Draft

Environmental Impact Statement / Overseas 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: Potential Mitigation, Preferred Alternatives' Impacts, and Cumulative Impacts

November 2009

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Guam and CNMI Military Relocation EIS/OEIS

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

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CHAPTER 1. INTRODUCTION

Volumes 2 through 6 of this Environmental Impact Statement/Overseas Environmental Impact Statement (EIS/OEIS) presented project-specific impacts and 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 intent of this volume is to present a broader perspective of proposed mitigation measures and potential cumulative impacts of the preferred alternatives identified in Volumes 2 through 6.

Chapter 1:

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 or practices that have influenced the resources on both islands since World War II (WWII) is presented to provide historical context for the current environmental setting of each island.

Chapter 2, Overview of Best Management Practices and Mitigation Measures, summarizes the mitigation and best management practices (BMPs) that were proposed in Volumes 2 through 6 of the EIS/OEIS. Mitigation refers to actions that would be taken 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 adaptive management techniques that can 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 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 there are fewer Marine Corps and other Department of Defense (DoD) actions on Tinian, the summary of impacts in that Volume suffices as the summary analysis so a separate summary analysis is not warranted. 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.

The summary of impacts associated with preferred alternatives is compared to no action, which is defined as the affected environment without any of the projects proposed in this EIS/OEIS to support the Marine Corps relocation, Navy transient aircraft carrier berthing and Army AMDTF. The comparison is by resource. 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 such other actions. A cumulative project list was generated for the time period 2011 to 2019. A determination was made whether reasonably foreseeable actions would have an additive effect when combined with the effects of the proposed actions covered in the preferred alternatives. For each resource area with a potential for additive effect, an assessment of severity (e.g., adverse or beneficial and moderate, minor or significant) of 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 Boundary

The island of Guam and the island of Tinian are the geographic boundaries of analyses in Volume 7. They are sufficiently distant from each as to have minimal aggregate effect 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 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 work force.
- Permanent increase in number of military and civilian personnel and dependents on Guam with a transient presence during training on Tinian.
- Increase in number and type of major equipment to support military personnel and operations (e.g., aircraft, ships, amphibious watercraft).
- Increase in number and type of training activities.
- Construction of new and improvements to existing facilities (main cantonment, training, waterfront, airfield, family housing, community support).
- Improvements to existing and 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	Marbo, Yigo, Dededo No. 1, and Macheche-improve existing facilities	-	-
Water	Andersen AFB - new facilities	-	-
Wastewater	Northern District Wastewater Treatment Plant- upgrade existing facilities	-	-
Solid waste	Apra Harbor-Navy landfill- existing facility	-	-
Roadways	Across island - improve existing roadways and few new roadways	-	-

Legend: - = not applicable. 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 development and operation of four firing ranges, all of which are located within the Military Lease Area (MLA). Volume 3 describes the proposed actions. The ranges proposed are as follows:

- Rifle known distance range
- Automated combat pistol /multipurpose firearm qualification course
- Platoon battle course
- Field firing range

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

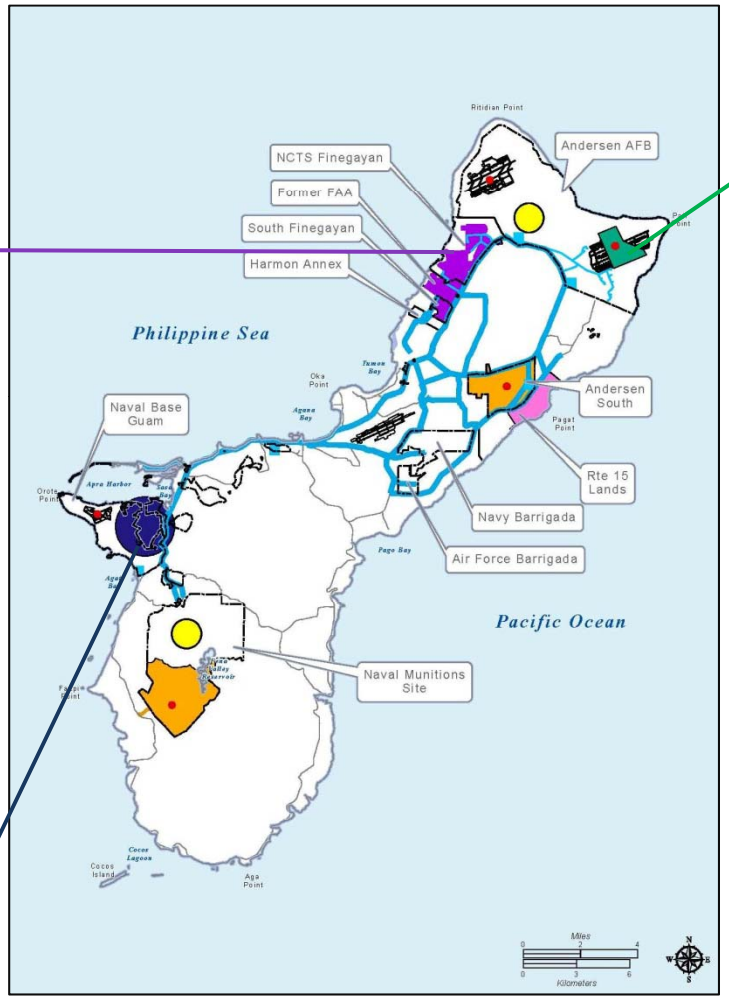
Figure 1.1-1 Overview of Preferred Alternatives on Guam

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

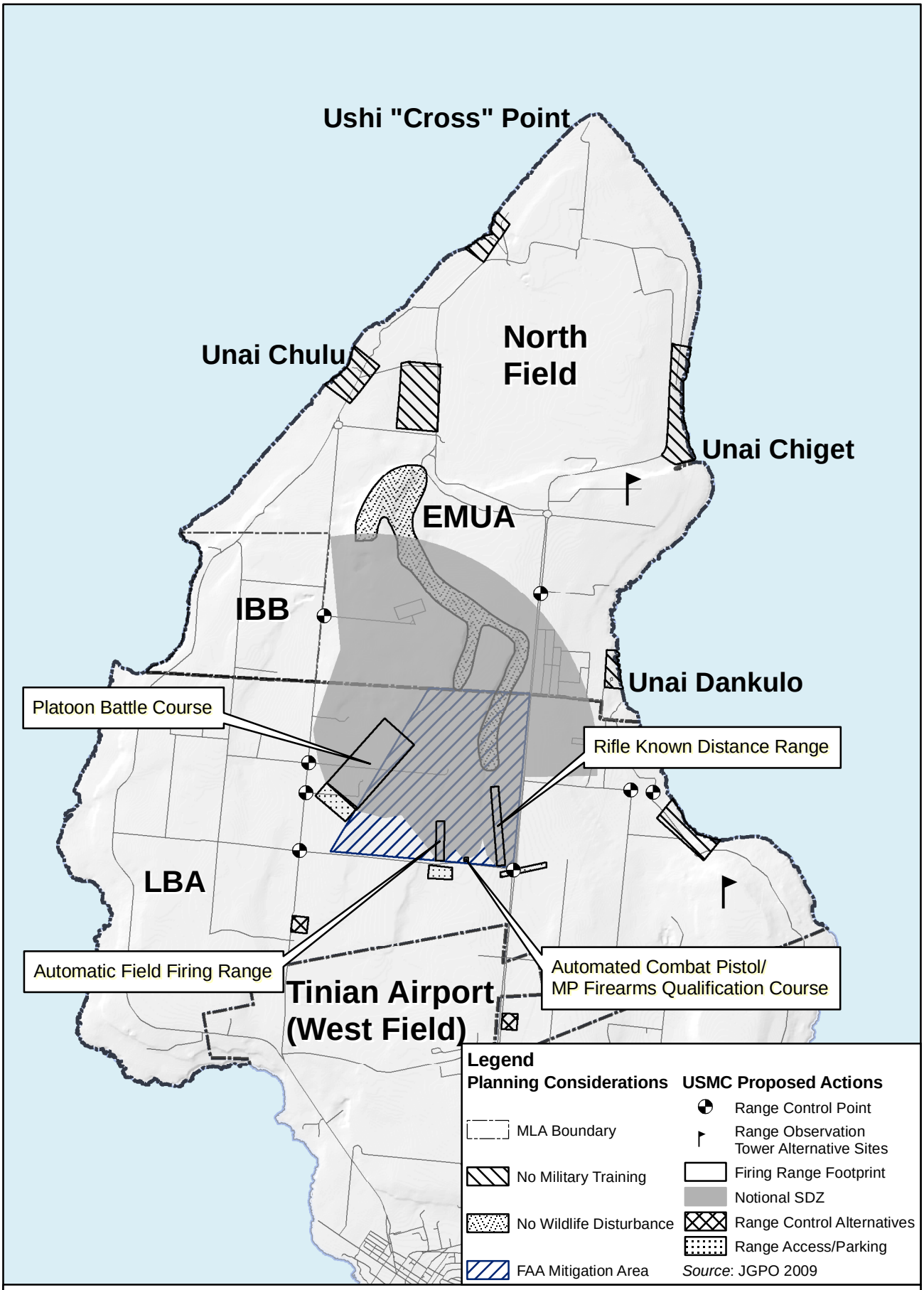


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Figure 1.1-2
Range Training Area Alternative 1

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/OEIS were implemented. The resources would be subject to the same influences (stressors) that they are today. Chapter 3 describes no action by resource. The trends in resources would 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 is 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 Marianas Islands. The island 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, and 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 Oceans, is southwest of Guam at 35,797 feet [ft] (10,911 meters [m]) deep. The highest point in 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 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, 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 on December 8, 1941, hours after the bombing of Pearl Harbor, 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. Although Guam receives no foreign aid, it does receive large transfer payments from the general revenues of the U.S. federal treasury into which Guam pays no income or excise taxes; under the provisions of a

special law of Congress, the Guam treasury, rather than the U.S. treasury, receives federal income taxes paid by local taxpayers including military and civilian federal employees assigned to Guam.

Guam is a popular destination for Japanese tourists. Its tourist hub, Tumon, features over 20 large hotels. It is a relatively short flight from Asia or Australia compared to Hawaii, with hotels and seven public golf courses accommodating over a million tourists per year. Although 75% of the tourists are Japanese, Guam receives a sizable number of tourists from South Korea, the U.S., the Philippines, and Taiwan.

1.3.3 Historical Events with Potential to Affect 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 8.7. On October 30, 1936 (October 29, Universal Time), a magnitude 6.7 shock occurred about 80 mi (125 km) southwest of Guam. Walls were cracked and plaster and tile fell. 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 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 in 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 and 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 possible 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 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 125 mph, which slammed Guam on December 8, 2002, leaving massive destruction. Typhoon Pongsona was the last typhoon of the 2002 Pacific typhoon season, and was the costliest U.S. disaster in 2002 (FEMA 2003). Damage on the island was more than $700 million, making Pongsona among the five costliest typhoons to hit the island. The typhoon was considered by the public to be the worst typhoon to ever strike the island (Kelly 2003).

Typhoon Pongsona maintained a 40-mi (65-km) wide eye upon crossing the northern, populated portion of the island of Guam; Andersen Air Force Base (AFB) was in the eye for two hours. Sustained winds from the typhoon reached 144 mph with gusts peaking at 173 mph; gusts of at least 100 mph affected the entire island. Communications on the island failed due to the winds and the entire island was left without power and phone service. The winds collapsed several walls at the Guam Memorial Hospital, resulting in major damage throughout the northern two-thirds of the facility and several hotels, churches, and schools received moderate damage.

Pongsona produced a storm surge 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-NOAA 2003).

Typhoon Pongsona also left the entire island without electrical power and 65% of the island's water wells inoperable with most of Guam without water service following the storm (FEMA 2003). Officials estimate the typhoon destroyed 1,300 homes, severely damaged 1,825 homes, and lightly damaged 4,800 homes (Gillespie 2002).

Wildfires

Wildfires plague the forested areas of Guam every dry season despite the island's humid climate. Most fires are man-caused 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. 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 leading to water quality problems for southern Guam. Eroded silt also destroys the marine life in reefs around the island. Soil stabilization efforts by volunteers and forestry workers to plant trees have had little success in preserving natural habitats (Neill and Rea 2004).

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 increases in the acreage of badlands (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, an average of over 750 fires was reported annually between 1979 and 2001, burning over 155 mi^2 (401 km^2) during this time period (Burdick et al. 2008). The largest fires (>1,000 acres [ac] {405 hectares [ha]}) during 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: Territory Of Guam Fire Assessment, 2004.

Invasive Species

An invasive species is often defined as an introduced species that has spread 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 World War II, 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 (Mehrtens 1987, Fritts and Leasman-Tanner 2001). As a result of abundant prey resources on Guam and the absence of natural predators outside of feral pigs and mangrove monitors, BTS populations reached unprecedented numbers (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, the snake 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).

The disappearance of birds on the island followed the advancing high densities of snakes. 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 species of birds 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, 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 flying fox, a crucial species for the pollination and seed dispersal of tropical trees. Also, without the presence of certain avian insectivores, the insect population may experience a population boom and therefore negatively impact 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 large-scale electrical power outages and damages to equipment. 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 United States. 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 inland 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 distributed throughout Asia and the Western Pacific including 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.

Adults are the injurious stage of the insect. 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 palms where spears are narrower. Mortality of young palms has already been observed on Guam.

Control measures have been developed for CRB and the current strategy on Guam is to implement an integrated eradication program using pheromone-baited, attractive traps to capture adults, various methods to eliminate infested and susceptible host material, and pesticides to kill larvae and adults. Pesticides may also be applied to un-infested trees as a preventive treatment. The eradication program is a cooperative effort between USDA (Neill and Rea 2004), GDA and the University of Guam (UOG). A joint initiative between Guam Customs & Quarantine Agency (trains detector dogs and their handlers), Guam Department of Agriculture (employs CRB detector dog handlers) and the UOG College of Agriculture (provides CRB Detector Dog program funding) is underway to implement the nation's first CRB Detector Dog Program. This program would provide enhanced capability and capacity to the CRB

eradication program to help reduce the overall CRB population on the island of Guam and prevent it from spreading to the outer islands.

Tinangaja

Invading 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 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). Much of Guam's foliage was lost during World War II. 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 being 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 Navy has funded this conservation project and provided access to their lands in northern Tinian for implementing this important 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 comprises 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 supporting live coral colonies surround most of Guam. The bordering fringing reefs in the south are broader than in the north. The width of these reefs ranges 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, Hagatiia, 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 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 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. Guam's primary tourist market is Asia, with the majority (70-80%) of tourists arriving from Japan (Burdick et al. 2008).

The Government of Guam established five marine preserves: Tumon Bay, Piti Bomb Holes, Sasa Bay, Achang Reef Flat, and Pati Point. The preserves were established in 1997 as a response to decreasing reef fish stocks, but were not fully enforced until 2001. Fishing activity is restricted in the 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 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, greater than 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
- 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. 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.

1.3.3.2 Key Anthropogenic Events Affecting the Ecology of Guam

Historical events, most notably WWI, 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.

During WWII, Guam was invaded by the Japanese armed forces shortly after December 8, 1941. 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, however, and were hidden by the Chamorro people.

The Battle of Guam began on July 21, 1944 with American troops landing on the western side of the island after several weeks of pre-invasion bombardment by the U.S. Navy. After several weeks of heavy fighting, Japanese forces officially surrendered on August 10, 1944.

Guam was subsequently converted into a forward operations base for the U.S. Navy and 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.

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.

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).

1.4 HISTORICAL PERSPECTIVE - TINIAN

The proposed actions to be undertaken to develop or expand military facilities on the island of Tinian, Commonwealth of the Northern Marinas (CNMI) to support the relocation of Marines from Okinawa and other Defense units would result in substantial changes to the natural and built environments of these islands.

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

1.4.1 Location and Brief History

Tinian is about 5 mi (8 km) southwest of its sister island, Saipan, from which it is separated by the Saipan Channel. It has a land area of 39 mi^2 (101.01 km^2). Together with uninhabited neighboring Aguijan Island (2.74 mi^2, or 7.09 km^2), it forms the Tinian municipality, one of the four constituent municipalities of the Northern Marianas. The total area of the municipality is 41.74 mi^2 (108.1 km^2). Tinian's largest village is San Jose.

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. During the war, six airstrips were constructed on Tinian and two more on Saipan to accommodate the B-29 aircraft (NCDC 2003). 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.

1.4.2 Tinian Today

With a small resident population, Tinian relies heavily of tourism. Facilities on the island include the Dynasty Hotel, which includes a luxury hotel, a casino, shops and restaurants and is adjacent to Tachogna and Taga Beaches. The village of San Jose has several smaller hotels and restaurants and bars. The airport is small and served by two airlines, Freedom Air, which operates daily scheduled flights, and Star Marianas Air, which operates by charter. There is also ferry boat service twice daily between Tinian and Saipan. The island also has the only intact Shinto shrine on the Mariana Islands (Pacific Wrecks 2009).

1.4.3 Historical Events and Occurrences Affecting the Ecology of Tinian

1.4.3.1 Key Natural Events

Earthquake

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 sometimes 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 Dec 8, 2002 also struck Tinian with sustained winds of 78 mph with a gust to 85 mph. The combination of winds and other effects from the typhoon destroyed 114 houses, severely damaged 154, and caused minor damage to 306; on the island, about 200 families were left homeless. The typhoon produced a storm surge of 22 ft (6 m) at Songsong Village, which crossed about 80% of the southwestern peninsula on Rota. The surge caused moderate beach erosion on the island, and destroyed a fuel pier and a loading pipeline. Additionally, the typhoon caused severe crop damage on the island. In all, the typhoon caused ten minor injuries on Rota, and resulted in over $30 million in damage (2002 USD) (FEMA 2003).

On Tinian, the passage of Super Typhoon Pongsona destroyed two homes; seven received major damage and another eight sustained minor damage. 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 Commonwealth of the Northern Mariana Islands. 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 both 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, USFWS removed Endangered Species Act (ESA) protections for this forest bird that is native to Tinian. Because of the threat of the BTS becoming established on Tinian, USFWS will continue to monitor the status of the species for at least five years (Foote 2004).

Fadang Tree

The UOG has completed the establishment of a conservation planting of Guam's endangered fadang tree on the island of Tinian. The Navy has funded the entire project and provided access to their lands in northern Tinian for implementing this important 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 in 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 which had a flying range equal to the distance from Saipan, Tinian and Guam 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 could be found 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 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 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 there. Essentially, the Navy controls all land uses within the leased area. Any non-military uses within the leased area must be approved by the Navy. 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 not being used for military training. Navy uses of the EMUA include both small and large 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 Navy 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 Navy 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 judged by the Navy to be compatible with long-term DoD needs, primarily grazing and agriculture.

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.

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CHAPTER 2.
OVERVIEW OF BEST MANAGEMENT PRACTICES AND MITIGATION MEASURES

This chapter presents an overview of all Best Management Practices (BMPs) and mitigation measures discussed in Volumes 2 through 6 of this EIS/OEIS. BMPs are management actions implemented as part of Department of Defense (DoD) policies or standard operating procedures to comply with local, state or federal regulations to ensure environmental protection. BMPs are not considered mitigation procedures because they are ongoing, regularly occurring practices. BMPs from Volumes 2 through 6 are summarized in this volume.

Mitigation refers to actions implemented to avoid, minimize, rectify, reduce/eliminate, or provide compensation for a significant impact tan alternative. In 40 Code of Federal Regulations (CFR) 1508.20, the Council on Environmental Quality (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.

Mitigation measures for the selected alternative will be identified in the Record of Decision (ROD). Mitigation measures identified in the ROD will be funded and efforts to ensure their successful implementation will be treated as compliance requirements and tracked as part of the Navy's post-ROD monitoring plan. Potential mitigation measures are identified and presented in Volumes 2 through 6 of this EIS/OEIS and are summarized and further discussed in this volume.

