC), Present (P),Reasonably Foreseeable (RF)*	*Potential Impacts*
T-15	DPW	Unknown	Marpo Valley Quarry (government)	non-MLA	2008 (FY)	CRMO application ongoing. CRM permit issued December 2008	Existing quarry operated by Power Builders International has to be relocated due to land lease to developers.	RF	Retain
T-16	Bridge Investment Group	Bridge Investment Group, Mr. Phillip Long	Tinian Oceanview Resort	non-MLA	2009 (FY)	CRM permit issued January 2008; construction has been initiated	This would be the second casino for Tinian and the first condominium project for the CNMI. It would also include 396 rooms and an 18-hole golf course. Construction to begin in 2009.	RF	Retain
T-17	Marianas Resort Development Group	MRDG, Mr. David Choi 670.235.0020	Matua Bay Resort and Golf Course	non-MLA	2009 for golf course; hotel and casino in later phase	CRM Permit issued December 2008; golf course under design	A 1,000-room hotel that would feature a golf course and a casino. The first phase of the two-phased project would involve the construction of a 500-room hotel and an 18-hole golf course at an estimated cost of U.S. $179 million. The second phase would include the completion of the facility.	RF	Retain
T-18	DPW	Unknown	Landfill	non-MLA	TBD	NEPA document prepared	Relocation of current landfill was pending DoD approval. As of November 2008, DoD was not taking action and CNMI was researching other potential locations.	RF	Retain
T-19	CUC	Unknown	WWTP Project (government) , western Tinian	non-MLA	TBD	Awaiting final NEPA	Proposed Tinian WWTP to be co-located with proposed landfill.	RF	Retain
T-20	CPA	Unknown	Tinian Airport	airport	TBD	Ongoing	Project and construction specifics TBD.	Unknown	Too speculative
T-21	CPA	Unknown	Tinian Airport Instrument Landing System	airport	TBD	unknown	ILS is necessary to attract tourists to the island and remove a level of danger for large aircraft. The bigger planes require the ILS. The funds are there. Need to expedite the process.	RF	There are no anticipated cumulative impacts
T-22	Unknown	Unknown	Reconstruction of Roads	MLA	TBD	Ongoing	Reconstruction of Broadway and 8th Avenues along existing alignments	RC	*De minimus* impacts
T-23	Neo Goldwings Paradise	Unknown	Neo Goldwings Paradise Casino on Tinian	non-MLA	TBD	Provisional lease signed by Governor and submitted to Legislature in Dec. '08	To be located on public land at the north end of Tinian. Plans include a 1,000-room hotel, casino, observatory, sauna and fitness center, indoor ice skating rink, outdoor concert hall, amusement park, water park, 36-hole golf link, horse riding ground, yacht basin, hot air balloon area, and a Chamorro cultural village.	RF	Retain
T-24	Unknown	Unknown	Tinian and Rota Seaport Rehabilitation	non-MLA and Rota	TBD	Unknown	Critical to help improve the port. Although these projects require a plethora of planning, environmental studies and have a level of high costs, these are critical to every aspect of these islands economy. A continuing decline in their condition would cause economic damage to these islands. Tinian - $45,000,000 Rota - $20,000,000 Comprehensive Economic Development Study (January 2009)	Unknown	Too speculative
T-25	CNMI DPW	CNMI Government	2030 CNMI Transportation Plan	island-wide	TBD	This plan guides federally -	This plan involves repairs and upgrades of Tinian transportation network. Projects are funded by FHWA and other sources.	RF	There are no anticipated cumulative impacts related to a plan

#	*Lead Agency or Proponent*	*Point of Contact at Lead Agency*	*Project Name/ Location*	*Area of Interest*	*Construction Year(s)*	*Status*	*Description (include purpose, scope, known issues)*	*Timeframe: Recently Completed (RC), Present (P),Reasonably Foreseeable (RF)*	*Potential Impacts*
						funded transportation projects from 2010 to 2030			
T-26	CNMI DPW	CNMI Government	Territorial Transportation Improvement Plan (TTIP)	island-wide	2008-2011	In place	Short-term federally-funded transportation projects (two projects).	P	Both projects are CATEX. There are no cumulative impacts
T-27	Resources - Management International	Unknown	Management International Quarry	non-MLA	2010	Permit application being reviewed	Quarry - approximately 5 ha.	RF	Retain
T-28	Department of Public Lands	CNMI Government	Homesteads (various proposals)	non-MLA	2010	Permitted, some lots assigned	Develop homestead villages (various projects)	RF	Retain

Legend: **Bold**: Project identified on Figure 4.3-5. RC = Recently completed, P = Present; RF = Reasonably foreseeable; MLA= Military Lease Area
Note: T-1 eliminated for being a duplicate project to another in the list
Sources:
1) * Identified in the Training Concept Plan (Marine Forces Pacific 2009), but siting would need to be revisited after the Record of Decision (ROD) is issued for this EIS. The project locations are too conceptual to site on a figure, but they generally would be within the Military Lease Area.
2) Interviews with CNMI agencies circa February 2009.
3) Additional projects added and project status updated based on agency review of the Draft EIS.

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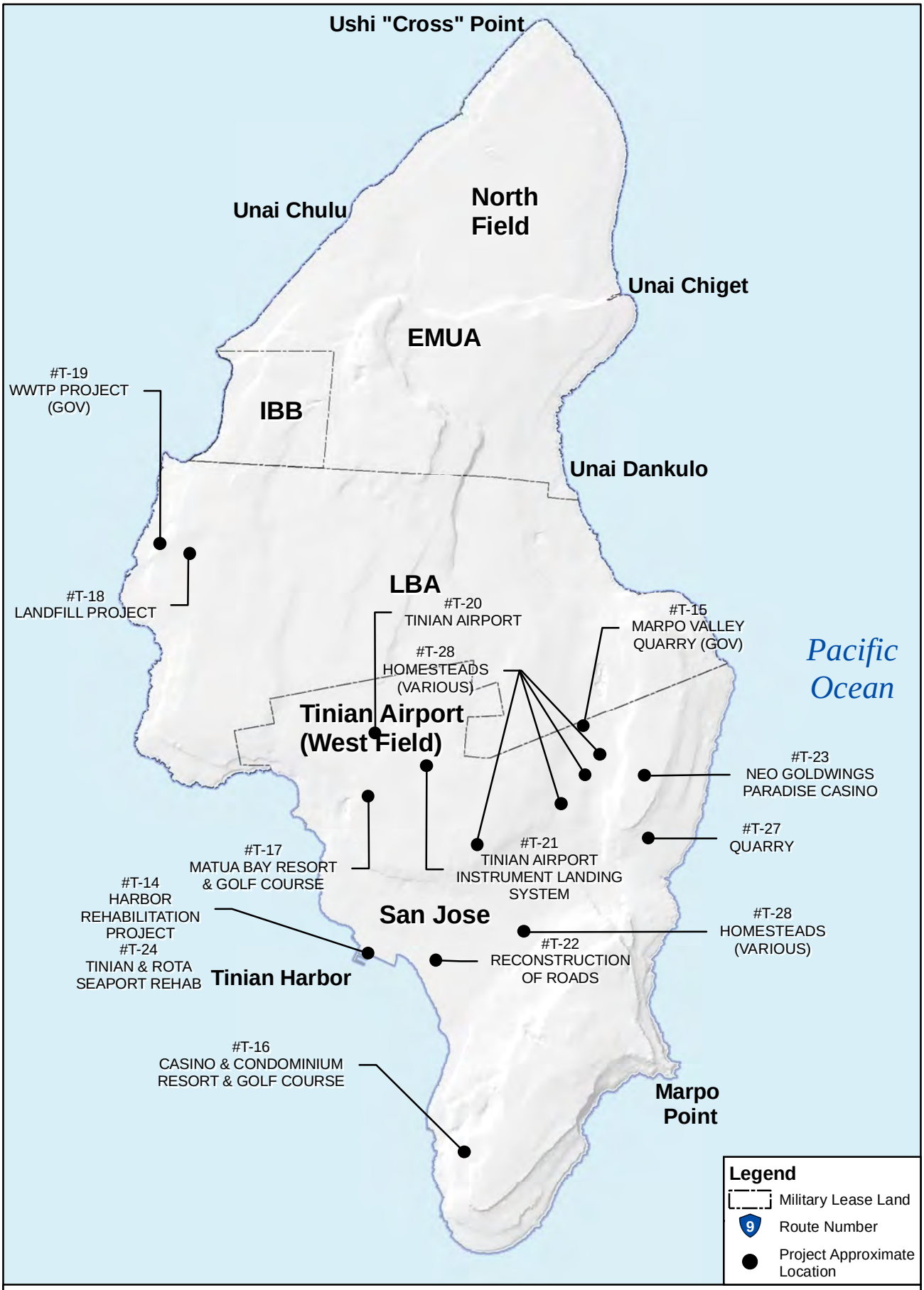

Figure 4.3-5
Anticipated Locations of some Recently Completed, Present and Reasonably Foreseeable Projects on Tinian

4.3.1 Commercial Port Modernization Program

The commercial port improvements were identified in Volume 6 as a non-DoD decision point action. There are three phases to the port modernization program: IA, IB, and II (Rosenthal 2010).

Phase IA: The focus is on productivity and efficiency improvements, such as new equipment, systems, and buildings, and terminal modernization and new yard capacity. Elements include demolition of buildings; installation of utilities; terminal yard paving and upgrade of pavement; installation of high mast lighting; installation of water, sewer, stormwater and fire protection systems including installation of new stormwater outfalls into Apra Harbor; installation of security systems; and new cargo handling and equipment systems. The project would significantly increase the operating efficiency and capacity of the terminal by an eastward extension of useable terminal area and through modernization of upland port facilities, equipment, utilities and systems including new gate systems with automated gate technology and modern truck scanning equipment (Rosenthal 2010). The NEPA process would be completed by the end of 2010, and full funding is anticipated in 2011. Preliminary design is projected to be complete in June 2010 and construction is to be completed in 2013 (Rosenthal 2010).

Phase IB: The focus is on structural refurbishment of existing docks (F4, F5, F6), modernization of terminal areas to the west, and acquisition of cranes. It includes dredging to increase berth depths at F4 through F6 to -42 ft (-13 m) MLLW, and security equipment and process improvements to meet International Ship and Port Facility Security Code (ISPS) requirements. Construction would last approximately two years. The preliminary design, preparation of permits and the NEPA process would start as soon as funding has been identified (Rosenthal 2010).

Phase II: The focus is on construction of a new berth (F7) and additional terminal capacity to the east to meet long-term organic growth. Creation of the new berth (F7) would require some land reclamation (i.e., placement of fill in Apra Harbor), removal of existing derelict vessels, and the addition of 900 ft (274 m) of berthing/wharf space. Dredging would also be included. Execution of this phase is likely to take 20 or more years; funding has not been identified (Rosenthal 2010).

4.3.2 Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Capability

The proposed action would establish an ISR/Strike operational capability in the Western Pacific, in four phases, over an approximate 16-year period beginning in fiscal year 2007. The ISR/Strike capability would consist of fighter, aerial refueling, bomber, unmanned aerial vehicle aircraft, and support personnel. The ISR/Strike EIS was finalized and a Record of Decision (ROD) was issued in January 2007 (PACAF 2007).

Andersen AFB was identified as the installation best suited to host the ISR/Strike capability. The average daily airfield operations would increase from 235 to 297 as a result of the action. The increase in aircraft events into and out of Andersen AFB requires improved range infrastructure to accommodate this increased training tempo, newer aircraft, and weapon systems commensurate with ISR/Strike force structure. There would be increased activity on all the current training areas supporting Air Force activities. Land acquisition is not proposed.

There would be construction to support approximately 3,000 additional personnel, including 190 family housing units. The Air Force would beddown and operate two squadrons and three training programs at Northwest Field, concurrent with ISR/Strike capability (addressed in a separate environmental assessment).

As part of the ISR/Strike mitigation plan, a new Habitat Management Unit of 148 ac (60 ha) would be established as a mitigation measure for impacts to biological resources. This mitigation plan would include:

- Development of an ungulate control plan.
- Ungulate exclusion fencing.
- A full-time wildlife management specialist position would be funded.
- Trees that are important to the Mariana Fruit Bat or the Marianna Crow would be planted.
- A noise study would be conducted.

At the time of the ISR/Strike EIS, there was an insufficient project description for the Guam and CNMI Military Relocation to be addressed and included in the Air Force cumulative impact project list. The Air Force was able to address the cumulative impacts of establishing an ISR/Strike Capability in their EIS (PACAF 2006) relative to a host of other cumulative projects identified.

4.3.3 Mariana Islands Range Complex (MIRC)

The Mariana Islands Range Complex (MIRC) EIS/OEIS proposes military training activities within the Mariana Islands (DoN 2010). The MIRC consists of the ranges, airspace, and ocean areas surrounding the ranges that make up the Study Area. The study area described in the MIRC EIS/OEIS does not include the sovereign territory (including waters out to 12 nautical miles [nm]) of the Federated States of Micronesia.

The proposed action would result in critical enhancements to increase training capabilities (especially in the undersea and air warfare areas) that are necessary if the military services are to maintain a state of military readiness commensurate with the national defense mission. The proposed action primarily focuses on the development and improvement of existing training capabilities in the MIRC, and would not include any military construction projects. However, the proposed action does not involve extensive changes to the MIRC facilities, activities, or training capabilities, nor does it involve an expansion of the existing MIRC property or airspace requirements. It does not involve the redeployment of Marine Corps or Air Force personnel or assets, carrier berthing capability, or deployment of strategic missile defense assets to the Marianas. Because new ranges are not being proposed, the project location is not shown in Table 4.3-1.

Governing procedures for the use of training areas, ranges, and airspace operated and controlled by the Commander U.S. Naval Forces, Marianas (such as instructions and procedures for the use of Guam, Saipan, Tinian, Rota and Farallon de Medinilla) are included in Commander Navy Region Marianas Instruction 3500.4 (Marianas Training Handbook). This guidance identifies specific land use constraints to enable protection of environmental resources during military training in the MIRC. These procedures would continue to be followed. Modification and augmentations of these procedures are being discussed among stakeholders. No new types of training would be required that would warrant new procedures in the MIRC EIS/OEIS.

4.3.4 Workforce Housing

There are nine permit applications approved, or pending approval, by the Guam Land Use Commission (GLUC) for workforce housing that would support the proposed action. The socioeconomic impacts of workforce housing are described in Volume 2, Chapter 16, as an indirect impact of the proposed action. Volume 1, Chapter 4 presents a qualitative impact assessment of workforce housing. Also, the workforce permit applications are included as cumulative projects (N-21, N-23, C-29 through C-33) as shown on

Figures 4.3-1 and 4.3-2. The cumulative impact discussion assumes that GovGuam would not permit land uses that could not be supported by Guam's infrastructure. The permits are temporary and extensions are subject to approval by the GLUC.

4.3.5 Cumulative Impact Assessment

For a proposed action of the scale addressed in this EIS, many of the project-specific impacts of the proposed action are inseparable from those of recently completed, present, and reasonably foreseeable future actions on Guam and in the CNMI. Many aspects of the proposed action are inherently interconnected with Guam's or the CNMI's systems; therefore, resulting impacts from the proposed action would be cumulative in nature. Throughout much of the analysis in this EIS, environmental conditions arising from recently completed, present, and future actions have been incorporated into the description of existing conditions and impact analysis. Therefore, most of the cumulative effects analysis contained below refers to analysis provided earlier in this EIS.

The primary purpose of this section is to identify additional impacts that could arise from the proposed action in combination with recently completed, present, and reasonably foreseeable future actions on Guam and in the CNMI. Adverse impacts would result to most resources on Guam and in the CNMI from the proposed action in combination with recently completed, present, and reasonably foreseeable future actions.

As previously stated, the Navy's position is to avoid impacts when possible, and to reduce impacts when avoidance is not possible. Mitigation measures to reduce or avoid impacts resulting from the proposed action, along with mitigation measures beyond DoD's control, are discussed in earlier analysis in Volumes 2 through 6 of this EIS and are listed in Chapter 2 of this volume. Additionally, Chapter 2 of this volume indicates that each of the mitigation measures proposed in this EIS would not only reduce or avoid project-specific impacts, they could also reduce or avoid cumulative impacts of the proposed action in combination with past, present, and reasonably foreseeable future actions on Guam and in the CNMI. The cumulative impacts identified below are considered unavoidable and could not be reasonably avoided or reduced with additional mitigation measures. Therefore, no additional measures are proposed in this section to mitigate cumulative impacts resulting from the proposed action.

The force flow reduction mitigation measure and APM of construction would reduce the peak population associated with the proposed action during construction. The APM measure necessarily includes force flow reduction because military population would not arrive until there are facilities to accommodate them. Chapter 2 of this volume discusses how these mitigation measures would reduce or avoid individual impacts resulting from the proposed action. This reduction, or avoidance, of individual impacts to resources would likewise result in a reduction or avoidance of cumulative impacts to resources, particularly during the construction phase of the proposed action.

4.3.5.1 Guam Cumulative Impacts Assessment

Table 4.3-3 shows the cumulative projects that were retained following the screening for relevance of the initial cumulative projects list (Table 4.3-1). Based on the limited information available on the cumulative projects, a qualitative assessment was made regarding the potential impacts of the cumulative projects on resources. Attempts could not be made to distinguish between less than significant and significant adverse impacts for some projects because not enough information about the projects was readily available. Beneficial impacts are indicated by "B" and adverse impacts are indicated by "X." The number of projects that potentially have an adverse impact on each resource is totaled at the bottom of the cumulative projects list. The next line identifies the impact findings from Chapter 3.

Table 4.3-3. Summary of Potential Operations Impacts to Resource Area – Guam Projects

#	*Lead Agency or Proponent*	*Project Name*	*Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)*	*Potential Impacts to Resources*																
				Geological and Soil Resources	*Water Resources*	*Air Quality*	*Noise*	*Airspace*	*Land Use/Ownership*	*Recreational Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Cultural Resources*	*Visual Resources*	*Marine Transportation*	*Off-base Roadways*	*Utilities*	*Socioeconomics*	*Hazardous Materials*	*Public Health & Safety*	*Environmental Justice & Protection of Children*
Guam – General Actions																				
1	Core Tech	Ironwood Estates (affordable housing)	RC		X		X		X		X		X	X			X	B	X		B
4	Commander Navy Region (COMNAV) Pacific	MIRC EIS/OEIS (See Section 4.3.3)	P	X	X	X	X				X	X	X						X		
7	Guam Department of Corrections	Territorial Prison	RF						X		X		X	X			X	B	X		
12	GPA	60 MW Power Plant	RF			X											B				
Guam - North																					
N-3	Air Force	AT/FP Perimeter Fence and Road Construction and Main Gate Relocation at Andersen AFB	RF						X		X		X	X			B	X	X	B	
N-6	36 WG of the Pacific Air Forces (PACAF)	Beddown of Training and Support Initiatives at NWF	P			X					X		X			X	X	X	X	X	X
N-7	36 WG of the Pacific Air Forces (PACAF)	ISR/Strike Capability, Andersen AFB (See Section 4.3.2)	P		X	X	X	X			X	X	X			X		X	X	X	X
N-8	Base Corp.	Paradise Estates, Yigo	P						X		X		X		X	X	X	X	X		

#	*Lead Agency or Proponent*	*Project Name*	*Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)*	*Potential Impacts to Resources*																
				Geological and Soil Resources	*Water Resources*	*Air Quality*	*Noise*	*Airspace*	*Land Use/Ownership*	*Recreational Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Cultural Resources*	*Visual Resources*	*Marine Transportation*	*Off-base Roadways*	*Utilities*	*Socioeconomics*	*Hazardous Materials*	*Public Health & Safety*	*Environmental Justice & Protection of Children*
N-10	36 WG of the PACAF	Various small scale- projects at Andersen AFB	RF						X		X		X	X			X	X	X		
N-14	GLUC[2,3]	Conditional Use Request	RF		X				X		X		X	X		X	X	X			B
N-15	GLUC[2,3]	Subdivision Variance Request	RF		X				X		X		X	X		X	X	X			B
N-16	GLUC[2,3]	Tentative Subdivision Approval	RF		X				X		X		X	X		X	X	X	X		
N-17	GLUC[2,3]	Wetland Permit	RF		X						X	X		X				X			
N-19	Private Development	Villa Pacita Estates	P		X				X		X		X	X	X	X	X	X	X		
N-21	Younex Enterprises	Workforce housing (See Section 4.3.4)	P		X	X	X		X		X		X	X		X	X	X	X		X
N-22	Air Force	BAMS	RF					X						X		X		X	X	X	X
N-23	Pacific International Guam Inc	Workforce housing (See Section 4.3.4)	RF		X	X	X		X		X		X	X		X	X	X	X	X	X
Guam - Central																					
C-2	Home Depot	Home Depot	RC						X		X		X	X		X	X	X	X		B
C-3	Access Development Company	Talo Verde Estates	RC						X	X	X		X	X	X	X	X	X	X		
C-4	TBD	Residential construction, Tamuning (private)	P						X	X	X		X	X	X	X	X	X	X		
C-5	Private Development	Talo Vista Tower	P						X	X	X		X	X	X	X	X	X	X		

#	*Lead Agency or Proponent*	*Project Name*	*Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)*	*Potential Impacts to Resources*																
				Geological and Soil Resources	*Water Resources*	*Air Quality*	*Noise*	*Airspace*	*Land Use/Ownership*	*Recreational Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Cultural Resources*	*Visual Resources*	*Marine Transportation*	*Off-base Roadways*	*Utilities*	*Socioeconomics*	*Hazardous Materials*	*Public Health & Safety*	*Environmental Justice & Protection of Children*
C-6	Core Tech	Workforce housing (See Section 4.3.4)	P		X	X	X		X		X		X	X		X	X		X	X	X
C-7	Private Development	Ypao Resort	RF		X				X		X		X	X	X	X	X	X	X	X	X
C-8	Private Development	Emerald Ocean View Park	P		X				X		X		X	X	X	X	X	X	X		
C-9	Unknown	Veterans Clinic	P						X		X		X	X	X	X	X	B	X	B	B
C-10	Navy	Defense Access Road	RF								X		X			B	X				
C-12	Private Development	Hotel Construction Bayview 5 Luxury Project, Tumon Bay	P		X				X	X	X		X	X	X	X	X	X	X	X	X
C-13	BUMED	Bureau of Medicine Naval Replacement Hospital Project	P						X		X		X	X			X	X	X	B	
C-14	Private Development	Hemlani Apartments	RF						X		X		X	X	X	X	X	X	X		
C-15	Guam International Airport Authority (GIAA)	Guam International Airport Improvements	RF		X		X	X			X		X	X			B	X	X	X	
C-16	GovGuam and the U.S. Navy	Reforestation of Masso Reservoir	RF	B	B						B	B	X	B							
C-17	Private Development	Ino Corp Development	RF		X				X		X		X	X	X	X	X	X	X		
C-18	GLUC[2,3]	Conditional Use Request	RF			X			X		X		X	X		X	X	X			B
C-19	GLUC[2,3]	PUD - Amendment	RF			X			X	B	X		X	X		X	X	X			B

#	*Lead Agency or Proponent*	*Project Name*	*Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)*	*Potential Impacts to Resources*																
				Geological and Soil Resources	*Water Resources*	*Air Quality*	*Noise*	*Airspace*	*Land Use/Ownership*	*Recreational Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Cultural Resources*	*Visual Resources*	*Marine Transportation*	*Off-base Roadways*	*Utilities*	*Socioeconomics*	*Hazardous Materials*	*Public Health & Safety*	*Environmental Justice & Protection of Children*
C-20	GLUC[2,3]	Seashore Clearance Request	RF	X	X					B	X	X	X	X			X	X			B
C-21	GLUC[2,3]	Subdivision Variance Request	RF		X	X			X		X		X	X		X	X	X			B
C-22	GLUC[2,3]	Tentative Development Plan Application	RF		X	X			X		X		X	X	X	X	X	X			B
C-23	GLUC[2,3]	Tentative Subdivision Approval	RF		X	X			X		X		X	X	X	X	X	X			
C-24	GLUC[2,3]	Wetland Permit	RF		X						X		X	X							
C-25	GLUC[2,3]	Zone Change Request	RF		X				X	B	X		X	X		X	X	X			B
C-27	Unknown	Subdivision	RF		X					X	X		X	X	X	X	X	X	X		
C-29	Chugach World Services	Workforce Housing (See Section 4.3.4)	RF		X	X	X		X		X		X	X	X	X	X	X	X	X	X
C30	S.K Construction Inc.	Workforce Housing (See Section 4.3.4)	RF		X	X	X		X		X		X	X		X	X	X	X	X	X
C-31	Black Construction Corp	Workforce Housing (See Section 4.3.4)	RF		X	X	X		X		X		X	X		X	X	X	X	X	X
C-32	DDT Konstract	Workforce Housing (See Section 4.3.4)	RF		X	X	X		X		X		X	X		X	X	X	X	X	X
C-33	Bob Salas	Workforce Housing (See Section 4.3.4)	RF		X	X	X		X		X		X	X		X	X	X	X	X	X
C-34	Bascon Corp	Workforce Housing (See Section 4.3.4)	RF		X	X	X		X		X		X	X	X	X	X	X	X	X	X

#	*Lead Agency or Proponent*	*Project Name*	*Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)*	*Potential Impacts to Resources*																
				Geological and Soil Resources	*Water Resources*	*Air Quality*	*Noise*	*Airspace*	*Land Use/Ownership*	*Recreational Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Cultural Resources*	*Visual Resources*	*Marine Transportation*	*Off-base Roadways*	*Utilities*	*Socioeconomics*	*Hazardous Materials*	*Public Health & Safety*	*Environmental Justice & Protection of Children*
Guam - Apra Harbor																				
AH-1	Navy	Kilo Wharf Improvements (P-451)	RC		X				X		X			X	X		X	X	X		
AH-4	CNM	Orote Magazines (P-425)	RF						X		X		X	X			X	X	B	X	
AH-8	Port Authority of Guam (PAG)	Modernization Program: Port Reconfiguration, Maintenance and Repair (See Section 4.3.1)	RF		X	B			X		X	X	X	X	B	X	X	B	X		
AH-10	CNM	Kilo Wharf Extension (P-502)	P		X				X			X		X	X		X	X	X		
AH-11	CNM	X-Ray Wharf Improvements (MILCON P-518)	RF		X				X		X	X		X	X		X	X	X		
AH-16*	MARFOR PAC	Amphibious Training, Dadi Beach (Marine Corps Proj. 10)	RF	X	X		X		X	X	X	X	X	X				X	X		
AH-17*	MARFOR PAC	Amphibious Training, Tipalao Beach (Marine Corps Proj. 11)	RF	X	X		X		X	X	X	X	X	X				X	X		
AH-18*	MARFOR PAC	Amphibious Training, Boat Ramp, Overland	RF		X		X		X	X	X	X	X	X		X		X	X		

#	Lead Agency or Proponent	Project Name	Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)	Potential Impacts to Resources																
				Geological and Soil Resources	Water Resources	Air Quality	Noise	Airspace	Land Use/Ownership	Recreational Resources	Terrestrial Biological Resources	Marine Biological Resources	Cultural Resources	Visual Resources	Marine Transportation	Off-base Roadways	Utilities	Socioeconomics	Hazardous Materials	Public Health & Safety	Environmental Justice & Protection of Children
AH-21	CNM	Mitigation for Kilo Wharf Extension	P	B	B						B	B	X	B				X			
AH-22	Army	Stationing and Operation of Joint High Speed Vessels (JHSV)	RF		X				X		X	X		X	X	X	X	X	X	X	X
Guam - South																					
S-1	USFWS	Draft Safe Harbor Agreement, Cocos Island	P								B							X		X	
S-2	DPW	New Landfill, Dandan	RF	X	X		X		X		X		X	X		X	X	B	X	B	B
S-7	GLUC [2,3]	Wetland permit	RF	X	X						X		X					X			
Number of recently completed projects potentially contributing to cumulative impacts				0	2	0	1	0	4	1	4	0	3	4	2	2	4	4	4	0	2
Number of present projects potentially contributing to cumulative impacts				2	9	5	4	1	11	3	15	4	14	11	8	11	12	14	14	7	6
Number of reasonably foreseeable projects potentially contributing to cumulative impacts				5	30	14	12	2	30	6	37	9	34	36	11	25	32	35	24	14	19
Summary Operation Impacts: Preferred Alternatives significant impacts (from Chapter 3)				**SI-M**	LSI (SI)	LSI	**SI**	LSI	**SI**	**SI (SI)**	**SI-M**	**SI-M (SI-M)**	**SI-M**	**SI-M**	**LSI**	**SI**	**SI-M (SI)**	**SI (SI)**	LSI	**SI (SI)**	**SI (SI)**
Preferred Alternatives impacts additive to past present and reasonably foreseeable future actions? yes[Y]/no[N]				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Degree of additive impact? S=strong; M=moderate; L= low				L	L	L	M	L	S	S	S	S	S	M	S	S	S	S	L	S	L

Legend: B = Beneficial impact, X = Adverse impact, Blank cell = No or minimal impact anticipated, SI = Significant impact, SI-M = Significant and mitigable to less than significant, **Bold** = project identified on Figure 4.3-5, RC= Recently completed; P = Present; RF = Reasonably foreseeable, ( ) = Indirect (workforce population and induced) population impact

The final two lines of the table indicate if an additive impact on the resource is anticipated, and whether the additive impact from the preferred alternatives is strong, moderate, or low.

The cumulative impacts study area for each resource is the island of Guam and its waters out to 164 ft (50 m). The following is a summary of the cumulative impact analysis by resource.

Geological and Soil Resources

Current Health and Historical Context. The affect of pre-colonial populations on the current health of Guam's geological resources is difficult to ascertain. During the Spanish Period (1668-1899) introductions and increases of domesticated animals (water buffalo, pigs, goats, and deer) and farm crops likely denuded soils and contributed to erosion from vegetation loss and trampling. However, Guam's geological and soil resources have been most recognizably affected by human populations in the past century. Of particular note are impacts associated with WWII, during which time much of Guam's foliage was lost to bombings as the U.S. retook control of the island from Japan in 1944. In 1947, the U.S. military seeded the island from the air with tangantangan (*Leucaena leucocephala* - native to the Americas) to control erosion (Section 1.3.3.1). Additional WWII impacts to soils and geological resources resulted from construction of Japanese defensive positions and the compaction and grading resulting from a massive build-up of American forces, including the construction of five airfields, immediately after the U.S. reclaimed control of the island (Volume 2, Section 12.1.1.3).

More recently, soil loss due to erosion is largely attributed to human-induced wildfires, construction and development with inadequate erosion control systems, recreation with off-road vehicles, and introduced mammals (Sections 1.3.2 and 3.3.2). Prior to the arrival of humans, Guam seldom experienced wildfires due to environmental conditions unfavorable to fire ignition. Despite Guam's humid conditions, approximately 750 wildfires were reported annually between 1979 and 2001. Although open fires are prohibited under existing local codes, the majority of wildfires are caused by humans. During this time period, over 155 mi^2 of vegetation burned and Guam lost nearly a quarter of its total tree cover (Volume 2, Section 3.1.1.4). The burn areas are often invaded by non-native grasses or become "barrens." The replacement of forest with savanna vegetation contributes to elevated soil loss, as erosion in savanna areas may be 100 times higher than in scrub forest. During the rainy season, erosion is accelerated in sparsely vegetated or barren burn areas and sediment is carried by heavy rains into Fena Lake Reservoir and the Ugum River, leading to water quality problems for southern Guam. Eroded silt from these burn areas also destroys marine life in reefs around the island (Section 1.3.2). Popular use of off-road vehicles for recreation is also believed to be a major contributor to the development and persistence of erosion-prone cover types.

During construction, grading and filling are often required; this may reduce soil quality that in turn may affect plant growth and runoff. When topsoil is removed, biological activity decreases, as does the presence of organic matter and plant nutrients, thereby affecting plant nutrition, control of pests and disease, water infiltration, and resistance to erosion. Compaction also typically occurs at construction sites and can also increase erosion potential (Volume 2, Section 3.1.1.4). Once construction is complete, the addition of impervious surfaces (i.e., rooftops, sidewalks, roads, and parking lots) can accelerate water flows and lead to further soil loss and erosion if appropriate storm water controls are not implemented.

There are no recently completed projects identified with the potential to contribute to a cumulative impact to geological and soil resources on Guam (Table 4.3-3). Two present projects with the potential to contribute to a cumulative impact to geological and soil resources on Guam were identified (Table 4.3-3): MIRC (4) and Mitigation for Kilo Wharf Extension (AH-21). Mitigation for Kilo Wharf Extension (AH-

21) is anticipated to have a beneficial effect on geological resources by reducing erosion and associated soil loss.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant and mitigable impacts to Guam's geological and soil resources as listed in Table 3.3-2 (see Volume 7, Section 3.3.2; Volumes 2, 4, and 5, Section 3.2; Volume 6, Section 5.2). The impacts are related to sinkholes and liquefaction potential. The proposed action is not expected to unreasonably increase vulnerability to a geologic hazard (e.g., earthquake, tsunami). Geotechnical surveys would be completed prior to construction, and sinkholes would be avoided to the extent practicable. Temporary direct impacts to geological resources that could contribute to a cumulative impact would primarily occur to soils during the construction phase when vegetation would be temporarily cleared and topsoil graded. The effects would be localized and would not affect productive agricultural soils. BMPs included in the proposed action are expected to be effective at controlling soil erosion and storm water during temporary construction and long-term operations. However, there is always the potential for uncontrollable BMP failures. For example, storm water control systems could be overwhelmed during a typhoon, resulting in undesirable affects that could be cumulative, such as increased erosion from accelerated sheet flows across impervious surfaces (i.e., rooftops, sidewalks, roads, and parking lots) added by the proposed action.

Reasonably Foreseeable Actions that Affect Geological and Soil Resources. Five reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to geological and soil resources on Guam (Table 4.3-3): New Landfill (Dandan; S-2), Amphibious Training (Tipalao Beach; USMC; AH-17), Amphibious Training (Dadi Beach; USMC; AH-16), Seashore Clearance Request (C-20), and the Reforestation of Masso Reservoir (C-16). Two of the projects would be in North Guam, two at Apra Harbor, and one in South Guam. Reforestation of Masso Reservoir (C-16) is anticipated to have a beneficial effect on geological resources by reducing erosion and associated soil loss.

Potential Cumulative Impacts. Anticipated temporary impacts to geological resources during construction and long-term impacts associated with operations, although considered to be insignificant, would have an adverse cumulative impact when combined with the past, present, and reasonably foreseeable actions on Guam identified above. Uncontrolled human and natural factors (e.g., typhoons, tropical storms, earthquakes, tsunamis) outside the military base would continue to have an adverse impact on geological and soil resources. The degree of additive impact resulting from the preferred alternative is considered to be low and would not appreciably impact the trend in the health of geological resources on Guam over time (Table 4.3-3).

Need for Mitigation. Mitigation measures proposed for avoiding and reducing impacts to geological resources are listed in Table 2.2-1. These mitigation measures would reduce and avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Water Resources

Current Health and Historical Context. The historical context of surface water, groundwater, nearshore water, and wetlands on Guam is difficult to ascertain. Soil erosion and stormwater runoff are largely responsible for degradation of surface and nearshore waters. As described above under Geological and Soil Resources, the introductions and increases of domesticated animals (water buffalo, pigs, goats, and deer) and farm crops likely denuded soils and contributed to erosion from vegetation loss and trampling. During WWII much of Guam's foliage was lost to bombings. When the U.S. retook control of the island

from Japan in 1944, Tangantangan (*Leucaena leucocephala* - native to the Americas) was planted to control erosion (Section 1.3.3.1).

More recently, soil loss (due to erosion) is largely attributed to human-induced wildfires, construction and development with inadequate erosion control systems, recreation with off-road vehicles, and introduced mammals (Section 1.3.2). As described under and Soil Resources above, the occurrence of wildfires has increased. Between 1979 and 2001, over 155 mi^2 of vegetation burned and Guam lost nearly a quarter of its total tree cover (Volume 2, Section 3.1.1.4). The burn areas are often invaded by non-native grasses or become barrens. The replacement of forest with savanna vegetation contributes to elevated soil loss, as erosion in savanna areas may be 100 times higher than in scrub forest. Eroded silt from these burn areas also destroys marine life in reefs around the island (Section 1.3.2). Popular use of off-road vehicles for recreation is also believed to be a major contributor to the development and persistence of erosion-prone cover types.

Once construction is complete, the addition of impervious surfaces (i.e., rooftops, sidewalks, roads, and parking lots) can accelerate water flows and lead to further soil loss and erosion if appropriate storm water controls are not implemented. Past construction and development on Guam has resulted in the addition of approximately 12,280 acres (4,970 ha) of developed impervious surface area (Department of Commerce et al. 2007), representing approximately 1% of the island's total land area.

Threats to surface water would continue to be monitored by federal and Guam agencies, and appropriate regulatory action would continue to occur in order to maximize surface water quality and availability. In time, water resource impacts would be expected to slowly be reduced as point and non-point sources of pollution are identified, and pollution loading to surface waters is reduced.

The identified nearshore water quality concerns for the marine waters of Guam include copper, aluminum, nickel, e*nterococci* bacteria, total residual chlorine, biochemical oxygen demand, and total suspended solids (Section 3.3.3.2). In time, nearshore water quality would be expected to slowly improve as point and non-point sources of pollution are identified and pollution loading to nearshore waters is reduced.

As described in Section 3.3.3.2, threats to groundwater availability and quality (e.g., saltwater intrusion and leaky septic systems) would continue to exist. Monitoring for saltwater intrusion, coordination amongst water users, and fewer septic systems anticipated in the future are expected to ensure a dependable and safe supply of groundwater would be maintained for Guam. In time, groundwater quality would be expected to slowly improve on Guam as point and non-point sources of pollution are identified, and pollution loading to surface waters is reduced, all within the framework of increasing the understanding of the Northern Guam Lens Aquifer (NGLA).

Wetlands can also be impacted by soil erosion, but direct impacts (due to removal by construction projects) have reduced wetlands over time. These threats to wetland areas are monitored by federal and Guam agencies. Appropriate regulatory action would continue to occur to protect wetland areas. In time, wetland quality would be expected to slowly improve as point and non-point sources of pollution are identified; however, the extent of wetlands (by acreage) may not significantly increase because the focus is currently on reducing potential future losses.

Two recently completed projects with the potential to contribute to a cumulative impact to water resources on Guam were identified (Table 4.3-3): Kilo Wharf Improvements (AH-1), and Ironwood Estates (affordable housing; 1).

Nine present projects with the potential to contribute to a cumulative impact to water resources on Guam were identified (Table 4.3-3): MIRC (4), ISR/Strike Capability (Andersen AFB; N-7), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12), Kilo Wharf (AH-10), and Mitigation for Kilo Wharf Extension (AH-21). Mitigation for Kilo Wharf Extension has a beneficial cumulative impact.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in less than significant impacts to Guam's water resources (surface water, groundwater, nearshore water, and wetlands), as summarized in Volume 7, Section 3.3.3, Table 3.3-5. The details of the impact analysis for the preferred alternatives are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 4.2; Volume 6, Section 6.2). This assessment assumes BMPs are effective at controlling soil erosion, pollutants of concern, and stormwater flow. Low Impact Development (LID) measures would be implemented. While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed per capita, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield. Monitoring groundwater chemistry and overlying sediments would ensure no harm to existing beneficial uses, and no damage to structures, utilities, or other facilities would result from potential soil settlement or saltwater intrusion. Wastewater treatment plant effluent discharges would be of the same or higher quality than current discharges, and would continue to meet discharge requirements in nearshore waters. An estimated 0.3 ac (0.12 ha) of wetlands could be impacted; mitigation measures would be required by the USACE to compensate for the loss. The uncontrolled human and natural factors outside the proposed actions would continue to have an adverse impact on water resources.

Reasonably Foreseeable Actions that Affect Water Resources. 30 reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to water resources on Guam (see Table 4.3-3). 22 of the projects would be in North Guam, six at Apra Harbor, and two in South Guam. Reforestation of Masso Reservoir (C-16) is anticipated to have a beneficial effect on water resources by reducing erosion and sedimentation. There is insufficient detail on the cumulative projects to know which ones may impact wetlands; however, it is likely some wetlands would be affected by projects such as N-17, C-24, and S-7 (GLUC wetlands permit), coastal projects such as the Marine Corps training (AH-16, AH-17, AH-18), wharf improvements such as X-Ray Wharf (AH-11), Port Authority Guam (AH-8), and JHSVs (AH-22). The remaining development projects that disturb soils have the potential to impact soils and increase impervious surfaces (i.e., rooftops, sidewalks, roads, and parking lots) and consequently have the potential to impact surface waters. Additionally, development projects are likely to increase the demand on Guam's groundwater resources, particularly the NGLA. The new PDW Dandan landfill project (S-2) is listed as having the potential to impact water resources; however, landfills are heavily regulated and routinely monitored.

Potential Cumulative Impacts. Cumulative projects would involve construction activities that would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. For cumulative projects disturbing more than one acre during construction (including the preferred alternative), a Construction General Permit would be obtained and followed and a Stormwater Pollution Prevention Plan (SWPPP) would be prepared and implemented to minimize temporary increases in runoff and pollutant loading related to construction activities.

In addition, cumulative projects would result in an increase in impervious surface area in urban and industrial settings, resulting in a corresponding increase in stormwater runoff that has the potential to have elevated levels of contaminants, such as sediments, nutrients, heavy metals, organic and inorganic compounds, and detrimental microorganisms. The increase in impervious surfaces would result in an associated increase in stormwater discharge intensities and volume. This increase would likely be accommodated by existing or new stormwater infrastructure to ensure the timely and low-impact flow of stormwater to minimize erosion and flooding concerns. In addition, cumulative actions would be expected to increase the amount of petroleum, oil, and lubricants (POLs), hazardous waste, pesticides, and fertilizers being stored, transported, and utilized. Increasing the storage, transportation, and use of these substances would increase the potential for releases to water resources. Implementation of BMPs associated with addressing site- and activity-specific water resource protection needs, provisions of facility-specific SWPPPs, and Spill Prevention, Control, and Countermeasure (SPCC) Plans would minimize potential impacts from facility operations, to include the transportation, storage, and use of fuel, on all water resources. In addition, adherence to surface water quality and volume control measures would also reduce pollutant loading to groundwater basins, nearshore waters, and wetlands. Many of the cumulative projects could potentially impact water resources. The preferred alternatives would increase the total existing development-related impervious surface area on Guam by approximately 7% (Section 3.3.3.1).

Reasonably foreseeable projects include connections to wastewater collection, treatment, and disposal systems that would reduce and/or ensure less reliance on septic systems for wastewater disposal; thereby resulting in a benefit to groundwater resources. Furthermore, identified sustainability measures associated with the preferred alternative (e.g., conserving water), when combined with similar measures for applicable cumulative actions, would benefit groundwater resources. These measures would also benefit nearshore waters by reducing the nutrient and bacteria load.

While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed per capita; thereby helping to minimize impacts to groundwater availability. Water managers would continue to proactively monitor groundwater chemistry and the depth to the freshwater/saltwater transition zone to ensure increased pumping does not adversely affect sources of drinking water. Careful monitoring of groundwater chemistry and overlying sediments would ensure no harm to existing beneficial uses; and no damage to structures, utilities, or other facilities would result from potential soil settlement.

Projects involving construction and/or dredging in Apra Harbor and the subsequent handling of the dredged material would have the potential for cumulative impacts to nearshore waters and wetlands. However, these projects would require Section 404(b) and Section 10 of the Rivers and Harbors Act permits from the USACE, and Water Quality Certification (WQC) from the GEPA. These permits would stipulate procedures and mitigation requirements in addition to dredging-related BMPs and potential impacts to nearshore waters and wetlands from these projects would be minimized.

There is the potential for the cumulative projects to have direct and indirect impacts to wetland areas possibly resulting in the loss of wetland area and/or function. Per USACE regulations, activities that are proposed in wetlands or that could potentially reduce wetland function, must be permitted and potentially mitigated to compensate for direct impacts to wetland areas. Therefore, any loss of wetland area or functionality would be potentially mitigated at a project and site-specific ratio, which would likely include creating or enhancing existing wetland habitat elsewhere. Indirect impacts to wetland areas (e.g.,

runoff, sediment loading, etc.) would be addressed on a project-specific level, and would likely be lessened with BMPs and associated short- and long-term stormwater runoff management measures.

The degree of additive impact resulting from the preferred alternative is considered to be low and would not appreciably impact the trend in the health of water resources on Guam over time (Table 4.3-3).

Need for Mitigation. Mitigation measures proposed for avoiding or reducing impacts to resources are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Air Quality

Current Health and Historical Context. There are no comprehensive ambient background air quality levels from recent monitoring available for Guam. The existing background air quality conditions around Guam can be defined based on the current ambient air quality attainment status applicable to Guam, which is:

- Attainment for all criteria pollutants except SO_2.
- Two SO_2 nonattainment areas within a 2.1 mi (3.5 km) radius around Piti and Tanguisson power plants.

Except for power generating facilities, there are no significant stationary sources of air emissions on Guam. It can be assumed that prior to the non-attainment designation in the 1970s, historical ambient air quality was good before and after WWII.

The future traffic growth would likely result in an increase in mobile source emissions on Guam. However, the reduction of mobile source engine emissions in the future, per CAA requirements, would contribute to a reduction of the overall mobile source and greenhouse gas emissions. Therefore, the air quality conditions affected by mobile source operations would likely remain the same or improve slightly, as compared to the existing conditions.

There were no recently completed projects identified with the potential to contribute to a cumulative impact to air quality on Guam (Table 4.3-3).

Five present projects with the potential to contribute to a cumulative impact to air quality on Guam were identified (Table 4.3-3): Workforce housing (Core Tech, C-6), Workforce housing (Younex Enterprises, N-21), ISR/Strike Capability (Andersen AFB; N-7), Beddown of Training and Support Initiatives at NWF (N-6), and MIRC (4).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in less than significant impacts to Guam's air quality, as summarized in Volume 7, Section 3.3.4, Table 3.3-7. The details of the impact analysis for the proposed actions are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 5.2; Volume 6, Section 7.2). Operational air emissions originate from stationary and mobile sources. The basis of the air impact analysis was a significance criterion of 250 tons per year (TPY) for air pollutants. As summarized in Volume 7, Section 3.3-8, it is the on- and off-base vehicle traffic that could exceed the 250 TPY threshold of significance for CO. These impacts, however, would be temporary and localized at intersections. The proposed action would also increase the levels of greenhouse gases, but the overall impact on air quality would still be less than significant.

Reasonably Foreseeable Actions that Affect Air Quality. 14 reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to air quality on Guam (see Table 4.3-3). One is a Guam general project, one would be in North Guam, 11 projects would be in central Guam, and one in Apra Harbor. One of the projects, programmed port improvements (AH-8), is anticipated to result in a benefit effect to air quality by increasing throughput efficiencies and reducing idling times.

Potential Cumulative Impacts. Current projects in Guam consist primarily of building developments, infrastructure upgrades and improvements, and military projects. There are several projects in the areas close to the Tanguisson nonattainment area, such as the Bayview 5 Luxury Project (C-12), Hemlani Apartments (C-14), and the Ino Corp. development (C-17). There are also a number of port improvement projects planned by GovGuam and the Navy close to the Piti nonattainment area. Additionally, a Guam general project (12) to add a 60 MW power plant would likely contribute to air emissions. These and other cumulative projects would contribute to man-made air emissions. However, the port improvement projects are expected to reduce air emissions in the Port. The GEPA has adopted the USEPA-established stationary source regulations discussed previously, and acts as the administrator to enforce stationary source air pollution control regulations in Guam. Current air quality regulations are applied to air emissions from new sources for the protection of human health. The cumulative projects would not necessarily result in increases in island-wide traffic and air emissions, but new destinations would shift the emissions from mobile sources.

Anticipated impacts to air quality, although considered to be less than significant, would have an adverse cumulative impact when combined with the past, present, and reasonably foreseeable actions on Guam identified above. The degree of additive impact resulting from the preferred alternative is considered to be low and would not appreciably impact the trend in the air quality on Guam over time (Table 4.3-3).

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to air quality resources are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Noise

Current Health and Historical Context. WWII bombings and air operations may represent the loudest period in Guam's history, however those noise impacts were temporary. Volume 7, Section 3.3.5.2, identifies existing sources that contribute to ambient noise, such as the commercial airport, Andersen Air Force Base airfield, industrial facilities, military training range activities, and traffic. Most of these noise impacts are temporary. Industrial noise, such as power generation, would emit noise for longer periods, but is subject to Occupational Safety and Health Administration (OSHA) regulations to protect the hearing of sensitive receptors, specifically workers. There is no island-wide noise level monitoring, and trends in noise are not documented island-wide. The assumption is there would be an increase in industrial activity, airfield activity, and traffic, resulting in a general increase in ambient noise levels with implementation of the proposed action, but increases in noise generation are only useful for impact analysis if the proximity of the noise sources to potential sensitive receptors is known.

One recently completed action with the potential to contribute to cumulative impacts to noise on Guam was identified (Table 4.3-3): Ironwood Estates (affordable housing; 1).

Four present projects with the potential to contribute to a cumulative impact to noise on Guam were identified (Table 4.3-3): MIRC (4), ISR/Strike Capability (Andersen AFB; N-7), Workforce housing (Younex Enterprises; N-21), and Workforce housing (Core Tech; C-6).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant impacts to Guam's ambient noise, as summarized in Volume 7, Section 3.3.5, Table 3.3-14. The details of the impact analysis for the proposed actions are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 6.2; Volume 6, Section 8.2). Noise levels associated with the preferred alternatives would increase locally by one or two decibels (dB) at the day-night noise level (DNL) around the Andersen AFB airfield. Aviation operations would raise noise levels locally, but only as the aircraft fly overhead. The Andersen South Training and Route 15 ranges would result in noise levels that are considered incompatible with surrounding land uses that are within Zone II noise contours.

Reasonably Foreseeable Actions that Affect Noise. 12 reasonably foreseeable future projects are anticipated to contribute to a cumulative noise impact on Guam (see Table 4.3-3). One of the projects would be located in North Guam, seven projects in central Guam, three at Apra Harbor, and one in South Guam. Guam International Airport Improvements (C-15) could potentially facilitate a greater volume of air traffic and associated noise. The three Marine Corps amphibious training activities (AH-16, AH-17 and AH-19) could contribute to noise in Apra Harbor and south of Orote Peninsula. The new landfill (S-2) would result in more traffic and operational noise associated with heavy equipment.

Potential Cumulative Impacts. Operations of all the cumulative projects would generate some level of noise. The projects would be distributed across the island and different sensitive receptors would be impacted by the projects. There may be some that overlap geographically. Very few projects are likely to generate noise at levels that would be subject to regulation or harmful to human health. Military mission changes such as Redhorse/Commando Warrior Training (N-6), ISR/Strike (N-7), MIRC (4) would produce localized noise impacts. The ISR/Strike EIS identified noise encroachment in the non-DoD community and these noise levels were the baseline for the noise impact assessment of this EIS. Improvements to the commercial airport (C-15) and the port (AH-8) would likely facilitate an increase in throughput and associated noise. The cumulative projects and the preferred alternatives would impact noise in localized areas. The impacted areas would be at Andersen AFB and on roadways. The degree of additive impact resulting from the preferred alternative is considered to be low and would not appreciably impact the trend in the ambient noise on Guam over time (Table 4.3-3).

Need forMitigation. Mitigation measures proposed for avoiding or reducing impacts to ambient noise are listed in Table 2.2-1. These mitigation measures would reduce or avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative noise impacts are proposed.

Airspace

A *Current Health and Historical Context*. As mentioned in Volume 7, Section 3.3.6.2, the commercial air traffic fluctuates based on tourism levels, and military use at Andersen AFB is mission-dependent. Training activities are addressed in the MIRC EIS/OEIS. Construction activities rarely impact airspace, but airspace is impacted by the resultant operations. Because there are multiple, and sometimes competing, demands, the Federal Aviation Administration (FAA) considers all aviation airspace requirements in relation to airport operations, federal airways, jet routes, military flight training activities, and other special needs to determine how the National Airspace System can best be structured to satisfy all user requirements. Significant impacts are avoided prior to FAA approval. While there may be a trend toward an increase in air traffic, the significant impacts are avoided through regulatory oversight.