2.1 BEST MANAGEMENT PRACTICES (BMPS) ON GUAM AND TINIAN

For the purposes of this EIS/OEIS, BMPs are management actions that are implemented by the Navy on an ongoing basis as part of standard operating procedures. BMPs are considered in the impact analysis because they would provide for ongoing environmental protection. This section provides a summary of potential BMPs that may apply to protection of geologic, biologic and water resources, and human resources (i.e., public education and outreach and environmental justice). These BMPs are followed during construction and operations by the DoD and are embedded in their numerous policies and orders. Table 2.1-1 provides a summary of the potential BMPs regarding when or where they might be applied and the resources they are designed to protect. Following the table is a discussion of the plans or policies where the BMPs are included.

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

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
1	Erosion Control	A range of BMPs are proposed to control erosion during construction and operations to eliminate and/or minimize nonpoint source pollution in surface waters due to sediment. Erosion control BMPs include the following 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 should 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 haybales; barriers that intercepts 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 should be covered during times of inclement weather. • Stockpiling of any excavated materials should occur 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).	X	X	X	X	X	X	X

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
		• 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). **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). • Control the carabao population (through hunting, etc.) in order to prevent soil erosion by feral ungulates. • Siting training locations (locate ground disturbing training activities on previously disturbed sites whenever possible). • Monitor erosion and drainage (monitor erosion and drainage at select locations). • Place a buffer zone of vegetation around sinkholes to prevent further erosion or expansion.							

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
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 procedures include: • 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). • 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
3	Stormwater Management under the CWA: Stormwater Pollution Prevention Plan (SWPPP)	• Facilities would be required to comply with the SWPPP during day-to-day operations to ensure that stormwater remains free of contaminants. • A SWPPP is a self-implementing plan for compliance with an installation's stormwater permit. It requires development of pollution prevention measures to reduce and control pollutants in stormwater discharge. • 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

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
4	Water Quality Monitoring Plan (WQMPs)	• 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
5	BioSecurity Plan	The Navy has provided funding for a biosecurity plan. A comprehensive biosecurity plan details procedures to minimize the risk of the spread of invasive species. For example, a successful biosecurity plan for Guam and Tinian would identify required components of a brown tree snake (BTS) containment program (such as traps, toxicants, working dogs, and hand capture) based on a risk assessment. A *Micronesian Biosecurity Plan* is being developed in cooperation with regulatory agencies The plan would include design, installation, and operational processes to prevent BTS and other invasive species from passing through entry and exit points at Guam and Tinian.	X	X			X	X	
6	Leadership in Energy and Environmental Design (LEED) Certification	Current Navy/Marine Corps policy pursues and facilitates LEED 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, reuse/recycle a minimum of 10% recycled content. • Alternative transportation. • Increased water efficiency. • Renewable energy. The sustainability/LEED initiatives will reduce potable water use and should have	X	X	X	X	X	X	X

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
		an effect on wastewater demand.							
7	Low Impact Development (LID)	The Navy could implement LID design technology to make use of innovative methods to capture stormwater that would otherwise flow into nearby watersheds. 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. • Native plant landscaping. • Avoidance of pesticides and fertilizers. • Bio-retention strips.	X	X	X	X	X	X	X
8	Energy Policy Act of 2005 (EPACT)	EPACT 2005 compliance includes analysis and life cycle cost analysis using a simulated model and the following energy conservation measures: • Buildings shall achieve an energy consumption level that is 30% below the level achieved by ASHRAE Standard 90.1. • Energy consuming products shall be either Energy Star-qualified or FEMP-recommended. • Optimize building orientation to reduce cooling loads or energy loads to cool the buildings • Optimize building insulation • Seal building envelope for air tightness • "Cool roof" • Use motion detectors to reduce lighting and to setback cooling in unoccupied buildings • Natural lighting							
9	Water Conservation	Implementation of a water conservation plan measures include: • Low-flow faucets	X	X		X			

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
	Plan	• 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). • Use of water softeners only as needed. • Use of wastewater recycling in industrial washing and rinsing of aircrafts 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 significantly improving the ability to quickly identify leaks and take corrective action. • Education of military population regarding practices that would conserve water (including full-load clothes washing).							
10	Hazardous Waste Management Program (HWMP)	HWMP includes waste minimization plans that provide protocols designed to encourage and promote the efficient use of hazardous substances, substitute products that are less toxic whenever feasible, minimization of their use, and promote recycling and reuse of hazardous substances. HWMPs include the following recommendations: • Update and implement the existing HWMP to include procedures for the transportation, storage, use, and disposal of hazardous waste. • DoD personnel training regarding facility-specific hazardous waste plans • Housekeeping protocol (improving overall hazardous waste housekeeping practices, keeping area free of trash, keeping area swept, wiping up spills, etc.) • Project hazardous waste disposal as it relates to operational requirements. • Using the Defense Reuse Marketing Office's capacity for hazardous	X	X					X

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
		substance storage, transportation, and disposal capacity prior to any expected increases • Ensure all federal, local, and DoD laws and regulations are being observed (i.e., inspection and surveillance); implement corrective actions as necessary. • Contractors would be required to manage, store, and dispose of hazardous wastes in accordance with applicable USEPA, RCRA, and HSWA requirements. • Contractors would be required to dispose of all petroleum, oil and lubricants (POL), polychlorinated biphenyls (PCBs), asbestos containing material (ACMs), and other hazardous substances in accordance with Guam Environmental Protection Agency (GEPA) regulations. • Contaminated topsoil removed from the site should be properly disposed of in an approved landfill in accordance with applicable regulatory requirements.							
11	Spill Prevention Control and Counter-measures Plans (SPCC) and Facility Response Plans (FRP)	• 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. • Fuel transfers (petroleum transfers would be kept away from water bodies, and a contingency plan would be in place in the event of any petroleum spills). • Labeling (ensure proper labeling of all hazardous substance containers to prevent contamination). • Contaminant migration control (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).	X	X	X	X	X	X	X

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
		• Ensure that contaminants (i.e., oils, greases, lubrication fluids for heavy equipment) are properly stored at work sites and temporary construction staging areas to avoid spills 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 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). •							
12	Hazardous Materials Management Plans (HMMP)	HMMP would describe implementation procedures for the transportation, storage, use, and disposal of hazardous materials. HMMPs would contain the following procedures: • Hazardous substance 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 (ensures DoD personnel and contractors 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). • Perform all vehicle maintenance activities off the training range at existing DoD maintenance shops. • Implement routine firing range clearance operations (e.g., annually or as	X	X	X	X		X	X

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
		needed) to mitigate munitions and explosives of concern (MECs). • Implement land use controls, fencing, signage, and other means to ensure no unauthorized access to the firing ranges.							
13	Munitions and Explosives of Concern	• Reduce the potential exposure to unexploded ordnance (UXO), through surveys to identify and remove ordnance from the work site. Work would be conducted by qualified UXO specialists prior to the start of construction. • 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
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). • Minimize land acquisitions. • Install utilities in existing corridors to the extent possible. • Avoid the acquisition of public facilities, such as park land (FHWA), to the extent practical.	X		X	X	X		
15	Natural Resource Management (Terrestrial and Marine Biology)	Terrestrial: Numerous measures are currently implemented and will continue to reduce impacts to terrestrial biology, such as the following: • 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.	X	X			X	X	

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
		• BTS interdiction and control measures are implemented by a 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 swiflet caves. The Navy has been contracting with USDA Wildlife Services to trap BTS at the swiftlet caves. BTS are also trapped in housing areas. • Use the minimum lighting necessary to comply with navigation rule and best safety practices aboard vessels at sea. • Sea Turtle protections (see marine biology BMPs for other protection measures). During the period of nighttime dredging activities, observers would monitor the beaches and look for recent turtle tracks and signs of nesting activity. If a nest is observed, the area would be photographed and marked, and the date and location recorded. Any activity that resulted, or might result in disturbance to the nesting or hatching, would be halted. Marine Biology: Sea Turtles: Navy would consider the following NOAA-recommended lighting and construction BMPs to minimize potential impacts on sea turtles: • Employ avoidance and minimization measures, including performance of a visual sweep of the project area prior to commencing in-water activities, if green turtles are seen, in-water activities would not commence until 15 minutes has passed or the animal has moved out of range, a ramping up of increased intensity in noise would be required during pile driving and dredging work allowing undetected animals to							

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
		voluntarily depart the area. • Inform construction personnel of the protected nature of these animals and procedures that should be implemented should a sea turtle enter a construction area. For example, if a dredge-related tug, barge or scow vessel operator sees that the vessel is approaching a sea turtle, the speed would be reduced, the boat would be turned, or other actions would be taken to avoid the turtle. • Avoid the use of artificial lighting near beaches, where possible, particularly during nesting and hatching seasons. • Shield or redirect lights to reduce as much as possible the amount of light that can be seen from the nesting beach. • Use low-intensity light sources, where possible, that emit long wavelength light (yellow, red) and avoid sources that emit short wavelengths (ultraviolet, blue, green, white). • Use minimum lighting necessary aboard dredge-related tug, barge or scow vessels at sea to comply with navigation rules and best safety practices. • Deploy silt curtains as part of the turbidity BMPs during dredging operations; however, precautions would be taken to ensure that curtains do not encircle turtles when put in place. If a turtle should enter the silt curtain area, work would be halted and the curtain lowered until the turtle voluntarily leaves the area. • Observers would be present during dredging operations specifically for sea turtle identification. If a sea turtle is sighted near any project activity and deemed that the activity could potentially adversely affect the sea turtle, the action would be suspended or modified to avoid any adverse effect. • Remove construction-related materials that may pose an entanglement hazard from the project site if not actively being used.							

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
		• Anchor lines from construction vessels would be deployed with appropriate tension to avoid entanglement with sea turtles. Other marine biology BMPS: • Maintain constant vigilance for the presence of ESA-listed species. • Alter course of vessels to remain at least 100 yards (yd) (91 m) from sea turtles and at least 50 yd (46 m) from other protected species. • Reduce vessel speed to 10 knots or less when piloting vessels in the proximity of marine mammals. • Reduce vessel speed to 5 knots or less when piloting vessels in areas of known or suspected turtle activity. • Avoid encircling or trapping marine mammals and sea turtles between multiple vessels or between vessels and the shore. • Do not attempt to feed, touch, ride, or otherwise intentionally interact with any protected species.							
16	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 you observe what may be MEC. • Promote public meeting announcements by posting ads in multiple places. • Provide public meeting written materials translated in Chamorro and Filipino, supply and 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).	X		X		X	X	X

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
		• Mail announcements of public meetings to more rural areas in the south (i.e. Agat and Talofofo). • Hold public meetings in the southern region in accessible locations to as many people in that region as possible (public transportation may not be available in all rural areas). • Educate residents about the significance and danger of sinkholes.							
17	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: • 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, stream channels, etc.) should result from project-related 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. • Provide advanced public notice of dredging activities to minimize	X	X	X	X	X	X	

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
		conflicts with commercial shipping and recreational boating. • Additional ship traffic should be addressed through scheduling and communications between Port Operations and contractors.							
18	Transportation Federal Highway Administration -(FHWA) specific	Roadway project construction BMPs include the following recommendations: • Individual roadway projects should be designed and constructed in accordance with 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	X		X	X	X		X

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
		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)							
19	Noise Abatement	Noise abatement measures may include the following: • Reduction of construction noise impacts to nearby residences may include project sequencing or temporary (or permanent) sound walls. Berms could be built behind and adjacent to the live-fire training ranges. • Equipment noise control (roadway construction): o Ensure that all equipment items have the manufacturers' recommended noise abatement measures, such as mufflers, engine enclosures, and engine vibration isolators, intact and operational o Inspect all construction equipment at periodic intervals to ensure proper maintenance and presence of noise control devices (e.g., mufflers and shrouding) o Turn off idling equipment. Administrative measures (roadway construction) should include the following: • Implement a construction noise monitoring program to limit impacts. • Plan noisier operations during times of reduced receptor sensitivity. • 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 impulse 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						
20	Utilities	For roadway projects, planning and continued coordination with utility providers during the preliminary engineering and final design, and construction stages of the	X						

Item	*BMP*	*Description*	*Activities*		*Geological Resources*	*Water Resources*	*Terrestrial Biological Resources*	*Marine Biological Resources*	*Hazmat Resources*
			Construction	*Operation*					
		project should minimize or eliminate interruption in utility service to customers. • Where feasible, utility relocations should be undertaken prior to roadway construction activities.							

Stormwater Management under the Clean Water Act (CWA). The CWA established the National Pollution Discharge Elimination System (NPDES) Stormwater Program, which addresses three types of stormwater discharges:

- Municipal Separate Storm Sewer Systems (MS4s) - Operators of large, medium and regulated small MS4s may be required to obtain authorization to discharge stormwater.
- Construction Activities - Operators of construction sites that are 1 ac (0.4 ha) or larger (including smaller sites that are part of a larger common plan of development) may be required to obtain authorization to discharge stormwater under an NPDES construction stormwater permit. As the USEPA is the permitting authority in Guam, operators must meet the requirements of the USEPA's Construction General Permit (CGP) (i.e., The Island of Guam Permit No. GUR100000).
- Industrial Activities - Industrial sectors may require authorization via an NPDES permit for Stormwater Discharges from Industrial Activities. The USEPA is the permitting authority in Guam, therefore operators must meet the requirements of USEPA's Multi-Sector General Permit (MSGP) (i.e., The Island of Guam Permit No. GUR050000).

The MS4 Program contains elements called minimum control measures that result in a significant reduction in pollutants discharged into receiving waters. These minimum measures are often summarized in a stormwater management plan and include:

- Public Education/Outreach and Participation/Involvement - Describes BMPs that involve the public in developing, implementing, and reviewing MS4 management programs and describes ways to reduce stormwater pollution.
- Illicit Discharge Detection and Elimination (IDDE) - Describes BMPs for identifying and eliminating illicit discharges and spills to storm drain systems.
- Construction Site Runoff Control - Describes BMPs for MS4s and construction site operators to address stormwater runoff from active construction sites.
- Post-Construction Runoff Control - Describes BMPs for MS4s, developers, and property owners to address stormwater runoff after construction activities have ended.
- Pollution Prevention/Good Housekeeping Fact Sheets and Webcasts

NPDES permits (both construction and industrial activity) require the development of a SWPPP. With respect to construction activity, the SWPPP is a site-specific, document that identifies potential sources of stormwater pollution at the construction site, it describes practices to reduce pollutants in stormwater discharges from the construction site (reduction of pollutants is often achieved by controlling the volume of stormwater runoff, e.g., taking steps to allow stormwater to infiltrate into the soil), and identifies procedures the operator should implement to comply with the terms and conditions of a construction general permit. With respect to industrial activities, the SWPPP identifies the industrial activities conducted at the site, describes any structural controls or other practices which the industrial facility operator will implement to prevent pollutants from making their way into stormwater runoff, and provides descriptions of other relevant information (e.g., the physical features of the facility, BMPs, and procedures for spill prevention, conducting inspections, and training of employees). The SWPPP is intended to be a “living” document, updated as necessary; when industrial activities or stormwater control practices are modified or replaced, the SWPPP is similarly revised to reflect these changes.

Stormwater Pollution Prevention Plan. The SWPPP is a self-implementing plan for compliance with an installation's stormwater permit. It requires development of pollution prevention measures to reduce and control pollutants in stormwater discharge. Its schedule of activities, prohibition of practices, maintenance procedures, management practices, and engineering controls are intended to prevent or reduce pollution into receiving waters.

Water Quality Monitoring Plan. WQMPs evaluate the effectiveness of different environmental permits and/or performance standards. These monitoring plans are formulated to identify ambient or control conditions at a particular site, and to 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, to measure failure to laboratory or field analysis of chemical and biological effects on water quality or organisms (acute/chronic bioassay), and are dependent on a given water resource. WQMPs always include procedures for reporting results and observations to the GEPA and provisions for corrective actions. Water quality monitoring is a standard requirement for all dredging, industrial point source discharges, municipal wastewater treatment plant discharges, thermal discharges, marine and underwater construction activities, aquaculture effluent discharges, and mass clearing and grading projects.

Leadership in Energy and Environmental Design (LEED) Certification. Current Navy/Marine Corps policy is to pursue and facilitate LEED Silver certification for bases. LEED is a voluntary point system tool that measures the degree of sustainability features incorporated into a development. Examples are included in Table 2.1-1.

Low Impact Development (LID). LID is a design technology that makes use of innovative methods to capture stormwater that would otherwise flow into nearby watersheds. Reducing stormwater runoff from Navy installations helps reduce the level of contaminants, such as metals and nutrients that end up downstream, resulting in a cleaner, safer environment, and improved water quality. LID represents a cost-effective method of reducing the environmental footprint of Navy and Marine Corps installations and activities, using a combination of retention devices and vegetation to allow stormwater to be retained and managed at the source, rather than relying on downstream efforts to control the flow of water and contaminants.

As part of this EIS/OEIS, the Navy is preparing a stand-alone Low Impact Development (LID) study and a comprehensive drainage study to determine stormwater runoff quantities and qualities under the action alternatives. These two studies and the USEPA (2009b) BMP Performance Tool will be used to identify and implement the LID plan by utilizing a variety of natural and built features that reduce the rate of runoff, filter out pollutants, and facilitate the infiltration of water into the groundwater basins. This LID planning will ultimately provide the foundation for the basis of design for permanent stormwater infrastructure.

Reduced Use of Water. DoD entities are required to reduce demand for indoor water by as much as 30% and outdoor water use by 50% in the coming years. Water resource sustainability is addressed in two categories: minimize water demand from groundwater sources, and maximize quantity and quality of groundwater recharge resulting from stormwater runoff. Elements identified to achieve minimum water use are:

- Water conservation - identify and specify appropriate minimum water demand fixtures and devices
- Irrigation - minimize use of irrigation systems and water

- Grey water use - evaluate options for use of grey water for irrigation
- Rainwater harvesting - investigate harvesting, storage and distribution systems

Biosecurity Plan. The U.S. Navy is providing leadership on the issue of biosecurity. Actions that prevent or control invasive species support the Executive Order 13112; Endangered Species Act of 1973 (16 U.S.C. 1531 *et seq*.), as amended (ESA); National Invasive Species Act of 1996; Brown Tree Snake Control and Eradication Act of 2004; Sikes Act (16 U.S.C. 670a *et seq*.); Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. 1855); and the Animal Damage Control Act of 1931, as amended (46 Stat. 1486; 7 U.S.C. 426-426c). Further instructions are found in DOD 4500.9-R (Chapters 505 and 506) and COMNAVMARIANASINST 5090.10A.

The U.S. Navy is collaborating with various agencies to develop a large scale Micronesia Biosecurity Plan (MBP). Experts from National Invasive Species Council, U.S. Fish and Wildlife Service(USFWS), U.S. Department of Agriculture, Guam Division of Aquatic and Wildlife Resources(GDAWR), Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife, and other interested parties will develop an approach to integrate techniques involving exclusion, detection, eradication, and control of non-native and invasive organisms that can be readily implemented into Standard Operating Procedures (SOPs), covering routine logistical and movement matters, training instructions for operational forces, and specific measures for construction projects implementing the proposed actions. This comprehensive plan will identify and prioritize hazards and risks for species, pathways, and vectors which could include, but are not limited to, nuisance and noxious species, construction equipment, personal protective equipment, foot traffic, vehicles and vessels, and shipping material. Among the tools that will be used in the analysis of underlying risks is an internationally recognized Step Hazard Analysis and Critical Control Point (HACCP) planning method (ASTM E2590-08) for reducing or eliminating the spread of unwanted species. HACCP and other instructions will be implemented for projects included in this EIS/OEIS.

Pursuant to the ROD which implements the proposed actions, DoD will seek resources to implement management actions identified in the biosecurity plan that will reduce the risk of introduction and spread via DoD activities, including Guam and Tinian.

2.2 POTENTIAL MITIGATION ON GUAM AND TINIAN

Implementing the proposed actions from each volume of this EIS/OEIS would result in impacts to various resources either during construction or from steady-state operations after construction. This section discusses the potential mitigations that could be undertaken to reduce the impacts from either of these two activities. Generally, mitigation discussed in this EIS/OEIS falls within two categories:

- Mitigation 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 on non-DoD land.
- Mitigation 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.

Examples of both DoD controlled mitigation and non-DoD controlled mitigation that would avoid, minimize, replace, or compensate impacts if implemented by Navy or non-DoD agencies are included in Table 2.2-1. Reasonable alternatives were developed based on a consideration for avoiding and minimizing potential impacts as a result of implementing the proposed alternatives.