There are no recently completed projects identified that have the potential to contribute to a cumulative impact to airspace on Guam (Table 4.3-3).

One present project with the potential to contribute to a cumulative impact to airspace on Guam was identified (Table 4.3-3): ISR/Strike Capability (Andersen AFB; N-7).

Direct and Indirect Impacts of the Preferred Alternative that Might Contribute to a Cumulative Impact. The preferred alternatives would result in less than significant impacts to Guam's airspace as summarized in Volume 7, Section 3.3.6, Table 3.3-16. The impact assessment details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 7.2; Volume 6, Section 9.2). A new Special Use Airspace (SUA) in the vicinity of Northwest Field would be required for training, but would not require any changes to existing arrivals or departures from the commercial airport. The SUA would have to be established to overlay the Surface Danger Zone (SDZ) footprint at the proposed Route 15 training range complex. It would also require a slight reduction in airspace surrounding the commercial airport. There would be no significant reduction in the amount of navigable airspace available for the commercial airport, and no change to en route airways. The impacts would be less than significant, until new procedures have been in effect for a few months.

Reasonably Foreseeable Actions That Affect Airspace. Two reasonably foreseeable future projects are anticipated to contribute to a cumulative airspace impact on Guam (see Table 4.3-3). Both projects would be located in North Guam: these are Guam International Airport Improvements (C-15) which could potentially facilitate a greater volume of air traffic, and the Broad Area Maritime Surveillance (BAMS) project (N-22).

Potential Cumulative Impacts. Andersen AFB projects (N-6, N-7) are present projects that are likely to impact airspace, and are included in the affected environment. BAMs (N-22) at Andersen AFB may also impact airspace, but it is un-programmed and not included in the affected environment. The FAA manages the cumulative impact of air traffic and special use airspace to ensure there are no significant impacts to airspace. There is an additive impact between the proposed actions and the cumulative projects, but the degree of additive impact resulting from the preferred alternative is considered to be low.

Need for Mitigation. No mitigation measures are proposed for the proposed action, and none are projected for the potential cumulative impacts.

Land and Submerged Land Ownership and Use

A *Current Health and Historical Context*. In 1950, DoD land ownership was estimated at 58% of Guam. As a result of the Guam Excess Land Act of 1994, and Base Closure and Realignment (BRAC) recommendations, DoD land control decreased to less than 30% over the past three decades. In the 1950s, Guam land use zoning was adopted to manage non-federally controlled land development; submerged lands ownership has not changed substantially since 1975. As lands were released through BRAC, adjacent submerged lands were not released, though there are a few exceptions such as DoD releasing nearshore submerged lands at Ritidian Point. There have and will continue to be zoning variances, conditional use permits, and changes to the zoning map. Historically, these were granted excessively, without consistent long range planning. The current and future trend is for increased management of land use to be consistent with community and master plans; however, it is difficult to correct historical zoning decisions. The accommodation of development that is inconsistent with zoning is occurring at a less rapid rate. It is difficult to ascertain if public access has become more restrictive over time outside of federal lands.

Four recently completed projects with the potential to contribute to a cumulative impact to land and submerged land use on Guam were identified (Table 4.3-3): Kilo Wharf Improvements (AH-1), Talo Verde Estates (C-3), Home Depot (C-2), and Ironwood Estates affordable housing (1).

11 present projects with the potential to contribute to a cumulative impact to land and submerged land use on Guam were identified (Table 4.3-3): Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Workforce housing (Core Tech; C-6), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C12), Bureau of Medicine Naval Replacement Hospital Project (C-13), and Kilo Wharf Extension (AH-18).

Direct and Indirect Impacts of the Preferred Alternative that Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant impacts to Guam's land use and ownership as summarized in Volume 7, Section 3.3.7, Table 3.3-18. The details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 8.2; Volume 6, Section 10.2). The summary of impacts from the preferred alternatives is described as significant for the land acquisition by the federal government. Impacts on land use were also described as significant because: 1) there would be access restrictions on submerged lands and acquired DoD lands to support the firing range complex near Route 15; and 2) the firing range complex land use would be incompatible with adjacent non-DoD low density residential properties, due to noise. The impact of the proposed increase in federal land would reverse the recent trend established through BRAC to reduce federally-controlled lands on Guam. Local zoning laws are not applicable to federally-controlled lands, but community master plans would change as a result of land acquisition.

Reasonably Foreseeable Actions That Affect Land and Submerged Land Use. 30 reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to land and submerged land use on Guam (see Table 4.3-3). Six would be located in North Guam, 15 in Central Guam, seven at Apra Harbor, one in South Guam, and one project, the Territorial Prison (7) is considered a general action. It is difficult to determine if the existing land uses are consistent with current zoning. The housing and hotel projects (C-7, C-14) and other development would result in a loss of open space.

Potential Cumulative Impacts. None of the proposed cumulative projects appear to require acquisition of non-federally controlled land or submerged lands; therefore, no additive cumulative impact is anticipated on land ownership. Some of the cumulative projects are obviously requests for variance or conditional use (i.e., N-14, N-15, C-18, C-19, C-21, C-25), but others listed may also have required land use variances. The cumulative impacts of granting variances and conditional use permits could be significant over time.

There is a strong additive cumulative impact between the proposed actions and the cumulative projects with respect to land use inconsistency and incompatibility with existing and planned zoning, and access restrictions. The historical land use/zoning inconsistencies contribute to the additive cumulative impact.

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to land ownership and use are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Recreational Resources

A *Current Health and Historical Context*. There is little historical information on recreational resource uses. Presumably, the boom in the tourist industry in the early 1990s resulted in an increase in conflicts among recreational users and physical deterioration of resources. Other human and natural factors, such as typhoons, coral bleaching, illegal harvesting of coral and fish, non-point source pollution, and insufficient funding for resource management, would continue to adversely impact recreational resources.

One recently completed project with the potential to contribute to a cumulative impact to recreational resources on Guam was identified (Table 4.3-3): Talo Verde Estates (C-3).

Three present projects with the potential to contribute to a cumulative impact to recreational resources on Guam were identified (Table 4.3-3): Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C12), Talo Vista Tower (C-5), and Residential construction (Tamuning; C-4).

Direct and Indirect Impacts of the Preferred Alternative that Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant impacts to Guam's recreational resources as summarized in Volume 7, Section 3.3.8, Table 3.3-20. The details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 9.2; Volume 6, Section 11.2). The impacts on recreational resources are significant because: 1) there would be changes to public access to resources and reduced recreational opportunities when land is acquired by the federal government; and 2) the increased population could result in conflict and competition among recreational users and deterioration of the resources. The proposed action would contribute to the declining trend in recreational resource health. Other factors unrelated to the project, such as coral bleaching, illegal harvesting of coral and fish, and non-point source pollution, would continue to adversely impact recreational resources.

Reasonably Foreseeable Actions that Affect Recreational Resources. Six reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to recreational resources on Guam (see Table 4.3-3). Three would be located in North Guam and three would be at Apra Harbor. Zone change request (C-25), seashore clearance request (C-20), and a PUD Amendment (C-19) could have beneficial effects. Coastal Marine Corps training activities (AH-16, AH-17, AH-18) could have an adverse affect.

Potential Cumulative Impacts. A few of the listed projects appear to have a recreational component, including PUD amendment (C-19), seashore clearance request (C-20, S-4, S-8), and a zone change request (C-21). Also planned are a 700-unit condominium in Tamuning (C-4); a 700-unit resort condominium proposed by Ypao Resort (C-7); a 396-unit resort condominium, and commercial uses proposed by Ino Corporation (C-17). The subdivisions listed are also likely to have playgrounds.

There are insufficient data to determine if the cumulative projects would alter access to recreational resources or reduce recreational opportunities. This could occur if a development, for example, replaces a baseball field or limits access to a beach. There are DoD mission changes on the cumulative project list that would also increase on-island population, such as Redhorse/Commando Warrior Training (N-6), and the ISR/Strike (N-7), which are included in the affected environment discussion of this EIS. Other potential mission changes, such as Army JHSV (AH-22) and BAMS (N-22), that might impact island population, were not included in the affected environment because there is insufficient detail on the project description.

Increases in recreational resources use would likely occur at beaches and parks, scenic points, historic and cultural sites, dive spots, trails, day use resorts, golf courses, sailing venues, on installations, and the rest of the island alike. Guam's tropical weather encourages year-round use of recreational resources by residents and visitors. Foreseeable impacts include inadequate or overly crowded facilities such as parking, picnic shelters, restrooms, showers, boat mooring facilities, etc. Moreover, an eroded sense of enjoyment, due to increased competition for opportunities among users, would result at most recreational facilities (e.g., golf courses on installations, popular dive spots, etc.). Lastly, an increase in the number of users would accelerate deterioration of existing facilities.

There is a strong additive cumulative impact between the proposed actions and the cumulative projects with respect to impacts on recreational resources. These impacts would accelerate the decline of recreational resource health.

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to recreational resources are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the preferred alternatives in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Terrestrial Biological Resources

A *Current Health and Historical Context*. As mentioned in Volume 7, Section 3.3.6.2, the terrestrial biological health on Guam is declining. The affect of pre-colonial populations on the current health of Guam's terrestrial biological resources is difficult to ascertain. During the Spanish Period (1668-1899) there were introductions and an increase of domesticated animals (i.e., water buffalo, pigs, goats, and deer). Introduced ungulates have significantly impacted native forests by consuming seeds, fruits and foliage and trampling plants. Feral pigs also cause additional damage by wallowing and rooting.

WWII physically destroyed extensive areas of habitat (due to war actions and construction) along with continued clearings associated with agriculture (i.e., crops and grazing). Shortly after WWII, BTS were inadvertently introduced to the island and by the late 1960s had spread throughout Guam (Section 1.3.3). In order to reduce erosion after WWII, tangantangan was planted and had spread to the point of replacing native plants in large areas.

Existing stressors (e.g., tropical storms, typhoons, non-native plants and animals, diseases, wildfires, and poaching) continue to degrade habitat quality and contribute to the trend of declining health of terrestrial biological resources. Ongoing efforts to manage terrestrial resources on military lands and non-federally controlled lands would continue to reduce the rate of decline.

Fewer than 1,000 threatened Mariana fruit bats were believed to live on Guam in 1972, and less than 100 bats from 1974 to 1977. During an intensive island-wide survey in 1978, it was concluded that fewer than 50 fruit bats survived. The most recent counts further confirm that fewer than 50 bats remain on Guam. Hunting pressure is largely responsible for the decline. Although hunting is illegal, it remains a threat.

The kingfisher population on Guam was federally listed as an endangered species in 1984, but by 1988, it was close to becoming extinct along with the majority of Guam's other avifauna as a direct result of predation by the introduced BTS. The remaining kingfishers were removed from the wild and placed in captivity, and in 2008, the captive population reached 100 individuals. Research and management efforts continue so that a wild population may eventually be reestablished on Guam.

Historically on Guam, the endangered Mariana crow was found throughout forested areas, and was considered common into the early 1960s. The current Mariana crow population on Guam is estimated at only two individuals, both males. Predation by BTS, rats, and monitor lizards prevents recovery.

Four recently completed projects with the potential to contribute to cumulative impacts to terrestrial biological resources on Guam (Table 4.3-3) are: Talo Verde Estates (C-3), Home Depot (C-2), Kilo Wharf Improvements (AH-1), and Ironwood Estates (Affordable Housing; 1).

Fifteen present projects with the potential to contribute to a cumulative impact to terrestrial biological resources on Guam were identified (Table 4.3-3): Mariana Islands Range Complex (4), ISR/Strike Capability (Andersen AFB; N-7), Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Workforce housing (Core Tech; C-6), Residential construction

(Tamuning; C-4), Talo Vista Tower (C-5), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12), Bureau of Medicine Naval Replacement Hospital Project (C-13), Beddown of Training and Support Initiatives at NWF (N-6), Mitigation for Kilo Wharf Extension (AH-21), and Draft Safe Harbor Agreement (Cocos Island; S-1). Mitigation for Kilo Wharf Extension and the Safe Harbor Agreement are considered to have beneficial cumulative impacts.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant and mitigable impacts to Guam's terrestrial biological resources, specifically special status species, as summarized in Volume 7, Section 3.3.9, Table 3.3-22. The impact assessment details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 10.2; Volume 6, Section 12.2). Section 3.3.9 quantifies impacts on special-status species habitat for the preferred alternatives. The total amount of primary limestone vegetation removed with implementation of the preferred alternative would be 29 ac (12 ha), and the total amount of ravine forest removed would be 17 ac (6.9 ha). Approximately 1,600 ac (647 ha) of disturbed limestone habitat would also be removed. Implementation of the preferred alternative would contribute to the trend in degradation of terrestrial biological resources, primarily through a loss of habitat. There is also the increased risk of invasive species introduction, but development of the Micronesia Biosecurity Plan (MBP) and implementation of biosecurity measures would minimize those risks. There are many acres of suitable habitat available on non-federally controlled land, but land is not the limiting factor. Unless other stressors are controlled, the listed species would not recover.

Reasonably Foreseeable Actions That Affect Terrestrial Biological Resources. 37 reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to terrestrial biological resources on Guam (see Table 4.3-3). Twenty-eight would be located in North Guam, seven at Apra Harbor, and two in South Guam. Reforestation of Masso Reservoir (C-16) is anticipated to have a beneficial effect on terrestrial biological resources. Most cumulative projects are presumed to impact terrestrial biological resources if there is ground disturbance. Insufficient details on each project are available to assess the total loss of habitat for the cumulative projects.

Potential Cumulative Impacts. Projects at Andersen AFB have been approved to remove 1.4 ac (0.6 ha) of primary limestone forest. Additional areas of disturbed limestone habitat would be removed at Andersen AFB. A private development project at Talo Verde Estates in east-central Guam near Pago Bay may remove as much as 35 ac (14 ha) of primary limestone forest, based on USFS (2006) mapping. The total amount of primary limestone forest that would be removed for recently completed, present, and foreseeable future projects on Guam is estimated at 61 ac (25 ha), and the total amount of ravine forest that would be removed is estimated at 16 ac (6.5 ha). Other projects throughout Guam, both military and commercial, are not proposed in areas known to have primary limestone forest. Due to the loss of primary limestone forest, there would be significant cumulative impacts to vegetation.

Native wildlife species that have been or would be impacted by recently completed, present, and foreseeable future actions include only several species that are widespread on Guam. There would be no significant impacts from cumulative projects.

Numerous past projects and military training on Guam have resulted in direct and indirect impacts to federally and Guam-listed terrestrial species and federal candidate species. The Mariana fruit bat has been impacted by past actions at Andersen AFB. The Biological Opinion (BO) for the ISR/Strike (N-7) identifies the following impacts: one Mariana fruit bat would be harmed, 21 bats would be killed, and two bat colonies would be harassed on Guam. Training at NWF from the NWF Beddown and ISR/Strike

actions, and Navy and U.S. Marine Corps training in Guam, would result in increased auditory and visual disturbance to fruit bats and to the few remaining Mariana crows.

Habitat loss for endangered species from various past actions at Andersen AFB (data from USFWS 2008), and the proposed action for the Guam and CNMI Military Relocation, are summarized in Table 4.3-4. Total essential habitat removed in the recently completed (since 2004), present, and foreseeable future are, at a minimum:

- 10.2% of the total habitat available for the Mariana fruit bat,
- 11.3% of the total habitat available for the Mariana crow,
- 9.9% of the total habitat available for the Guam Micronesian kingfisher, and
- 10.3% of the total habitat available for the Guam rail.

Table 4.3-4. Summary of Recently Completed Project Cumulative Impacts to Endangered Species Habitat

Resource	*Foraging, Roosting, Breeding, or Sheltering Habitat (ac [ha])*			
	Fruit Bat	*Crow*	*Rail*	*Kingfisher*
Baseline Habitat (USFWS 2008)				
Baseline of Essential Habitat* that was Available on Guam in 2004	12,026 (4,867)	10,774 (4,360)	12,172 (4,926)	12,026 (4,867)
Projects with Essential Habitat* Removal or Other Impacts (USFWS 2008)				
NW Field Beddown 2006 (N-6)	116 (47)	116 (47)	116(47)	116 (47)
Cell Tower at Tarague Beach Overlook 2006	2.5 (1.0)	2.5 (1.0)	2.5 (1.0)	2.5 (1.0)
Vegetation Clearing at Pati Point 2006	1.5 (0.6)	1.5 (0.6)	1.5 (0.6)	1.5 (0.6)
Vegetation Removal AAFB 2007 (N-4)	62 (25)	62 (25)	62 (25)	62 (25)
ISR Strike 2007-2016 (N-7)	460 (186)	506(201)	57 (23)	477(193)
Multiple IRP Remedial Sites NW Field 2008	14 (5.7)	14 (5.7)	14 (5.7)	14 (5.7)
Site 12/Landfill 17 2008	1.0 (0.4)	1.0 (0.4)	1.0 (0.4)	1.0 (0.4)
Tarague Beach Improvement Project 2008 (N-12)	1.3 (0.5)	1.3 (0.5)	1.3 (0.5)	1.3 (0.5)
Totals	659 (267)	705 (285)	256 (104)	676 (274)
Guam Military Relocation (this EIS)				
Recovery Habitat* Removed	1,559 (631)	1,557 (630)	1,268 (513)	1,559 (631)
Total Past, Present and Foreseeable Future Habitat Removed Since Baseline of 2004				
Habitat Removed	2,218 **(**898**)**	2,262 **(**915**)**	1,524 (617)	2,235 (904)

Legend: *Essential habitat and recovery habitat are similar and for purposes of this analysis, they are treated similarly and are both assumed to represent suitable habitat; recovery habitat has only been recently identified on Guam by USFWS

The non-DoD cumulative projects are also likely to remove vegetation and adversely impact biological resources. There is a strong, additive cumulative impact between the proposed actions and the cumulative projects with respect to impacts on terrestrial biological resources. These impacts would accelerate the decline of terrestrial biological resource health.

Need for Mitigation. Mitigation measures proposed for avoiding and reducing impacts to terrestrial biological resources are listed in Table 2.2-1. These mitigation measures would avoid, or reduce and mitigate impacts resulting from implementation of the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Marine Biological Resources

A *Current Health and Historical Context*. As described in Section 3.3.10.2, stressors on marine biological resources include human-induced (i.e., point source pollution, overfishing, industrial discharge) and natural events (i.e., storms and bleaching). Prior to Spanish conquest, the Chamorro and other Pacific societies retained property rights within the family that extended out to sea. Fishing occurred but was likely to occur at sustainable levels (see Volume 2, Section 16.1.6.9). Harvesting of sea turtles and their eggs also occurred. The effect of pre-WWII events on the current health of Guam's marine biological resources is difficult to ascertain. There was likely coral damage due to storm and wave events but low levels of human-induced stress because population and industry levels were much lower.

The creation of Inner and Outer Apra Harbor during WWII required extensive dredge and fill. The navigational approach to Inner Apra Harbor was dredged and this is an area proposed for dredging under the proposed action. In addition to the direct physical impact on marine resources due to the war, indirect impacts resulted from an increase in soil erosion as described under the terrestrial biological resources section. The sediment load in the coastal waters likely had an impact on the health of the reefs.

Since WWII, the health of marine biological resources has been affected by an increasing population, and associated recreational, industrial and commercial operations that impact the natural environment. Examples of stressors include overfishing, increased pollutants released directly to the marine environment, or indirectly from land, point and non-point source discharges of stormwater and wastewater treatment plant outfalls, invasive species, recreational activities, diseases, coral bleaching, and storms. Human disturbances also include deliberate harm to reefs by activities such as dynamite fishing and the harvesting of corals for the aquarium trade. Post-WWII dredging in Apra Harbor resulted in a decline of coral communities and compensatory mitigation proposals are being implemented to restore the ecosystem function in other watersheds.

Globally, coral health has been in decline due to human-caused stressors, and these same stressors are active in the Marianas Islands. Increased sedimentation is one of the most common and serious human-induced influences; however, sediment impact to coral can vary greatly depending on a broad spectrum of factors (Volume 4, Section 11.1.2.2). Additional stressors to coral include polluted runoff (input of nutrients), exposure to warm water (global warming and thermal effluents) leading to bleaching, overfishing, anchor damage, tourism-related impacts, ship groundings, and certain military activities (Volume 2, Section 11.1).

The vitality of many of Guam's reefs has declined over the past 40 years, consistent with a general global decline of this resource (Section 3.3.10.2 of this Volume). The average live coral cover was approximately 50% in the 1960s, but dwindled to less than 25% by the 1990s, with only a few areas having over 50% live cover. In the past, however, Guam's reefs have recovered after drastic declines. For example, an outbreak of the crown-of-thorns starfish in the early 1970s reduced coral cover in some areas from 50-60% to less than 1%. Twelve years later, live coral cover was restored to pre-1970s conditions (Section 1.3.3.1 of this Volume).

Recently eighty-two coral species have been the subject of petitions for listing under the ESA and have been classified as candidate species (Volume 2, Section 11.1). The determination to list these coral species is dependent upon ESA criteria currently under review by the NMFS. The effects of such a listing on future actions impacting waters around Guam are not currently known and would be determined when the species are listed. INRMPs covering NAVBASE Guam and Tinian are being updated to address conservation measures for all coral species.

The special-status species relevant to this EIS are the green and hawksbill sea turtles, common bottle nose dolphin, and spinner dolphin. Threats to green sea turtles include direct harvesting of eggs or adults, beach cleaning and replenishment, recreational activities, debris, incidental take from fishing, and seagrass degradation. The hawksbill sea turtle is subject to similar threats as the green sea turtle. The spinner dolphin is expected to regularly occur all around Guam, except at the mouth of Apra Harbor where there are rare occurrences of this species.

The conclusion of a recent *State of the Coral Reef Ecosystem on Guam* assessment was that the health of Guam's coral reefs varies significantly. Reefs unaffected by sediment and nutrient loading, such as those in the northern part of the island and some coastal areas in the south, have healthy coral communities. Guam's reefs have been spared from large-scale bleaching events and coral diseases which are prevalent in so many parts of the world. A number of Guam's reefs are impacted by land-based sources of pollution and over-fishing. Guam identified land-based sources of pollution as its number one priority focus area in 2002. Sedimentation, algal overgrowth due to decreased fish stocks, and low recruitment rates of both corals and fish are important issues that must also be addressed (see Volume 2, Section 16.1.6.9) Big Blue Reef in Apra Harbor is considered one of the healthiest reefs in the harbor due to the reef's protection from water quality factors associated with Inner Apra Harbor and ship-induced sediment resuspension that impact other reef systems in the harbor. Reefs off Dry Dock Island, which was artificially created during WWII, are considered to also be among the healthiest reefs in the harbor, primarily due to protection from stressors (Volume 4, Section 11.1.2.2). In contrast, the coral reef along Polaris Point, which was also constructed during WWII, is of marginal quality and has the greatest signs of stress, including high levels of total suspended solids (TSS) likely derived from watershed discharge. Recreational activities result in physical damage to coral reefs, and fish feeding by snorkelers and divers can alter fish behavior. Recent studies conducted in support of this EIS identify evidence of anchor and/or anchor chain damage to coral in Apra Harbor, including the formation of a rubble field on the southern side of the floating dry dock (Volume 4, Section 11.1.2.2). Movement of mooring chains on the southern side of the floating dry dock has produced a significant rubble field, although mooring chains on the northern (outer) side of the floating dry dock do not appear to have caused similar damage.

No recently completed projects with the potential to contribute to a cumulative impact to marine biological resources on Guam were identified (Table 4.3-3).

Four projects currently in progress with the potential to contribute to cumulative impacts to marine biological resources on Guam were identified and include the following (Table 4.3-3): MIRC (4), ISR/Strike Capability (Andersen AFB; N-7), Kilo Wharf Extension (AH-18), and Mitigation for Kilo Wharf Extension (AH-21). Mitigation for Kilo Wharf Extension has a beneficial cumulative impact.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant and mitigable impacts to Guam's marine biological resources during operations. The summary of impacts is in Volume 7, Section 3.3.10, Table 3.3-26. The impact assessment details are provided in Volumes 2 through 6 (Volumes 2, and 4, Section 11.2). The increase in marine traffic would result in localized, infrequent, minor impacts from the increased noise, re-suspension of sediment during vessel movements, and the potential for increased discharges of pollutants into the water column. Construction-phase impacts would be significant with respect to marine flora, invertebrates and associated essential fish habitat and special status species due primarily to the construction of a transient aircraft carrier wharf in Outer Apra Harbor. The dredging and pile driving activities would impact coral and live/hard bottom communities (EFH) and special-status species. The

DoD would provide compensatory mitigation measures for the ecological services lost and the compensatory mitigation plan would be reviewed during the USACE Section 10/404 permitting process.

Indirect cumulative impacts to EFH from induced growth may occur island-wide. These impacts would be significant and mitigable through an increase in coastal resource management from local and federal agencies. Additionally, DoN plans to educate its service members, dependants and construction workers on the importance of coastal ecosystems and the proper way to enjoy those resources while avoiding and minimizing damage to reefs that is typically caused by anchors, walking on the reef, overfishing, inadvertent damage to coral while SCUBA diving, snorkeling, and fishing. A summary of proposed mitigation measures, summarized in Chapter 2 of this Volume, would assist in minimizing potential future impacts.

Reasonably Foreseeable Actions that Affect Marine Biological Resources. Nine reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to marine biological resources on Guam (see Table 4.3-3). Three of the projects would be located in North Guam and six at Apra Harbor. Reforestation of Masso Reservoir (C-16) is anticipated to have a beneficial effect on marine biological resources by reducing erosion and sediment input into the nearshore environment. The DoD training projects that may contribute to a cumulative impact include the activities covered in MIRC EIS/OEIS (4) and the amphibious beach training projects (AH-16, -17, and -18). In-water projects include DoD's X-Ray Wharf (AH-11) and PAG modernization (AH-8).