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

Potential Mitigation Measure		*Volume*				
		2	*3*	*4*	*5*	*6*
Geological and Soil Resources – No mitigation measures						
Water Resources – Within DoD Control						
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. Types of mitigation are: wetlands creation, restoration, enhancement or preservation.	X	X			
WR-2	Implement an in-stream monitoring program.	X				
WR-3	Attempt to avoid impacts to potentially jurisdictional cave and pool systems; if avoidance is not possible, minimize potential impacts.	X				X
WR-4	Sections 401 and 404 of CWA require certain procedures be followed to prevent short term and localized impacts of re-suspended sediments. Dredging is regulated under Section 10 of the Rivers and Harbors Act. Mitigation measures may include: • Physical barriers (such as silt curtains, bubble curtains) and no barge overflow during dredging • Dredging within seasonal windows to avoid impacts to coral, • Dredging rate limitations • Water quality monitoring	X		X		
WR-5	A Floodplain Evaluation is required under the National Flood Insurance Program (23 CFR 650, Subpart A Section 650). Measures to mitigate floodplain impacts could include: • Channel widening, channel lining, channel re-contouring • Pier placement/reconfiguration • Utility line relocation where utilities cause obstructions to flow • Debris removal, incorporation of debris noses upstream of piers and wingwalls	X				X
Air Quality – Refer to Utilities' mitigation						
Noise (Human Receptors) – No mitigation measures						
Airspace – No mitigation measures						
Land and Submerged Land Use – Within DoD Control						
LU-1	Negotiate long-term leases instead of purchase of non-federally controlled land.	X		X		
Land and Submerged Land Use – Outside DoD Control						
LU-2	Revise community plans to address proposed DoD land uses. May include buffers around federal-controlled property.	X				
Recreational Resources – Within DoD Control						
RR-1	Prepare a Recreational Carrying Capacity Management Plan that addresses recreational user use, demand, preference, conflicts, and conditions.	X				
RR-2	Offer resources in forms of time and donation or use of equipments to assist the volunteer conservation officer (VCO) at Andersen AFB.	X				
RR-3	Collaborate with the GDAWR to establish outreach programs and docent programs for the five marine preserves and other environmentally sensitive areas on Guam.	X				
RR-4	Marine Corps to provide for improvement and maintenance of Tanguisson Beach, along with the management of the coastline to the north of Hilaan that contains significant natural, cultural, scenic, and recreational resources.	X				

Potential Mitigation Measure		*Volume*				
		2	*3*	*4*	*5*	*6*
RR-5	To alleviate impacts to the limited recreational resources at Apra Harbor during carrier visits, provide additional on-base shuttle bus and taxi services to ensure sailors and air men have the ability to access comparable and/or alternate recreational resources off-base			X		
Terrestrial Biological Resources – Within DoD Control						
TB-1	Adopt the Andersen AFB aircraft operations monitoring program and adaptive management strategy for Mariana fruit bats and crows and modify as necessary for project-specific actions.	X				
TB-2	Translocate Guam tree snails at Navy Barrigada to another site on DoD lands after approval by USFWS (not required for preferred alternative).				X	
TB-3	Conduct biological surveys for the Mariana fruit bat and Mariana crow before clearing.	X			X	X
TB-4	Update the COMNAV Marianas Training Handbook with procedures to protect special-status species during project-specific training.	X	X			
TB-5	Use hooded lights on roads associated with the proposed new Andersen AFB access gate, truck inspection station, aircraft staging areas, and magazines.	X			X	
TB-6	Monitor fruit bat roost sites weekly in the project area until 1 year after the construction is completed with increased frequency after typhoon events.	X			X	
TB-7	Place additional restrictions on the use of Haputo beach and ERA.	X			X	
TB-8	Place controls on the use of the access road established for NMS training.	X				
TB-9	No ships would be allowed to enter Sasa Bay at night			X		
TB-10	Update the existing Navy Ungulate Management Plans to include the new lands proposed for training and cantonment areas	X			X	
TB-11	Update the existing Navy Fire Management Plan to include new lands proposed for training.	X	X			
TB-12	Establish high quality habitat with perimeter fencing to exclude invasive animals and for establishment of foraging plots.	X			X	X
TB-13	Install fencing or patrols to prevent poaching.	X			X	
TB-14	Conduct biological surveys for Endangered Species Act- (ESA) listed species before construction clearing		X			
TB-15	Monitor birds using "Tropical Monitoring of Avian Productivity and Survival" survey methodology.		X			
TB-16	Develop and implement a Tinian monarch management plan.		X			
TB-17	Reforest plots to improve habitat.		X			
TB-18	Designate new mitigation areas to compensate for Tinian monarch and other bird habitat loss due to the use of some of the existing designated FAA mitigation area.		X			
TB-19	A survey would be conducted in the Rt. 15 range footprint areas prior to clearing for *Heritiera longipetiolata* with subsequent translocation or propagation if found; mature trees identified in previous studies would not be removed	X				
TB-20	Establish Base policies, instructions, or orders to ensure that cats and dogs are documented and all pets are controlled and not allowed at Haputo ERA	X			X	
TB-21	Monitor the Mariana fruit bat, Micronesian kingfisher, and Mariana crow in areas surrounding demolition, breacher, and small arms training areas to determine potential noise impacts and if this monitoring determined that these species were being affected, techniques to reduce noise generation, such as noise barriers, would be employed.	X				
TB-22	Use Hazard Analysis and Critical Control Point (HACCP) planning for high-risk activities and construction projects.	X	X	X	X	
TB-23	Investigate invasive insect management options for the ESA-listed fire tree	X			X	

Potential Mitigation Measure		*Volume*				
		2	*3*	*4*	*5*	*6*
	and SOGCN cycad.					
TB-24	Establish or expand new ecological reserves and conservation areas	X			X	X
TB-25	Conduct sea turtle natural history studies to better understand the species and benefit long-term military mission planning	X		X	X	
TB-26	Limit construction period if Mariana crows are present during the day. No construction at night to avoid impacts to Mariana fruit bat.	X			X	X
TB-27	Monitor the Tinian monarch and Mariana common moorhen (Alternative 1 only for the moorhen) would be conducted in areas surrounding the ranges to determine potential disturbance impacts and, if impacted, noise reduction techniques would be employed.		X			
TB-28	Conduct additional surveys for the Pacific slender-toed gecko at NCTS Finegayan and, habitat enhancement at NMS if necessary	X			X	
TB-29	Establish greenbelt for watershed protection, wildfire control, and restoration of habitat	X				X
TB-30	Exclusion fencing and foraging plots would be set up for protection of wildlife and special-status species.	X			X	
TB-33	Natural resource awareness briefings would be conducted for construction personnel.	X				
Marine Biological Resources –Within DoD Control						
MB-31	Seasonal dredging prohibitions similar to those EPA suggested for the Kilo Wharf dredging activities.					
MB-32	No ships would be allowed to enter Sasa Bay at night.			X		
MB-33	Dredging/filling in the marine environment would be scheduled to avoid coral spawning and recruitment periods.			X		
MB-34	Provide marine biological resources education and training on Essential Fish Habitat (EFH), Endangered Species Act (ESA) and Marine Mammal Protection Act (MMPA): this may include Base Orders, natural resource educational training (i.e., watching of short Haputo Ecological Reserve Area (ERA) video required before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of *Military Environmental/ Natural Resource Handbook, distribution of natural resource educational materials to dive boat operators*), or a combination.	X		X		
MB-35	Consider a suite of compensatory mitigation project proposals for impacts to coral reef communities: • Artificial reefs • Watershed restoration and management projects (aforestation, enhancement of riparian areas, and stream bank stabilization) • Coastal water resources management (shallow water reef enhancement, upgrade wastewater management systems) • In-lieu fee or mitigation banking program			X		X
MB-36	Increased effort toward ERA enforcement (HAPUTO) and other ESA, MMPA, and EFH policies	X				
Cultural Resources – Within DoD Control						
CR-1	Data recovery of sites • Vol 2, Alternative 2 (preferred):1044, 1046, 1021, 1022, 1023, 1012, 238, 1020, 1024, 1026, 1033, 1034, 1678, 1681, 1063, 1065, T-9-1 and T-9-2 • Vol 2, Alternative 1 and 8 only:1044, 1046, 1021, 1022, 1023, 1012, 381, 1020, 1026, 1678, 1681, 1063, 1065, T-9-1, and T-9-2. • Vol 2, Alternative 3 only: 1044, 1046, 1021, 1023, 1012, 381, 1020, 1026, 1033, 1034, 1063, T-9-1 and T-9-2 • Vol 3, Alternative 1(preferred).Tinian sites: 86th Street, 3FII, 3aII-	X	X		X	

Potential Mitigation Measure		*Volume*				
		2	*3*	*4*	*5*	*6*
	G, 3g-I, 30, and 991 • Vol 3 Alternatives 2 and 3 only. Tinian sites: 30, 33,600, 1040, 942, 944, 985. • Vol 5:1021, 1023, and T-3-1					
CR-2	Update and execute Pagat Preservation Plan for 04-0021 and 04-0022.(All Alternatives).	X				
CR-3	Preservation of 04-0642 and 04-0024 sites. (All Alternatives).	X				
CR-4	Archival research and detailed mapping of 6 architectural resources. (All Alternatives).	X				
CR-5	Preserve site and upgrade sign for 811 (All Alternatives).	X			X	
CR-6	Documentation of site, brochure, signs for 08-007. (All Alternatives)	X				
CR-7	Cultural access would be granted to the Pagat site when Navy procedures are followed.	X				
CR-8	Relocation or curation of 1024 and 1032 (Alternatives 2, 3).	X				
CR-9	Impacts to traditional resources such as the nunu tree, dukduk tree, ifit tree, and da'ok tree, would be avoided if possible.	X			X	X
CR-10	Archaeological monitoring of medium archaeological probability areas during construction in consultation with the Historic Preservation Officer.	X	X		X	X
CR-11	Conduct cultural resources education training of Marines and soldiers to promote protection of sensitive sites. (Alternatives 1 and 3 for Volume 2; Alternative 1, 2 and 3 for Volume 3; all Alternatives for Volume 5)	X	X		X	
CR-12	Provide public educational materials and displays about the National Historic Landmark and the history of Tinian.		X			
CR-13	Avoidance of Mount Barrigada; public education regarding Mount Barrigada. (Alternative 3 for Volume 2 and Alternatives 2 and 3 for Volume 5).	X			X	
CR-14	For post review discoveries an assessment will be made for NRHP eligibility in consultation with the Historic Preservation Office.	X			X	X
CR-15	For areas or properties that have not been inventoried for historic properties, the DoD would record surface sites and, when necessary, areas would also be archaeologically sampled for subsurface sites.					X
CR-16	If NRHP-eligible sites are impacted, data recovery excavations will take place.	X			X	X
Visual Resources – Within DoD Control						
VR-1	Avoid impact by clearing only the areas directly associated with the proposed firing ranges.		X			
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.	X	X			
VR-3	Establish and implement design guidelines for all buildings that are comparable to the Guam archetype (e.g., Spanish – stucco over concrete with stamped tile concrete roofs, muted and earthen color palette).				X	X
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.	X			X	
VR-5	Grade landfill to mimic naturally occurring landform as much as technically feasible.					X
VR-6	Paint all facilities, including the exhaust stacks with neutral colors to blend with the surrounding environment.					X
VR-7	Implement buffer areas around surrounding residential development to decrease impacts of incompatible uses.					X
Visual Resources – Outside of DoD Control						
VR-8	Provide an open railing to the extent possible to provide improved views					X

Potential Mitigation Measure		*Volume*				
		2	*3*	*4*	*5*	*6*
	from bridges.					
VR-9	Develop an Aesthetics and Landscape Master Plan for the island's roadway corridors through a community-based effort that allows direct community input into the design process (i.e., Context-Sensitive Design Solutions).					X
VR-10	Screen utilities from the view on the bridge or adjacent land uses.					X
VR-11	To the extent feasible where roadways are widened, preserve existing trees or stands of vegetation by shifting the roadway alignment.					X
Transportation-Marine – No mitigation						
Transportation – Road – Within DoD Control						
TR-1	On-base roadways: • Mitigation measures for Andersen AFB and the Navy Base may include road widening, restriping, traffic signal and other traffic control devices. Off-base roadways: • No mitigation within DoD control would be required.					X
Transportation – Road – Outside DoD Control (Federal Highway Administration)						
TR-2	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					X

Potential Mitigation Measure		*Volume*				
		2	*3*	*4*	*5*	*6*
	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					
Utilities and Infrastructure – Within DoD Control						
UI/W-1	Develop a Memorandum of Understanding (MOU) to allow DoD to transfer excess groundwater production capacity to Guam Water Authority (GWA) to mitigate for Guam potable water supply impacts (if GWA has a water shortage). Set up additional physical interconnections.					X
UI/W-2	Rehabilitate existing wells that are currently out of service.					
UI/W-3	Carefully monitor the chloride concentrations in the sub-basins and shift pumpage to wells further from impacted sub-basins if high chloride concentrations are detected.					X
UI/W-4	Set up a joint GWA, CCU, and DoD Northern Guam Lens Aquifer (NGLA) advisory panel to include University of Guam [UOG], Water Engineering Resource Institute [WERI].					X
UI/W-6	Utilize a proper rate structure for DoD personnel that will reinforce the need to conserve water.					X
UI/W-7	The construction tempo could be reduced to reduce the peak water use of construction workforce. This is discussed further in Volume 7 under adaptive management.					X
UI/W-8	Incentivize construction to reduce on-island construction workforce requirements by using off-island prefabrication techniques and/or sequencing labor intensive construction activities in such a way to reduce the peak construction workforce needs.					X
UI/P-1	Assist Guam to develop a comprehensive energy management plan for Guam. The plan will focus on reducing the energy footprint of DoD infrastructure, a "Nega Watt" approach and the development of renewable energy sources for Guam. Nega Watt and renewable energy efforts will be coordinated closely with GPA.					X
UI/P-2	DoD will make available to GPA excess power capacity from existing DoD power plants on a case-by-case and as requested basis for periods of off-base high power demand (e.g., peak shaving) .					X
UI/P-3	The Navy could potentially include the following in the construction contracts: • Establish anti-idling requirements for construction vehicles that require vehicles to be shut down if not in use for a set period of time. • Pursue operational agreements that reduce or redirect work or shift times to avoid community exposures when sites are in proximity to vulnerable populations (e.g., schools). • Pursue technological improvements to equipment, such as off-road dump trucks and bulldozers. These could include particulate matter traps, oxidation catalysts, and other devices that provide an after-treatment of exhaust emissions	X				X
UI/P-4	Adding NO_x controls to the Orote power plant would eliminate potential exceedances of PSD SILs (does not apply preferred alternative).	X				X
UI/P-5	Improvements to source physical parameters would be made and/or cleaner fuel types would be used in DoD facilities.	X				X
Utilities and Infrastructure – Outside DoD Control						
UI/W-9	GWA could implement improvements to reduce water losses associated with unaccounted for water (UFW) (i.e., leakage of theft). GWA current					X

Potential Mitigation Measure		*Volume*				
		2	*3*	*4*	*5*	*6*
	UFW reduction plan is 20%.					
UI/W-10	GovGuam could implement control measures such as building permit approvals, to steer development to areas where utilities will be less impacted by induced population growth.	X				
UI/W-11	Through the workforce housing permit approval process, GovGuam could charge development impact fees that would go toward improving the GWA water system.					X
UI/W-12	Accelerate construction of new water supply and/or leak detection and repair to reduce unaccountable water (e.g., leakage or theft) on GWA systems.					X
UI/W-13	Accelerate development of new GWA supply wells and treatment and distribution (T&D) systems.					X
UI/W-143	Import water for industrial or other non-potable uses.					X
UI/W-15	Negotiate a water exchange between the DoD and GWA systems should one have a surplus and one a deficit.					X
UI/W-16	Use temporary small self contained desalination plants (reverse osmosis) to augment water supply, provided regulatory approvals would be received.					X
UI/W-17	GWA could assess system development charges to contractors to meet anticipated demands.					
UI/W-18	Incentivize water conservation on Guam.					X
UI/WW-1	Add chemical coagulants 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 0.8 MGd (2.8 mld) without adverse effects on the North District Wastewater Treatment Plant (NDWWTP). This would be done with advance regulatory approval.					X
UI/WW-2	Inspect and upgrade the collection system to minimize infiltration and inflow.					X
UI/WW-3	The construction workforce housing could be located where a different WWTP would support the wastewater treatment needs. This could reduce the demand at NDWWTP by 1.47 MGd (5.55 mld). This one mitigation would reduce the peak flow to the NDWWTP to 11.3 MGd (42.7 mld), within the design capacity of the NDWWTP. DoD does not control where this workforce housing would be established. This is in control of GovGuam through the permitting process					X
UI/P-6	Energy Policy Act of 2005 compliance measures include: • Energy conservation: o Buildings shall achieve an energy consumption level that is 30% below the level achieved by ASHRAE Standard 90.1 o Energy consuming products shall be either Energy Star - qualified or FEMP-recommended. o Optimize building orientation to reduce cooling loads or energy loads to cool the buildings o Optimize building insulation o Seal building envelope for air tightness o "Cool roof" o Use motion detectors to reduce lighting and to setback cooling in unoccupied buildings o Natural lighting • Energy compliance analysis and life cycle cost analysis using a simulated model					X
UI/P-7	Air quality improvement measures:					X

Potential Mitigation Measure		*Volume*				
		2	*3*	*4*	*5*	*6*
	• Guam Power Authority(GPA) could develop and implement a Traffic Management Center to monitor traffic flow and congestion. Implement the addition of pollution control equipment to reduce emissions at the combustion turbine facility. Establish speed limit enforcement off DoD property create of buffer zones between new or expanded road alignments and areas of vulnerable populations. • Burn low sulfur diesel fuel in the Combustion Turbines (CT) • Provide the option of using low sulphur diesel fuel for construction and highway vehicles • As construction vehicle engines typically idle when not in use, establish anti-idling requirements for construction vehicles that require vehicles to be shut down if not in use for a set period of time. • Pursue operational agreements that reduce or redirect work or shift times to avoid community exposures when sites are in proximity to vulnerable populations (e.g., schools). • Pursue technological improvements to equipment, such as off-road dump trucks and bulldozers. These could include particulate matter traps, oxidation catalysts, and other devices that provide an after-treatment of exhaust emissions. • Measures would be implemented to cover odorous sources from sludge handling, such as aeration tanks. • Improvements to source physical parameters would be made and/or cleaner fuel types would be used at GovGuam facilities					
UI/P-8	Recondition GPA's combustion turbines located in northern Guam to increase the reliability of the IWPS and provide reliable sources of power generation to support the existing and future off-base populations during emergencies.					X
Socioeconomics and General Services – Within DoD Control						
SE-1	DoD can reduce construction and operations tempo to reduce the adverse impacts of a large increase in construction population on Guam – eliminating the population boom and bust effect identified in the analysis.	X			X	X
SE-2	Prohibit dependents from accompanying Marines until construction is complete.	X			X	X
SE-3	Assist GovGuam in seeking federal funding to expand the stock of low- to moderate-income housing on Guam, reduce impacts on housing availability and expense,.	X				
SE-4	DoD can implement: • Incentive programs for military spouses and dependents that apply for and are hired into GovGuam public service agency employment. • Volunteer programs for military, their spouses and dependents, linking them to long-term government of Guam (GovGuam) public service agency volunteer positions. • Collaborative efforts with the federal government and GovGuam to identify and provide grant writing assistance to Guam public service organizations and agencies that have existing AmeriCorps program, or have the potential to host an AmeriCorps program, to facilitate an increase in AmeriCorps service on Guam.	X			X	X
SE-5	Assist GovGuam in seeking federal funding for: • Necessary permanent number professional staff identified, as	X			X	X

Potential Mitigation Measure		*Volume*				
		2	*3*	*4*	*5*	*6*
	well as the number of administrative and supporting staff needed for these professions to perform their positions adequately. • An increase in the number of private staffing and service contractors currently working for service agencies, to match staffing requirements. • A one-time hiring bonus of 20% of base pay for all GovGuam agency positions, to increase interest in GovGuam agency employment and compete with wages offered by private offices.					
SE-6	Assist GovGuam with technical assistance, development and implementation of comprehensive data collection systems focused on: • Public services provided to FAS citizens in order to facilitate GovGuam access of Compact Impact and other related funding. • Public services provided to military individuals, in order to facility GovGuam access of TRICARE and other related funding. • Patient information, records, and services accessed, in order to facilitate appropriate care administered in a timely manner.	X			X	X
SE-7	Assist GovGuam in seeking federal funding for technical assistance, 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.	X			X	X
SE-8	Collaborate with GovGuam public safety agencies to develop a comprehensive and regular shore patrol system, and maintain a regular visible preventative presence.	X		X		
SE-9	Develop community outreach task forces aimed at addressing community crime and social order concerns. These task forces would provide ongoing review, improvement and implementation of military policies related to such offenses or concerns. Members of these task forces would partner with existing civilian groups with similar concerns to share information regarding current policies and programs. The task forces would also implement volunteer programs for military spouses and dependents to link them to long-term volunteer positions at these civilian groups or similar non-profit entities on Guam.	X		X		
SE-10	Assist GovGuam in seeking federal funding for collaborative efforts with FSM governments and relevant federal agencies to educate in-migrants on the laws and cultures of the island of Guam, focused areas where there are known cultural differences.	X		X		
SE-11	Implement an orientation course on Guam local culture and history, designed in conjunction with the Guam Department of Chamorro Affairs, to be attended by all arriving active-duty DoD personnel and dependents.	X		X		
SE-13	Assist GovGuam in seeking federal funding for technical assistance to identify, translate and produce all necessary GovGuam informational brochures and materials likely to be accessed by in-migrant groups.	X		X		
SE-14	Minimize local community perceptions of separation of local resident and military communities, DoD will consider developing a mayoral outreach task force aimed at developing military-civilian relationships. 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.	X		X		
SE-15	Enhance economic benefits and compensate for economic costs for local businesses, the Marine Corps would consider granting trainees some		X			

Potential Mitigation Measure		*Volume*				
		2	*3*	*4*	*5*	*6*
	liberty at the end of every training mission so that they might spend money in local establishments and interact with local residents.					
SE-16	To reduce Tinian residents' anxiety about the military limiting access to these areas, the Marine Corps would consider providing written clarification of training activities' effects on civilian access to San Jose harbor and the civilian airport at west field.		X			
Public Health and Safety – No mitigation. See table of BMPs						
Hazardous Materials and Waste – No mitigation. See table of BMPs						
Environmental Health and Safety – See mitigation for noise, socioeconomics and land use impacts **.**						

Various mitigation identified in this Draft EIS/OEIS would be implemented on land not under DoD control. Mitigation in these areas could be undertaken by the responsible entities that would lessen impacts to various resources. Examples of mitigation measures include improvements to various GovGuam utility and port facilities, public roadway improvements, management of Guam resources, and construction associated with the induced population growth.

The DoD has limited authority to implement mitigation measures on non-DoD land. Mitigation measures involving expansion or improvement to utilities, roadways, and other public services, for example, can be addressed by State and local governments using revenues from an expanded tax base, adjusted utility rates, connection fees, and other service charges. In fact, taxes, rates, fees, and service charges are the tools state and local governments normally use to address increased demand or improvements to public services they provide or control. Recognizing Guam's unique circumstances and world economic conditions may make it difficult for Gum to address mitigation on non-DoD lands using normal revenue sources; the Navy 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.

2.3 APPLICATION OF ADAPTIVE TECHNIQUES TO MITIGATION

2.3.1 Traditional Adaptive Management (Terrestrial/Marine Resources)

The concept of adaptive management has been around since the early 1900s and is rooted in the concept of scientific management 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 literature, the specific idea of adaptive management as a strategy 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. It 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 about how resources will respond to actions. Natural resources 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

Department of Interior defines adaptive management as (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."

2.3.2 Adaptive Management Techniques for Other Resource Areas Sensitive to Construction Tempo

Adaptive management techniques can also be applied to resources other than natural resources. The large construction program proposed on Guam lends itself well to such an approach because of the potential for significant impacts to various utility resources. These resources are sensitive to the short-term increases in population or demands brought about by this construction effort.

Adaptive management would be applied as mitigation in all resource areas in this Draft EIS/OEIS and used as an environmental planning-based approach that allows for adjusting program management/implementation strategies in response to actual monitoring of significantly impacted resource areas. By applying adaptive management methodology the Navy would monitor the impacts of its actions and evaluate the need to adjust its plan to implement the selected alternative plans to avoid and/or minimize environmental impacts. Avoidance of environmental impacts, where possible, is the Navy's preferred method of mitigation.

To successfully achieve the full relocation of Marines to Guam by 2014 as agreed between the Governments of the United States and Japan, the Navy proposes to complete an average of approximately $2 billion (B) of construction work per year, with a peak of approximately $2.8 B in 2014 (Volume I, Table 2.7-1). This amount of construction requires a large increase in construction workforce on Guam. The estimated increase in construction labor and induced population increases are in direct correlation to dollars expended at any given time, with approximately 75 construction workers and 99 induced populations correlating to $10 million (M) of construction. As indicated in Volume 6, during the height of construction there is a projected peak in utility demands. These peak utility demands may be significant and are directly related to the increased labor force and population levels and associated demands.

Volume 6 discusses the preferred interim and/or long-term alternatives for each resource. Only the preferred interim alternative for power, potable water, wastewater, and air quality is discussed below to

demonstrate how adaptive management techniques could be applied. Discussion of the preferred long-term alternatives as noted in Volume 6 is discussed on a programmatic level and would be evaluated further through tiered National Environmental Policy Act (NEPA) documents. If interim alternatives other than the preferred are selected in the ROD the same approach described in this section will be used for the selected interim alternatives.

Navy policy requires readable, understandable and consistent mitigation measures addressed in decision documents (Navy 2007). As part of this policy, the Navy is required to provide clearly written and defined mitigation procedures that succinctly specify: (1) what mitigation procedures are to be implemented, (2) how the mitigation procedures should be implemented, (3) when the mitigation measures should be implemented, and (4) who (action proponent, or designee) would be responsible for completing the mitigation measures.

As a matter of policy, the Navy adaptively manages all resource areas to ensure impacts are avoided using BMPs or instituted mitigation measures. A post-ROD monitoring plan will be developed to ensure additional mitigation is applied to all resource areas. In the event that adaptive management is selected as mitigation it will be included in the post-ROD monitoring plan and would be developed in cooperation with USEPA, GovGuam, GEPA, GWA, and GPA and other agencies as necessary, to identify roles and responsibilities and determine what monitoring criteria and data points will act as indicators of system stress. This plan would rely on a cooperative approach between DOD and GovGuam agencies to gather, share, and analyze data in a collaborative manner. Some of the adaptive management mitigation measures are within DoD control. For those actions that are outside of DoD control, DoD would work with the respective agency to facilitate the mitigative action.

The goals and objectives of the post-ROD monitoring plan specific to adaptive management would include, but not be limited to:

- Establish a means to ensure mitigation is occurring as specified in the ROD
- Establish roles and responsibilities for each agency participating in the management of the resource
- Develop a reporting system for each resource area, to include the following actions
  - Collect and monitor usage data for power, potable water, wastewater and air emissions
  - Designate where the data is maintained
  - Identify Navy and or GovGuam personnel who would be responsible for recording resource usage
  - Review of new civilian population data
  - Review of construction/other permit data for non-DoD related projects
  - Prepare trend analysis for determination of projected impacts
  - Establish of implementation procedures to avoid reaching a significant impact for each resource
  - Project changes in supply and demand
  - Other parameters related to water quality or air quality
  - Construction award values and actual construction work in place
  - Establish a standard process for DoD, GovGuam and other appropriate regulatory agencies to meet regularly and discuss the impacts to respective resources and changes in population (contractor off-island workforce, DoD personnel [military and civilian], and general civilian growth)

After examination of the applicability of adaptive management concepts, the Navy determined it would focus adaptive management techniques on the resource areas of power, potable water, wastewater, and air quality. These particular resources:

- Have the greatest potential for significant impacts
- Are sensitive to changes in peak populations
- Are resources that the Navy is able to adjust demands through altering construction contract awards

It is assumed that population increases will cause an increase in utility demands and traffic with the potential to impact air quality. These impacts may be significant or non-significant, depending on the resource area.

The Navy has identified "action points" and "tipping points" that need to be established in the post-ROD monitoring plan for resources. The tipping point represents an established indicator level that if exceeded, would result in a significant impact. The action point would consider an appropriate reserve or buffer, agreed upon by DoD and GovGuam. The action point identifies an early warning level indicator associated with each resource that once reached, signals the Navy to apply appropriate adaptive management techniques to address significant impacts.

By monitoring data on a regular basis and using trend analysis, DoD would be able to determine actual per capita usage rates correlated to population, construction work in place, and projected construction awards. When trend analysis forecasts that a tipping point may be reached, DoD would implement appropriate mitigation action and continue to monitor the effectiveness of that mitigation (see Figure 2.3-1).

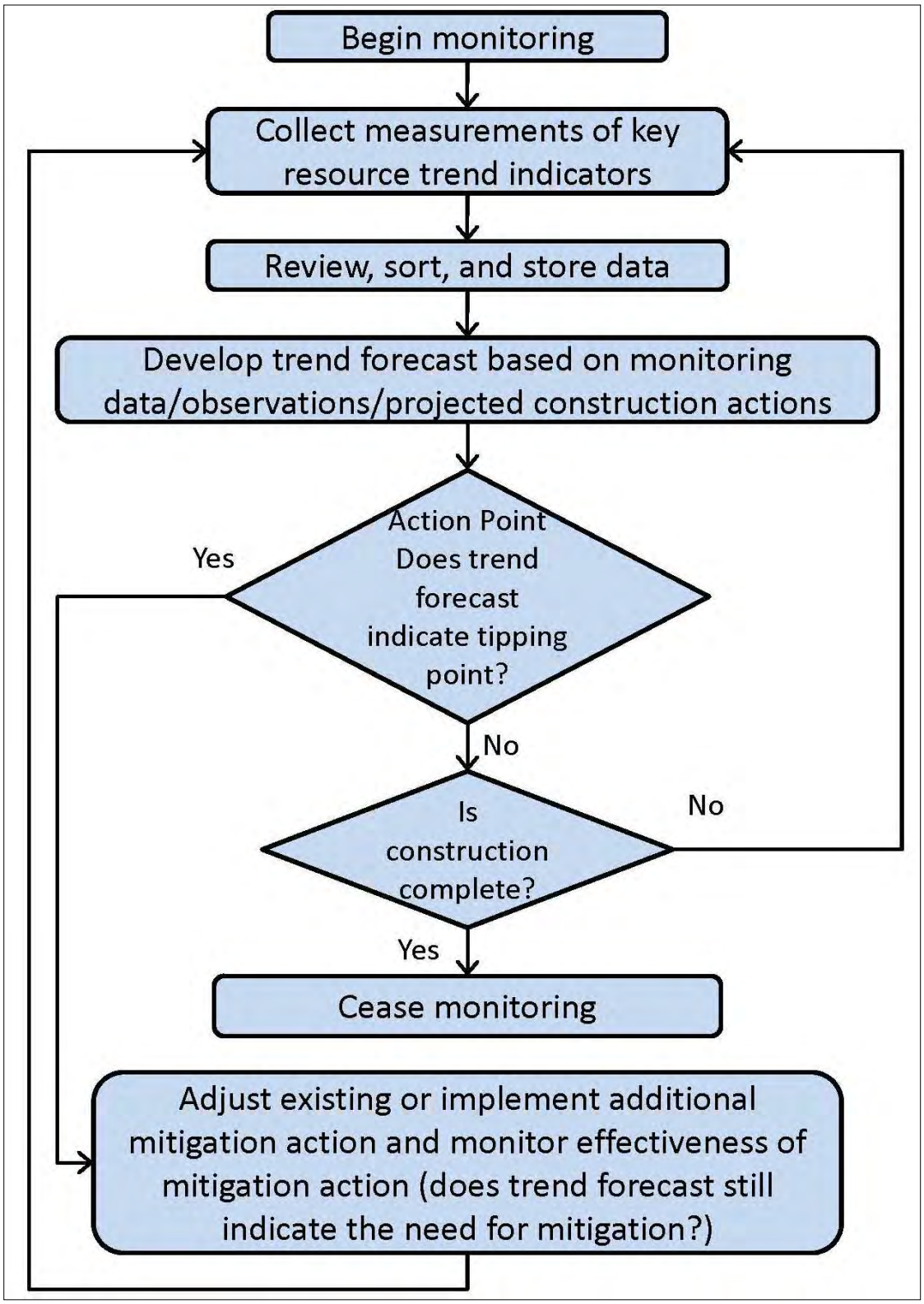

Figure 2.3-1. Monitoring Plan Flow Chart

As previously discussed, mitigation actions can be DoD controlled or non-DoD controlled (see Table 2.2-1). Potential mitigation measures as adaptive management mitigation can also be DoD and non-DoD controlled. DoD controlled adaptive management mitigation measures common to all resource areas discussed include:

- Alter the construction tempo. Construction tempo refers to the process of analyzing the correlations mentioned above, and altering the timing and/or execution of short term (planned within 0 to 3 months), mid-term (3 to 12 months), and long-term (12 to 24 months) construction contract awards to reduce population increases and thus mitigate for impacts to the resource area.
- Redirect the sequence of construction to areas requiring fewer construction workers, thus slowing the workforce population rate of increase and in turn reducing power demand.
- Use sustainability approaches and incentivize contractors to employ current sustainable approaches to construction, such as off-island pre fabrication techniques to reduce on-island work force requirements, employ water saving mechanisms for their construction work force housing, such as: waterless or ultra low consumption urinals: composting portable toilets: low flow faucets: showerheads and washing machines in housing units; water saving dishwashers; washwater recycling in industrial washing and rinsing of aircrafts and vehicles; water efficient cooling systems, minimal landscaping; rainwater collection and reuse.
- Adaptive management analysis for power, potable water, wastewater and air emissions as a result of implementing the proposed actions are discussed in the following sections.

2.3.3 Power

Power on Guam is supplied by the integrated GPA island-wide power system (IWPS). The system is on an island-wide grid system, thus power demand can be considered as a single source. Accordingly, the power demand is independent of the location on Guam where the action takes place. DoD has no separate power system except for some emergency generators including somewhat large systems at Orote and NCTS. Utilizing those generators to meet normal daily DoD power demand associated with this action is not planned under the preferred alternative.

This section is derived from analysis found in Volume 6. For a full discussion of supply or demand calculations or alternatives analysis for power, please refer to Volume 6; this section will provide only applicable portions to demonstrate how adaptive management techniques would be applied as mitigation to the preferred alternative.

Interim Alternative 1 is the preferred alternative to meet the increased power demands as a result of implementing the proposed actions on Guam. The preferred interim alternative for power would recondition up to four existing permitted GPA combustion turbines to restore the system to its original design capacity, and support interim-load demands with no modifications to air permits. This alternative would recondition up to four existing combustion turbines that are not current in their maintenance requirements and cannot be reliably used to their permit limits. Units to be reconditioned would include the combustion turbines at Yigo, Dededo Units No. 1, Marbo, and Macheche. An additional combustion turbine (Dededo Unit No. 2) was recently reconditioned by GPA and would also be utilized under this alternative.

2.3.3.1 Projected Supply and Demand

Implementing the proposed actions on Guam would create an increased power demand. Table 2.3-1 lists the anticipated demand for each component of the proposed military buildup. The estimated total future

peak DoD demand is 123.63 megawatts (MW) (existing, transient, and future). The total peak demand is anticipated to occur as early as 2015, when all planned facilities would be in service and operational. Each of the demand values in Table 2.3-1 is based on the Unified Facility Code (UFC) planning criteria for facility demand and does not include any additional spare capacity, as is typically used in power generation planning.

Table 2.3-1. Estimated Department of Defense Power Demand for Guam

Demand Description	*Demand (MW)*			
	Existing DoD Demand	*Other Planned DoD Demand*	*Marine Corps Increased Demand*	*Total DoD Future Planned Demand*
Andersen AFB	18.10	8.64	0.46	27.20
Andy South	1.00	0.00	0.00	1.00
NCTS Finegayan (plus utilities)	1.20	2.82	14.47	18.50
South Finegayan Housing Area	1.50	0.00	5.87	7.37
Barrigada	1.30	0.00	0.00	1.30
Naval Hospital	3.20	1.66	0.00	4.86
Naval Base Guam	20.75	1.12	0.14	22.01
Total Demand (excludes transient)	**47.55**	**15.32**	**20.94**	**83.81**
Naval Base Guam (max. transient demand) a				**39.82**
Total Electrical Demand (MW) b				**123.63**

Legend: AFB = Air Force Base; DoD = Department of Defense; MW = megawatts; NCTS = Naval Computer and Telecommunications Station.

[a] Represents maximum demand on any given day for aircraft carrier and associated escort ships (Navy), or Expeditionary Strike Group (ESG) (Marine Corps) (not in port on the same days) .

[b] For 19 service locations.

Source: NAVFAC Pacific 2008b.

A transient power demand will occur when either the proposed berthing/embarkation of a transient aircraft carrier and escorts, or the Expeditionary Strike Group (ESG) are in port. It is not anticipated that the transient aircraft carrier and its associated escort ships would be in port at the same time as an ESG; therefore, the power demand for the transient aircraft carrier and an ESG is not combined. The higher demand number related to the transient aircraft carrier was considered in demand projections and is part of the total estimated future demand of 123.63 MW.

In addition to the DoD power demand, two other types of demand are expected to increase overall power demand on Guam. One is induced civilian growth and the other is construction workers. Table 2.3-2 indicates the anticipated demand requirements considering DoD, construction workers, general population growth projections, and population growth induced by the proposed DoD buildup on Guam.

Table 2.3-2. Power Supply and Demand on Guam

GPA Power System	*Demand (MW)*									
	Interim Period without 25% Growth Factor					*Long-Term without 25% Growth Factor*				
	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Island-wide, including anticipated growth (existing DoD and GPA baseline projected growth included)										
Existing Guam	281	287	294	299	303	306	309	312	315	318
Guam Induced Civilian Increase (induced growth caused by military increase)	4.93	12.25	19.99	23.44	29.24	22.08	11.23	7.75	7.75	7.88
Construction Worker Increase	1.18	2.99	5.19	6.51	6.70	4.43	1.38	0.00	0.00	0.00
DoD Increase (less 39.8MW load from transient aircraft carriers)	1.83	2.18	5.04	11.35	17.99	33.31	35.29	35.29	35.29	36.26
Total Demand	**288.94**	**304.42**	**324.21**	**340.29**	**356.93**	**365.82**	**356.90**	**355.03**	**358.03**	**362.14**
Total Available Supply	**490.00**	**490.00**	**550.00**	**550.00**	**550.00**	**630.00**	**630.00**	**630.00**	**630.00**	**630.00**
Future Supply Accounting for 1.52 Reliability Factor	322.37	322.37	361.84	361.84	361.84					
Future Supply Accounting for 1.52 Reliability Factor						414.47	414.47	414.47	414.47	414.47
Supply – Demand (net excess or shortfall without transient loads)	33.43	17.95	37.63	21.55	4.91	48.66	57.58	59.44	56.44	52.33
Transient Load (Highest requirement with CVN group)						39.82	39.82	39.82	39.82	39.82
Supply – Demand (net excess or shortfall with transient loads)	33.43	17.95	37.63	21.55	4.91	8.84	17.76	19.62	16.62	12.51

Legend: MW = megawatts.
Source: NAVFAC Pacific 2008d. Guam Power Authority Integrated Resource Planning (IRP 2008) for existing Guam growth projections

The Public Utilities Commission (PUC) requires that GPA maintain a generation reliability standard as a "reserve" power supply. To meet this requirement, GPA has identified that 1.52 times the system's peak demand level is required to provide the necessary reserve margin. During the interim period the peak load for the IWPS is projected to reach 357 MW, applying the 1.52 reserve capacity, GPA would need a generation capacity of 543 MW to meet the PUC requirement. GPA has an installed generation capacity of 550 MW. To reach its installed capacity, GPA will need to recondition existing generation units and return them to full service capability.