Potential Cumulative Impacts. The reasonably foreseeable projects mentioned above and four present projects (such as Kilo Wharf Extension [AH-10]) would have direct and indirect impacts on marine resources. The dredging impacts to special aquatic sites (SAS) (e.g., coral reef removal) would be mitigated through implementation of a compensatory mitigation plan approved by the USACE. As described under Water Resources and Geological and Soil Resources, all development projects could contribute to increased sediment loading in stormwater flow. Cumulative projects would result in an increase in impervious surface area in urban and industrial settings, resulting in a corresponding increase in sediment laden stormwater runoff into coastal waters, which has the potential to have elevated levels of contaminants such as nutrients, heavy metals, organic and inorganic compounds, and detrimental microorganisms. Project and site-specific best management practices (BMPs), construction-related permits, and the provisions of construction- and facility-specific (industrial) Stormwater Pollution Prevention Plans (SWPPPs), and Spill Prevention, Control, and Countermeasure (SPCC) Plans would minimize potential impacts from industrial operations, including the transportation, storage, and use of fuel, on all water resources. There is a strong additive cumulative impact between the proposed actions and the cumulative projects with respect to impacts on marine biological resources (Table 4.3-3). These impacts may contribute to the decline of marine biological resource health.

Need for Mitigation. Mitigation measures proposed for avoiding and reducing impacts to marine biological resources are listed in Table 2.2-1. These mitigation measures would reduce and avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed that have not already been identified.

Cultural Resources

Current Health and Historical Context. As described in Volume 2, Section 12.1.1.3, cultural resources include pre- (before European contact) and post-Contact archaeological resources, architectural resources and traditional cultural properties. The main Mariana Islands were settled before 1500 B.C. The Pre-Latte period was from 1500 B.C. to 1000 A.D.; evidence of residency and community composition is difficult

to identify. The Latte Period (1000 A.D. to 1300 A.D.) is distinguished by the presence of *latte* stone structures. The post-Contact period begins in 1521 A.D with Magellan's landing. Subsequently, disease and war decimated the local population, reducing it from 40,000 in 1668 to 1,800 in 1690. In the 20th century, Guam was ceded to the U.S. by Spain. Between 1898 and 1941, Guam served as a coaling and fueling station for Naval ships and as a landing place for the Pan-American transpacific air clippers. In 1941, Japan attacked Guam and in 1944, the U.S. commenced an intensive bombardment. After the U.S. captured the island there was a massive build-up of military forces - including construction of five new airfields. Since the 1960s, tourism has been an important industry.

Section 106 of the National Historic Preservation Act of 1966 (NHPA) requires federal agencies to take into account the effects of their undertakings on historic properties. It is difficult to determine if there was active preservation of historic sites on Guam prior to the 1960s; the Guam Register of Historic Places has entries dating only as far back as 1974.

Adverse impacts on cultural resources may include the following:

- Physical destruction, damage, or alteration of all or part of the resources;
- Alteration of the character of the resource's use or of physical features within the resource's setting that contribute to the resource's qualifications for listing on the National Register of Historic Places;
- Removal of the resource from its historic location;
- Introduction of visual, audible, or atmospheric elements that are out of character with the resource or diminish its historic features;
- Neglect of the resource resulting in its deterioration or destruction; and
- Transfer, lease, or sale of the property out of federal ownership or control without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historic significance.

The potential impacts on historic properties include vandalism (intentional or unintentional), intentional and inadvertent disturbance from construction activities, natural degradation and damage due to erosion Many WWII-era historic structures remain on Guam; however the war itself resulted in the loss of many other culturally important sites. The trend since the conclusion of WWII is a decline in cultural resources due to the potential impacts listed.

Three recently completed projects with the potential to contribute to a cumulative impact to cultural resources on Guam are identified (Table 4.3-3): Talo Verde Estates (C-3), Home Depot (C-2), and Ironwood Estates (Affordable Housing; 1).

Present projects with the potential to contribute to a cumulative impact to cultural resources on Guam were identified (Table 4.3-3): MIRC (4), ISR/Strike Capability (Andersen AFB; N-7), Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Workforce housing (Core Tech; C-6), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12), Bureau of Medicine Naval Replacement Hospital Project (C-13), Beddown of Training and Support Initiatives at NWF (N-6), and Mitigation for Kilo Wharf Extension (AH-21).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant and mitigable impacts to Guam's cultural resources, as summarized in Volume 7, Section 3.3.11, Table 3.3-29. The impact assessment details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 12.2; Volume 6, Section 14.2). The summary of

impacts from the preferred alternatives are significant and mitigable for impacts on cultural resources because there would be 1) direct impacts to approximately 31 historic properties on Guam, 2) significant adverse indirect impacts to three traditional cultural properties, and 3) deterioration of archaeological resources due to natural degradation or damage due to weathering. The proposed action would contribute to the declining trend in preservation of cultural resources. Other factors unrelated to the project, such as vandalism and weathering, would continue to adversely impact cultural resources. Mitigation measures would be established through Section 106 consultation with the State Historic Preservation Office. Impacts and mitigations to Chamorro culture is discussed under Socioeconomics and General Services.

Reasonably Foreseeable Actions that Affect Cultural Resources. All of the reasonably foreseeable future projects could impact historic properties through ground disturbance. Thirty-four reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to cultural resources on Guam (see Table 4.3-3). Twenty-seven projects would be located in North Guam, five at Apra Harbor, and two in South Guam. There is insufficient information to determine if existing historic buildings would be removed or otherwise impacted by new development projects off of federally controlled property.

Potential Cumulative Impacts. In general, there will likely be cumulative effects associated with the proposed action and the actions of other federal agencies, local governments, and the private sector on historic properties in Guam. These effects may be linked to projects, developments, and actions that do not meet the criteria for a federal undertaking as defined in NHPA. Although the Final EIS does address some of these projects, developments and actions, such as the development of workforce housing in Volume 1, Chapter 4, many of these projects, developments, and actions, and their impacts on historic properties, cannot be determined with any specificity or certainty at this time. Therefore, it can reasonably be assumed that there may be various types of historic properties that could be affected by the proposed action, but with no specific details regarding the individual impacts or effects.

Implementation of the preferred alternatives, when considered in conjunction with specific projects on Guam would have a significant cumulative effect on historic properties. Recently completed, present, and reasonably foreseeable development would have an adverse effect on both pre-Contact and post-Contact properties along the coast and in the interior. Although projects would be coordinated with the Guam SHPO and mitigated in accordance with laws and regulations related to the management and preservation of cultural resources in Guam, loss of some historic properties, even with data recovery, cannot be completely mitigated. Disturbance or destruction of these cultural resources would further diminish the regional historic record, thus decreasing the potential of its overall research contribution.

Need for Mitigation. To mitigate these cumulative impacts, DoD would assist the Guam SHPO with the five-year update of their Historic Preservation Plan (HPP). DoD proposes to support updates of the HPP by providing information developed as part of DoD cultural resources investigations, updated project planning information, and logistical support for meetings with local, state, and other federal stakeholders. It is anticipated the Guam plan will address the long term, cumulative effects of the military build-up on historic properties. In addition to the HPP, proposed mitigation measures include the production of a Guam Synthesis or Cultural Landscape Reports to reduce impacts to historic properties from cumulative impacts.

Visual Resources

Current Health and Historical Context. It is difficult to ascertain the visual quality of Guam prior to WWII, but it was presumably high due to the prevalence of open space. As presented in Volume 7, Section 3.3.12.2, urban development is likely the most notable cause for change in visual environments; the physical characteristics of a development as well as where it is located, determine the resulting visual

effect. Natural disasters, such as typhoons and earthquakes, contribute to the degradation of the appearance of existing developments. Some developments are abandoned and fall into disrepair with an adverse impact on visual resources. When the economy is good, there is a tendency for increased development or property improvement. Conversely, during hard economic times, buildings are not maintained or are abandoned. The visual resources trend over time is not linear, but is influenced by critical events. In general, there is a trend toward degradation of visual resources.

Four recently completed projects with the potential to contribute to a cumulative impact to visual resources on Guam were identified (Table 4.3-3): Core Tech/Ironwood Estates (affordable housing) (1), Home Depot (C-2), Kilo Wharf Improvements (AH-1), and Talo Verde Estates (C-3).

11 present projects with the potential to contribute to a cumulative impact to visual resources on Guam were identified (Table 4.3-3): Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Workforce housing (Core Tech; C-6), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C12), Bureau of Medicine Naval Replacement Hospital Project (C-13), Kilo Wharf Extension (AH-18), and Mitigation for Kilo Wharf Extension (AH-21). The Mitigation for Kilo Wharf Extension would have a beneficial impact.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant and mitigable impacts to Guam's visual resources, as summarized in Volume 7, Section 3.3.12, Table 3.3-31. The impact assessment details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 13.2; Volume 6, Section 15.2). The significant and mitigable impacts on visual resources are due to proposed roadway improvements, increased urban development and loss of open space on military lands. The proposed action would contribute to the declining trend in visual resources. Other factors unrelated to the project, such as natural disasters and economic downturns, would continue to adversely impact visual resources.

Reasonably Foreseeable Actions That Affect Visual Resources. All of the reasonably foreseeable cumulative projects would likely remove some open space and result in an adverse impact on visual resources. Thirty-six reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to visual resources on Guam (see Table 4.3-3). One project is considered a general action (Core Tech /Ironwood Estates), eight of the projects would be located in North Guam, seven at Apra Harbor, nineteen in Central Guam, and one in South Guam. Reforestation of Masso Reservoir (C-16) is anticipated to have a beneficial effect on visual resources.

Potential Cumulative Impacts. There would be minimal cumulative impacts related to the listed projects proposed on federally-controlled land because the projects are generally inside military bases and not visible to the public. The visual character at the cumulative project sites was not assessed. There is insufficient information on the cumulative projects to determine if they would have an adverse impact on visual resources. The development projects would likely remove open space and result in an adverse impact. There are other projects that may replace abandoned or deteriorated buildings that would result in an improvement to visual resources. There is a moderate, additive cumulative impact between the proposed actions and the northern Guam cumulative projects with respect to impacts on visual resources. The impact is due to proximity of the cumulative projects in the north to the proposed action's primary development areas. The other areas of Guam would not experience an additive cumulative impact.

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to visual resources are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the

preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Marine Transportation

Current Health and Historical Context. It is difficult to ascertain if port capacity was an issue prior to WWII. Presumably, the Spanish and the Japanese improved port capacity as needed. During WWII, port capacity was greatly expanded. As new military ships are brought to Guam and military missions change, there is always the potential for an increase in military marine traffic. The commercial traffic is a function of population and general economic health of the island. The number of non-military vessels visiting the Port of Guam would continue to reflect the need to service the population and economic growth.

Two recently completed projects with the potential to contribute to a cumulative impact to marine transportation on Guam were identified (Table 4.3-3): Kilo Wharf Improvements (AH-1) and Talo Verde Estates (C-3).

Eight present projects with the potential to contribute to a cumulative impact to marine transportation at Guam were identified (Table 4.3-3): Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C12), and Kilo Wharf Extension (AH-18).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in less than significant impacts to Guam's marine transportation, as summarized in Volume 7, Section 3.3.13, Table 3.3-33. The impact assessment details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 14.2; Volume 6, Section 16.2). There would be additional vessels visiting Apra Harbor as a result of the proposed relocation of Marines from Okinawa to Guam. Additional container ships would also be required to transport the equipment and supplies necessary to support the relocation. There would be approximately 145 container ships required in 2015 (the peak year of container shipments) above the annual average of 124 container ships. In addition, there would be about 127 trips over a period of six to nine months by a tug and scow to dispose of dredged material from Sierra Wharf. Because there has been a steady and substantial decline in the number of commercial vessels visiting the Port of Guam from 1995 through 2008 (2,924 to 1,022 vessels), the addition of up to 269 vessels is still well below the total number of vessels visiting the Port of Guam in 1995.

Reasonably Foreseeable Actions that Affect Marine Transportation. 11 reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to marine transportation at Guam (see Table 4.3-3). Eight of the projects would be located in Central Guam and three would be located at Apra Harbor. One of the Apra Harbor projects would also result in a beneficial effect to marine transportation: Modernization Program: port reconfiguration, maintenance and repair (AH-8). It is assumed that development of housing (C-14, C-17, C-22, C-23, C-27, C-29, C-34) and resort (C-7) projects would result in a population increase and associated increased need for goods. The Port Authority of Guam modernization projects (AH-8), and military wharf improvements (AH-1, AH-11, AH-22) would facilitate an increase in marine traffic.

Potential Cumulative Impacts. There is an additive impact between the proposed actions and the cumulative projects, but the degree of additive impact resulting from the preferred alternative is considered to be low.

Need for Mitigation. No mitigation measures are proposed for the proposed action, and none are projected for the potential cumulative impacts.

Utilities and Roadways

Current Health and Historical Context. It is difficult to ascertain if roadway and utility capacity was an issue prior to WWII.

Periodic master plans and roadway studies have been prepared by GovGuam to assess roadway and traffic conditions to identify and prioritize roadway and traffic improvement projects. The most recent comprehensive planning effort is the *2030 Guam Transportation Plan*, published in December 2008. Forecasts for population and employment through the year 2030 were used to develop an integrated strategy for a multimodal (e.g., vehicle, pedestrian, mass transit) transportation system. According to the Plan, overall traffic levels on Guam would increase; some areas increased by as much as 80% between 2003 and 2008. The roadway conditions vary from acceptable (no major safety issues), to poor (minor safety issues) to unacceptable. There is a bus system that includes a fixed route, and service for the handicapped; however, there are concerns with scheduling that result in poor ridership. No designated bicycle lanes are available and sidewalks are limited to main routes in urbanized areas.

The traffic on roadways is driven by island population and employment related to land use development. Roadway condition is a function of construction material, age, vehicle type, traffic volume, and natural influences such as climate, typhoons and earthquakes. Since 1950, population has continued to increase on Guam. The future trends in population growth are expected to increase and continue through 2030; however, the Plan included increases related to the military relocation. Without the proposed action, the population projection was estimated to increase 26% from 2008 by 2030, assuming a steady increase of 1.5% annually. The roads serving Dededo and Tamuning are currently the most congested because they serve major residential and employment centers. Roadway improvements were identified to address projected 2030 traffic issues, and projects would be implemented as funds become available. Volume 6, Section 4.2.2.5 of this Final EIS describes the baseline conditions for the specific roadways that would be affected by the preferred alternatives, assuming the improvements identified in the Plan are implemented. Most of the roads are projected to be congestion-free in 2014 and 2030, with a few exceptions: Route 25 and the southern portion of Route 28 for both target years, and Route 10 for the year 2030 only. Island-wide there are an estimated 12 intersections in 2014 and 24 in 2030 that would have the poorest level of service. Although some projects are programmed for funding, traffic conditions are projected to deteriorate on Guam. The natural influences on roadway conditions would continue into the future.

There are private shopping and tour busses that operate among Micronesian Mall, KMART, Guam Premier Outlets and other destinations. The recently established Guam Regional Transit Authority (GRTA) is responsible for public transit functions. It approved the Guam Transit Business Plan in January 2010, which includes purchasing new buses, constructing a bus maintenance facility, and modifying the bus schedule. Pending funding, a future trend is for improvements to bus service. Guam public law (Bill 273) requires the consideration and construction of bicycle and pedestrian paths with all new road construction projects. The 2030 Guam Transportation Plan also identifies a plan for bicycle and pedestrian facilities. Although new developments and roadway projects would include pedestrian and bicycle facilities and improve pedestrian and bicycle options, without adequate funding the existing deficiencies in facilities are likely to continue.

Power demand forecasts, including all current and foreseeable projects, indicate that there would be sufficient power generation capacity during and after the proposed relocation with implementation of the preferred alternative, thus no mitigation measures are proposed for power. The Guam Power Authority's

Integrated Resource Plan indicates the need for a new base load power plant in 2017, however the assumptions for that need may or may not be realized. Alternative power sources (wind, solar, and geothermal) are forecast for 2015.The water distribution system is identified as poor; it does not meet basic flow and pressure requirements for all customers. The wastewater infrastructure has deteriorated over the years with frequent sewage spills at pump stations and collection piping, collapse of collection piping, and failure of treatment plant equipment. There have also been violations of National Pollutant Discharge Elimination System (NPDES) permit conditions. The water and wastewater systems would continue to degrade until capital improvements are made. A new GovGuam landfill is in construction and anticipated to open in July 2011. The Navy landfill at Apra Harbor would remain in use for waste streams that cannot be accepted by the new GovGuam landfill (such as construction and demolition debris and asbestos). Therefore sufficient capacity to meet solid waste demand would be provided.

Two recently completed projects with the potential to contribute to a cumulative impact to roadways on Guam were identified (Table 4.3-3): Talo Verde Estates (C-3) and Home Depot (C-2).

Eleven present projects with the potential to contribute to a cumulative impact to roadways on Guam were identified (Table 4.3-3): Beddown of Training and Support Initiatives at NWF (N-6), ISR/Strike Capability (N-7), Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Workforce housing (Core Tech; C-6), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), and Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12). The two workforce housing projects are considered to be temporary developments and the workers would be provided bus transport, but they are included because the workforce housing would add to roadway traffic and the facility may be reutilized in the future.

Four recently completed projects with the potential to contribute to a cumulative impact to utilities on Guam were identified (Table 4.3-3): Home Depot (C-2), Talo Verde Estates (C-3), Kilo Wharf Improvements (AH-1), and Ironwood Estates affordable housing (1).

Twelve present projects with the potential to contribute to a cumulative impact to utilities on Guam were identified (Table 4.3-3): Beddown of Training and Support Initiatives at NWF (N-6), Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Workforce housing (Core Tech; C-6), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12), Bureau of Medicine Naval Replacement Hospital Project (C-13), Kilo Wharf Extension (AH-18), Mitigation for Kilo Wharf Extension (AH-21), and Draft Safe Harbor Agreement (Cocos Island; S-1). Mitigation for Kilo Wharf Extension and the Safe Harbor Agreement would have beneficial cumulative impacts. All of these projects have been included in the estimation of future utility demands and are included in Volume 6 impact assessments.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The impact assessment details are provided in Volume 6. The summary of impacts from the preferred alternatives is described in Volume 7, Section 3.3.14, Table 3.3-34. (see Volume 6, Sections 3.2 and 4.2).Less than significant impacts were identified for power, water, and solid waste. Impacts to water and power would be less than significant because DoD proposes utility improvements to address potential impacts. Solid waste impacts assume the use of existing and planned landfills. Impacts on wastewater systems and on-base roadways are summarized as significant and mitigable. Improvements to the NDWWTP are proposed to address the direct impact of the increased population, but the Guam wastewater collection systems are in poor condition and indirect impacts due to the induced population

would be exacerbated. Impacts to off-base roadways are significant and roadway improvements are proposed to address the impacts. The proposed action would contribute to the demand on deteriorating infrastructure.

The utilities and off-base roadway impacts analysis in this EIS are island-wide and based on the total proposed population increase on Guam associated with the Marine Corps, Navy and Army preferred alternatives, including associated workforce and induced populations. The population during the peak construction period would have the greatest demand on utilities, therefore, utilities and roadways impacts represent peak year impacts. The preferred alternatives include utilities and roadways repairs, upgrades and improvements, which are designed to address peak year demands, as detailed in Volume 6.

The proposed action would adversely impact roadways in all geographic areas with roads serving DoD lands in the north and central portions of Guam projected to be the most congested. Volume 6 proposes roadway improvements specifically to mitigate for the proposed actions described in Volumes 2 through 5. Assuming the roadway improvements are funded and implemented as indicated in the project description, significant roadway capacity impacts identified for roadway capacity in the North and the other geographic areas would be mitigated (improved) to less than significant impacts. With respect to intersection capacity, there would be less than significant impacts in all geographic areas, assuming that all recommended intersection projects are funded and implemented.

Reasonably Foreseeable Actions that Affect Roadways and Utilities. 25 reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to roadways on Guam (see Table 4.3-3). Five of the projects would be located in North Guam, 16 in Central Guam, three in Apra Harbor, and one in South Guam. The Defense Access Road (C-10) as a roadway project would have a beneficial impact on traffic. Development projects would cumulatively alter the traffic flow and they are predominantly proposed in areas already experiencing high traffic levels in the North and Central areas of Guam (N-14, N-15, N-16, N-23, C-7, C-14, C-17, C-18, C-19, C-21, C-22, C-23, C-25, C-29, C-30, C-31, C-32, C-33, C-34). Seven of these North and Central projects are workforce housing projects. As described above under present projects, there would be impacts associated with workforce housing even though they are considered temporary developments. Population inducing projects such as military mission changes would also increase traffic and these include BAMs (N-22), Amphibious training with an overland route (AH-18) and JHSVs (AH-22). The Port Authority of Guam is proposing modernization projects (AH-8) that include improved roadways onsite. The increased efficiency at the wharves may result in increased throughput and trucking traffic on public roadways. The new landfill (S-2) would induce new truck traffic in the southern part of Guam.

Thirty-two reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to utilities on Guam (see Table 4.3-3). Six of the projects would be located in North Guam, four at Apra Harbor, eighteen in Central Guam, and one in South Guam; Core Tech/Ironwood Estates (1) and the Territorial Prison (7) are considered general actions that would also have a cumulative impact on utilities on Guam. Guam International Airport Improvements (C-15) and AT/FP Perimeter Fence, Road Construction, and Main Gate Relocation at Andersen AFB (N-3) are expected to have a beneficial effect on utilities and traffic. Infrastructure improvement projects would have beneficial impacts such as, the Air Force AT/FP fencing and roadway project (N-3), Defense Access Road (C-10), Port Authority of Guam modernization program (AH-8), new landfill (S-2), new 60 MW power plant (12), and military wharf improvements (AH-11). Other reasonably foreseeable projects would facilitate or induce new demand on existing infrastructure through transient populations, such as the workforce housing projects (N-21, N-23, C-28, C-29, C-30, C-31) and the resort project (C-7). These would result in adverse impacts.

Potential Cumulative Impacts. Anticipated impacts from the preferred alternative are considered to be significant for roadways when combined with past, present, and reasonably foreseeable actions on Guam identified above. The degree of additive impact resulting from the preferred alternative is considered to be strong.

Anticipated impacts from the preferred alternative are considered to be significant for power, water, and wastewater when combined with past, present, and reasonably foreseeable actions on Guam identified above. The degree of additive impact resulting from the preferred alternative is considered to be strong.

Need for Mitigation. Mitigation measures proposed for avoiding and reducing impacts to roadways are listed in Table 2.2-1. These mitigation measures would reduce and avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Mitigation measures proposed for avoiding and reducing impacts to utilities are listed in Table 2.2-1. These mitigation measures would reduce and avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Socioeconomics and General Services

Current Socioeconomic and Historical Context. As summarized in Volume 2, Section 16.1.2 and Volume 7 Section 3.3.15, Guam's socioeconomic history is heavily influenced by Spanish rule, Pre-WWII American occupation, and the battles of WWII. The economic history of Guam post WWII is described in Volume 2, Section 16.1.2, and summarized below.

Guam's population experienced substantial increase – from a pre-war 1940 level of 22,900 (with a military and dependent population of 1,427) to 59,498 (with a military and dependent population of 26,617) in 1950. From 1950 to 2000 Guam's population grew at an average rate of 21% per decade (about 2.1% annually). However, the Census Bureau projects (without the proposed action) that this growth will taper off, possibly due to out-migration rates observed around 2002. The military population was highest in 1950 and declined through the 1980s with an increase from the later 1980s through 1990s. During the 1980s, military lands were released including Naval Station Agana, which corresponded to the reduction in military population. The increase in military population is attributed to cold war military spending and relocation of military personnel from the Philippines.

Guam's economy has experienced a volatile past. Super typhoon Karen in the 1960s left many residents homeless. The economy stagnated in the 1970s to early 1980s, partly due to the 1973 oil embargo. Tourism peaked between 1995 and 1997 but ended with the Japanese financial crisis in 1997. Super typhoon Pongsona as well as the September 11, 2001 terrorist attacks on the U.S. also affected the tourism market that was previously on the verge of recovery.

From 2000 through 2008, Guam's economy has continued to mirror this volatile recent past. From 2001 to 2003, Guam's economy contracted: unadjusted for inflation, total payroll declined by 2%, employment declined by 4%, and individual salaries increased by 1%. From 2004 to 2006, partially in response to the announcement of the proposed action, Guam's economy has once again showed signs of expansion. Using 2005 data, a study for the Guam Visitors Bureau found that tourism was the island's second largest private industry (following Finance, Insurance, and Real Estate) and both the primary Japanese and second Korean market were growing at that time.

As of the end of 2008, Guam's real estate market has shown signs of slowing. Commercial real estate on Guam has declined in value due to worldwide issues of tight credit and declines in consumer discretionary spending. Reports show that Guam real estate sales and construction activity have dropped from 2007 levels due to the global economic decline coupled with a moratorium on development in the Tumon Bay area that at the time of writing continues to be under debate. By the end of 2008, international economic conditions plus other market and demographic factors produced declining year-over-year trends for a variety of key tourism indicators, including total arrivals, hotel occupancy rates and taxes, and hotel room-nights sold.

Four recently completed projects with the potential to contribute to a cumulative impact to socioeconomics and general services on Guam were identified (Table 4.3-3): Home Depot (C-2), Talo Verde Estates (C-3), Ironwood Estates affordable housing (1), and Kilo Wharf Improvements (AH-1).

Fourteen present projects with the potential to contribute to a cumulative impact to socioeconomic conditions and general services on Guam were identified (Table 4.3-3): Beddown of Training and Support Initiatives at NWF (N-6), ISR/Strike Capability (Andersen AFB; N-7), Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12), Bureau of Medicine Naval Replacement Hospital Project (C-13), Kilo Wharf Extension (AH-18), Mitigation for Kilo Wharf Extension (AH-21), and Draft Safe Harbor Agreement (Cocos Island; S-1). The Veterans Clinic has a beneficial cumulative impact.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant impacts to Guam's socioeconomic conditions and general services resources, as summarized in Volume 7, Section 3.3.15, Table 3.3-40. The impact assessment details are provided in Volumes 2, 4, and 5 (see Volume 2 and 4, Section 16.2; Volume 6, Section 17.2). Population impacts are considered mixed significant and beneficial, because population growth fuels economic expansion but sudden growth also strains government services and the social fabric. Economic impacts are considered beneficial. Public service, sociocultural, and land acquisition impacts are considered significant.

Reasonably Foreseeable Actions that Affect Socioeconomics and General Services. All of the reasonably foreseeable projects could impact socioeconomics by providing jobs and facilitating the flow of goods and services. Thirty-five reasonably foreseeable future projects are anticipated to contribute to a cumulative impact to socioeconomic conditions and general services on Guam (see Table 4.3-3). Eight of the projects would be located in North Guam, seven at Apra Harbor, 17 in Central Guam, and two in South Guam; the Territorial Prison (7) is considered a general action. Three of the projects are anticipated to have a beneficial effect on Guam's socioeconomic conditions and general services: Territorial Prison (7), Modernization Program: Port Reconfiguration, Maintenance and Repair (AH-8), and New Landfill (Dandan, S-2).

Potential Cumulative Impacts.

The summary of preferred alternatives socioeconomic impacts would be significant and there would be an additive cumulative impact when combined with past, present, and reasonably foreseeable actions on Guam identified in Table 4.3-5. The degree of additive impact resulting from the preferred alternative is considered to be strong (Table 4.3-5).

Development projects, i.e., most of the cumulative projects, are generally a response to socioeconomic conditions. For example, new hotels and subdivisions could be a response or anticipation of increases in resident or tourist populations. Construction of these development projects generate jobs, resulting in beneficial impacts to the economy. However, adverse impacts could be associated with high numbers of construction workers on island at one time. The operation of new facilities, such as Home Depot (C-2) and hotels (C-12) would also generate jobs, with beneficial impact to the economy.

Population increases have inherently mixed impacts (both beneficial and adverse), because population growth fuels economic expansion but sudden growth also strains government services and the social fabric. Such population increases could be fueled by the development projects mentioned above. In addition, there are DoD mission changes on the cumulative project list that would increase the on-island population, such as Redhorse/Commando Warrior Training (N-6) and ISR/Strike (N-7), which are included in the affected environment discussion of this EIS. Other mission changes, such as Army JHSV (AH-22) and BAMS (N-22), that might impact island population, were not included in the affected environment because there is insufficient detail on the project description.

Some projects would have beneficial impacts to public services available on Guam, such as a new prison (7), a new high school (N-20), a veteran's clinic (C-9), and a new landfill (S-2). The workforce housing projects would support a transient worker population, which is beneficial if support services are provided to the workers through the workforce housing.

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to socioeconomics and general services are listed in Table 2.2-1. These proposed mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Hazardous Materials and Waste

Current Health and Historical Context. As presented in Volume 7, Section 3.3.16.2, there is little historical data on hazardous material, toxic substance, and hazardous waste handling; collectively referred to as hazardous substances. WWII established a high baseline of environmental releases; but overall, the trend in hazardous substance use is associated with increases in population and industrial activity. During the 1970s, there were numerous local and federal environmental regulations enacted to protect human health and the environment and to closely control and regulate the transport, storage, use and disposal of hazardous substances. While the trend in use of hazardous substances is expected to increase over time, regulations currently in place minimize the risk of release to the environment as well as the risk to human health. This trend would continue at a more gradual rate of increase. The impacts are largely related to human activities, but natural events such as typhoons and earthquakes can result in inadvertent releases of regulated hazardous substances.

Four recently completed projects with the potential to contribute to hazardous substance cumulative impacts on Guam were identified (Table 4.3-3): Ironwood Estates affordable housing (1), Home Depot (C-2), Talo Verde Estates (C-3), and Kilo Wharf Improvements (AH-1).

14 present projects with the potential to contribute to cumulative hazardous substance impacts on Guam were identified (Table 4.3-3): MIRC (4), ISR/Strike Capability (Andersen AFB; N-7), Paradise Estates (Yigo; N-8), Villa Pacita Estates (N-19), Workforce housing (Younex Enterprises; N-21), Residential construction (Tamuning; C-4), Talo Vista Tower (C-5), Workforce housing (Core Tech; C-6), Emerald Ocean View Park (C-8), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon

Bay; C-12), Bureau of Medicine Naval Replacement Hospital Project (C-13), Kilo Wharf Extension (AH-18), and Beddown of Training and Support Initiatives at NWF (N-6).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in less than significant hazardous materials management impacts as summarized in Volume 7, Section 3.3.16, Table 3.3-61. The impact assessment details are provided in Volumes 2 through 6 (see Volumes 2, 4, and 5, Section 17.2; Volume 6, Section 18.2). The impacts would be less than significant because the transportation, storage, handling, use, and disposal of these substances is heavily documented, controlled, and regulated at the federal and local level in a "cradle to grave" comprehensive manner.

Reasonably Foreseeable Actions that Affect Hazardous Substances. Many of the reasonably foreseeable projects could potentially involve transportation, storage, handling, use, or disposal of hazardous substances during construction and operation. 24 reasonably foreseeable future projects are anticipated to contribute to cumulative hazardous substance impacts on Guam (see Table 4.3-3). Five of the projects would be located in North Guam, 10 in Central Guam, four at Apra Harbor, and one in South Guam. The Territorial Prison (7) is considered a general action that would also contribute to the cumulative impact. Orote Magazines (AH-4) is anticipated to have a beneficial effect on hazardous substance impacts. Residential developments (N-21, C-3, C-8, C-14, C-21, C-23, C-27, C28, C-29, C-30, C-31) would use minor amounts of hazardous substances for maintenance. Hotels (C-7) also use hazardous substances. Industrial facilities such as commercial (AH-8) and military waterfront (AH-11) areas and airports (C-15) use hazardous substances and the cumulative projects would increase capacity at these facilities resulting in handling of more regulated waste materials.

Potential Cumulative Impacts. Anticipated impacts from the preferred alternative are considered to be less than significant when combined with past, present, and reasonably foreseeable actions on Guam identified above. The degree of cumulative impact resulting from the preferred alternative is considered to be low. This additive impact is regarded as low because the existing environmental laws and regulations and associated BMPs and SOPs require that these hazardous substances are handled, used, and disposed of in a comprehensive "cradle to grave" manner that inherently reduces the overall risk to human health and the environment.

This projection is based on the assumption that existing hazardous materials, toxic substances, and hazardous waste transportation, handling, storage, use, and disposal procedures and protocols are properly implemented and modified as appropriate to address the increased hazardous substances demand. Most of the cumulative projects would increase the management of regulated hazardous substances on Guam. However, these impacts would not contribute appreciably to the increasing trend in the volume of regulated hazardous substances already being handled and managed on Guam.

Need for Mitigation. No mitigation measures are proposed for the proposed action, and none are proposed for the potential cumulative impacts.

Public Health and Safety

Current Status and Historical Context. The historical trends in public health and safety are difficult to determine. WWII is the most damaging recent event in Guam's history impacting human health and safety. The trends in public health and safety are a function of changes in population and operations, or industries that involve dangerous materials (e.g., hazardous substances, live ammunition, electromagnetic energy, radiological substances). The socioeconomics section describes changes in population over time. From 1970 to 2000, the population on Guam increased, but declined in subsequent years. The number of

occupational and traffic accidents have increased gradually over the years. Aircraft mishaps are associated with economics, and are cyclical. The trend in notifiable diseases is increasing gradually, but is related to population. The increase in construction and ground disturbing activities would increase the risk of uncovering UXO; live ammunition is largely a military activity and changes with the military mission. Guam health and public services (i.e., lack of skilled professionals and lack of up-to-date equipment) are sub-standard due to lack of funding; this trend is likely to continue in the absence of economic development.

There are no recently completed projects identified with the potential to contribute to an adverse cumulative impact to public health and safety on Guam (Table 4.3-3).

Seven present projects with the potential to contribute to a cumulative impact to public health and safety on Guam were identified (Table 4.3-3): ISR/Strike Capability (Andersen AFB; N-7), Beddown of Training and Support Initiatives at NWF (N-6), Workforce housing (Core Tech; C-6), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12), Bureau of Medicine Naval Replacement Hospital Project (C-13), and Draft Safe Harbor Agreement (Cocos Island; S-1). The Veterans Clinic, Bureau of Medicine Naval Replacement Hospital Project, and Safe Harbor Agreement have a beneficial cumulative impact.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant impacts to public health and safety on Guam, as summarized in Volume 7, Section 3.3.17, Table 3.3-62. The impact assessment details are provided in Volumes 2, 4, 5, and 6 (see Volumes 2, 4, and 5, Section 18.2; Volume 6, Section 19.2). The significant impacts on public health and safety are due to:

- potential increase in ambient noise.
- potential impacts on water quality.
- Staff shortage at Guam clinics and hospital.
- increases in notifiable diseases and mental illness as well as increases in public services requirements (e.g., health care services and protective services) proportional to increases in population.

Reasonably Foreseeable Actions that Affect Public Health and Safety. 14 reasonably foreseeable future projects are anticipated to contribute to a cumulative public health and safety impact on Guam (see Table 4.3-3). Three of the projects would be in North Guam, eight would be in Central Guam, two at Apra Harbor, and one in South Guam. The New Landfill (Dandan, S-2), Defense Access Road (C-10), and AT/FP Perimeter Fence, Road Construction, and Main Gate Relocation at Andersen AFB (N-3) are anticipated to have beneficial effects on public health and safety. Projects could potentially impact public health and safety because they would induce an increase in population (resorts, workforce housing [C-6, C-23, C-29, C-30, C-31, C-32, C-33, C-34]), military mission (AH-22, N-22) or they involve industrial increases (landfill [S-2]) (Table 4.3-5).

Potential Cumulative Impacts. Anticipated impacts to public health and safety would have a cumulative impact when combined with past, present, and reasonably foreseeable actions on Guam identified above. The degree of additive impact resulting from the preferred alternative is considered to be strong because impacts are related to increases in population (Table 4.3-5) and associated inadequate health care services to support this population.

Need for Mitigation. Compliance with statutes and regulations on hazardous materials and wastes would be adhered to and these materials would be secured within the military installation to deter unauthorized

access; therefore, no mitigation measures are proposed for avoiding and reducing impacts resulting from use of hazardous materials. Mitigation measures for cumulative impacts to health care services would be for the federal inter-agency task force to succeed in finding funding and/or other assistance to help Guam upgrade their capacity to care for increased incidences of illness.

Environmental Justice and the Protection of Children

Current Status and Historical Context. Environmental Justice is a relatively new concept that was introduced in 1994 by Executive Order 12898. It applies to federal actions. Guam has a higher percentage of racial minorities, low-income populations, and children, when compared with the continental U.S. Much of the island's population would likely continue to struggle with poverty and access to basic community services, especially when the social and health services are inadequate for the existing population. The existing inadequate roads and utilities would likely continue to deteriorate, having an adverse and disproportionate impact on disadvantaged residents of Guam. (Although it is noted that the proposed action would improve various roads and highways affected by the proposed action [Volume 6])

Two recently completed projects with the potential to contribute a cumulative environmental justice and protection of children impact on Guam were identified (Table 4.3-3): Home Depot (C-2) and Ironwood Estates (Affordable Housing; 1). These projects are considered to have a beneficial impact.

Six present projects with the potential to contribute to environmental justice and protection of children cumulative impact on Guam were identified (Table 4.3-3): Workforce housing (Core Tech; C-6), Veterans Clinic (C-9), Hotel Construction Bayview 5 Luxury Project (Tumon Bay; C-12), Beddown of Training and Support Initiatives at NWF (N-6), ISR/Strike Capability (Andersen AFB; N-7), and Workforce housing (Younex Enterprises; N-21) would have adverse cumulative impacts. The Veterans Clinic would have a beneficial cumulative impact.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. If a resource area did not have significant impacts, or impacts were mitigable to less than significant, as analyzed in each resource chapter in Volumes 2 through 6, then it was not further analyzed in the Environmental Justice and Protection of Children chapters. The preferred alternatives would result in significant direct impacts with regard to environmental justice and protection of children on Guam, as summarized in Volume 7, Section 3.3.18, Table 3.3-66. Details on the impact assessment are described in Volumes 2, 4, 5, and 6 (see Volumes 2, 4, and 5, Section 19.2; Volume 6, Section 20.2). Impacts associated with the construction workforce and induced development would result in significant indirect impacts that would disproportionately affect low-income populations and children. The impact would be significant for public health care services and socioeconomics (described in other resource sections), which could result in disproportionately high and adverse effects on low-income populations and children of low-income families. Significant indirect impacts on disadvantaged populations would result in the areas of potable water and wastewater utilities, and public health. To minimize adverse impacts on public health care and protective services associated with the proposed military relocation program, the DoD is leading a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam. Proposed mitigation measures including the implementation of force flow reduction and/or APM measures (Volume 7, Section 2.3 and 2.4) would reduce significant indirect impacts associated with the construction workforce and induced population. However, the proposed action would contribute to the trend of increasing adverse impact on disadvantaged populations.

Reasonably Foreseeable Actions that Affect Environmental Justice and the Protection of Children. 19 reasonably foreseeable future projects are anticipated to contribute to a cumulative environmental justice and protection of children impact on Guam (see Table 4.3-3). Four of the projects would be in North

Guam, 13 projects would be on Central Guam, one at Apra Harbor, and one in South Guam. Nine of the projects are anticipated to have a beneficial affect with regard to environmental justice and protection of children on Guam: New Landfill (Dandan; S-2), Zone Change Request (C-25), Tentative Development Plan Application (C-22), Subdivision Variance Request (C-21), Seashore Clearance Request (C-20), PUD – Amendment (C-19), Conditional Use Request (C-18), Subdivision Variance Request (N-15), and Conditional Use Request (N-14). There is insufficient detail on the demographics surrounding the cumulative projects' sites to determine if there are disadvantaged populations near the project sites. In general, increases in population related to military mission changes (N-22, AH-22) or workforce housing to support the military (N-21, N-23, C-6, C-28, C-29, C-30, C-31) could impact disadvantaged populations through increases in traffic. Improvements to infrastructure (S-2), public services, and new affordable housing projects (1), are likely to have a beneficial impact on disadvantaged populations. Projects that create jobs, such as retail facilities (N-14, N-15, C-2, C-8, C-19, C-20, C-21, C-25) would have a cumulative beneficial impact on disadvantaged populations (Table 4.3-5).

Potential Cumulative Impacts. Anticipated direct impacts to environmental justice and the protection of children as a result of the preferred alternatives are considered to be significant; indirect impacts are also considered to be significant. Direct and indirect impacts would have a cumulative impact when combined with past, present, and reasonably foreseeable actions on Guam. The degree of additive impact resulting from the preferred alternative is considered to be low (Table 4.3-5).

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to environmental justice are listed in Table 2.2-1. These proposed mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

4.3.5.2 Tinian Cumulative Impacts Assessment

The Tinian cumulative projects that were retained following the initial screening are listed in Table 4.3-5. The criteria for dismissal are listed in Section 4.2. Based on the limited information available on the cumulative projects, a qualitative assessment was made regarding potential impacts of the cumulative projects on resources. Beneficial impacts are indicated by "B" and adverse impacts are indicated by "X." No attempt was made to distinguish between less than significant and significant adverse impacts potentially resulting from these projects. The number of cumulative projects that potentially have an adverse impact on each resource is totaled at the bottom of the cumulative project list. The next line is the significant impact findings from Chapter 3 that summarized the preferred alternatives' impacts. The final two lines of the table indicate if the preferred alternative would have an additive impact on the resource and whether the additive impact from the preferred alternatives is strong, moderate or low.

Table 4.3-5. Summary of Potential Operations Impacts to Resource Area – Tinian Projects

#	*Lead Agency or Proponent*	*Project Name/ Location*	*Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)*	*Potential Impacts to Resources*																	
				Geological and Soil Resources	*Water Resources*	*Air Quality*	*Noise*	*Airspace*	*Land Use*	*Recreational Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Cultural Resources*	*Visual Resources*	*Marine Transportation*	*Off-base Roadways*	*Utilities*	*Socioeconomics*	*Hazardous Materials*	*Public Health & Safety*	*Environmental Justice & Protection of Children*
CNMI-Tinian																					
T-2*	Marine Corps	1,500/3,000 Man Base Camp, Phase 2 (Marine Corps Proj. 13B) /MLA	RF		X	X	X		X	X	X	X	X	X	X		X	X	X	X	X
T-3*	Marine Corps	Ammunition Storage (Marine Corps Proj. 14) /MLA	RF		X	X	X		X	X	X	X	X	X	X		X	X	X	X	X
T-4*	Marine Corps	Automated Multipurpose Range (Marine Corps Proj. 15)/MLA	RF		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
T-5*	Marine Corps	Combined Arms Live Fire Training Area (Marine Corps Proj. 16)/MLA	RF		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
T-6*	Marine Corps	Company Level Live-Fire and Movement Range (Marine Corps Proj. 17)/ MLA	RF		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
T-7*	Marine Corps	Mortar and Artillery Ranges (Marine Corps Proj. 18)/ MLA	RF		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
T-8*	Marine Corps	North Field Helicopter Operations (Marine Corps Proj. 19) /MLA	RF		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
T-9*	Marine Corps	Small Arms and Machine Gun Ranges (Marine Corps Proj. 20)/MLA	RF		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X
T-10*	Marine Corps	Stationary Target Range (Marine Corps Proj. 21)/ MLA	RF		X	X	X	X	X	X	X	X	X	X	X		X	X	X	X	X

#	*Lead Agency or Proponent*	*Project Name/ Location*	*Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)*	*Potential Impacts to Resources*																
				Geological and Soil Resources	*Water Resources*	*Air Quality*	*Noise*	*Airspace*	*Land Use*	*Recreational Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Cultural Resources*	*Visual Resources*	*Marine Transportation*	*Off-base Roadways*	*Utilities*	*Socioeconomics*	*Hazardous Materials*	*Public Health & Safety*	*Environmental Justice & Protection of Children*
T-11*	Marine Corps	Waterfront Upgrades (Marine Corps Proj. 22)/ non-MLA	RF		X	X	X		X	X	X	X	X	X	B	X	X	X	X	X	X
T-12*	Marine Corps	Infrastructure Upgrades (Marine Corps Proj. 23)/ MLA	RF		X	X	X		X	X	X	X	X	X			X	X	X	X	X
T-15	DPW	Marpo Valley Quarry (government)/non-MLA	RF	X		X	X		X		X	X	X			X		B	X	X	X
T-16	Bridge Investment Group	Tinian Oceanview Resort/ non-MLA	RF		X	X	X	X		B	X	X	X	X	X	X	X	B	X	X	B
T-17	Marianas Resort Development Group	Matua Bay Resort and Golf Course/ non-MLA	RF		X	X	X	X	X	B	X	X	X	X	X	X	X	B	X	X	B
T-18	DPW	Landfill/MLA	RF	X		X	X		X		X	X	X			X		B	X	X	B
T-19	CUC	Wastewater treatment plant/MLA	RF		X	X	X		X		X	X	X	X			X		X	X	B
T-23	Neo Gold-wings Paradise	Neo Goldwings Paradise Casino on /non-MLA	RF	X	X	X	X	X	X	X	X	X	X	X	X	X	X	B	X	X	B
T-27	Resources - Management International	Quarry	RF	X		X	X		X		X	X	X			X		B	X	X	X
T-28	Department of Public Lands	Homesteads (various proposals)	RF		X	X			X		X	X	X	X		X	X	B	X	X	B
Number of recently completed projects potentially contributing to cumulative impacts				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of present projects potentially contributing to cumulative impacts				0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Number of reasonably foreseeable projects potentially contributing to cumulative impacts				4	16	19	18	10	18	14	19	19	19	19	13	8	16	18	19	19	19

#	*Lead Agency or Proponent*	*Project Name/ Location*	*Recently Completed (RC), Present (P) and Reasonably Foreseeable (RF)*	*Potential Impacts to Resources*																
				Geological and Soil Resources	*Water Resources*	*Air Quality*	*Noise*	*Airspace*	*Land Use*	*Recreational Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Cultural Resources*	*Visual Resources*	*Marine Transportation*	*Off-base Roadways*	*Utilities*	*Socioeconomics*	*Hazardous Materials*	*Public Health & Safety*	*Environmental Justice & Protection of Children*
Summary Operation Impacts: Preferred Alternatives significant impacts (from Chapter 3)				LSI	LSI	LSI	LSI	NI	SI	LSI	SI-M	LSI	LSI	SI-M	NI	LSI	LSI	SI	LSI	LSI	SI
Preferred Alternatives impacts additive to past present and reasonably foreseeable future actions? yes[Y]/no[N]				Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
Degree of additive impact? S-strong; M-moderate; L- low				L	L	L	M	S	S	S	S	L	S	L	L	L	L	S	L	L	S

Legend: B = Beneficial impact, X= Adverse impact, Blank cell = No or minimal impact anticipated, SI = Significant impact, SI-M = Significant and mitigable to less than significant, X= Potential adverse impact, RC= Recently completed, P = Present, RF= Reasonably foreseeable

The cumulative impacts study area for each resource is the island of Tinian and its waters extending out to 164 ft (50 m). The following is a summary of the cumulative impact analysis by resource.

Geological and Soil Resources

Current Health and Historical Context. The effects of pre-colonial populations on the current health of Tinian's geological resources is difficult to ascertain. During the Spanish Period (1668-1899) the introduction of cattle and farm crops likely denuded soils and contributed to erosion from vegetation loss and trampling. However, Tinian's geological and soil resources have been most recognizably affected by human populations in the early 20th century. Two primary influences affecting soils are intensive sugar cane cultivation in the 1920s and the subsequent rapid island-wide impacts of warfare and war-related development in the 1940s during WWII. In the 1920s, the Japanese intensively cultivated sugar cane on approximately 80% of Tinian's arable land (See Section 12.1.1.3 of Volume 3). Sugar cane production in tropical soils has been known to contribute to soil loss from erosion and reduction of soil fertility.

During WWII, military bombings and development contributed to soil loss and erosion from large-scale vegetation removal, grading activities that both removed stabilizing vegetation and further destabilized soils, and soil compaction reducing infiltration to groundwater. Large additions of impervious surfaces (i.e., roads, sidewalks, driveways and parking lots) accelerated sheet flow resulting in erosion from storm water. The strategically important island was developed for military uses by Japan, intensively bombed (essentially destroying the entire sugarcane operation, most Japanese military structures, and leaving behind a denuded forest) and then invaded by the U.S. in 1944. Upon being taken under U.S. control, the island underwent additional rapid development for military uses by the U.S. During WWII, Tinian briefly reached its largest recorded population of approximately 150,000, almost all of which were U.S. troops, and was the location of the largest WWII airfield, with six 8,500-ft long runways for B-29 bombers, in addition to repaired airstrips originally constructed by the Japanese. By 1945, a substantial portion of the northern one-third of the island had been graded and paved with air strips, and over 112 million cubic yards of coral had been used for fill. Given the current prevalence of tangantangan (a rapidly growing tree that is not native to the Marianas) across the island, the U.S. may have seeded the island with tangantangan, as they did on Guam, in order to slow erosion resulting from plant cover loss.

Immediately following WWII, Tinian's population shrank into the hundreds and it has slowly been re-populated and re-developed over the past 60 years. The human population increased most quickly following the agreement with the U.S. to become part of the CNMI in 1976 and reached a population of 3,540 by the time of the 2000 U.S. Census. Also, during this time period, vegetation cover has been returning, with open fields decreasing 11.6% and secondary forest coverage increasing 10.3% (Volume 2, Section 10.1.2.1). A casino and several hotels serve tourists, and the northern two-thirds of the island are now used for military training activities by the USMC.

There are no recently completed projects identified in the past six years with the potential to affect geological resources on Tinian (Table 4.3-5).

There are no preset projects identified in the past six years with the potential to affect geological resources on Tinian (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. Direct impacts to geological resources that could contribute to a cumulative impact would primarily occur during the construction phase to soils, when a maximum of up to 225 acres (91 ha) of vegetation would be temporarily cleared and topsoil graded. These impacts would be localized and would not affect productive agricultural soils. Vegetation lost during construction would return when construction is completed. Since the topography of the proposed ranges is flat, the preferred alternative would not

diminish soil stability. Proposed range locations do not lie over Takapochao Limestone, so compaction of soils would not affect infiltration of surface water into groundwater. Sinkholes would be avoided if encountered and left with vegetation buffers to avoid further erosion and expansion.

Reasonably Foreseeable Actions that Affect Geological and Soils Resources. Four reasonably foreseeable actions with potential to affect geological resources were identified: Marpo Valley Quarry (T-15), Department of Public Works Landfill (T-18), Neo Goldwings Paradise Casino (T-23), and Quarry at Western Tinian (T-27) (see Table 4.3-5).

Potential Cumulative Impacts. Anticipated temporary impacts to geological resources during construction, although considered to be insignificant, would have a cumulative impact when combined with past, present, and reasonably foreseeable actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be low (Table 4.3-5).

Need for Mitigation. Mitigation measures proposed for avoiding and reducing impacts to geological resources are listed in Table 2.2-1. These mitigation measures would reduce and avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions on Tinian. No additional mitigation measures for cumulative impacts are proposed.

Water Resources

Current Health and Historical Context. The effects of pre-colonial populations on the current health of Tinian's water resources is difficult to ascertain. Two primary events of the early 20th century impacting geological resources - intensive sugarcane production by the Japanese in the 1920s, and warfare and development during WWII - likely also had the greatest affect on Tinian's water resources. However, detailed information on the effects of these activities on Tinian's water resources is not readily available. Overall surface water quality data are limited on Tinian. In general terms, stormwater runoff is vulnerable to sewage disposal overflows, animal wastes, and sediment erosion carried into streams during periods of heavy rainfall. Historically, approximately 40 wells were drilled at an average depth of 230 ft (70 m); however, most of these have been abandoned. Currently, there are nine production wells on Tinian (Volume 3, Chapter 4). The municipal and agricultural wells are located in or near the Makpo wetland area, and the potable water is stored in tanks at Makpo Heights and Carolinas Heights.

The potential for high chloride levels resulting from saltwater intrusion into the freshwater lens due to excessive pumping of the freshwater aquifer is of concern on Tinian. While it is not currently a problem, it may be in the future if groundwater pumping rates exceed the recharge capacity of the aquifer. Located beneath the Makpo Wetland, the aquifer is considered to be groundwater under direct influence of surface water that must meet the same drinking water treatment technologies standards as surface water. Groundwater aquifers on Tinian are also vulnerable to contamination by substances introduced onto the soil surface because the thin soils and underlying permeable limestone do not significantly impede the passage of contaminants to the shallow aquifer.