Planning indicates that new power generation capacity would be available by 2015 to support the additional demand and power supply required for long-term power consumption. This new power capacity would be approximately 80 MW generated from a new power plant.

As shown in the table, there is no power supply shortfall anticipated as a result of implementing the proposed action(s).

2.3.3.2 Projecting Tipping Point(s) and Action Point(s)

Monitoring real time data for power should include the daily demand curves averaged over a workweek and weekends, GPA supply capacity, and population rate projections. This data should be used to identify trends correlating with the buildup/construction. With this correlation, revised projections of future demand would be calculated. In-progress refurbishments would be taken into account when forecasting power supply, as should operational limitations in the permits.

Both the tipping point and the action point would be identified and agreed upon by the agencies participating in developing the post-ROD monitoring plan. By monitoring the data described above, the tipping point and action point could be identified using trend analysis. The action point would need to be identified far in advance so that mitigation actions could be implemented to prevent the tipping point from occurring. For power, the reserve capacity should be included in action point and tipping point determination, so as to preserve that margin of safety.

2.3.3.3 Potential Impacts and Mitigation

Potential impacts of exceeding available power supply would be rolling blackouts or brownouts, a reduction in the reliability of the supply system (may also cause blackouts), or utilization of GPA interruptible supply agreements with certain customers. As previously stated the post-ROD Monitoring Plan would identify mitigation to address significant impacts as a result of the proposed action. Some of these mitigation measures are within DoD control. For those actions that are outside of DoD control, DoD would work with the respective agency to facilitate the mitigative action

Mitigation action employing an adaptive management approach to address the significant impact of excess power demand must recognize that the projected demand numbers are estimates and forecasts based on many assumptions, such as population projections and demand calculations. Adaptive management would proactively monitor the implementation of the interim preferred alternative power demand and supply data in real time to allow effective mitigation action.

Reaching an action point would trigger the need to implement one or more mitigation measures. All of the DoD-controlled mitigation measures related to utilities in Table 2.2-1 or DoD controlled adaptive management techniques described in Section 2.3.2 above could reduce impacts. With respect to the DoD-controlled adaptive management mitigation technique of altering the construction tempo, should a power demand exceed the future supply (without utilizing the reserve capacity) the Navy could slow the construction tempo, reducing the construction worker and induced civilian populations, thus reducing the power demand. In addition to the DoD-controlled adaptive management mitigation measures described previously, DoD would request GPA to implement their interruptible power supply agreements with current customers, whereby they use temporary power generators instead of drawing power from GWA's system, thus reducing demand.

Mitigation outside DoD control include rearranging workforce hours to smooth peak power demand requirements.

2.3.4 Potable Water

Potable water supply is provided via two water systems on Guam: the DoD system and the GovGuam system. The DoD system is split into subsystems and includes groundwater in northern Guam and surface water sources in southern Guam. GovGuam obtains its water from groundwater from NGLA in northern

Guam and has an allotment to purchase an additional 4 MGd (15.1 mld) from DoD's surface water in southern Guam. Both DoD and GWA groundwater systems utilize the NGLA solely and thus are both incentivized to properly manage this aquifer. The aquifer has numerous sub-basins with different sustainable yields. The proposed military buildup on Guam would be located at Andersen AFB, Naval Computer and Telecommunications Station (NCTS) Finegayan, South Finegayan, Andersen South, Barrigada, and Naval Base Guam. These areas are currently served by the DoD potable water systems of Andersen AFB and Navy. The Navy's surface water system would not be altered, so it will not be discussed, except to the extent needed to provide adequate context for overall water availability.

This section is derived from analysis found in Volume 6. For a full discussion of supply or demand calculations or alternatives analysis for potable water please refer to Volume 6, as this section below will provide only applicable portions to demonstrate how adaptive management techniques would be applied as mitigation.

The preferred alternative (Alternative 1) for meeting the potable water demand includes installation of new water supply wells (up to 22 wells at Anderson AFB) in the northern area utilizing the NGLA, rehabilitation of existing wells, new/replacement of treatment and distribution systems, and interconnection with GWA. This alternative was developed to support the Main Cantonment at Finegayan (i.e., Main Cantonment Alternatives 1 and 2, Volume 2). The new DoD supply wells would provide additional water supplies to northern Guam area and the ability to transfer to southern Guam via the island-wide Navy system as needed.

Development of groundwater resources would require coordination between DoD, GWA, and the GEPA. This coordination is a necessary part of the well permitting and construction process, and proper management of the NGLA, a designated sole source aquifer. During use of the wells, coordination would continue between DoD and GWA. Groundwater monitoring for pumping rates and chloride content would continue to be measured as an indicator of saltwater intrusion and over pumping in the NGLA. Modification of well usage would be evaluated jointly to maximize use of the resource.

According to a 1991 report (Barrett Consulting Group 1991) that was reviewed and validated in a 2009 report commissioned by DoD and performed by UOG, the WERI (NAVFAC PAC 2009) estimated the sustainable yield of the aquifer to be 80 MGd (302 mld). Thus, the overall NGLA capacity is sufficient provided the wells are properly managed. Development of new DoD supply wells would be coordinated with GWA to ensure the sustainability of the aquifer. Thus, the overall elements of concern for potable water supply are:

- DoD potable water supply system (primarily wells in the NGLA).
- GWA potable water supply system (wells in the NGLA and associated infrastructure).
- Overall sustainable yield of the NGLA.

2.3.4.1 Projected Supply and Demand

DoD Water System

Implementing the proposed actions on Guam would create an increase in potable water demand on the DoD water system over the long term, as additional DoD personnel arrive in Guam. The DoD water system has a current supply of 18.8 MGd (71.1 mld)available to meet the current DoD maximum daily demand of 12.4 MGd (46.9 mld)and a 4 MGd (15.1 mld) allotment that is available for transfer to GWA when needed per the current memorandum of understanding. The current water supply and additional supply required to meet future on-base DoD demands are summarized below in Table 2.3-3 and Table 2.3-4. Table 2.3-3 is derived from calculations using current UFC criteria that do not include new DoD

policy to incorporate sustainability principles that would reduce potable water usage. As shown, DoD would develop new water supply wells to add 11.1 MGd (42 mld) and rehabilitate an existing well to add an additional 0.5 MGd (1.9 mld) supply to the DoD system to meet future Marine Corps, Army, Air Force, and Navy demands would be required for the military buildup. The resulting planned supply of 27.1 MGd (102.4 mld) would meet the overall projected maximum daily demand of 27.1 MGd (102.4 mld) on the DoD system. Given the 1.3 MGd (4.9 mld) shortfall that would occur specifically for the Navy water system, a long term alternative would be necessary to resolve that specific shortfall. Alternatively the shortfall could be addressed through transfer of excess water from the Marine Corps base through the Navy island wide system and maintenance that would allow transfer of excess water in the Anderson AFB system to the Navy IWWS.

Table 2.3-3. Basic Alternative 1-Proposed DoD Water Supply and Demand

Water Supply Sources(Existing and Proposed)	*Water Supply (in MGd)*			
	Marine Corps Finegayan	*Andersen AFB*	*Navy*	*Total*
Main Cantonment Alternatives 1 and 2				
Current Surface Water Supply			11.0	11.0
Current Groundwater Supply		4.7	3.1	7.8
Development of new water supply wells	11.1			11.1
Rehabilitation of existing Navy well			0.5	0.5
GWA Transfer Projected Need in 2019[a]			-3.3	-3.3
Planned Supply Cantonment Alternatives 1 and 2	**11.1**	**4.7**	**11.3**	**27.1**
Maximum Daily Demand Using UFC Guidance	10.5	4.0	12.6	27.1
Planned Supply Cantonment Alternatives 1 and 2 Using Sustainability Principals	**6.9**	**4.7**	**11.3**	**22.9**
Maximum Daily Demand Using Sustainability Principals	**6.3**	**2.8**	**10.1**	**19.2**

Notes: [a] Per current memorandum of agreement, GWA has access to up to 4MGd allotment of water from Navy system. It is projected that GWA may use 3.3 MGd of this allotment.
Source: NAVFAC Pacific 2008c

Table 2.3-4 presents the DoD water supply and demand estimates assuming reductions for compliance with the executive orders regarding water conservation and sustainability efforts for this project. As shown, the sustainability principles would reduce demand estimates at Marine Corps Finegayan to only 6.9 MGd (26.1 mld) (compared to 11.1 MGd [42 mld] when calculated using current UFC [Table 2.3-3]). This reduction would allow DoD to reduce its supply. Thus, using an estimate of the revised UFC values and if water conservation measures are implemented, the planned 22.9 MGd (86.6 mld) water supply is sufficient to meet the overall maximum daily demand of 19.2 MGd (72.6 mld) and to meet demand requirements at each base.

Table 2.3-4. Potable Water Basic Alternative 1 Proposed DoD Water Supply and Demand Assuming Water Conservation and Sustainability Factor

Water Supply Sources(Existing and Proposed)	*Water Supply (in MGd)*			
	Marine Corps Finegayan	*Andersen AFB*	*Navy*	*Total*
Main Cantonment Alternative 1 & 2				
Current Surface Water Supply			11.0	11.0
Current Groundwater Supply		4.7	3.1	7.8
Development of new water supply wells	6.9			6.9
Rehabilitation of existing Navy well			0.5	0.5

Water Supply Sources(Existing and Proposed)	*Water Supply (in MGd)*			
	Marine Corps Finegayan	*Andersen AFB*	*Navy*	*Total*
GWA Transfer Projected Need in 2019[a]			-3.3	-3.3
Planned Supply Cantonment Alternative 1 & 2	**6.9**	**4.7**	**11.3**	**22.9**
Maximum Daily Demand using Executive Order Compliance and Sustainability Principles	6.3	2.8	10.1	19.2
Projected Excess (Supply minus Demand)	0.6	1.9	1.2	3.7

Notes: [a] Per current memorandum of agreement, GWA has access to up to 4MGd allotment of water from Navy system. It is projected that GWA may use 3.3 MGd of this allotment.
Source: NAVFAC Pacific 2008c

GWA Water System

The GWA water system is not a component of the Alternative 1 water supply. The Navy would continue to transfer up to 4 MGd (15 mld) to GWA under the current memorandum of understanding. As noted above, it is projected that the amount transfer amount in 2019 will be reduced to 3.3 MGd (12.5 mld) due to GWA planned water system expansion.

Projected initial water demands on the GWA water system are summarized in Table 2.3-5, which summarizes the existing demand on the GWA water system (including projected increases in civilian demand related to natural population growth), projected increases associated with the imported construction workforce, and civilian increases in demand that would result from induced growth as a result of the military buildup. Demand projections are then compared to the planned GWA potable water supply to identify whether shortfalls would be expected during the construction phase.

Table 2.3-5. Projected Water Supply and Demand on the GWA Water System

GWA Water System	*Year*									
	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*
Potable Water Demand[a]										
Existing Guam Civilian[b]	48.9	49.3	49.8	50.2	50.6	51.1	51.5	51.9	52.3	52.7
Construction Workforce	0.6	1.5	2.7	3.3	3.4	2.3	0.7	0.0	0.0	0.0
Induced Civilian Increase	1.2	3.1	5.1	5.9	7.4	5.6	2.8	2.0	2.0	2.0
Total Projected Demand	50.7	54.0	57.5	59.5	61.5	58.9	55.0	53.9	54.3	54.7
Potable Water Supply										
Existing GWA Supply[c]	48.4	48.4	48.4	48.4	48.4	48.4	48.4	48.4	48.4	48.4
Projected Excess before Expansion (Supply-Demand)	-2.3	-5.6	-9.1	-11.1	-13.1	-10.5	-6.6	-5.5	-5.9	-6.3
GWA Planned Expansion[d]	0	0	7	7	7	7	7	7	7	7
Total Planned Supply	48.4	48.4	55.4	55.4	55.4	55.4	55.4	55.4	55.4	55.4
Projected Excess after Expansion (Supply-Demand)	-2.3	-5.6	-2.1	-4.1	-6.1	-3.5	0.4	1.5	1.1	0.7

Notes: All units are MGd. This table does not include GWA's effort to detect and fix leaks, unaccounted for water (UFW).
[a] Demand is based on calculations using the UFC, 50% UFW rate, and population estimates provided in Volume 6, Table 2.2-3
[b] Includes projected increases in civilian demand related to natural population growth.
[c] Assumes 4 MGd transferred from Navy to GWA.
[d] GWA Draft Capital Improvement Plan 2010-2014
Source: GWA 2007

As summarized in Table 2.3-5, the total civilian demand on the GWA water system (including demand associated with the construction workforce and induced civilian growth) is projected to exceed available GWA supply by 2.3 MGd (8.7 mld) and a maximum of 6.1 MGd (23.1 mld) in 2014. This changes to a surplus from 2016 through 2019. The GWA water system currently has the capacity to supply 48.4 MGd (183.2 mld) of potable water. Planned GWA expansions would add 16 potable wells with combined capacity of 7 MGd (26 mld) to increase that capacity to 55.4 MGd (209.7 mld). However, there are shortfalls during the construction period even with GWA's planned expansion. Although GWA currently has plans to drill wells starting in 2012, much of this new water will offset wells that are being shutdown or subjected to reduced pumping due to high chlorides. GWA has indicated that they do not possess the financial resources to drill new wells in time to meet the early demands expected as a result of the buildup. In the CIP, well construction is identified in 2012. An option to supply this potential water shortfall would be that DoD could transfer excess water production capacity to GWA, if requested, as a mitigation measure. Current assessments indicate the Andersen Air Force Base water system has excess well production capacity of 3 MGd that could be transferred to assist GWA with potential shortalls in northern Guam. Navy surface water resources from Fena Resevoir may also be available to GWA in addition to the current allotment of up to 4 MGd to further mitigate the shortfalls. The sustainable yield of the NGLA can support the withdraw and transfer of water from DoD wells to GWA during the shortfall years.

NGLA Sustainable Yield

The overall sustainable yield of the NGLA approximately 80 MGd (302 mld) is sufficient for short- and long-term projections and would not exceed the rate at which groundwater could be continuously withdrawn from the aquifer at acceptable quality or the quantities if the preferred alternative for the relocation action is implemented.

Figure 2.3-2 shows the anticipated average daily demand (ADD) versus the entire sustainable yield for the NGLA at several different unaccounted for water (UFW) rates for the GWA and DoD system. Demand calculations for the DoD water system (Tables 2.3-3 and 2.3-4) were calculated assuming 15% UFW rate based on the condition of the DoD T&D system, while the GWA system demand calculations (Table 2.3-5) were calculated assuming 50% UFW based on its deteriorated condition. As shown, based on a maximum UFC of 50%, combined DoD and GWA demand would be peak at approximately 65 MGd (245.7 mld), well below the 80 MGd (302 mld) sustainable yield of the NGLA. As future improvements are made to the T&D systems, UFW rates would be reduced, thus total demand would also be reduced.

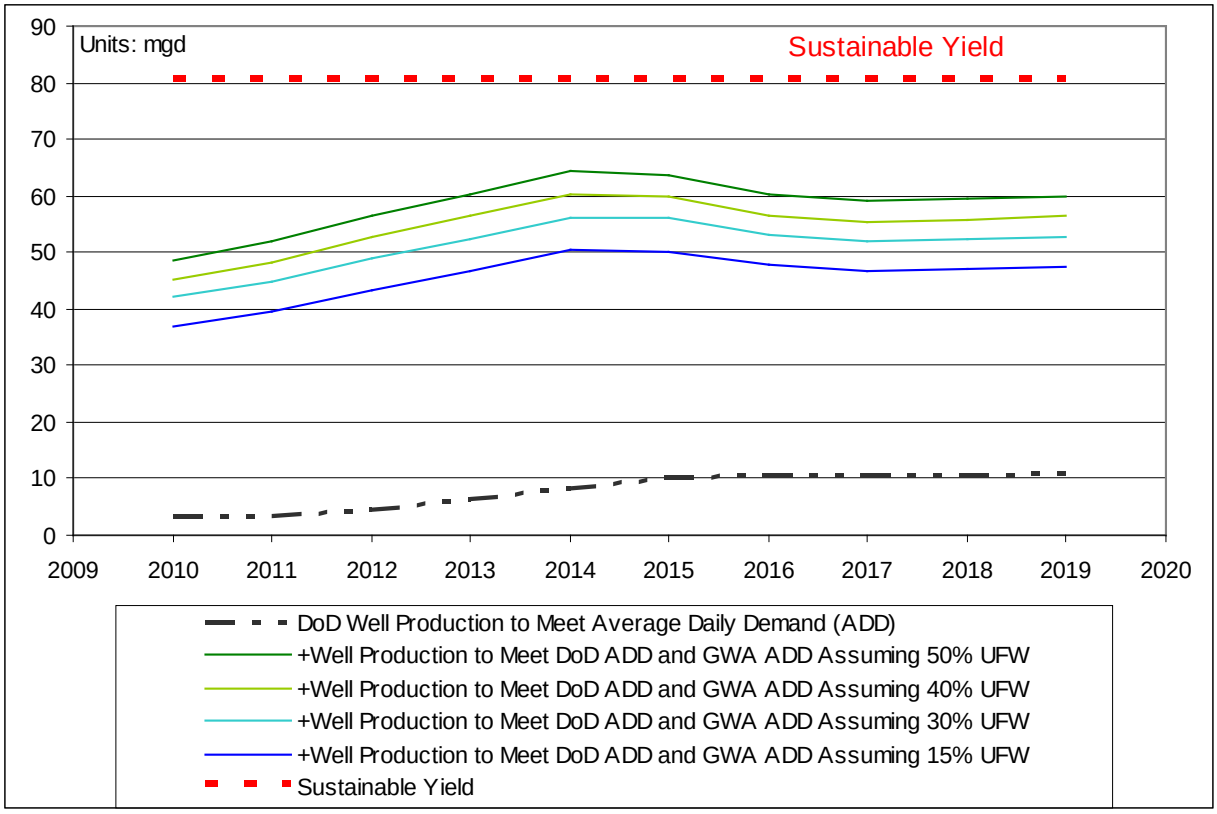

Figure 2.3-2. Well Production to Meet DoD Average Daily Demand and GWA Average Daily Demand (15-50% UFW for GWA)

2.3.4.2 Projecting Tipping Point(s) and Action Point(s)

There are many variables which could impact both supply and demand of potable water. Each should be monitored to assess potential impacts to the availability of adequate potable water. Supply side elements include:

- T&D Systems
- Sustainable yield at individual wells and sub-basins (acceptable quality and quantity)
- Pace of construction of water system facilities
- Reduction in UFW (fixing leaking distribution)
- Unexpected weather damage to existing facilities (such as wells, pump stations, etc.)
- Seasonal variations and weather trends

Demand side elements include:

- Population changes that may deviate from plan
- Metering current un-metered uses (linked to UFW)
- Further degradation of the distribution system leading to an increase in UFW
- Construction peaks affecting water pressure locally or throughout the distribution system

Monitoring real-time data for potable water should include all individual wells for total available supply, quality, capacity of the treatment and distribution systems, and sustainable yield of the NGLA and

population rate projections. These data should allow for trends identification correlating with the buildup/construction. With this correlation, revised projections of future demand would be calculated. A preliminary monitoring and mitigation strategy would be based on the information in the McDonald and Jenson report (June 2003) which establishes acceptable chloride limits regarding salt-water intrusion. Wells would be monitored at agreed upon intervals for chloride. Experts on the NGLA such as McDonald and Jenson as well as U.S. Geological Service (USGS) would be consulted by the Navy during the development of an appropriate salinity monitoring plan and its periodic resulting data.

Supply would be forecast for both the DoD and GWA water systems based on trends from the supply wells and knowledge of planned new supply wells and T&D construction. Each well would be reviewed to determine a most probable allowable pumping rate. All the wells would be totaled to provide current and future potential supply. As discussed previously, to be able to effect new facilities or construction tempo forecast of potential problems must be identified in a timely manner. Recent weather trends, forecasted weather patterns, and known seasonal variations must also be taken into consideration.

The demand side would be monitored based on metered usage where possible. UFW also would be monitored to assist in assessing how well the distribution system is working and whether or not there are leaks or un-metered usage occurring.

The tipping points for potable water systems would be identified in the post-ROD Monitoring Plan and are defined as when the potable water demand exceeds an agreed upon percent of the available potable water supply. The action point will be set as a percent of supply at which the trend analysis indicates that the tipping point may be reached.

2.3.4.3 Potential Impacts and Mitigation

The potential impacts of exceeding the water supply include water outages or reduced water pressure conditions in parts of the water systems, rationing, poor water quality due to potential salt water intrusion, and violations of regulatory requirements. Water outages or low water pressure can result in microbiological and other contaminants entering the distribution system, potentially resulting in illness. Water outages or low water pressure can also potentially prevent effective fire fighting and degrade the basic sanitary needs of the population. These are significant impacts with potentially serious implications to the Guam population.

Any mitigation action employing adaptive management techniques to potentially reduce significant impacts of excess demand must recognize that the projected demand numbers are estimates and forecasts based on many assumptions such as projected population increases. Adaptive management would require real time monitoring the potable water supply and demand associated with the implementation of the interim preferred alternative and would enable DoD to make adjustments in contract execution to potentially avoid significant impacts.

In analyzing mitigation for water, an island-wide approach considering both DoD and GWA water systems must be pursued. Both systems draw from the same aquifer thus DoD and GWA must work together to provide the necessary mitigations. This will likely require a financial obligation from both parties to ensure that both sufficient and high quality potable water is provided to customers located in the northern area of Guam which relies on groundwater. These relationships would be carefully defined in the post-ROD Monitoring Plan.

Reaching an action point would trigger the need to implement one or more mitigation measures. All of the DoD controlled mitigation measures related to utilities in Table 2.2-1 or DoD controlled adaptive management mitigation techniques described in Section 2.3.2 could reduce impacts.

Although control of where temporary housing for construction workers is located resides with construction contractors and Gov Guam through its planning process, DoD is interested in avoiding adverse impacts through effective planning. Contractors proposing workforce housing will be responsible for coordinating site approvals and permits with local Guam planning and zoning agencies, and with GWA. DoD can require minimum housing standards for worker housing through contract provisions and selection criteria, which should guide the contractors to select locations with adequate utility infrastructure.

If enough new planned GWA wells are not brought online by 2010, the proposed project has the potential to result in significant impacts on the Guam water supply. To mitigate those impacts, DoD could transfer excess water production capacity to GWA, if requested. Current assessments indicate the Andersen Air Force Base water system has excess well production capacity of 3 MGd that could be transferred to assist GWA with potential shortalls in norhtern Gaum. Navy surface water resources from Fena Resevoir may also be available to GWA in addition to the current allotment of up to 4 MGd to further mitigate the shortfalls. GWA would need to formally request this support through the Navy Region Marianas Utilities Department, who would determine water availability and appropriate rates reimbursement. The DoD expects that GWA or the developer requesting additional water would install the necessary piping to make the interconnections with DoD water systems.

With respect to the DoD controlled adaptive management mitigation technique of altering the construction tempo, should a projected potable water demand trend toward exceeding projected supply, the Navy could slow the construction tempo which would reduce construction worker and induced civilian populations, which would in turn reduce the rate of increase in potable water demand. An example of how this might work can be demonstrated using the projected 6.1 MGd (23 mld) deficit on the GWA water system in the year 2014 (see Table 2.3-5 above). One mitigation approach to eliminating this deficit would be to slow the construction tempo and reduce the rate of increase in construction workers and induced civilian population. As previously established, for each $10 M reduction in construction work, there would be an estimated reduction of 75 construction workers and associated 99 induced population reduction, which would result in 3,263 gpd (0.003263 MGd) reduction for every $1M of construction[1]. To achieve a reduction of 6.1 MGd (23 mld), DoD would need to reduce construction tempo by approximately $1.9B in that year[2]. This level of impact to the construction tempo would likely not be acceptable and a variety of mitigations would be adopted, in addition to construction tempo adaptive management.

An additional DoD controlled mitigation measure would be to accelerate construction of new water supply and/or leak detection and repair to reduce UFW. Non-DoD mitigation measures that could also be implemented are:

- Accelerate construction of new water supply and/or leak detection and repair to reduce UFW on GWA systems
- Accelerate development of new GWA supply wells and T&D systems

[1] Average potable water demand calculation for each $1M worth of construction: The demand for additional civilians utilizing the GWA water system is estimated at 187.5 gpcd, assuming a UFW rate of 50% (see Volume 6 Section 2.2.2.2). The assumption has also been made that all construction workers (75 per $10M of construction) and all induced civilian population (99 per $10M of construction) would live in northern or central Guam (which is served by well water). Thus, for each reduction of $10M worth of construction, the population being served by well water would be reduced by 174 people, representing 32,625 gpd demand reduction, or 0.003263 MGd per $1M construction.

[2] Projected 2014, supply deficit would be 6.1 MGd. Dividing 6.1 MGd deficit by 0.003263 MGd per $1M equals approximately $1.9B.

- Import water for industrial or other non-potable uses
- Work out a water exchange between the DoD and GWA systems to allow transfer of excess DoD water capacity to GWA
- Use temporary small self contained desalination plants (reverse osmosis) to augment water supply, provided regulatory approvals would be received

2.3.5 Wastewater

There are three wastewater treatment plants (WWTP) servicing the northern and central portions of Guam affected by the proposed action:

- North District Wastewater Treatment Plant (NDWWTP) - The NDWWTP is owned and operated by Veolia under contract with GWA. The treatment plant treats wastewater flows from civilian populations and DoD installations that are located in northern Guam: Andersen AFB, NCTS Finegayan, and South Finegayan. The NDWWTP is a primary treatment plant designed for an average daily flow of 12.0 MGd (45.4 mld) and a peak capacity of 27 MGd (102 mld). Communication with GWA has indicated that the current average daily flow to the NDWWTP from civilian and military sources is approximately 5.7 MGd (22 mld) (GWA 2008a). The NDWWTP had received a 301(h) modified permit (NPDES Permit No. GU0020141) that expired on June 30, 1991 that authorized the NDWWTP to discharge a maximum daily flow of 6 MGd (23 mld). Based on plant operation performance and data provided by GWA on the actual discharged wastewater qualities, USEPA denied GWA's application for a renewed variance from full secondary treatment on September 30, 2009, and concluded that the CWA 301(h) criteria have not been met at the NDWWTP.
- Apra Harbor WWTP - The Apra Harbor wastewater collection and treatment system is Navy owned and operated. It services the Naval facilities at the Naval Base Guam, Apra Heights, and NMS. The Apra Harbor wastewater system also collects and treats discharged sludge flow from the Navy's Fena WTP. The Apra Harbor WWTP is a secondary treatment facility designed to treat an average daily flow of 4.3 MGd (16 mld) and a peak flow of 9 MGd (34 mld). The treatment plant currently receives an average daily flow of approximately 2.9 MGd (11 mld). Treated effluent is discharged through an ocean outfall into Tipalao Bay under NPDES Permit No. GU0110019. This permit authorizes the Apra Harbor WWTP to discharge an average monthly flow of 4.3 MGd (16.3 mld). A military construction project to rehabilitate/upgrade the existing Apra Harbor WWTP is currently under way.

This section is derived from analysis found in Volume 6. For a full discussion of supply or demand calculations or alternatives analysis for wastewater please refer to Volume 6, as this section will provide only applicable portions to demonstrate how adaptive management techniques would be applied as mitigation to the preferred alternative.

Alternative 1 has two options for meeting wastewater demands as a result of implementing the proposed actions. Basic Alternative 1a (preferred alternative) supports the proposed Main Cantonment Alternatives 1 and 2 and Basic Alternative 1b supports the proposed Main Cantonment Alternatives 3 and 8. Both Basic Alternatives 1a and 1b include NDWWTP actions: upgrading primary treatment facilities and expansion to secondary treatment. Basic Alternative 1b has an additional requirement for a new sewer line from Barrigada housing to NDWWTP. Since this additional requirement does not impact supply or demand, it will not be discussed in this section. Only the NDWWTP Basic Alternative 1a will be analyzed for adaptive management since all flows from the current and proposed future military buildup

at Andersen AFB and the proposed Marine Corps relocation at Finegayan would be conveyed to the NDWWTP.

2.3.5.1 Projected Supply and Demand

Table 2.3-6 summarizes existing civilian and peak DoD flows for northern Guam for Main Cantonment Alternatives 1 and 2. Included in this table are projected increases in northern Guam's civilian flows as a result of natural population growth, projected DoD increases associated with the military buildup, increases associated with the imported construction workforce, and civilian increases that could result from induced population growth in northern Guam. The table includes projected increases in flows from Guam civilians related to natural population growth, projected DoD increases associated with the military buildup, increases associated with the imported construction workforce, and induced civilian increases under Main Cantonment Alternatives 1 and 2.

Table 2.3-6. Projected Peak Wastewater Flows for Main Cantonment Alternatives 1 and 2

Source of Wastewater Flow	*Year*					
	2010	*2011*	*2012*	*2013*	*2014*	*2015*
Northern District Wastewater Treatment Plant						
Existing Guam Civilian	5.20	5.20	5.20	5.20	5.20	5.20
Existing DoD	0.53	0.53	0.53	0.53	0.53	0.53
Guam Civilian Increase	0.42	0.64	0.85	1.06	1.26	1.47
DoD Increase	0.24	0.48	0.53	0.57	2.71	2.95
Construction Workforce	0.26	0.66	1.14	1.43	1.47	0.97
Subtotal Direct DoD and Guam Civilian	**6.65**	**7.50**	**8.25**	**8.79**	**11.17**	**11.11**
Induced Civilian Increase	0.27	0.66	1.08	1.27	1.58	1.19
Total Average Daily Flow—all sources	**6.92**	**8.16**	**9.33**	**10.05**	**12.75**	**12.31**
Total Peak Daily Flow—all sources	**15.56**	**18.37**	**20.99**	**22.62**	**28.69**	**27.69**

Legend: measurements given in million gallons per day (Mgd).

As shown above in Table 2.3-6, wastewater flows to the NDWWTP from military and civilian sources are projected to increase to a peak of 12.8 MGd (48.3 mld) in 2014, which is somewhat more than the design capacity of 12.0 MGd (45 mld). The prior permit (currently expired) limit of 6 MGd would require that GWA reach agreement with GEPA and EPA on the ability to process the greater estimated demand. In addition, the current physical condition of the NDWWTP would require refurbishment to once again attain the original design capacity in order to meet the demand. The slight excess demand over original design capacity would be handled by adding chemical coagulants or increasing 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 projected additional flow without adverse effects on the NDWWTP, with regulatory approval.

2.3.5.2 Projecting Tipping Point(s) and Action Point(s)

Monitoring real time data for wastewater should include the maximum daily demand and the average daily demand curves and population rate increases. These data should be used to identify trends correlating with the buildup/construction. With this correlation, revised projections of future demand would be calculated. In-progress refurbishments would be taken into account when forecasting wastewater demands, as should operational limitations in the permits.

Both the tipping point and the action point would be identified and agreed upon by the agencies participating in developing the post-ROD monitoring plan. By monitoring the data described above, the tipping point and action point could be identified using trend analysis. The action point would need to be identified far in advance so that mitigation actions could be implemented to prevent the tipping point from occurring. For wastewater, the water quality at the discharge point should be included in action point and tipping point determination, so as to avoid permit violations.

2.3.5.3 Potential Impacts and Mitigation

Potential impacts as a result of exceeding the capacity of the NDWWTP include degradation of water quality which would impact public health and safety. Additionally, recreational uses such as fishing, boating or swimming could potentially be impacted if located near the discharge points where these activities occur. Socioeconomic impacts related to tourism could result if mitigation implementation is delayed.

Any mitigation action employing adaptive management techniques to potentially reduce significant impacts of excess demand must recognize that the projected demand numbers are estimates and forecasts based on many assumptions such as projected population increases. Adaptive management would require real time monitoring of the wastewater demand, capacity requirements and permit limitations associated with implementation of the interim preferred alternative and would enable DoD to make adjustments in contract execution to potentially avoid significant impacts.

Reaching an action point would trigger the need to implement one or more mitigation measures. All of the DoD-controlled mitigation measures related to utilities in Table 2.2-1 or DoD controlled adaptive management mitigation techniques described in Section 2.3.2 could reduce impacts.

With respect to the DoD controlled adaptive management mitigation technique of altering the construction tempo, should a projected wastewater demand trend toward exceeding capacity, the Navy could slow the construction tempo which would reduce construction worker and induced civilian populations, which would in turn reduce the rate of increase in wastewater demand. An example of how this might work is to take the projected flows for year 2014. The projected wastewater demand is an average daily demand of 12.75 MGd, or 0.75 MGd in excess of the anticipated permit level. As previously established, for each $10 M reduction in construction work, there would be an estimated reduction of 75 construction workers and associated 99 induced population reduction, which would result in 996 gpd (0.000996 MGd) reduction for every $1M of construction[3]. To achieve a reduction of 0.75 MGd, then DoD would need to reduce construction tempo by approximately $753 M in that year[4]. With that reduced construction tempo, the anticipated wastewater demand for year 2014 would equal 12 MGd, exactly the anticipated permitted allowance.

In addition to the DoD-controlled adaptive management mitigation discussed in Section 2.3.2, DoD would:

- Work with GWA to expedite the planned improvements and request for a NPDES permit modification to increase the effluent discharge limitation from 6.0 MGd (22.7 mld) to 12.0 MGd (45.4 mld), then comply with its modified NPDES permit requirements

[3] Average wastewater demand calculation for each $1M worth of construction: The demand for additional civilians is estimated at 120 gpcd. The assumption has also been made that two-thirds of the construction workers (2/3 of 75, or 50 per $10M of construction) and 1/3 of the induced civilian population (1/3 of 99, or 33 per $10M of construction) would live in the NDWWTP service area. Thus, for each reduction of $10M worth of construction, the population being served by NDWWTP would be reduced by 83 people, representing 9960 gpd demand reduction per $10M, or 0.000996 MGd per $1M construction.
[4] Supply deficit is 0.75 MGd. Dividing 0.75 MGd deficit by 0.000996 MGd per $1M equals approximately $753M.

- Work with GWA and EPA and GEPA in advance to obtain a provisional permit variance to allow for short term exceedances of the permitted flow limits
- Work with and assist GWA in checking for infiltration of water into DoD collection system and repair as necessary
- Work with GovGuam to divert induced civilian growth and construction worker growth to be housed in areas feeding wastewater to other treatment facilities
- Utilize tanker trucks to ship excess wastewater from the NDWWTP to other treatment facilities on Guam
- Require construction contractor to use a cruise ship or hotel barge docked at a commercial pier and be used as housing instead of areas that feed wastewater to NDWWTP

Potential non-DoD mitigation:

- Adding chemical coagulants or increasing 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 projected additional flow without adverse effects on the NDWWTP

2.3.6 Air Quality

Air quality is not a utility and therefore is not discussed here in terms of supply and demand. However, population increases cause increases in operation of stationary, mobile, and area air emission sources and results in impacts to air quality. Air quality is discussed in terms of permitted activities for stationary sources and impacts to the National Ambient Air Quality Standards (NAAQS) or mobile source air toxics (MSATs).

Even though the air quality impacts discussed in Volume 6 show that major stationary source permit limits will not be exceeded and no significant air quality impacts were predicted in Volumes 2-6 under the preferred alternatives, air quality will decline as a result of implementing the proposed actions. As with the utilities sections above, only the preferred alternatives are discussed in this section.

2.3.6.1 Background

The USEPA, under the requirements of the 1970 Clean Air Act (CAA), as amended in 1977 and 1990 (Clean Air Act Amendments [CAAA]), has established NAAQS for six contaminants, referred to as criteria pollutants (40 CFR 50): carbon monoxide (CO), nitrogen dioxides (NO_2), ozone (O_3) (with nitrogen oxides [NO_x] and volatile organic compounds [VOCs] as precursors), particulate matter (PM) (PM_{10}—less than 10 microns in particle diameter; $PM_{2.5}$—less than 2.5 microns in particle diameter), lead (Pb), and sulfur dioxide (SO_2).

Areas where concentration levels are below the NAAQS for a criteria pollutant are designated as being in "attainment." Areas where a criteria pollutant level equals or exceeds the NAAQS are designated as being in "nonattainment." Based on the severity of the pollution problem, nonattainment areas are categorized as marginal, moderate, serious, severe, or extreme. Where insufficient data exist to determine an area's attainment status, it is designated as either unclassifiable or in attainment. Guam is in attainment with the primary NAAQS, with the exception of sulfur dioxide in two areas: a 2.2-mi (3.5-km) radius of the Piti Power Plant and a 2.2-mi (3.5-km) radius of the Tanguisson Power Plant. (Figure 2.3-3). An emissions inventory shows that the power plants are the major source of SO_2 on Guam.

Both areas are designated nonattainment for sulfur dioxide as a result of monitored and modeled exceedences in the 1970's prior to implementing changes to power generation facilities. In the 1990's both plants were rebuilt, upgrading their emission controls. Guam has submitted a re-designation request to

USEPA. That pending re-designation request shows that they are now in attainment; however, USEPA has not re-designated these areas as attainment for SO_2 to date. Both plants are on the western side of the island. The trade winds blow persistently from east-to-west, further lessening the impact of the SO_2 emissions on the people of Guam from the power plants.

Because SO_2 is a criteria pollutant and the two areas around the power plants are in non-attainment for SO_2, the *de minimis* level established by USEPA applicable to the two non-attainment areas is 100 TPY of SO_2. If the total direct and indirect emissions of a pollutant are above the *de minimis* level, a formal general conformity determination is required for that pollutant. The net increase in SO_2 emissions with potential to emit from the proposed action within the two SO_2 nonattainment areas was predicted for operational and construction activities with potential to occur. As summarized in Chapter 3,Table 3.3-8 annual SO_2 emissions under the preferred alternatives would not exceed the *de minimis* criterion of 100 TPY of SO_2 in both the Tanguisson and the Piti nonattainment areas and a formal conformity determination is not required. A Record of Non-Applicability will be included in the Final EIS.