All the nearshore waters surrounding Tinian are designated Class AA, except for the nearshore waters of San Jose Harbor that are designated Class A. Sewage outfalls, sewer collection overflows, sedimentation from unpaved roads and development, urban runoff, reverse osmosis discharges, and nutrients from golf courses and agriculture are the most significant stressors on the CNMI's marine water quality. Class AA waters should remain in their natural pristine state as nearly as possible with an absolute minimum of pollution or alteration of water quality from any human-related source or actions. The uses protected in these waters are the support and propagation of marine life, conservation of coral reefs and wilderness areas, oceanographic research, and aesthetic enjoyment and compatible recreation inclusive of whole body contact (e.g., swimming and snorkeling) and related activities. Only one nearshore area on Tinian,

Unai Chulu, did not support its designated use classification due to exceedances in *enterococci* bacteria violations. This beach is classified as being only partially supportive of its designated uses.

No recently completed or present actions with the potential to affect water resources have been identified (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. Direct construction and operation impacts from the preferred alternative are considered to be less than significant to surface water, groundwater, nearshore waters, and wetlands, except for impacts to approximately 0.3 acre (0.1 ha) of potential jurisdictional wetland. The Marine Corps would attempt to first avoid this impact by adjusting the layout of the proposed Platoon Battle Course layout to avoid the potential wetland. If avoidance is not possible, then potential impacts could be mitigated to be less than significant by replacement of the area filled or creating or improving existing wetland areas on Tinian.

Construction activities would temporarily increase stormwater runoff, erosion, and sedimentation, and operation impacts would include increased stormwater volume and intensity and training-related residual contaminants. The surface water impacts would increase the potential for local groundwater contamination. Construction and operations would also result in minor increases in runoff volume and loading potential for nearshore waters. In addition to fill of 0.3 acre (0.1 ha) of potential wetland during construction, operations would result in a minor increase in pollutant loading potential at wetlands from expended rounds. This would result in less than significant impacts to water resources. However, less than significant direct impacts might contribute to a cumulative impact.

Reasonably Foreseeable Actions that Affect Water Resources. 16 reasonably foreseeable actions with potential to affect water resources were identified: 1,500/3,000 Man Base Camp, Phase 2 (T-2), Ammunition Storage (T-3), Automated Multipurpose Range (T-4), Combined Arms Live Fire Training Area (T-5), Company Level Live-Fire and Movement Range (T-6), Mortar and Artillery Ranges (T-7), North Field Helicopter Operations (T-8), Small Arms and Machine Gun Ranges (T-9), Stationary Target Range (T-10), Waterfront Upgrades (T-11), Infrastructure Upgrades (T-12), Tinian Oceanview Resort (T-16), Matua Bay Resort and Golf Course (T-17), Wastewater treatment plant (T-19), Neo Goldwings Paradise Casino (T-23), and Homesteads (T-28) (see Table 4.3-5).

Potential Cumulative Impacts. Cumulative projects would involve construction activities that would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. For cumulative projects disturbing more than one acre during construction (including the preferred alternative), a Construction General Permit would be obtained and followed and a Stormwater Pollution Prevention Plan (SWPPP) would be prepared and implemented to minimize temporary increases in runoff and pollutant loading related to construction activities.

In addition, cumulative projects would result in an increase in impervious surface areas (i.e., rooftops, sidewalks, roads, and parking lots) in urban and industrial settings, resulting in a corresponding increase in stormwater runoff that has the potential to have elevated levels of contaminants, such as sediments, nutrients, heavy metals, organic and inorganic compounds, and detrimental microorganisms. The increase in impervious surfaces would result in an associated increase in stormwater discharge intensities and volume. This increase would likely be accommodated by existing or new stormwater infrastructure to ensure the timely and low-impact flow of stormwater to minimize erosion and flooding concerns. In addition, cumulative actions would be expected to increase the amount of petroleum, oil, and lubricants (POLs), hazardous waste, pesticides, and fertilizers being stored, transported, and utilized. Increasing the storage, transportation, and use of these substances would increase the potential for releases to water resources. Implementation of BMPs associated with addressing site- and activity-specific water resource

protection needs, provision of facility-specific SWPPPs and Spill Prevention, Control, and Countermeasure (SPCC) Plans would minimize potential impacts from facility operations, including the transportation, storage, and use of fuel, on all water resources. In addition, adherence to surface water quality and volume control measures would also reduce pollutant loading to groundwater basins, nearshore waters, and wetlands. Many of the cumulative projects would potentially impact water resources.

There is the potential for the cumulative projects to have direct and indirect impacts to wetland areas, potentially resulting in the loss of wetland area and/or function. Per USACE regulations, activities that are proposed in wetlands or that could potentially reduce wetland function, must be permitted and potentially mitigated to compensate for direct impacts to wetland areas. Therefore, any loss of wetland area or functionality would be potentially mitigated at a project and site-specific ratio, which would likely include creating or enhancing existing wetland habitat elsewhere. Indirect impacts to wetland areas (e.g., runoff, sediment loading, etc.) would be addressed on a project-specific level, and would likely be lessened with BMPs and associated short- and long-term stormwater runoff management measures.

Anticipated temporary impacts to water resources during construction and long-term operations impacts from the preferred alternative, although considered to be less than significant or able to be mitigated to less than significant in the case of wetlands, would have a cumulative impact when combined with past, present, and reasonably foreseeable actions on Tinian. The degree of additive impact resulting from the preferred alternative is considered to be low and would not appreciably impact the health of water resources on Tinian over time (Table 4.3-5).

Need for Mitigation. Mitigation measures proposed for avoiding and reducing impacts to water resources are listed in Table 2.2-1. These mitigation measures would reduce and avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions on Tinian. No additional mitigation measures for cumulative impacts are proposed.

Air Quality

Current Health and Historical Context. Given the generally temporary nature of air quality conditions and impacts, historical air quality impacts are not expected to contribute to current and future cumulative air quality impacts (for global warming and climate change assessment see Section 4.3.4.3). The following brief discussion is therefore only intended to provide a historical context for air quality on Tinian.

The effects of pre-colonial and colonial populations on the current health of Tinian's air quality are difficult to ascertain, but they likely consisted of particulate emissions associated with the use of wood-fueled fires for food preparation, hunting, warmth, and religious purposes. Emissions from unfiltered and open burning fires, particularly within structures, is a primary source of air pollution-related illnesses worldwide today. However, air quality on Tinian was likely at its worst during WWII as warfare and war-related activities contributed to air pollution on the island. As noted above in the discussion of geological resources and earlier in this EIS (Section 1.4.2), for a period of time Tinian was the largest airfield during WWII, and emissions from aircraft landings and departures from Tinian were likely substantial. Following WWII, the island's human population rapidly diminished into the hundreds and for decades the relative absence of emissions sources likely resulted in relatively good ambient air quality conditions.

Today, except for power generating facilities, there are no significant sources of air emissions on Tinian. However, military training vessels, on-road vehicles, and open burnings are sources of emissions that impact existing ambient air quality conditions on the island. While there are no air monitoring stations on Tinian, it can be assumed that ambient air quality is good, has remained constant in recent years, and is in

compliance with air quality standards. The relatively small number and density of emission sources, absence of geologic features (e.g., active volcanoes) that would create or trap air pollutants, and the circulation of air across the island contribute to Tinian's good ambient air quality. The island is currently designated as an attainment area for all criteria pollutants (Section 3.3.4 and Volume 3, Section 5.1).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. Emissions resulting from the preferred alternatives would contribute to cumulative impacts on Tinian. Emissions would consist of SO_2, CO, PM_{10}, NO_x, VOC, CO_2, and particulates resulting from both construction and operations. These emissions are considered to be insignificant (Section 3.3.4.1).

Reasonably Foreseeable Actions That Affect Air Quality. Construction of all 19 reasonably foreseeable future projects listed in Table 4.3-5 would impact air quality, but the air quality impacts from construction would be temporary. Operational emissions would likely consist of increased emissions from power generation and vehicles. The two quarry projects, two resorts (Tinian Oceanview Resort [T-16] and Matua Bay [T-17]) and, and the Marine Corps helicopter training project would likely impact air quality during operations. The two resorts would also indirectly increase the air and ground traffic emissions by increasing the tourism-related population and activities.

Potential Cumulative Impacts. Emissions from the proposed action in combination with past, present, and reasonably foreseeable future actions would contribute to a cumulative impact to air quality on Tinian. Emissions from the preferred alternatives would be greatest during construction when a maximum of up to 225 acres (91 ha) of topsoil would be graded (Volumes 3, Chapter 5); however, project-related emissions would not be significant (Section 3.3.4.1 and Table 3.3-7). Operational air emissions from vehicles would be well below the significance threshold of 250 TPY. The significance threshold was developed in order to control cumulative impacts to air quality (i.e., each project in an air basin is required to meet the threshold in order to avoid an unacceptable level of cumulative emissions). Therefore, the cumulative impact resulting from the proposed action would be low (Table 4.3-5).

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to air quality are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions on Tinian. No additional mitigation measures for cumulative impacts are proposed.

Noise

Current Health and Historical Context. WWII bombings and air operations likely represent the loudest period in Tinian's history, but the noise impacts were temporary. A historical tuna trans-shipment facility at the port generated localized temporary noise as an industrial facility. Today, the main sources of noise on Tinian are daily commercial airport operations, infrequent military activities in the MLA, and civilian traffic (Section 3.3.5.2).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. Noise levels (if any) experienced by sensitive receptors would be low and associated with operations. Noise potentially perceptible by sensitive receptors would be concentrated on the days the airlift is transporting Marines to and from Tinian's West Field or North Field. Similarly, live-fire exercises would generate noise, but at locations too far away from the nearest human receptor(s) to be heard; consequently, the preferred alternatives would not create an incompatible noise zone that would extend past the boundary of military controlled lands on Tinian. Likewise, temporary construction noise generated by the preferred alternatives would likely not be perceptible by sensitive receptors because it would be located well within the boundary of the MLA and beyond audible range. Therefore, noise from

the airlift of Marines to and from West Field and North Field is the most likely impact with the potential to contribute to a cumulative impact on Tinian (Section 3.3.5.1).

Reasonably Foreseeable Actions that Affect Noise. 18 projects listed in Table 4.3-5 are expected to impact ambient noise on Tinian: 1,500/3,000 Man Base Camp, Phase 2 (T-2), Ammunition Storage (T-3), Automated Multipurpose Range (T-4), Combined Arms Live Fire Training Area (T-5), Company Level Live-Fire and Movement Range (T-6), Mortar and Artillery Ranges (T-7), North Field Helicopter Operations (T-8), Small Arms and Machine Gun Ranges (T-9), Stationary Target Range (T-10), Waterfront Upgrades (T-11), Infrastructure Upgrades (T-12), Marpo Valley Quarry (T-15), Tinian Oceanview Resort (T-16), Matua Bay Resort and Golf Course (T-17), Landfill (T-18), Wastewater Treatment Plant (T-19), Neo Goldwings Paradise Casino (T-23), and the DPW Quarry (T-27).

Temporary noise impacts are anticipated to occur from construction. Long-term operational noise impacts are expected to occur from additional traffic and population increases, including from tourism, associated with reasonably foreseeable future actions. Operations of two future resorts (Matua Bay and Tinian Oceanview Resort) and a casino (Neo Goldwings Paradise) would directly generate noise at their sites and they would also increase tourist air and ground traffic, which would indirectly generate additional noise on Tinian.

Potential Cumulative Impacts. Although the preferred alternatives' noise impacts would be less than significant individually, there would be an additive cumulative impact on Tinian when combined with past, present, and reasonably foreseeable future actions identified above. Operations of all the cumulative projects would generate some level of noise, and although the noise would be localized, the human-induced noise levels experienced across the island would cumulatively increase. There would be less area on Tinian unaffected by human-caused noise. The Marine Corps cumulative project training ranges could result in substantial increase of noise to sensitive receptors, primarily if ranges are used concurrently. Most of the noise would be in the MLA, but noise modeling would be required to determine impacts to sensitive receptors. The industrial quarries would also generate noise during operations. The degree of additive impact resulting from the preferred alternative, in combination with past, present, and reasonably foreseeable future actions is considered to be moderate (Table 4.3-5).

Need for Mitigation. No mitigation measures to reduce or avoid noise impacts are proposed for the preferred alternatives.

Airspace

Current Health and Historical Context. As mentioned in Volume 7, Section 3.3.6.2, since WWII, the Tinian Airport (West Field) air traffic fluctuates based on tourism levels. The military use at North Field is training mission-dependent and addressed in the MIRC EIS/OEIS. Airspace impacts would not occur during construction, and are only applicable to operations. Because there are multiple, and sometimes competing demands, the FAA considers all aviation airspace requirements in relation to airport operations, federal airways, jet routes, military flight training activities, and other special needs to determine how the National Airspace System can best be structured to satisfy all user requirements. Significant impacts are avoided prior to FAA approval.

Direct and Indirect Impacts of the Preferred Alternatives That Might Contribute to a Cumulative Impact. There would be no impact from the preferred alternatives on airspace. (Section 3.3.6 and Volume 3, Chapter 7). There would be no new SUA, and existing arrival and departures from either the Tinian or Saipan airports would not require any changes. There are no en-route low-altitude airways, so no Instrument Flight Rule procedures would have to be changed. Access to, and the approach and departure patterns associated with the airports and airfields would not be restricted, nor would they be required to

change. Airspace management procedures would be implemented. Well-established procedures and rules governing flight operations, in both controlled and uncontrolled navigable airspace and existing SUA, make future adverse impacts on public health and safety unlikely. Aircrews for military participants and non-participating aircraft would be responsible for using see-and-avoid techniques to avoid hazards.

Reasonably Foreseeable Actions that Affect Airspace. 10 projects listed in Table 4.3-5 are expected to impact airspace on Tinian. The Automated Multipurpose Range (T-4), Combined Arms Live Fire Training Area (T-5), Company Level Live-Fire and Movement Range (T-6), Mortar and Artillery Ranges (T-7), North Field Helicopter Operations (T-8), Small Arms and Machine Gun Ranges (T-9), and Stationary Target Range (T-10) on the cumulative project list would need to be evaluated for potential direct impacts on airspace. The two resorts, Tinian Oceanview Resort (T-16) and Matua Bay (T-17), and Neo Goldwings Paradise Casino (T-23) would indirectly increase the volume of air traffic to support tourists, which could also indirectly impact airspace.

Potential Cumulative Impacts. The notional concept of operations for a more robust training complex on Tinian (T-2 to T-12, Table 4.3-5) relies on ship or high speed vessel transport of troops, not aircraft; therefore, there would be minimal impacts on air traffic volume due to training. There is a periodic review of MIRC airspace requirements that would address future airspace needs should the training mission requirements change. The FAA manages the cumulative impact of air traffic and special use airspace to ensure there are no significant impacts to airspace. The anticipated impacts on airspace are less than significant; the preferred alternatives would have a cumulative impact when combined with past, present, and reasonably foreseeable actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be low (Table 4.3-5).

Need for Mitigation. No mitigation measures to reduce or avoid impacts to airspace are proposed for the preferred alternatives.

Land and Submerged Land Ownership and Use

Current Health and Historical Context. Prior to WWII, the land use on Tinian was primarily agricultural with sugar cane being the predominant crop. During WWII, the island was transformed into a military base by the Japanese and the local population was relocated off island and later the U.S. expanded the military base. After WWII, the population gradually returned to Tinian. In the 1970s, gambling was permitted on-island, and the Tinian Dynasty Hotel and Casino opened. It is the only casino on-island. Military leasing of land began in 1975; some lands were ceded back to the CNMI but generally the acreage of federally-controlled land and submerged land has remained constant. In the 1990s, there was a tuna trans-shipment industry on the island. Cattle grazing and crop production have occurred on-island since WWII and continue today. There is interest in improving the agricultural productivity in the future and the casino may be closing. The land uses on non-federally controlled land are managed by the CNMI government. The Department of Public Lands is required to designate Tinian public lands for homestead villages, and there are other proposals to create additional homestead villages. A master plan is currently being prepared for Tinian so that planned land uses are consistent with community values and zoning requirements.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in significant for impacts on agricultural land use, and less than significant impacts on land ownership/management (Section 3.3.7 and Volume 3, Section 8.1). The land use impacts are assumed to occur over the long-term during the operations phase of the projects; therefore, no construction-phase impacts are identified. There would be no impact to the acreage of federally-controlled land and submerged land. Agricultural permits that are located within the proposed

SDZ would be terminated, causing a less than significant impact to land ownership, but a significant impact to agricultural land use. The decrease in public access to the MLA is an adverse land use impact, but it is considered less than significant because it is within the authority of the federal government to restrict access during training events for public safety. In addition, access to the northern portion of the island would be provided via 8th Avenue during training, and unlimited access to the training ranges SDZs would be permitted during non-training periods.

Reasonably Foreseeable Actions that Affect Land and Submerged Land use. 18 reasonably foreseeable future actions have the potential to affect land use on Tinian (Table 4.3-5). These projects include the establishment of two new resorts (T-16 and T-17), a new casino (T-23), and the utilization of existing federal lands for additional training ranges by the USMC. The Marine Corps training complex projects (T-2 through T10, and T-12) would further restrict access to the MLA and result in termination of additional agricultural permits, representing an impact on recreational and agricultural land use. Many of the development projects listed that are located on non-federally controlled land are not consistent with the designated agricultural land use areas on Tinian, including the resort developments (T-17, T-23). None of the projects would result in an addition of federally-controlled land or a change in use of submerged land area.

Potential Cumulative Impacts. The preferred alternatives, in combination with past, present, and reasonably foreseeable future actions identified above would result in a substantial cumulative impact on land use on Tinian, primarily from the loss of land for agriculture and recreational activities. The degree of additive impact resulting from the preferred alternatives is considered to be strong (Table 4.3-5).

Need for Mitigation. No mitigation measures to avoid or reduce impacts to land and submerged land use are proposed for the preferred alternatives.

Recreational Resources

Current Health and Historical Context. There is little detailed data on historical recreational resource uses on Tinian. The island has struggled for decades to promote tourism activity, with one of the greatest challenges being its isolation from major population centers. As stated above, immediately following WWII, Tinian's population shrank to the hundreds and the island has slowly been re-populated and re-developed over the past 60 years. The human population increased most quickly following the agreement with the U.S. to become the CNMI in 1976 and reached a total of 3,540 by the time of the 2000 U.S. Census. In the 1970s, gambling was permitted on-island, and the Tinian Dynasty Hotel and Casino opened. It is the only casino on-island. Most establishments catering to the community and tourism activities are in the coastal San Jose village to the southwest. Much of Tinian's coastline consists of precipitous cliffs; however, there are pockets of cove and beach areas. Notable recreational resources include trails, historic and cultural attractions, scenic points, and SCUBA diving (Volume 3, Section 9.1.2). Human and natural factors, such as typhoons, coral bleaching, illegal harvesting of coral and fish, non-point source pollution, and insufficient funding for resource management have adversely impacted Tinian's recreational resources in the past and are anticipated to remain challenges to Tinian's recreational resources in the future. No present projects currently under construction are anticipated to contribute to a cumulative impact to Tinian's recreational resources (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in less than significant impacts to Tinian's recreational resources (Section 3.3.8 and Volume 3, Section 9.1). Impacts resulting from implementation of the preferred alternatives would primarily consist of changes to public access to resources and reduced recreational activities when ranges would be used. During training, tourists could be inconvenienced

when access by Broadway is denied and traffic is diverted to 8th Avenue. Additionally, although proposed structures are not located in proximity to existing recreational resources, the preferred alternatives would potentially inconvenience some tourists traveling on roads that would also be temporarily used by construction-related vehicles. These impacts are considered to potentially contribute to the declining trend in recreational resource health on Tinian.

Reasonably Foreseeable Actions that Affect Recreational Resources. 14 reasonably foreseeable actions with the potential to affect recreational resources were identified (Table 4.3-5): 1,500/3,000 Man Base Camp, Phase 2 (T-2), Ammunition Storage (T-3), Automated Multipurpose Range (T-4), Combined Arms Live Fire Training Area (T-5), Company Level Live-Fire and Movement Range (T-6), Mortar and Artillery Ranges (T-7), North Field Helicopter Operations (T-8), Small Arms and Machine Gun Ranges (T-9), Stationary Target Range (T-10), Waterfront Upgrades (T-11), Infrastructure Upgrades (T-12), Tinian Oceanview Resort (T-16), Matua Bay Resort and Golf Course (T-17), and Neo Goldwings Paradise Casino (T-23). In particular, the Marine Corps training range complex projects are anticipated to have an adverse impact by changing public access to recreational resources and reducing recreational activities when the ranges are in use. The two resort projects (T-16 and T-17) and casino (T-23) are expected to have a generally positive impact on recreational resources by expanding recreational opportunities available on the island.

Potential Cumulative Impacts. There would be an additive impact on recreational resources from the preferred alternatives and the additional projects identified above. The reasonably foreseeable future resort and casino projects would provide recreational opportunities, representing a beneficial impact. The Marine Corps training projects would have an adverse impact on recreational resources because there would be limited access to the MLA, where many of the recreational resources are located. The degree of additive impact (beneficial and adverse) resulting from the preferred alternatives, in combination with past, present, and reasonably foreseeable future actions could be strong and contribute to the declining trend in recreational resource health on Tinian (Table 4.3-5). Other factors unrelated to the project, such as coral bleaching, illegal harvesting of coral and fish, and non-point source pollution, are anticipated to continue adversely impacting the island's recreational resources.

Need for Mitigation. No mitigation measures to avoid or reduce impacts to recreational resources are proposed for the preferred alternatives.

Terrestrial Biological Resources

Current Health and Historical Context. Existing human-induced stressors (e.g., non-native, invasive plants, animals and diseases, wildfires, and poaching) that degrade habitat quality contribute to the trend of declining terrestrial biological resources on Tinian. Heavy disturbance of native forests began in the 18th century when the Spaniards used Tinian as a supply island for Guam, and maintained large herds of cattle and other ungulates on the island (Fosberg 1960). In 1926, a Japanese company leased the entire island and cleared additional forested lands for sugarcane production, cultivating approximately 80% of the island's total arable land. During WWII, sugarcane plantations and most of the remaining native vegetation were destroyed by military campaigns and construction (Baker 1946). After the war, the U.S. may have seeded the island (similar to Guam) with tangantangan, a rapidly growing tree that is not native to the Marianas, in order to slow erosion resulting from plant cover loss. Currently, the vegetation on Tinian is highly disturbed, with tangantangan thickets being an abundant habitat type. Based on the most recent vegetation mapping, it is estimated that only 2.6% of the island is still dominated by native limestone vegetation.

Non-native animal species introduced by humans over time have contributed to the ecological decline of Tinian and have spurred the tightening of restrictions and monitoring of shipments to the island, particularly from Guam where BTS have decimated the island's bird populations and inflicted enormous ecological damage (see discussion of BTS above for cumulative impacts on Guam). Introduced animal species on Tinian include, but are not limited to rats, mice, shrews, cats, dogs, monitor lizards, marine toads, mangrove crabs, cattle, goats and other domesticated animals. Potentially most significant, eight unconfirmed sightings of BTS have been reported on Tinian since 1990, with three sightings reported in 2003. If BTS became established on Tinian, impacts to Tinian's ecology are anticipated to be similar to the impacts of BTS on Guam (Volume 3, Section 10.1.2.3).

The Tinian monarch, an endemic species, was federally delisted in 2004 and delisted by the CNMI government in 2009. Native tree species are preferred monarch nesting sites. The population of this species may be in decline (USFWS 2009). The monarch currently inhabits approximately 62% of the land area on Tinian, of which approximately 70% is secondary and tangantangan vegetation, and less than 3% is native limestone forest.

Three surveys conducted between 1982 and 2008 indicate mixed results for bird population trends. During that time period, the reported abundance of collared kingfisher, white-throated ground-dove, rufous fantail, Micronesian starling, and yellow bittern increased while the abundance of Tinian monarch, Mariana fruit dove, and Micronesian honeyeater decreased (Volume 3, Section 10.1.2.2). The Micronesian gecko is endemic to Micronesia, is native to Tinian, and is the only CNMI-listed gecko in the CNMI. It was believed to be extirpated from Tinian after 1946, but was again collected in 2003, was sighted in 2007, and collected (a single specimen only) in limestone forest during 2008 studies (Volume 3, Section 10.1.2.4).

There are no present projects currently under construction that are anticipated to contribute to a cumulative impact to Tinian's terrestrial biological resources (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternative would individually result in impacts to Tinian's terrestrial biological resources, particularly to wildlife and special-status species, and these impacts are anticipated to also contribute to cumulative impacts on Tinian. Under the preferred alternative, Tinian monarch habitat would be removed and approximately 1% of the Tinian monarch population would be impacted. Loss of habitat would also impact other native birds. As no primary limestone forest would be removed, the impact to vegetation is assessed as less than significant. However, indirect significant impacts could result from termination of existing grazing leases and the relocation of grazing animals to other locations on Tinian (Section 3.3.9 and Volume 3, Section 10.2).

Reasonably Foreseeable Actions that Affect the Resource. All 19 of the reasonably foreseeable future actions identified in Table 4.3-5 have the potential to affect terrestrial biological resources because each project involves ground disturbances that may result in both temporary and permanent habitat loss. There is insufficient detail on each project site to determine if the areas are already disturbed, and the assumption is habitat would be lost at most project sites.

Potential Cumulative Impacts. Anticipated impacts to terrestrial biological resources with implementation of the preferred alternative are adverse but are not considered significant and would have a cumulative impact when combined with past, present, and reasonably foreseeable actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be strong (Table 4.3-5). The preferred alternative would contribute, primarily through a loss of habitat, to the trend of

degradation of terrestrial biological resources on Tinian, while other natural and human factors unrelated to the project would continue to adversely impact biological resources.

Need for Mitigation. Mitigation measures proposed for avoiding and reducing impacts to terrestrial biological resources are listed in Table 2.2-1. These mitigation measures would reduce and avoid impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

Marine Biological Resources

Current Health and Historical Context. Although not well-documented specifically for Tinian, anthropogenic stressors to marine biological resources that are known to have increased locally and globally are likely to have also increased on Tinian's marine biological resources over time. These stressors generally coincide with human population growth and include overfishing, increased pollutants released directly to the marine environment, or indirectly from land, point and non-point source discharges of stormwater and wastewater treatment plant outfalls, invasive species, recreational activities, and introductions of diseases.