As discussed in Volume 2, Chapter 5, Air Quality, the EIS/OEIS selected the "major stationary source" definition (250 TPY or more of any air pollutant subject to regulations under the CAA from the Prevention of Significant Deterioration (PSD) program as the threshold for locations that are in attainment for determining the potential significance of air quality impacts from these sources. 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 proposed action and the alternatives under NEPA. However, since the 250 TPY threshold is selected in the context of the *de minimis* threshold established in the GCR providing only an

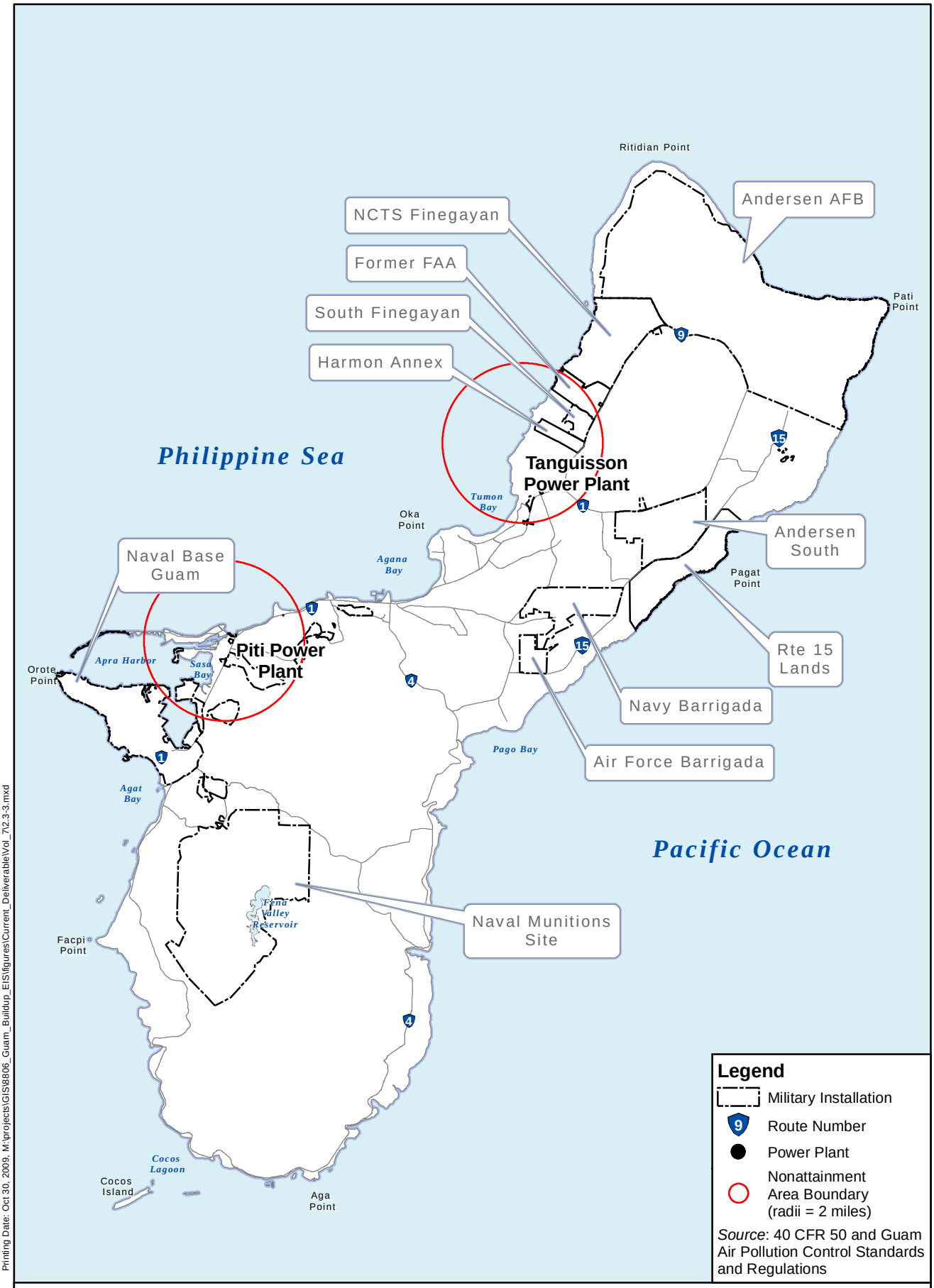

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Figure 2.3-3
Guam SO_2 Non-Attainment Areas

indication of potential significant impact, a further formal impact analysis should be conducted if such threshold is exceeded, where appropriate.

2.3.6.2 Summary of Preferred Alternatives Air Impacts

The Cumulative Impacts chapter of this Volume (Chapter 4) discusses the impacts of all preferred alternatives when combined together, both construction and operations. Please refer to Chapter 3 for a full analysis of air quality impacts on the summary of preferred alternatives.

As discussed in the Cumulative Impacts chapter, the only pollutant that exceeds the 250 TPY threshold is CO for operations in the North area. 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 CO emissions are predicted to exceed 250 TPY under operational conditions, further microscale dispersion modeling performed at the intersections that are likely to have the greatest air quality impacts (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. Volume 7, Chapter 3, Table 3.3-9 lists the intersections and results of CO analysis on Guam that are likely to have the greatest impact on air quality. These intersections showed no exceedances of the CO NAAQS under the preferred alternative.

Additionally, the preferred alternative for power (reconditioning the four combustion turbines) would not exceed the existing permitted capacity established in the CAA Title V permit for the major stationary sources. Therefore, implementation of the preferred power alternative would be in compliance with all required CAA regulations and standards resulting in no significant air quality impacts.

2.3.6.3 Projecting Tipping Point(s) and Action Point(s)

There are no permit exceedences or threshold exceedences anticipated from implementing the proposed actions on Guam. However, it is anticipated that overall air quality will generally decline on Guam as a result of implementing the proposed action due to increased population, increased power usage (increased burning of high sulphur fuels), increased construction and related traffic.

The GovGuam has not collected ambient air quality data since 1991. Therefore, no existing ambient air quality data is available to represent current air quality conditions with respect to the criteria pollutants for which the NAAQS were established. Therefore determining an action point or tipping point as it relates to ambient air quality is not possible.

An action point or tipping point could best be determined by monitoring the data collection effort discussed in the power section of adaptive management. The monitoring data discussed in that section, included testing for fuel sulfur content, weekly monitoring for opacity, and a continuous monitoring system to monitor fuel consumption and the ratio of water-to-fuel being fired in the CTs. This data when added to the population rate projections and the data collected in the power plant itself relating to supply and demand should be used to identify trends correlating with the buildup/construction.

For mobile sources, preliminary coordination with the USEPA has resulted in their request to perform an mobile source air toxic (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 (ASHTO) (ICF International 2007). To comply with USEPA's request as part of the NEPA process, additional traffic analysis will be conducted to generate the information necessary to assess traffic volumes, particularly at intersections, and vehicle-hours for idling heavy duty diesel trucks during peak

construction. The MSAT analysis and results using the method based on the ASHTO report will be presented in the Final EIS, along with the MSAT analysis based on the FHWA guidance that is included in this Draft EIS/OEIS. If the results of the MSAT analysis indicate an adverse air quality impact, potential mitigation measures could be implemented to reduce the impacts.

2.3.6.4 Potential Impacts and Mitigation

Potential impacts associated with a decline in air quality include health risks, visibility and nuisance.

As previously stated, the post-ROD Monitoring Plan would identify mitigation to address significant impacts as a result of the proposed action. Some of these mitigation measures are within DoD control. For those actions that are outside of DoD control, DoD would work with the respective agency to facilitate the mitigative action. Mitigation action employing an adaptive management approach to address the adverse impact on air quality are based on assumptions such as population projections and demand calculations.

Because air quality is not a utility like power, potable water and wastewater, mitigation measures are more difficult to define. However, any mitigation related to reducing power and mobile source emissions would intuitively reduce the impacts to air quality. With respect to the DoD controlled adaptive management mitigation technique of altering the construction tempo, if the Navy slowed the construction tempo reducing population increases associated with construction workers and induced civilian populations, the air emissions would be reduced. The pending MSAT analysis results would also be used as a consideration for avoiding potential significant health risks from on-road vehicle operations during construction periods.

Other potential DoD controlled mitigation includes:

- In cooperation with GEPA, short-term air monitoring sampling for pollutants such as particulate matter and VOC could be considered to monitor potential construction air quality impact around major construction sites in the sensitive neighborhood with lengthy construction duration.
- Assist GovGuam and/or other agencies to determine ways to reduce air emissions as described in the Non-DoD controlled mitigation below.
- The Navy could potentially include the following in the construction contracts:
    - Establish anti-idling requirements for construction vehicles that require vehicles to be shut down if not in use for a set period of time
    - Pursue operational agreements that reduce or redirect work or shift times to avoid community exposures when sites are in proximity to vulnerable populations (e.g., schools)
    - Pursue technological improvements to equipment, such as off-road dump trucks and bulldozers. These could include particulate matter traps, oxidation catalysts, and other devices that provide an after-treatment of exhaust emissions

Non-DoD controlled mitigation includes:

- EPA could cancel waivers allowing GPA to use of high sulphur fuels.
- GovGuam could:
    - Develop and implement a Traffic Management Center to monitor traffic flow and congestion

- Implement the addition of pollution control equipment to reduce emissions at the combustion turbine facility
- Establish speed limit enforcement off DoD property
- Create of buffer zones between new or expanded road alignments and areas of vulnerable populations
- Burn low sulfur diesel fuel in the CTs
- Provide the option of using low sulfur diesel fuel for construction and highway vehicles
- As construction vehicle engines typically idle when not in use, establish anti-idling requirements for construction vehicles that require vehicles to be shut down if not in use for a set period of time
- Pursue operational agreements that reduce or redirect work or shift times to avoid community exposures when sites are in proximity to vulnerable populations (e.g., schools)
- Pursue technological improvements to equipment, such as off-road dump trucks and bulldozers. These could include particulate matter traps, oxidation catalysts, and other devices that provide an after-treatment of exhaust emissions

2.4 POTENTIAL BENEFITS TO OTHER RESOURCE AREAS NOT AS SENSITIVE TO CONSTRUCTION TEMPO

The Navy determined it would focus on the resource areas of power, potable water, wastewater, and air quality for adaptive management techniques because these resources are most likely to be significantly impacted, and are sensitive to changes in peak population during the construction period. If determined to be necessary, the Navy is able to commit to adjusting the intensity and duration of the construction tempo to influence significant impacts for these resource areas as discussed above in Section 3.2. By implementing an adaptive management strategy as a mitigation measure, the Navy may reduce significant impacts on power, potable water, wastewater, and/or air quality as appropriate. Certain other resource areas may also benefit to some degree from the alteration of construction tempo. Still other resource areas may not be affected at all by a reduction in construction tempo. The remaining resource areas are discussed below to indicate how an adaptively managed construction tempo may potentially change the projected impacts previously discussed throughout this EIS/OEIS.

2.4.1 Geological and Soil Resources

The proposed action involves construction of a large number of facilities throughout Guam and other islands. Each of the respective construction actions would involve some degree of changes to geology and/or soils. The impacts of disturbance are related to the locations and amount of construction proposed not the construction tempo. Managing the construction tempo to change construction workforce or induced population would not result in significant changes to the impacts on geology and soils already discussed in this EIS/OEIS.

2.4.2 Water Resources

The proposed action involves construction that would result in some degree of erosion and stormwater runoff. Managing the construction program to alter tempo would influence the amount of erosion and stormwater runoff occurring at any one time, but would not change the overall amount. Erosion and stormwater BMPs and construction permit requirements would result in control and minimization of the impacts for the duration of construction activities. Managing the construction tempo to change construction workforce or induced population would not result in significant changes to the impacts on water resources already discussed in this EIS/OEIS.

2.4.3 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. Altering the construction tempo would likely change the amount of noise experienced at any given time, 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, managing the construction tempo to change construction workforce or induced population would not result in significant changes to the operational noise impacts already discussed in this EIS/OEIS.

2.4.4 Airspace

Impacts to airspace relate to restrictions placed on the use of that space caused by the creation of special use airspace (SUA) associated with aircraft operations and flight paths. The second restriction is from surface danger zones (SDZs) associate with training activities on ranges. Each of these restrictions is associated with the proposed operations taking place as a result of the proposed action, not the construction tempo or population. Managing the construction tempo to reduce construction workforce or induced population would not result in significant changes to the impacts on airspace already discussed in this EIS/OEIS.

2.4.5 Land and Submerged Land Use

Significant impacts on land use primarily result from proposed land acquisitions and required relocations necessary for new infrastructure development. Regardless of construction tempo, the end-state land use impacts would remain the same as discussed in the EIS/OEIS. Analysis of short-term construction impacts in the EIS/OEIS is based on all proposed construction occurring simultaneously to evaluate the maximum potential environmental effects. Managing the construction tempo to reduce construction workforce or induced population would spread out the timing of certain construction projects but would not change the end-state land uses, and thus, would not result in significant changes to the impacts on land and submerged land use already discussed in this EIS/OEIS.

2.4.6 Recreational Resources

Recreational resources both within DoD-controlled property and within the civilian community would be significantly impacted with the implementation of the proposed action. Foreseeable impacts include inadequate or overly crowded facilities such as parking, picnic shelters, restrooms, showers, boat mooring facilities, golf courses, dive spots, etc. These impacts would result from long-term population increases, as well as the short-term construction workforce and related induced population increases. Impacts on these resources are very sensitive to population changes, but given the wide variety of specific resources to monitor, recreational resources is not a good candidate as a driver for adaptive management mitigation techniques. Because it is unknown which specific resources would be impacted or to what degree by the increased construction tempo related population; it is difficult to establish a direct correlation between increase population and impact to a specific recreational resource. However, it is recognized that managing the construction tempo to reduce construction workforce or induced population generally would lessen the impacts already discussed in this EIS/OEIS.

2.4.7 Terrestrial Biological Resources

Potential impacts to terrestrial biological resources would occur from implementing the proposed action. The impacts to the natural environment (e.g. various forested communities and wetlands) would generally be the same regardless of construction tempo as these impacts are associated with actual construction or operational activities. However, the change in construction tempo could lessen the potential impacts to some species. The reduction in construction tempo could provide species a better chance to adapt to construction activities. Other species could benefit from a seasonal change in construction tempo. Still, for other species, the impacts would generally be the same regardless of construction tempo. Therefore, adaptively managing the construction tempo could potentially have an ancillary benefit to some species.

2.4.8 Marine Biological Resources

Potential impacts to marine biological resources would occur from implementing the proposed action. The impacts to the natural environment (e.g., coral and seagrass beds) would generally be the same regardless of construction tempo as these impacts are associated with actual construction or operational activities. However, the change in construction tempo could lessen the potential impacts to some species. The reduction in construction tempo could provide species a better chance to adapt to construction activities. Other species could benefit from a seasonal change in construction tempo. Still, for other species, the impacts would generally be the same regardless of construction tempo. Adaptively managing the construction tempo could potentially have an ancillary benefit to some species; however, it could also result in adverse effects to other species due to prolonged construction activities.

2.4.9 Cultural Resources

It is anticipated that cultural resources would be impacted as a result of direct construction activities and some impact during training activities. Neither of these activities is a function of construction tempo nor construction-related population increases. Managing the construction tempo to reduce construction workforce or induced population would not result in significant changes to the impacts on cultural resources already discussed in this EIS/OEIS.

2.4.10 Visual Resources

A number of construction projects would have substantial impacts on view sheds that are mitigated to less than significant. The impacts are not a function of construction tempo or short-term changes in population. Thus, managing the construction tempo to reduce construction workforce or induced population would not result in significant changes to the impacts on visual resources already discussed in this EIS/OEIS.

2.4.11 Traffic and Marine Transportation

There are two types of transportation that could be impacted by the proposed action: land and marine transportation (not sport fishing, see recreational resources). Marine related transportation impacts are associated with the port and harbor area and the ability to adequately accommodate the increase in container ship traffic. It is understood that any long-term increase in population would require a greater throughput of material at the port; however, the requirement for imported construction related material would also have a greater impact on harbor operations. The degree of impact is more closely related to the construction tempo, not the associated increase in population. Therefore managing the construction tempo to reduce construction workforce or induced population generally would also reduce the throughput of construction materials and lessen the marine transportation impacts already discussed in this EIS/OEIS.

Land based transportation impacts are subject to both construction tempo and population. Changes in construction tempo would correspondingly change the volumes of construction related traffic (equipment and trucks hauling material) on various roads and at intersections. Changes in population as a result of construction tempo would also change the volume of vehicles. Therefore managing the construction tempo to reduce construction workforce or induced population generally would also reduce the materials delivery traffic and work force traffic, lessening the traffic impacts already discussed in this EIS/OEIS.

2.4.12 Solid Waste

The Navy Sanitary Landfill at Apra Harbor has the potential to provide 14 years of capacity and the GovGuam Layon Landfill is scheduled to be completed and begin accepting waste in July 2011. The construction tempo would gradually increase to a peak in year 2014. It is anticipated that existing landfill capacity would accommodate the first two years of construction. As documented in a signed letter with GovGuam, the Navy intends to enter into a contractual arrangement for the use of the Layon Landfill. With the availability of these two landfills and their capacity to handle the anticipated solid waste generated during the construction phase the impacts to solid waste disposal are not considered sensitive to the construction tempo. Managing the construction tempo to reduce construction workforce or induced population would not result in significant changes to the impacts on solid waste already discussed in this EIS/OEIS.

2.4.13 Socioeconomics

There are both beneficial and significant adverse island-wide impacts on the socioeconomics of Guam. The impacts peak in the years 2013 and 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 entail substantial growing pains related to rapid population influx, housing and public service shortages, and cost of living increases, among others. Impacts on socioeconomic resources are very sensitive to population changes, but given the wide variety of specific resources to monitor, socioeconomic resources is not a good candidate as a driver for adaptive management mitigation techniques. However, it is recognized that managing the construction tempo to reduce construction workforce or induced population generally would lessen the adverse socioeconomic impacts already discussed in this EIS/OEIS. A reduced construction tempo could provide GovGuam and the private sector a longer period of time to increase available public services for the increased short-term population increase which may also help alleviate initial shortfalls for the projected long-term population increase.

2.4.14 Hazardous Material/Waste

The proposed action would result in increased transportation, handling, use, and disposal of hazardous materials and hazardous waste. Through the use of best BMPs and standard operating procedures, the Navy would be instituting various controls and safeguards for handling these hazardous materials and wastes and no additional specific mitigation is proposed. The usage/generation of hazardous materials and hazardous wastes is primarily a function of the magnitude of DoD activities, as such, the construction tempo would impact the quantities of materials used and disposed of for any given time period. However, overall quantities and handling would remain the same and there would not be a reduction in total hazardous materials or wastes should the construction tempo change. Therefore, managing the construction tempo to reduce construction workforce or induced population would not result in significant changes to the impacts on hazardous materials and hazardous waste already discussed in this EIS/OEIS.

2.4.15 Public Health and Safety

There are a number of public health and safety issues associated with operational aspects of implementing the proposed action. However based on the various procedures and safeguards that are part of BMPs and standard operating procedures, impacts on public health and safety would not be considered significant. Health and safety impacts from long-term operations are not sensitive to construction tempo. Similarly, potential impacts associated with the increase in construction related population and induced population, such as diseases, other illness, and traffic mishaps that are sensitive to population changes, are not considered significant. While managing the construction tempo to reduce construction workforce or induced population would generally reduce certain public health and safety impacts, it would not result in significant changes to the impacts on public health and safety already discussed in this EIS/OEIS.

2.4.16 Environmental Justice and Protection of Children

The proposed action would have significant impacts or impacts mitigated to less than significant on traffic, cultural resources, noise, water quality, and socioeconomics that have potential to affect low income or children populations. The proposed action, however, would not have any disproportionate impacts on low-income populations or children. While managing the construction tempo to reduce construction workforce or induced population could generally lessen the short-term impacts, it would not result in significant changes to the impacts on Environmental Justice and Protection of Children already discussed in this EIS/OEIS.

CHAPTER 3. PREFERRED ALTERNATIVES: SUMMARY OF IMPACTS

3.1 INTRODUCTION

Chapter 3 summarizes the construction and operational impacts of the preferred alternatives for Guam and Tinian that were presented in previous volumes. Those impacts are compared to the existing trends in resources to determine whether the preferred alternatives would adversely impact the overall health of each resource.

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 from previous volumes.

3.2 PREFERRED ALTERNATIVES' DEFINITION

The term preferred alternatives 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 proposed actions occur concurrently. To assess a maximum potential adverse effect, it is assumed that proposed construction actions would occur during a compressed period. 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.

The construction impacts would presumably peak in 2014, and that is the point of reference used for describing 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 planned mitigation 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 continue unchanged for an undetermined amount of time into the future. It would represent the long-term impact of the preferred alternatives in isolation of reasonably foreseeable actions.

Relative to the construction phase, the operational phase would 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 preferred alternatives' impacts from Volumes 2 through 6:

    a. Consolidate the findings of the preferred alternatives' impact analyses presented in previous volumes of the EIS/OEIS, by resource area. This is done for an anticipated construction peak in 2014 and the post-construction operational steady-state. 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. A second assumption is the 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 criteria. Identify the highest level of adverse impact indentified among the volumes for that criteria and designate that significance level as the summary of impacts for the specific criteria. This list represents the summary of the preferred alternatives impacts from Volumes 2 through 6 for all preferred alternatives for Guam. There are exceptions to this method based on the specific resource, as noted in the discussions by resource. 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.

   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 and a separate summary of impacts as a whole is not warranted. The preferred alternatives' impacts in Volume 3 are essentially a summary of impacts for Tinian. These findings are reiterated.

2. Describe no action for each resource. Describe the island-wide (Tinian and Guam) trends in resource health for each resource in the absence of any of the preferred alternatives described in this EIS/OEIS. This is referred to as "no action". 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 Volume 2 through 6. Under no action, each resource is described in terms of its ability to accommodate additional effects or stress.

   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. 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.

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, 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 principal 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 together under each resource. A summary table summarizing the findings for all resources is presented after the resource discussions.