Impacts to the island's surrounding marine biological resources during WWII were substantial. As indicated above, during WWII Tinian was briefly home to the largest airfield in the world and a human population of approximately 150,000 military personnel. Over 112 million cubic yards of coral were used for fill, primarily for the airfield's runways. WWII military bombings and development also likely contributed to soil runoff into the ocean, particularly resulting from widespread loss of vegetation cover across the island. Invasive species, pollutants, and pathogens may have been introduced in ballast water of marine vessels. Additional releases that may have occurred from point and non-point sources during rapid war-related construction and operations, and warfare conducted across the island, are not well-documented.

Green and hawksbill sea turtles, common bottlenose dolphin, and spinner dolphin are the special status marine species relevant to the preferred alternatives. Green sea turtles nest on Tinian beaches, but the hawksbill has not been observed nesting. Recent threats to these species from humans have included direct harvesting of eggs or adults, beach cleaning and replenishment, recreational activities, debris, incidental take from fishing, and seagrass degradation. A new non-native species of algae (*Gracilaria*) has been intentionally introduced into Tinian Harbor and an abalone species has also been introduced. Algae reproduce vegetatively and are highly competitive. Although *Gracilaria* is preferred forage by green sea turtles, fish don't seem to prefer it as forage. Organisms and pollutants released by ship ballast water are in greatest concentration within 6 km (3 nautical miles) of Tinian's coast (Volume 3, Section 11.1.4.3).

Coral health around U.S. waters has been in decline and on a global scale increased sedimentation is one of the most common and serious anthropogenic influences (Volume 3, Section 11.1.2.2). The trend in resource decline has spurred a petition to list 82 coral species as threatened and endangered under the ESA, including coral species found in waters around Tinian (Volume 2, Section 11.1.1.3). The determination to list the coral species would be dependent upon the outcome of NMFS review of information submitted. The affects of such a listing on future actions impacting waters around Tinian are not currently known and would be determined when the species are listed. INRMPs covering NAVBASE Guam and Tinian are being updated to address conservation measures for coral species.

No present projects currently under construction are anticipated to contribute to a cumulative impact to Tinian's marine biological resources (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in less than significant impacts to Tinian's marine biological resources (Section 3.3.10 and Volume 3, Section 11.2). However, there is the potential from the preferred alternatives to impact the quality and quantity of the surface runoff on Tinian, which could contribute to a cumulative impact to marine biological resources in combination with past, present, and reasonably foreseeable future actions on the island. Long-term training activities may cause erosion and sedimentation that can degrade coastal waters and potentially indirectly impact nearshore marine biological resources. In addition, the preferred alternatives would increase the potential for leaks and spills of petroleum, oil, and lubrications (POL), hazardous waste, pesticides, and fertilizers. These potential impacts may indirectly and cumulatively affect the coastal waters and, in turn, the biological resources and habitats.

Reasonably Foreseeable Actions that Affect Marine Biological Resources. All 19 of the reasonably foreseeable actions have the potential to affect marine biological resources because they involve ground disturbances that may result in increased runoff into nearshore waters (Table 4.3-5). The Marine Corps training ranges (T-2 to Y-10) would likely have surface danger zones that extend into the water, but the potential impacts on marine resources would be minimal. Waterfront upgrades (T-11), resorts (T-16 and T-17), and the wastewater treatment plant (T-19) may have direct impacts on marine resources. Additionally, the two resort and casino projects would attract additional population to the island, in the form of tourists, therefore increasing stressors associated with recreation and releases into waters.

Potential Cumulative Impacts. Cumulative projects that occur in the water that would have direct impact on the marine environment include those that are located in or near surface water that connects to the ocean or in the ocean. Project and site-specific BMPs and the provisions of facility-specific SWPPPs and SPCC Plans would minimize potential impacts from facility operations, including the transportation, storage, and use of fuel on all water resources. However, all of the cumulative projects listed would result in an increase in impervious surface area and increase in erosion potential, resulting in a corresponding additive increase in stormwater runoff into coastal waters. Stormwater runoff has the potential to have elevated levels of contaminants such as sediments, nutrients, heavy metals, organic and inorganic compounds, and detrimental microorganisms. Operations associated with the preferred alternatives and shipping traffic associated with reasonably foreseeable future actions would increase the potential for leaks and spills of POL, hazardous waste, pesticides, and fertilizers. The effects of such leaks and spills can be additive in nature. Anticipated impacts to marine biological resources during construction and operations of the preferred alternatives, although considered to be less than significant, would have a cumulative impact when combined with the past, present, and reasonably foreseeable actions on Tinian identified above. The degree of additive impact resulting from construction and operation of the preferred alternatives is considered to be low (Table 4.3-5).

Need for Mitigation. No mitigation measures to avoid or reduce impacts to marine biological resources are proposed for the preferred alternatives.

Cultural Resources

Current Health and Historical Context. Many WWII cultural sites were established on Tinian, but the war itself resulted in the loss of cultural sites. Few archaeological and architectural resources show evidence of the area's status as a colony of Spain and Germany while numerous structures and relics attest to the island's role in WWII (Volume 3, Section 12.1.1.3). The stressors on cultural resources include vandalism (intentional or unintentional), intentional and inadvertent disturbance from construction activities, and deterioration due to erosion. The trend since the conclusion of WWII is a decline in historic properties

due to the stressors listed. No present projects currently under construction are anticipated to contribute to a cumulative impact to Tinian's cultural resources (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternative would individually result in significant but mitigable impacts to Tinian's historic properties (Section 3.3.11 and Volume 3, Section 12.2). Impacts to archaeological resources resulting from implementation of the preferred alternative would include significant adverse direct impacts to 9 historic properties and indirect impacts to one historic property in the SDZ. These impacts could contribute to cumulative impacts to cultural resources on Tinian by furthering the declining trend in cultural resources on the island. Other factors unrelated to the project, such as vandalism and weathering, are expected to continue to adversely impact historic properties.

Reasonably Foreseeable Actions that Affect Cultural Resources. All 19 of the reasonably foreseeable actions identified in Table 4.3-5 have the potential to affect historic properties because each of the actions would involve ground disturbance.

Potential Cumulative Impacts. Implementation of the preferred alternatives, when considered in conjunction with past, present, and reasonably foreseeable future actions on Tinian would have a significant cumulative effect on h. There are hundreds of historic properties throughout Tinian. Recently completed, present, and reasonably foreseeable development would have an adverse effect on both pre-contact and post-contact sites along the coast and in the interior. Although projects would be coordinated with the CNMI HPO and mitigated in accordance with laws and regulations related to the management and preservation of cultural resources in the CNMI, loss of some historic properties, even with data recovery, cannot be completely mitigated. Disturbance or destruction of these cultural resources would further diminish the regional archaeological record, thus decreasing the potential of its overall research contribution. The significant mitigable impacts of the preferred alternatives would have a cumulative impact when combined with the past, present, and reasonably foreseeable actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be strong (Table 4.3-5).

Need for Mitigation. To mitigate these cumulative impacts, DoD would assist the CNMI SHPO with the five-year update of their Historic Preservation Plan (HPP). DoD proposes to support updates of the HPPs by providing information developed as part of DoD cultural resources investigations, updated project planning information, and logistical support for meetings with local, state, and other federal stakeholders. It is anticipated the CNMI plan will address the long term, cumulative effects of the military build-up on historic properties. In addition, mitigation to reduce cumulative impacts to historic properties may include implementing the Cultural Landscape Report for the North Field National Historic Landmark or production of a thematic synthesis.

Visual Resources

Current Health and Historical Context. Visual resources on Tinian declined due to activities at the beginning of the 20th century, with the worst point being the immediate aftermath of the WWII bombings by the U.S. to take control of the island. There has been improvement of the island's overall visual resources in the decades following WWII, but this improvement has been negatively impacted by a trend of development and abandonment of developments, along with the degradation of developments from natural events.

The visual setting of Tinian underwent dramatic visual changes in the early 20th century when intensive agriculture and WWII-related activities altered the natural and built environments of the island. In the 1920s a large-scale agricultural initiative by the Japanese resulted in the planting of sugarcane crops on

approximately 80% of the island's arable land. Not long after, the visual setting became increasingly influenced by development associated with WWII. In 1944 the entire sugarcane operation and most Japanese war-related structures were destroyed by U.S. bombings; only a denuded forest was left behind. The U.S. may have later seeded the island with tangantangan -similar to Guam- in order to slow erosion resulting from plant cover loss resulting from bombings. The island then underwent additional rapid development for military uses by the U.S. During WWII, Tinian briefly reached its largest recorded population of approximately 150,000, almost all of which were U.S. troops, and was the location of the largest WWII airfield, with six 8,500-ft long runways for B-29 bombers, in addition to repaired airstrips originally constructed by the Japanese. By 1945 a substantial portion of the northern third of the island had been graded and paved with air strips. Historical aerial views of Tinian are provided in Volume 3 of Northwest Field in 1945 (Figure 12.1-2), Northern Tinian (Figure 13.1-1), and North Field (Figure 13.1-2).

Natural revegetation and the abandonment and development of structures likely represent the most notable changes to Tinian's visual setting following WWII. Immediately following the war, Tinian's population shrank to the hundreds and the island has slowly been re-populated and re-developed over the past 60 years. Over that time period, some developments were abandoned and fell into disrepair, particularly during times of economic hardship, and new developments were constructed during times of increased economic activity. Natural disasters, such as typhoons and earthquakes, contribute to the degradation of the appearance of existing developments. A casino and several hotels serve tourists. The Dynasty Hotel and Casino development is the largest post-WWII development on the island. Some of the WWII facilities remain today as historic sites. The northern two-thirds of the island are now used for military training activities, primarily conducted by the USMC, and landing strips from WWII are still present. Since the early 1980s, vegetation cover has been documented to be returning across the island. Open fields have decreased 11.6% and secondary forest coverage increased 10.3%; however, only 2.6% of the island is still dominated by native limestone vegetation (Volume 3, Section 10.1.2.1).

There are no present projects currently under construction that are anticipated to contribute to a cumulative impact to Tinian's visual resources (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in significant and mitigable impacts to visual resources on Tinian (Section 3.3.12 and Volume 3, Section 13.2). Implementation of the preferred alternative would result in significant and mitigable impacts on views from Mount Lasso, along Broadway, and along 8th Avenue. The proposed action would contribute to the declining trend in visual resources from development. Other factors unrelated to the project, such as the effect of natural disasters on developments, would continue to adversely impact visual resources.

Reasonably Foreseeable Actions that Affect Visual Resources. All 19 reasonably foreseeable actions have the potential to affect visual resources because the actions involve increased human development, which is generally considered to degrade the natural visual setting of the island. The two new resorts, Tinian Oceanview Resort (T-16) and Matua Bay (T-17) and the Neo Goldwings Paradise Casino (T-23) would be the largest land development proposals in both area and mass, and would have an impact on visual resources and scenic viewpoints. Village homesteads, infrastructure improvements and minor facilities would have less impact on the visual landscape. Although not on the cumulative project list, the closure of the Dynasty Hotel could result in abandonment of Tinian's largest most recent development, which would degrade the visual setting of the surrounding area.

Potential Cumulative Impacts. All of the cumulative projects would likely remove some open space and result in an adverse impact on visual resources, contributing to the decline of Tinian's natural visual

setting since the beginning of the 20th century. If all the Marine Corps ranges are constructed, then there would likely be no public access to the MLA and the scenic viewpoints located there. Anticipated long-term and temporary impacts to visual resources, although considered to be less than significant, would have a cumulative impact when combined with the past, present, and reasonably foreseeable future actions on the island identified above. The degree of additive impact resulting from the preferred alternatives is considered to be low (Table 4.3-5).

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to visual resources are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions on Tinian. No additional mitigation measures for cumulative impacts are proposed.

Marine Transportation

Current Health and Historical Context. The Inner Tinian Harbor was built in 1944 by U.S. Navy Engineers. Marine transportation to and from Tinian was at its peak during WWII when approximately 150,000 U.S. military personnel briefly populated the island. Immediately following WWII and the departure of U.S. troops, marine transportation to and from the island likely almost stopped altogether and resulted in the total island population dropping to several hundred people. The harbor was a center for fish transshipment in the 1990s, an operation that ended with the bankruptcy of the owner of the tuna transshipment and freezer facility later that decade (Volume 3, Section 16.1.1.2). The number of vessels (military and non-military) visiting Tinian Harbor varies with the economy. The Tinian Dynasty Hotel & Casino (item T-23 on Table 4.3-5) operates Tinian's shipping and the ferry service between Saipan and Tinian. Currently, there are only one to two trips per day, which is a decrease over the peak six trips per day in the 1970s. Marine transportation to and from Tinian is expected to decline, or remain at about the current level, unless there are increases in tourism, military mission, or other industry.

There are no present projects currently under construction that are anticipated to contribute to a cumulative impact to Tinian's marine transportation resources (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in a less than significant impact to marine transportation resources on Tinian (Section 3.3.13 and Volume 3, Section 14.2). For the proposed monthly Marine training, if the training equipment is moved by barge, one single barge would be able to carry the equipment necessary to support the estimated 200 to 400 Marine training evolution. Tinian Harbor currently accommodates this type of marine vessel activity on a regular basis. The addition of one barge per month would result in a less than significant impact to marine transportation in Tinian Harbor.

Reasonably Foreseeable Actions that Affect Marine Transportation. 13 reasonably foreseeable actions with the potential to affect marine transportation were identified (Table 4.3-5) including the Marine Corps range complex projects (T-2 through T-11), two new resorts, Tinian Oceanview Resort (T-16) and Matua Bay resort and Golf Course (T-17), and the Neo Goldwings Paradise Casino (T-23). These projects would primarily affect marine transportation temporarily during construction, when materials and equipment would arrive in Tinian Harbor. Additional longer term impacts would result from movements of people and supplies to support the additional population, primarily tourists, associated with the reasonably foreseeable actions.

Potential Cumulative Impacts. The military training complex projects (T-2 through T-10) are not programmed, but the concept was to develop a training range complex on Tinian that would include as many of the ranges listed as practical. Military forces and equipment would arrive largely by sea. Waterfront upgrades (T-11) would provide the improvements required to increase the wharf capacity. The

resort and casino projects would indirectly impact marine transportation by increasing the need for goods and services that would arrive by ship and attracting tourists who could opt to arrive by ship rather than by air. If these cumulative projects were to operate concurrently, the port could exceed capacity. Anticipated impacts to marine transportation, although considered to be less than significant, would have a remote possibility of cumulatively impacting Tinian's marine transportation resources when combined with the past, present, and reasonably foreseeable future actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be low (Table 4.3-5).

Need for Mitigation. No mitigation measures to avoid or reduce impacts to marine transportation are proposed for the preferred alternatives.

Utilities and Roadways

Current Health and Historical Context. Most of Tinian's roads were paved during WWII or shortly thereafter when the island was under U.S. military control. A new power plant was built in 1998 and power and water meet the existing and near future demand (but not all reasonably foreseeable projects have been considered). However, outdated and inefficient power equipment has been identified as resulting in high utility rates that drain consumer expenditures from other normal activity (Volume 3, Section 16.1.1.1). Wastewater management has historically and currently relied on septic systems and leachfields, with the exception of the Dynasty Hotel, which has a tertiary treatment system. There are plans to construct a centralized wastewater treatment plant co-located with a proposed solid waste landfill (cumulative project T-18). The municipal solid waste disposal site is operated as an open burning dump; therefore, it does not comply with the Resource Conservation and Recovery Act, Subtitle D, regulations for municipal solid waste landfills (40 Code of Federal Regulations Part 258). Power and wastewater are anticipated to continue to meet the current trend in demand, but the wastewater and solid waste management systems are inadequate.

There are no present projects currently under construction that are anticipated to contribute to a cumulative impact to Tinian's utilities and roadways (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in a less than significant impact to wastewater treatment and potable water systems, and no impact to solid waste and power, on Tinian (Section 3.3.14 and Volume 3, Sections 14.2 and 15.2). The proposed action would contribute to deteriorating infrastructure. The additional traffic proposed by transporting equipment and ammunition from the airport to the ranges would not exceed the existing capacity of the roadways and the impact would be less than significant.

Reasonably Foreseeable Actions that Affect Roadways and Utilities. 16 reasonably foreseeable actions with potential to affect utilities were identified, and eight projects affecting off-base roadways were identified. These include municipal projects for a new wastewater treatment plant (T-19) and landfill (T-18), two new resorts (Matua Bay and Tinian Oceanview Resort) and a casino (Neo Goldwings Paradise), and the Marine Corps training range complex (T-2 through T-10; Table 4.3-5). The new resorts and casino are expected to have the greatest impact on utilities and roadways by increasing the tourist population, and thus demand, on infrastructure. The Marine Corps training range complex includes a proposal for infrastructure upgrades (T-12) to meet the additional military demand on utilities. Municipal projects for a new wastewater treatment plant (T-19) and landfill (T-18) are beneficial projects. The off-base roadway improvements would be required to support the cumulative projects.

Potential Cumulative Impacts. All reasonably foreseeable future development projects would have some cumulative impact on utility and roadway infrastructure by increasing demand and deterioration,

respectively; but population growth-inducing projects would have the greatest impact, including the new resorts(T-16 and T-17) and casino (T-23). Anticipated impacts to utilities and roadways from the preferred alternatives, although considered to be insignificant, would have a cumulative impact when combined with past, present, and reasonably foreseeable future actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be low (Table 4.3-5).

Need for Mitigation. No mitigation measures to avoid or reduce impacts to utilities and roadways are proposed for the preferred alternatives.

Socioeconomics and General Services

Current Socioeconomic and Historical Context. Refer to Volume 3, Section 16.2 for more detailed information regarding Tinian's socioeconomic history. Tinian's population was temporarily at its highest during WWII, when the island was populated by 150,000 U.S. military personnel and contained the largest airfield during WWII. Immediately following WWII, Tinian's population shrank to several hundred and the island has slowly been re-populated and re-developed over the past 60 years. The population increased most quickly following the agreement with the U.S. to become the CNMI in 1976 and reached a population of 3,540 by the time of the 2000 U.S. Census. By 2005 the population had declined to 2,829.

During the Spanish Period (1668-1899) the economy was based on agriculture, cattle and farm crops. In the 1920s, the Japanese intensively cultivated sugar cane on approximately 80% of Tinian's arable land (Volume 3, Section 12.1.1.3). With the return of the population after WWII, subsistence farming resumed and eventually allowing cattle and crop production for export to Saipan. In the 1970s, gambling was permitted on-island, and the Tinian Dynasty Hotel and Casino opened. It is the only casino on-island. In the 1990s, there was a tuna transshipment industry on the island. There is interest in improving the agricultural productivity in the future, but the casino may be closing, resulting in an adverse impact to the island's economy. Tinian's economy is currently dominated by the casino, a small tourism trade centered on the island's role in WWII, and marine activities such as diving.

There are no present projects currently under construction that are anticipated to contribute to a cumulative impact to Tinian's socioeconomics and general services (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would result in significant economic impacts to Tinian due to the termination of agricultural leases and loss of access to wild chili plants at the proposed training areas and associated SDZs. There would be slight beneficial impacts to on-island employment during construction. The preferred alternatives may require the addition of a police officer during construction (Section 3.3.15 and Volume 3, Sections 16.2).

Reasonably Foreseeable Actions that Affect Socioeconomic Resources. Eighteen (18) reasonably foreseeable actions with the potential to beneficially impact socioeconomics were identified (Table 4.3-5), including two new resorts and a casino: Tinian Oceanview Resort (T-16), Matua Bay Resort and Golf Course (T-17), and the Neo Goldwings Paradise Casino (T-23). Beneficial socioeconomic impacts would largely result from increased employment and economic activity associated with these development projects. The quarry projects (T-15 and T-27) and landfill (T-18) could also have beneficial impacts on the economy and infrastructure of the island. Beneficial socioeconomic impacts could also result from the waterfront (T-11) and infrastructure upgrades (T-12). The Marine Corps projects (T-2 through T-10), if developed concurrently as planned, to create a training complex, would have an adverse impact on the socioeconomics because there would be no access to key tourist sites and the agricultural leases in the

LBA are likely to be terminated. There would be some full time employment on-island to support the range complex.

Potential Cumulative Impacts. Anticipated impacts to socioeconomics resulting from the preferred alternatives are significant and would have a cumulative impact when combined with the past, present, and reasonably foreseeable future actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be strong (Table 4.3-5).

Need for Mitigation. Mitigation measures proposed to avoid or reduce socioeconomic and general services impacts are listed in Table 2.2-1. These mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions on Tinian. No additional mitigation measures for cumulative impacts are proposed.

Hazardous Materials and Waste

Current Health and Historical Context. There are few historical data on hazardous material, toxic substance, and hazardous waste handling, collectively referred to as hazardous substances handling, on Tinian. World War II established a high baseline of environmental releases; but overall, the trend in hazardous substance use is associated with increases in population and industrial activity on the island. During the 1970s, there were numerous local and federal environmental regulations enacted to protect human health and the environment and to closely control and regulate the transport, storage, use and disposal of hazardous substances. While the trend in use of hazardous substances is expected to increase over time, regulations in place minimize the risk of release to the environment as well as to human health. This trend would continue at a more gradual rate of increase. The impacts are largely related to human activities, but natural events, such as typhoons and earthquakes, can result in inadvertent releases of regulated hazardous substances. The CNMI Department of Environmental Quality (DEQ) Hazardous and Solid Waste Management Branch regulates hazardous substances generated within the CNMI. In 1984, the CNMI DEQ adopted the federal hazardous waste regulations under RCRA and the hazardous and solid waste amendments. The CNMI does not have hazardous waste regulations that are more stringent than USEPA regulations.

There are three hazardous waste sites being managed on Tinian that overlap or are near the proposed project footprint (Sites L-4, L-7, and L-12). These sites are shown on Figure 17.2-1 and discussed on Table 17.1-1 in Volume 3. When DoD hazardous waste is generated on Tinian it is transported to DRMO facilities on Guam in accordance with DOT regulations. Once on Guam, the DRMO arranges for the subsequent transfer and disposal of the hazardous waste off-island at licensed hazardous waste facilities. In the case of asbestos containing materials, these materials are disposed of at federal facilities on Guam.

There are no present projects currently under construction that are anticipated to contribute to a cumulative impact to Tinian's hazardous substances (Table 4.3-5).

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in less than significant impacts related to regulated hazardous substances because the transportation, storage, handling, use, or disposal of these substances would occur in accordance with strict federal and local regulations in a "cradle to grave" comprehensive manner (Section 3.3.16 and Volume 3, Section 17.2).

Reasonably Foreseeable Actions that Affect Hazardous Substances. All 19 of the reasonably foreseeable future actions could potentially involve transportation, storage, handling, use, or disposal of hazardous substances during construction and operation (Table 4.3-5). The Marine Corps training range complex

projects (T-2 through T-12) and possibly the new quarries (T-15 and T-27) would use explosives. The proposed resorts (T-16 and T-17) and casino (T-23) would use hazardous substances to maintain the recreational activities, landscaping, air conditioning, wastewater, and other engineering support functions. The homestead villages are also likely to handle minor amounts of hazardous substances.

Potential Cumulative Impacts. Anticipated impacts from the preferred alternative are considered to be less than significant when combined with the past, present, and reasonably foreseeable actions on Tinian identified above. The degree of cumulative impact resulting from the preferred alternative is considered to be low (Table 4.3-5) because existing environmental laws and regulations and associated BMPs and SOPs require that these hazardous substances are handled, used, and disposed of in a comprehensive "cradle to grave" manner that inherently reduces the overall risk to human health and the environment.

This assessment is based on the assumption that existing hazardous materials, toxic substances, and hazardous waste transportation, handling, storage, use, and disposal procedures and protocols are properly implemented and modified as appropriate to address the increased hazardous substances demand. Most of the cumulative projects would increase the management of regulated hazardous substances on Tinian. However, these impacts would not contribute appreciably to the increasing trend in volume of regulated hazardous substances already being handled and managed on Tinian.

Need for Mitigation. No mitigation measures to avoid or reduce hazardous materials impacts are proposed for the preferred alternatives.

Public Health and Safety

Current Health and Historical Context. The trends in public health and safety on Tinian are a function of changes in population and operation, or industries that involve dangerous materials (e.g., hazardous substances, live ammunition, electromagnetic energy, radiological substances). WWII is the most damaging recent human-caused event in Tinian's history impacting human health and safety. The socioeconomics section describes changes in population over time. From 1970 to 2000, the population on Tinian increased, but then declined in subsequent years. Occupational and traffic accidents, along with increases in incidents of disease, have gradually increased with population. Aircraft mishaps are associated with economics, and are cyclical. The Tinian health and public services are sub-standard due to lack of funding; this trend is likely to continue in the absence of economic development.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in less than significant impacts to public health and safety for the following reasons (Section 3.3.17 and Volume 3, Section 18.2):

- The potential increase in noise and air quality emissions would be less than significant; therefore, overall potential impacts to human health and safety would be less than significant.
- Health care professionals and public service personnel are anticipated to maintain existing service conditions; therefore, no impact to health care, police, or fire service is anticipated.
- No impact to public health and safety are anticipated from water quality concerns and management of hazardous substances.
- Excavation for building foundations, roads, underground utilities, and other infrastructure could encounter unexploded military munitions; however, qualified UXO personnel would perform surveys to identify and remove potential MEC items prior to the initiation of ground-disturbing activities. Additionally, UXO supervision would be provided during earth moving activities and MEC awareness training would be provided to construction workers.

The increase in construction and ground disturbing activities associated with the preferred alternatives would increase the risk of uncovering UXO; live ammunition is largely a military activity and changes with the military mission.

Reasonably Foreseeable Actions that Affect Public Health and Safety. All 19 of the reasonably foreseeable future actions could potentially impact public health and safety on Tinian because each action would induce an increase in Tinian population (resorts and casino) or they involve industrial (quarries, landfill wastewater treatment plants) or other potentially dangerous activities (military training, construction; Table 4.3-5). All projects that involve excavation could encounter unexploded military munitions during construction, but only the quarry (T-15, T-27) and landfill (T-18) projects would be likely to encounter UXO during operations. The two new planned resorts and casino (T-16, T-17, T-23) would provide employment that may lead to increases in the Tinian population with proportionate increases in notifiable disease and accidents, and pressure on public services, such as fire and police departments. The Marine Corps training range complex would impact noise levels and fire protection service, but the permanent population would be limited to maintenance staff.

Potential Cumulative Impacts. Anticipated impacts to public health resulting from the preferred alternatives, although considered to be less than significant, would have a cumulative impact when combined with past, present, and reasonably foreseeable future actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be low because impacts are primarily related to increases in population, and the proposed action would have a minimal impact on the population trend on the island (Table 4.3-5).

Need for Mitigation. No mitigation measures to avoid or reduce public health and safety impacts are proposed for the preferred alternatives.

Environmental Justice and the Protection of Children

Current Health and Historical Context. Environmental Justice is a relatively new concept; it was introduced in 1994 by Executive Order 12898 and applies to federal actions. Tinian's population, when compared to a village on Guam with a similar demographic profile (Dededo), and the U.S. population as a whole, has a high percentage of racial minorities and households living in poverty. The trend is expected to remain the same or possibly worsen in the absence of economic development on Tinian.

Direct and Indirect Impacts of the Preferred Alternative That Might Contribute to a Cumulative Impact. The preferred alternatives would individually result in significant impacts associated with environmental justice and protection of children (Section 3.3.18 and Volume 3, Section 19.2). The preferred alternatives would have disproportionate impacts to racial minorities on the island of Tinian in terms of recreational and cultural resources, socioeconomics, and terrestrial biological resources. People with low incomes relative to the average U.S. population are likely to be adversely affected by restricted access to the currently leased areas of the island. Significant impacts could occur to Tinian ranchers and locals who pick and sell wild chili-peppers from the leased land; they could be restricted from accessing the land needed to perform their work.

Reasonably Foreseeable Actions that Affect Environmental Justice and the Protection of Children. All 19 of the reasonably foreseeable projects listed in Table 4.3-5 could potentially have an environmental justice impact. Some projects provide economic opportunities, such as new resorts (T-16 and T-17) and the casino (T-23). The infrastructure improvement projects (waterfront improvements [T-1] and landfill [T-18]) would also have a beneficial cumulative impact. Homestead Villages (t-28) would have a beneficial impact to disadvantaged populations. The Marine Corps training range complex (T-2 through T-10) projects would have an overall adverse impact on the Tinian population (Table 4.3-5). Increases in

population related to military mission changes (T-2 through T-10) could impact disadvantaged populations through increases in traffic and noise, and additional limitations on access to recreational and cultural sites in the MLA. Improvements to infrastructure (T-18), public services, and homestead villages (T-28) are likely to have a beneficial impact on disadvantaged populations. Projects that create jobs, such as new hotels (T-16, T-17, T-23) could have a cumulative beneficial impact on disadvantaged populations through employment opportunities. This advantage may be offset by increases in traffic with a potential adverse impact on disadvantaged populations.

Potential Cumulative Impacts. Anticipated impacts to environmental justice and the protection of children resulting from the preferred alternatives are considered to be significant and would have a cumulative impact when combined with the past, present, and reasonably foreseeable future actions on Tinian identified above. The degree of additive impact resulting from the preferred alternative is considered to be strong (Table 4.3-5).

Need for Mitigation. Mitigation measures proposed to avoid or reduce impacts to environmental justice are listed in Table 2.2-1. These proposed mitigation measures would avoid or reduce impacts resulting from the preferred alternative in combination with other past, present, and reasonably foreseeable future actions. No additional mitigation measures for cumulative impacts are proposed.

4.4 CLIMATE CHANGE AND GLOBAL WARMING

Greenhouse gases (GHGs) are compounds that contribute to the greenhouse effect. The greenhouse effect is a natural phenomenon where these gases trap heat within the surface-troposphere (lowest portion of the earth's atmosphere) system, causing heating (radiative forcing) at the surface of the earth. Scientific evidence indicates a trend of increasing global temperature over the past century due to an increase in GHG emissions from human activities (USEPA 2009a). The climate change associated with this global warming is predicted to produce negative environmental, economic, and social consequences across the globe. The average global temperature since 1900 has risen by 1.5°F and is predicted to increase by up to 11.5°F by 2100 (Karl et al. 2009).

Predictions of long-term negative environmental impacts due to global warming include sea level rise, changing weather patterns with increases in the severity of storms and droughts, changes to local and regional ecosystems including the potential loss of species, shrinking glaciers and sea ice, thawing permafrost, a longer growing season, and shifts in plant and animal ranges.

Climate change is likely to negatively impact Pacific islands, including Guam and Tinian. The degree to which climate change and variability would affect Guam and Tinian depends upon a variety of factors, including the geology, area, height above sea level, extent of reef formation, and the size of the freshwater aquifer (USEPA 2009c). Guam, as other small islands, is considered extremely vulnerable to climate change because extreme events can have major impacts on small islands (USEPA 2009c). The climate studies conducted are global in focus or centered on particular regions or the earth. However, studies specific to Guam are not currently available. The Water and Environmental Research Institute plans to complete studies specific to Guam. Studies specific to Guam would presumably be more relevant to predictions of future impacts on the NGLA because the characteristics and hydrogeology of the aquifer can be considered.

In 2007, the U.S. generated about 7,150 Tg CO_2 Eq (USEPA 2009b). This total includes emissions from Guam and Tinian; after 2002 the United Nations no longer reports energy statistics for Guam separately (Marland et al. 2008) and emissions from Tinian were never reported separately. Since the U.S. inventory does not provide a baseline for Guam, using the U.S. baseline condition for a comparison is considered appropriate for current conditions. The 2007 inventory data (USEPA 2009b) show that CO_2, CH_4, and

N_2O contributed from fossil fuel combustion processes from mobile and stationary sources include approximately:

- 5,736 teragrams (Tg) (or million metric tons) of CO_2
- 9 Tg CH_4
- 45 Tg N_2O

This section begins by providing the background and regulatory framework for GHGs (Section 4.4.1). It then provides a quantitative evaluation of the increase in GHG emissions based on the preferred alternatives and cumulative GHG air quality impacts (Section 4.4.2). The remaining section provides a qualitative discussion on climate change adaptation (Section 4.4.3).

4.4.1 Background and Regulatory Framework

GHGs trap heat in the atmosphere by absorbing infrared radiation. These emissions occur from both natural processes and human activities. The primary long-lived GHGs directly emitted by human activities are carbon dioxide (CO_2), methane (CH_4), nitrous oxide (N_2O), hydrofluorocarbons (HFCs), perfluorocarbons (PFCs), and sulfur hexafluoride (SF_6). Although CO_2, CH_4, and N_2O occur naturally in the atmosphere, their concentrations have increased by 38, 149, 23 percent, respectively, from the preindustrial era (1750) to 2007/2008 (USEPA 2009a). Further information on GHGs is provided in Volume 2, Section 5.1.1.6.

Federal agencies address emissions of GHGs by reporting and meeting reductions mandated in laws, EOs and policies. The most recent of these are EOs 13514 federal Leadership in Environmental, Energy, and Economic Performance of October 5, 2009 and EO 13423 Strengthening Federal Environmental, Energy, and Transportation Management of January 26, 2007.

EO 13514 shifts the way the government operates by: 1) establishing GHGs as the integrating metric for tracking progress in federal sustainability; 2) requiring a deliberative planning process; and 3) linking to budget allocations and OMB scorecards to ensure goal achievement.

The targets for reducing GHG emissions discussed in EO 13514 for Scope 1 - direct greenhouse gas emissions from sources that are owned or controlled by a federal agency - and Scope 2 - direct greenhouse gas emissions resulting from the generation of electricity, heat, or steam purchased by a federal agency - have been set for DoD at a 34% reduction of GHG from the 2008 baseline by 2020. Scope 3 targets - greenhouse gas emissions from sources not owned or directly controlled by a Federal agency but related to agency activities such as vendor supply chains, delivery services, and employee travel and commuting – were set at a 13.5% reduction The EO 13514 Strategic Sustainability Performance Plan (SSPP) was submitted to CEQ on June 2, 2010 and contains a guide for meeting these goals.

GHGs for the proposed action would be reduced by incorporating the Leadership in Energy and Environmental Design (LEED) program into the proposed action. LEED is an internationally recognized green building certification system, providing third-party verification that a building or community was designed and built using strategies aimed at improving performance across all the metrics that matter most: energy savings, water efficiency, CO_2 emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts. There are four levels of certification in LEED and Navy/Marine Corps policy support and facilitate silver certification for bases. Buildings constructed for actions associated with the proposed action would qualify for LEED silver. Low impact land development (LID) would also be used during design to save water and energy to meet the targets

established under EO 13514.

EO 13423 established a policy that federal agencies conduct their environmental, transportation, and energy-related activities in support of their respective missions in an environmentally economic way. It included a goal of improving energy efficiency and reducing GHG emissions of the agency, through reduction of energy intensity by 3% annually through the end of fiscal year 2015, or 30% by the end of fiscal year 2015, relative to the baseline of the agency's energy use in fiscal year 2003.

CEQ Draft NEPA Guidance on Consideration of the Effects of Climate Change and Greenhouse Gas Emissions (CEQ, 2010) states that "*if a proposed action would be reasonably anticipated to cause direct emissions of 25,000 metric tons or more of CO_2-equivalent GHG emissions on an annual basis, agencies should consider this an indicator that a quantitative and qualitative assessment may be meaningful to decision makers and the public.*" These recommendations are consistent with the Mandatory Reporting of Greenhouse Gases rule (40 CFR Parts 86, 87, 89 et al.) effective December 29, 2009, applies to fossil fuel suppliers and industrial gas suppliers, direct greenhouse gas emitters and manufacturers of heavy-duty and off-road vehicles and engines. Under the rule, suppliers of fossil fuels or industrial greenhouse gases, manufacturers of vehicles and engines, and facilities that emit 25,000 metric TPY of GHG emissions are required to submit annual reports to the USEPA. The Mandatory Reporting rule for the proposed action applies to DoD stationary sources. GHG emissions for GPA Power and Layon Landfill sources would require separate annual reports to the USEPA. Construction emissions are relatively short in nature, and as such, are not listed in these rules, which were designed primarily for tracking and regulating stationary sources. The rule provides accurate and timely data to inform future climate change policies and programs, but does not require control of GHGs. Monitoring begins January 1, 2010 and the first electronic reports are due March 31, 2011.

On May 13, 2010 the USEPA finalized the Prevention of Significant Deterioration (PSD) and Title V Greenhouse Gas Tailoring Rule to address GHG under stationary sources. This final rule "tailors" the requirements of these CAA permitting programs to limit which facilities would be required to obtain PSD and Title V permits. The USEPA is phasing in the CAA permitting requirements for GHGs in two initial steps. The first step will occur from January 2, 2011 – June 30, 2011 and covers only sources currently subject to the PSD permitting program (i.e., those that are newly-constructed or modified in a way that significantly increases emissions of a pollutant other than GHGs) that would be subject to permitting requirements for their GHG emissions under PSD. For these projects, only GHG increases of 75,000 TPY or more of total GHG, on a CO2eq basis, would need to determine the Best Available Control Technology (BACT) for their GHG emissions. Similarly for the operating permit program, only sources currently subject to the program (i.e., newly constructed or existing major sources for a pollutant other than GHGs) would be subject to Title V requirements for GHG. During the first step, no sources would be subject to CAA permitting requirements due solely to GHG emissions. Step 2 will occur from July 1, 2011 to June 30, 2013 and build on Step 1. In this phase, PSD permitting requirements will cover for the first time new construction projects that emit GHG emissions of at least 100,000 TPY, even if they do not exceed the permitting thresholds for any other pollutant. Modifications at existing facilities that increase GHG emissions by at least 75,000 TPY will be subject to permitting requirements, even if they do not significantly increase emissions of any other pollutant. In Step 2, operating permit requirements will, for the first time, apply to sources based on their GHG emissions even if they would not apply based on emissions of any other pollutant. Facilities that emit at least 100,000 TPY CO2eq will be subject to Title V permitting requirements. The emissions with potential to result from the proposed action at affected existing stationary sources discussed in this EIS are below the permitting thresholds covered by the

Prevention of Significant Deterioration (PSD) and Title V Greenhouse Gas Tailoring Rule, as shown in Table 7.2-5 of Volume 6.

4.4.2 Proposed Action and Cumulative GHG Impacts

The potential effects of proposed GHG emissions are by nature global and cumulative impacts, as individual sources of GHG emissions are not large enough to have an appreciable effect on climate change. In keeping with CEQ guidance, the focus of the cumulative air quality GHG analysis is on GHG emissions that are affected by the proposed action and its significance on climate change as compared to the no action alternative. The impact of proposed GHG emissions as they pertain to climate change is discussed in the context of the combined impacts as compared to the total amount of GHG emissions that the U.S. produces.

To estimate total GHG emissions, each GHG is assigned a global warming potential (GWP). The GWP is the ability of a gas or aerosol to trap heat in the atmosphere. The GWP rating system is standardized to CO_2, which has a value of one. For example, CH_4 has a GWP of 21, which means that it has a global warming effect 21 times greater than CO_2 on an equal-mass basis (Intergovernmental Panel on Climate Change [IPCC] 2007). To simplify GHG analyses, total GHG emissions from a source are often expressed as CO_2 equivalents (CO_2 Eq). The CO_2 Eq is calculated by multiplying the emissions of each GHG by its GWP and adding the results together to produce a single, combined emission rate representing all GHGs. While CH_4 and N_2O have much higher GWPs than CO_2, CO_2 is emitted in much higher quantities, so that it is the overwhelming contributor to CO_2 Eq from both natural processes and human activities. GWP-weighted emissions are presented in terms of equivalent emissions of CO_2, using units of teragrams (1 million metric tons, or 1 billion kilograms) of carbon dioxide equivalents (Tg CO_2 Eq).

The total GHG emissions in terms of CO_2 Eq for the preferred alternatives were predicted for the following three source categories:

- Mobile fossil fuel combustion sources including construction equipment,
- Stationary fossil fuel combustion sources, and
- Solid waste landfill.

Among the primary long-lived GHGs directly emitted by human activities, only CH_4 and N_2O have the potential to be produced from fossil fuel combustion sources (USEPA 2009b). CH_4 could also be produced during landfill operations in addition to production from combustion sources.

Although the USEPA final rule on Mandatory Reporting of Greenhouse Gases (October 30, 2009) provides various methodologies to estimate CO_2 equivalencies based on fuel test and consumption data, this rule is essentially designed for specific stationary facility reporting purposes and cannot be directly implemented in this EIS to address various source categories. Most of the USEPA tools that are widely used for NEPA study purposes (e.g., AP-42, NONROAD [USEPA 2008] and Mobile6 emissions factor models [USEPA 2003]) do not provide emission factors for CO_2 Eq other than for CO_2. Therefore, given the lack of regulatory tools to provide reasonable estimates of CO_2 Eq, this report utilizes the inventory ratios among CO_2, CH_4 and N_2O summarized in the most recent USEPA inventory report (USEPA 2009b) as the basis for approximating and prorating CH_4 and N_2O emission levels.

The 2007 inventory data (USEPA 2009b) show that CO_2, CH_4, and N_2O contributed from fossil fuel combustion processes from mobile and stationary sources include approximately:

- 5,736 teragrams (Tg) (or million metric tons) of CO_2
- 9 Tg CH_4

- 45 Tg N_2O

The ratios among CO_2, CH_4 and N_2O based on the above inventory levels were used to predict CH_4 and N_2O equivalencies from mobile and stationary combustion sources as follows:

- CH_4 = (tons per year [TPY] of CO_2) * (9 / 5,736) = 0.16% TPY of CO_2.
- N_2O = (TPY of CO_2) * (45 / 5,736) = 0.78% TPY of CO_2.

Based on these ratios, the GHG contribution from CH_4 and N_2O is less than 1% of the total CO_2 equivalency for fossil fuel combustion sources. CH_4 emissions from the landfill were predicted directly using the Landfill Gas Emissions Model (LandGEM) (USEPA 2005), as described in Volume 9, Section 2.5.

Table 4.4-1 provides the CO_2 Eq from combustions sources and the landfill under the preferred alternatives (Volume 7, Section 3.3.4) under both construction and operational years.

Table 4.4-1. Preferred Alternatives CO2 Emissions Equivalents (TPY)

Year	*Combustion from Construction*	*Combustion from Operation*	*Landfill*		*Total*
	CO_2	*CO_2*	*CO_2*	*CH_4*	*CO_2 Eq**
2011	16490.5	-	164.4	59.9	18079.4
2012	20317.8	-	571.8	208.4	25474.9
2013	31464.8	-	1194.8	435.5	42131.8
2014	18516.7	-	1903.0	13.9	20915.3
2015	6375.2	52032.2	2900.0	21.1	62363.6
2016	1591.9	52032.2	3664.9	26.7	58422.6
2017 and on	-	52032.2	4055.3 – 8235.0	29.6 – 60.0	57269.9 – 62129.8

Legend: * CO_2 Eq= Combustion CO_2 (1+0.01) + Landfill CO_2 + Landfill CH_4 (GWP of 21)

The alternatives discussed in the Preliminary Final EIS are unlikely to vary substantially in the quantity of CO_2 emissions from stationary and mobile combustion sources and landfill locations. For example, the same amount of construction activities would occur regardless of the different locations (alternatives), resulting in essentially the same amount of GHG emissions. Therefore, the GHG emissions for the different alternatives would be similar to those of the preferred alternatives.

In 2007, the U.S. generated about 7,150 Tg (million metric tons) CO_2 Eq (USEPA 2009b). This total includes emissions from Guam and Tinian, as after 2002 the United Nations no longer reports energy statistics for Guam separately (Marland et al. 2008) and emissions from Tinian were never reported separately. As the U.S. inventory does not provide a baseline for Guam, using the U.S. baseline condition for a comparison is considered appropriate for current conditions. The total maximum quantities of GHG emissions from the preferred alternatives comprise less than 0.00085% of the annual U.S. emissions.

The change in climate conditions caused by GHG resulting from the burning of fossil fuels from both stationary and mobile sources and landfilling is a global effect, and requires that the emissions be assessed on a global scale. Therefore, the disclosure of localized increments has limited or no weight in addressing climate change. The proposed action mainly involves the relocation of the military operations that are already occurring in the West Pacific region; therefore, fossil fuel burning activities in the West Pacific region are unlikely to change significantly. Consequently, overall global GHG emissions are likely to remain near the current level on a regional or global scale under the proposed action, resulting in an insignificant cumulative impact to global climate change. No specific GHG emission mitigation measures are warranted.

4.4.3 Climate Change Adaptation

Climate change is a global issue for DoD. As is outlined in the Quadrennial Defense Review Report (QDR) of February 2010, DoD would need to adjust to the impacts of climate change on our facilities and military capabilities. The Department already provides environmental stewardship at hundreds of DoD installations throughout the United States and around the world, working diligently to meet resource efficiency and sustainability goals as set by relevant laws and executive orders. Although the United States has significant capacity to adapt to climate change, it will pose challenges for civil society and DoD alike, particularly in light of the nation's extensive coastal infrastructure. In 2008, the National Intelligence Council judged that more than 30 U.S. military installations were already facing elevated levels of risk from rising sea levels. DoD's operational readiness hinges on continued access to land, air, and sea training and test space. Consequently, the Department must complete a comprehensive assessment of all installations to assess the potential impacts of climate change on its missions and adapt as required.

The QDR goes on to illustrate that DoD will work to foster efforts to assess, adapt to, and mitigate the impacts of climate change. Domestically, the Department will leverage the Strategic Environmental Research and Development Program, a joint effort among DoD, the Department of Energy, and the Environmental Protection Agency, to develop climate change assessment tools. Abroad, the Department will increase its investment in the Defense Environmental International Cooperation Program not only to promote cooperation on environmental security issues, but also to augment international adaptation efforts. On the Navy operational side, the Office of the Vice Chief of Naval Operations published on May 21, 2010 the Task Force Climate Change Roadmap, which building off the QDR, focuses on the naval operational challenges of a changing climate. Although the document does not address compliance issues, the roadmap also recognizes the need to address sea level rise impacts on infrastructure and real estate through strategic investments and installation adaptation strategies to address water resource challenges.

Guam and the CNMI would have some unique adaptation issues to evaluate and consider. The U.S. Global Climate Research Program (USGCRP) report, "Global Climate Change Impacts in the U.S." reviewed the unique impacts of Climate Change on Islands. According to the report, climate change presents U.S.-affiliated islands with unique challenges. Small islands are vulnerable to sea-level rise, coastal erosion, extreme weather events, coral reef bleaching, ocean acidification, and contamination of freshwater resources with saltwater. The islands have experienced rising temperatures and sea level in recent decades. Projections for the rest of this century suggest continued increases in air and ocean surface temperatures in both the Pacific and Caribbean, an overall decrease in rainfall in the Caribbean, an increased frequency of heavy downpours nearly everywhere, and increased rainfall during the summer months (rather than the normal rainy season in the winter months) for the Pacific islands. Hurricane wind speeds and rainfall rates are likely to increase with continued warming. Island coasts would be at increased risk of inundation due to sea-level rise and storm surge with major implications for coastal communities, infrastructure, natural habitats, and resources.

The report goes on to illustrate that island communities, infrastructure, and ecosystems are vulnerable to coastal inundation due to sea-level rise and coastal storms. Flooding would become more frequent and coastal land would be permanently lost as the sea inundates low-lying areas and the shorelines erode. Loss of land would affect living things in coastal ecosystems. Hurricanes and other storm events cause major impacts to island communities including loss of life, damage to infrastructure and other property, and contamination of freshwater supplies. With further warming, hurricane and typhoon peak wind intensities and rainfall are likely to increase, which, combined with sea-level rise, would cause higher storm surge levels.

4.4.3.1 Climate Change and Impacts on Waterfront Facilities

Until 1900, there was little change in sea level, but during the last century, sea level rose gradually and is currently rising at an increased rate (IPCC 2007). The average rate of sea level rise measured by tide gauges from 1961 to 2003 was 0.071 ± 0.02 inches (in) (0.18 ± 0.05 centimeters [cm]) per year, with an annual increase of 0.12 ± 0.03 in (0.31 ± 0.07 cm) seen between 1993 and 2003, and a total increase of 6.7 ± 2 in (17 ± 5 cm) during the 20th century (Bindoff et al. 2007). This increase is due to thermal expansion (indicating increased heat content) and the exchange of water between oceans and other reservoirs (glaciers, ice, etc.). By the end of this century, sea level is predicted to rise 7-23 in (18-59 cm), with an additional 4-8 in (10-20 cm) rise possible due to the melting of land ice sheets in Greenland (IPCC 2007).

Projections made for Guam indicate that sea level rises of up to 39 in (100 cm) would result in a few low lying areas of Apra Harbor being inundated (DoD and DOE 2010). The Navy acknowledges there is the potential for their existing and future coastal facilities to be adversely affected by sea level rise, inundations from more extreme storm events and other consequences of climate change. However, predictive models on future sea level rise are subject to variability, due in part to unknown future greenhouse gas emissions. The variability increases with the period of time being assessed. Risk assessment methodologies and technologies are being developed to predict the potential impacts of climate change on existing Navy coastal facilities. As new design criteria relevant to climate change are adopted by the Navy, they will be incorporated into project design. Projects in Guam are designed to include tsunami, typhoon, wind, and earthquake conditions. The preferred aircraft carrier wharf deck elevation of 14 ft (4 m) is higher than the adjacent Alpha and Bravo Wharves' elevation of 10 ft (3 m). This elevation was designed to withstand anticipated storm surge events, not sea level rise; however, the design elevation may accommodate a change in sea level if the projected 39 in (100 cm) rise mentioned above is realized (NAVFAC Pacific 2010). The Inner Apra Harbor wharf improvements do not alter the original wharf design; the elevations are not altered. These facilities could be at risk from sea level rise. No mitigation measures are proposed.

No waterfront facilities are proposed on Tinian and no additive impact or risk to waterfront facilities is anticipated.

4.4.3.2 Climate Change and Impacts on Aquifers

The availability of freshwater is likely to be reduced, with significant implications for island communities, economies, and resources. Most island communities in the Pacific and Caribbean have limited sources of freshwater. Many islands depend on freshwater lenses below the surface, which are recharged by precipitation. Changes in precipitation, such as the significant decreases projected for the Caribbean, are thus a cause of great concern. Sea-level rise also affects island water supplies by causing salt water to contaminate the freshwater lens and by causing an increased frequency of flooding due to storm high tides. Water pollution (such as from agriculture or sewage), exacerbated by storms and floods, can contaminate freshwater supplies, affecting public health. The proposed action, specifically the additional population, could have an additive cumulative impact with climate change impacts on aquifer yield.

4.4.3.3 Climate Change and Impacts on Coral Reefs

Coral reefs are particularly sensitive to the impacts of climate change as even small increases in water temperature can cause coral bleaching. As concentrations of atmospheric CO_2 increase, more CO_2 is absorbed at the surface of water bodies. Elevated CO_2 concentrations are resulting in ocean acidification, which changes the chemistry of ocean water, including a decrease in the saturation state of calcium

carbonate. Marine calcifiers, such as corals, use calcium carbonate to form shells, skeletons, and other protective structures and reduced availability of it can slow or even halt calcification rates in these organisms.

The proposed action on Guam, specifically dredging coral communities, would have an additive cumulative impact in conjunction with the climate change impacts on the future health of corals and other marine resources in Guam. Volume 7, Chapter 3, Table 3.3-27 lists the historical dredging projects and their direct impacts on coral. The loss of coral ecosystem due to recently completed and present dredging projects are subject to Section 404 of the Clean Water Act compliance, and compensatory mitigation measures have been proposed to replace the coral, generally in other watersheds. In addition to dredging, there are other potential impacts to marine resources associated with the proposed action (i.e., increased marine recreational use) that would contribute to the cumulative impact; however, mitigation measures such as awareness training could offset these impacts to some degree.

There would be no additive cumulative impact associated with the proposed actions on Tinian.

4.4.3.4 Conclusions

Given these potential climate change impacts to Guam and the CNMI, the following adaptation strategies have been explored for the proposed action. As climate science advances, the DON would regularly reevaluate climate change risks and opportunities on Guam and in the CNMI to develop policies and plans to manage its effects on the DON's operating environment, missions, and facilities. Volume 6, sections 2.1.2 (screening process for renewable energy) and 2.1.5 (energy efficiency impacts) and Volume 8, Chapter 6 (sustainability) discuss renewable energy projects under the proposed action and additional renewable energy opportunities. Managing the national security effects of climate change would require DON to work collaboratively, through a whole-of-government approach, with both GovGuam and the government of the CNMI.

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