3.3.2 Geological and Soil Resources

3.3.2.1 Summary of Preferred Alternatives' Impacts

Most impacts on geological and soil resources are less than significant during construction and operation. The only significant impact identified is to topography at Finegayan because of the large amount of construction (approximately 1,093 ac [422 ha]) that would occur. When summarizing the total impact on geology and soils for Guam the significance is reduced to less than significance because the significant impact is localized and would not impact the entire island.

During site planning, sinkholes and karst caves were identified and avoided. A buffer zone of vegetation would remain around them through construction and operation to prevent further erosion or expansion on Tinian and Guam. Minimal 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. The ground disturbance is much less on Tinian than on Guam. With the implementation of protective measures, including requirements for stormwater compliance, there would be no significant impacts from soil erosion during construction or operation. Soil types lost would not be agriculturally productive soils. Topographic or landscape features would not be changed substantively by the proposed actions and the preferred alternatives are not located in a seismically-active zone.

Construction on previously disturbed land such as Apra Harbor and South Finegayan is less likely to impact soil and geological resources. Liquefaction is a risk at Apra Harbor, but impacts to development would not be significant.

The preferred alternatives would have an overall less than significant impact on geology and soils during construction. Operational risks are limited to geologic hazards. There is ahigh 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 to reduce risk of damage to structures from seismic hazards. The risk cannot be reduced to zero; therefore, a less than significant impact remains.

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

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

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

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

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

Legend: SI = Significant impact, 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 are a function of both 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 construction projects that did not employ BMPs, wildfires, and even wildlife such as ungulates. 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 occur without the preferred alternatives being implemented.

Soil erosion on Guam and Tinian has historically been a problem due to natural and anthropogenic influences. While the trend has improved with the adoption of federal non-point source regulation since WWII, the increase in erosion and the ongoing effects of historical influences is likely to continue into the near future. This adverse trend in soil erosion is considered a significant impact under no action, Future construction projects, would have less than significant impact because BMPs, outlined in an erosion Control Plan, would be required for erosion and stormwater management. There are other measures to address the ongoing problem such as ungulate control, planting exposed soils, enforcement of existing policies and laws, and passing new laws to reduce impacts.

Surface runoff and sediment losses from soil erosion are major contributors to 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 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 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. 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, and existing badlands and exposed soils. The island-wide no action trend in erosion due to pre-existing conditions would continue to increase with significant but mitigable impact.

The preferred alternatives for Tinian would not significantly impact topography at the specific site and there would be no significant effect on island-wide topography. Under no action there would potentially be localized impacts to topography from planned construction activities that would also be considered less than significant.

Guam and Tinian have a history of earthquake activity. Geologic hazards also include sinkholes and karst features that would always limit developable areas on both islands. Geological surveys would continue to ensure that construction is not planned in areas where geological hazards could lead to structural problems by creating buffer zones around sinkholes. There may be impacts in localized areas of construction, but island-wide there would be no operational impact. During preferred alternatives operation and no action, there would continue to be a risk with less than significant impacts.

3.3.3 Water Resources

3.3.3.1 Summary of Preferred Alternatives' Impacts

The following has been determined at all sites regarding impacts to water resources as a result of all of the preferred alternatives:

- Increases in stormwater would be managed by existing or new stormwater infrastructure and stormwater flow paths would continue to mimic area topography.
- Stormwater would continue to be managed in accordance with laws, regulations, and plans which would reduce potential impacts to groundwater and nearshore waters.
- Through the development and implementation of site-specific BMPs, Low Impact Development (LID) measures, and facility-specific plans and procedures, there would be no increased risk from environmental hazards or to human health.
- 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.
- 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 of groundwater chemistry and overlying sediments would ensure no harm to existing or beneficial use, and no damage to structures, utilities, or other facilities due to potential soil settlement or saltwater intrusion.

- With the implementation of dredge-specific mitigation measures for the dredging of Apra Harbor, impacts to nearshore waters would be less than significant.
- Dredged material dewatering sites would not be located over areas with groundwater not used for groundwater production; dredge effluent that percolates into the underlying soils would not affect groundwater drinking quality or quantities.
- Increased groundwater production could potentially impact cave and pool water levels; potential impacts to the system could require review and/or permitting by the U.S. Army Corps of Engineers (USACE).
- 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.
- With the implementation of 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.
- All actions would be implemented in accordance with all applicable federal, Government of Guam (GovGuam), and military orders, laws, and regulations, including Commander Navy Region (COMNAV) Marianas Instruction 3500.4 (COMNAV Marianas 2000).

During construction, the preferred alternatives could result in temporary increases in stormwater runoff that would be reduced to less than significant levels through the use of BMPs. There may be less than significant indirect impacts to wetlands and nearshore waters due to sedimentation on Guam. There are planned dredging projects under the preferred alternatives in Apra Harbor that would temporarily impact the water quality of nearshore waters. BMPs would limit the impacts to the dredge area.

The same water quality impacts on Guam during construction are anticipated on Tinian, except 1) there may be direct impact (fill) of 0.3 ac (0.12 ha) of a potential jurisdictional wetland, and 2) no dredging is proposed. The wetland delineation on Tinian has not been verified and it is likely the final quantity of wetlands would decrease or the firing range would be modified to avoid wetlands, to the extent practical.

Table 3.3-3 lists impacts to water resources under all preferred alternatives are summarized in the following discussion. If there is a direct or indirect impact it is indicated in the table. If that impact can be quantified, an area of fill is listed.

Table 3.3-3. Summary of Construction Impacts to Jurisdictional Waters of the U.S. and Wetlands

Volume	*Component Action*	*Jurisdictional*		*Impacted Feature*
		Waters (Area ac/ha)	*Wetlands*	
2	Dredging	Direct impact	Indirect impact	Inner Apra Harbor
	In-Water Construction	Direct	-	Inner Apra Harbor
	Landing Ramps	0.02/0.01	-	Inner Apra Harbor
3	Platoon Battle Course	-	0.3/0.12	Palustrine wetland
4	Dredging	Direct	Indirect	Outer Apra Harbor
	Wharf Rip Rap	3.6/1.45	-	Outer Apra Harbor

Legend: - = no impact

Tables 3.3-4 and 3.3-5 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.

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

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

Table 3.3-5. Summary of Preferred Alternatives Operation Impacts – Water

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

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

During operations, stormwater would be managed on-site. There is 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 on Guam would result in a beneficial impact of improved water quality. There may 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 impact. However, 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 groundwater drinking quality or quantities.

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, 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 is 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 and coordination amongst water users, as well as potential designations for groundwater resources is expected to ensure there is a dependable, safe supply of groundwater for Guam/Tinian users. In time, groundwater quality is 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; sewer system overflow and failure; agricultural runoff (e.g., animal wastes, fertilizers, and pesticides); urban runoff; erosion from stream beds, construction sites, and derelict land; leaks and spills; and landfill leachate. 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. 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 continue to 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 is expected to slowly improve as point and non-point sources of pollution are identified and corrected.

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 area and function are of 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 is expected to slowly improve as point and non-point sources of pollution are identified;

however, the extent of wetlands (by acreage) is not expected ot increase. The emphasis of agency efforts is to reduce future losses of wetlands.

3.3.3.3 Comparison of Preferred Alternatives to No Action

Under no action, the existing primary threats to surface water, groundwater, nearshore water, and wetlands would continue on Guam and Tinian. Over time, more development and ground disturbance would occur on federally-controlled and non-federally controlled lands. Local and federal regulations applicable to development projects would mitigate potential construction impacts on wetlands and water. Stormwater management during construction and operations would continue.

There would continue to be feral ungulates and invasive plant species and natural events that contribute to erosion on Tinian and Guam but the preferred alternatives would not exacerbate the ongong impacts on water quality due to soil erosion. As compensation mitigation for coral community impacts under the preferred alternatives in Apra Harbor, watershed management projects are proposed that would address some of the erosion issues in specific watersheds on th southwest coat of Guam.

During operations, the preferred alternatives would not appreciably impact the existing trend 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 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. For air quality, construction data is 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

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

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

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

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

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

There would be less than significant adverse impacts to air quality under construction and operation for Guam and Tinian. Construction and operation emissions from the preferred alternatives would be below significance criteria of 250 tons per year (TPY) for air pollutants adopted in the EIS/OEIS with an exception for the operational carbon monoxide (CO) emission level primarily generated from on road vehicle operations.

As discussed in Volume 2, Chapter 5, Air Quality, the EIS/OEIS 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 is used as the criteria for locations that are in attainment for determining the potential significance of air quality impacts from these sources. 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 is selected in the context of the *de minimis* threshold established in the GCR providing only an indication of potential significant impact, a further formal impact analysis should be conducted if such threshold is exceeded, where appropriate.

Based on a more refined CO concentration modeling analysis for on road vehicle operational impact described in Volume 6, no exceedances of the CO National Ambient Air Quality Standards (NAAQS) were predicted at the location of 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 were also 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.

Greenhouse gas (GHG) emissions into the atmosphere are of concern because they contribute to global warming by trapping re-radiated energy. The total quantity of GHG emissions are expressed in terms of carbon dioxide (CO_2) emissions resulting under the preferred alternative. CO_2 is not a criteria pollutant and the 250 TPY significance threshold is not applicable to CO_2. GHGs are 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.

The issues covered in this section respond to public concerns raised during scoping meetings including: increases in vehicle and vessel emissions (mobile sources), increases in emissions from existing power

sources, increase in construction-related emissions, and compliance with the GCR in siting project facilities, and project elements that would be major contributors to GHGs.

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 roadways in each Guam ROI (Volume 6, Alternative 1).

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

Table 3.3-8. Guam Annual Emissions – Preferred Alternatives

	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	21.9	16,490.5
	2012	74.6	111.1	21.3	16.8	109.5	29.4	20,317.8
	2013	116.1	156.4	32.4	36.7	167.4	37.8	31,464.8
	2014	63.6	116.0	26.0	16.1	99.2	38.1	18,467.9
	2015	19.6	53.5	23.2	8.0	35.3	22.1	6,326.9
Operation	2017 and on	120.1	**2,997.7**	76.2	53.2	205.2	221.1 –223.0	180,215.5 – 186,134.2

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

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 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 would result primarily 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 of highest anticipated level 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 highest level of emissions on Guam that were analyzed for CO concentration levels. Consequently, overall potential air quality impacts would be less than significant under the preferred alternative.

Table 3.3-9. Intersections Analyzed 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. As the preferred alternative would potentially involve activities in Piti and Tanguisson SO_2 nonattainment areas, the GCR is applicable to those proposed activities within the nonattainment areas. Therefore, a subsequent general conformity applicability analysis is required.

The *de minimis* level established by USEPA is 100 TPY of SO_2, and it is applicable to the two non-attainment areas on Guam, Piti and Tanguisson. If the total direct and indirect emissions of a pollutant are 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 and a formal conformity determination is not required. A Record of Non-applicability will be included in the Final EIS.

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

	Year	*SO_2 (TPY)*
Construction	2011	8.6
	2012	12.6
	2013	15.5
	2014	15.5
	2015	18.2
	2016	12.9
Operation	2017 and on	8.3
	de minimis level	***100***

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

	Year	*SO_2 (TPY)*
Construction	2011	2.4
	2012	2.4
	2013	2.4
	2014	2.4
	2015	1.6
	2016	1.6
Operation	2017 and on	0.9
	de minimis level	**100**

Greenhouse Gases

The predicted construction CO_2 emissions range from about 16,490 to 31,464 TPY from 2011 to 2014 (see Table 3.3-8) and the predicted operational CO_2 emissions range from about 180,216 to 186,134 TPY from 2015 on (Table 3.3-8). The upper end of the range would primarily be due to vehicular emissions. In 2007, the U.S. generated about 7,879 million tons of CO_2 emissions (USEPA 2009). The operational CO_2 emissions from the preferred alternatives would result in a roughly 0.002% increase over the U.S. 2007 CO_2 emissions.

However, 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 and 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 particularly applicable under the operational conditions, resulting in an insignificant impact to global climate change.

On Tinian, all air emissions would be well below the significance threshold of 250 TPY for air pollutants subject to regulations under the CAA for both construction and operation as shown on 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

	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	N/A
	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

3.3.4.2 No Action

The future traffic growth would likely result in an increase in mobile source emissions at Guam. However, the improvement of mobile source engine emissions in the future as per CAA requirements would contribute 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 would 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, as the cleaner fuel becomes available at 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 from 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 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 condition applicable 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 at 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 under no action on Tinian 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 alternative there would be less than significant effects on criteria pollutants including those in existing nonattainment areas from all construction and operation components. The GHGs effects would also be considered less than significant. Under no action, there would be essentially no impact since the air quality conditions would remain the same as the existing condition. 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

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 to 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.

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

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

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant,
LSI = Less than significant impact,; LSI* = Noise impacts are short-term and localized.

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

Potential Impacts	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*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	LSI	NA	NA	NA	NA	NA	NA	NA	LSI	LSI
Other Operations	NA	NA	NA	NI	NI	NI	NI	SI	SI	NA
Noise Operation 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

There are adverse impacts associated with construction of the preferred alternatives on Guam and Tinian. The sensitive receptors are most likely impacted by roadway improvements because of proximity. These impacts would be temporary.

Noise levels associated with the preferred alternatives would increase locally by one or two decibels (dB) 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 Route 15 training ranges would result in noise levels that are considered incompatible with residential use. There are very few residences in the vicinity but community master plans may result in higher density residential. The most effective BMP would be constructing the berms and would reduce noise levels 10-15 dB. Using BMPs could reduce the noise levels to less than significant levels. The use of BMPs is assumed in the summary of impacts. The roadway noise is a significant impact in the north and central areas of Guam and mitigation has not been determined. Noise walls are potential mitigation, but they have adverse impacts on views.

The construction and operational impacts on Tinian are less than significant. Island-wide noise impacts would not occur for either construction or operation because noise is generated at a source, 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.

3.3.5.2 No Action

Unlike for some other potential impacts, most human activities generating noise impacts are localized and do not affect the entire islands of Guam or Tinian. Traffic could be considered an exception in that 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 noise. Regionally, northern Guam would continue to experience noise from Andersen AFB aircraft, Northwest field training, small arms firing at NCTS Finegyan, 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, there are fewer noise sources than the rest of the island and the noise levels would likely continue at the same levels. The *Guam 2030 Transportation Plan* would improve roadways on Guam, but significant noise impacts are not anticipated once the construction is complete. Large population and traffic increases, and significant noise impacts are not anticipated.

On Tinian, the major noise generators would continue to be Tinian Airport operations, current military activities and minor traffic.

3.3.5.3 Comparison of Preferred Alternatives to No Action

The "peak" for noise impacts is construction-related direct impacts due to the preferred alternatives. Construction noise under the preferred alterantives or no-action would not likely be an issue because such activities are localized. Construction noise impacts would be short-term, ceasing when the construction project is completed. An adverse significant impact would only emerge when multiple construction activities occur in a compressed time period and immediately adjacent to one another and in proximity to sensitive receptors. Construction would be localized and occur predominately during daylight hours (except for Apra Harbor dredging, with no noise impact island-wide).

Long-term operation noise impacts would be related to the increased traffic on the Guam roadway network under th epreferred alterantives. Traffic noise would be most evident in northern and central Guam and around Apra Harbor, and less so in southern Guam. Overall, the island would experience a significant increase in traffic noise due to the increased number of motor vehicles on the island. This impact would not be realized under no action.

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 above 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 - Air Space

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

Legend: NA= Not applicable

Table 3.3-16. Summary of Preferred Alternatives Operation Impacts - Air Space

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

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

The preferred alternatives on 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.

New Special Use Airspace (SUA) in the vicinity of Northwest Field is required for training, but would not require any changes to existing arrivals and departures from the commercial airport. There would be no en route low-altitude airways. The impact on this airspace action on air traffic control and airspace users is anticipated to be moderate, but less than significant, until new procedures have been in effect for a few months.

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 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. 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 and departure traffic flows, due to the increase in military aircraft assigned to Guam.

On Tinian, 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 need to change. Approach and departure patterns associated with the airports and airfields would not be restricted, nor would they be required to change.

Well-established and understood aviation procedures and 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 individually for the preferred alternatives discussed in each volume.

3.3.6.2 No Action

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.

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

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. 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

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

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact * LSI is assigned as overall summary impact instead of SI-M, because the SI is mitigable through TPM

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

Potential Impacts	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Land Ownership										
Land	SI-M	NI	NI	NI	NI	LSI	NI	SI-M	SI-M	NI
Submerged Land	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Land Use										
1. FPPA	NI	NI	NI	NI	NI	NI	NI	NI	NI	SI
2. Consistency with existing or proposed land use:										
DoD land	LSI	NI	NI	NI	NI	NI	NI	NI	LSI	LSI
DoD submerged lands	BI	NI	NI	NI	NI	NI	NI	NI	BI	NI
Non-DoD land	LSI	NI	NI	NI	NI	LSI	NI	LSI	LSI	NI
Non-DoD submerged lands	LSI	NI	NI	NI	NI	NI	NI	NI	LSI	NI
3. Public Access	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Land Ownership Summary:									**SI-M**	**NI**
Land Use Summary:									**LSI**	**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; temp= temporary construction – related impact

The following findings were common to the preferred alternatives:

- No submerged lands would be acquired.
- Land use within Department of Defense (DoD) property boundaries is consistent or compatible with proposed land uses in the vicinity.
- No significant impact on agricultural productivity was identified on Guam.

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 and nearby properties. The Traffic Management Plan (TMP) prepared for the project shall 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. The TMP would mitigate construction phase impacts to less than significant.

There would be a significant mitigable 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. This impact could be mitigated through long-term leases of the property instead of purchase; however, this may not be possible in all cases and the significant mitigable level of impact is retained in the summary of impact. There would also be relocations, and land acquisition or long-term

lease for roadway improvements. Utility distribution lines would generally be within existng rights-of-way, but new alignments would also require new easements.

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. Less than significant land use consistency impacts were identified on federally controlled land due to increase area under noise contours on Andersen AFB. Less than significant impacts due to firing range land use being inconsistent with surrounding designated land use. Access to GovGuam submerged lands and the natural and cultural resources in the range areas would be restricted during training.

No change in land ownership or lease covenant is proposed on Tinian. On Tinian, many and possibly all of the agricultural/grazing permits within the Lease Back Area (LBA) would be terminated, causing 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. In keeping with the intent of the FPPA to protect agricultural land, the termination of permits is considered a significant impact. Current permits within LBA account for 2,552 ac (1,032 ha) of the 11,956 ac (4,838 ha) agricultural-designated land use on Tinian (including grazing land, crop land, plantation orchard and mixed agricultural) total that represents approximately21% of total agricultural lands on the island. The leases are subject to termination at military discretion and no mitigation was identified.

The decrease in public access to the Military Lease Area (MLA) is an adverse impact, but considered less than significant because it is federally controlled land. There are other adverse iapcts idneitifed under socioeconomics.

3.3.7.2 No Action

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 Navy 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 Navy 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. No change to submerged lands ownership is anticipated.

Community plans, and zoning and building codes direct land development and use on Guam and Tinian. Community plans do not accelerate development, but guide land development in accordance with community values. The *North and Central Guam Land Use Plan* (Bureau of Statistics and Plans 2009) has not been adopted by legislature. It addressed the EIS/OEIS alternatives based on preliminary notional plans, that identified most development in the northern/central Guam, including development of NCTS Finegayan area. The proposed military land use would be consistent with this plan. Once the EIS/OEIS record of decision is published the community plan may need to be revisited to capture the final development decisions.

The plan designates uses of lands that were once designated agricultural, but there are areas reserved for agricultural use. As development pressure increases and the interest in farming decreases, there is pressure to develop agricultural lands. Community plans help to retain sufficient lands for agricultural use.

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

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

The amount of MLA on Tinian has remained relatively constant is recent years and is likely to remain the same in the near future. There are federal submerged lands and no change is anticipated to submerged land ownership.

There are two resorts being planned for Tinian that would impact agricultural lands and the impacts could be significant. No other significant changes in land use are proposed. A master plan is being prepared for Tinian that would presumably ensure the planned land uses are consistent with community values and adjust zoning accordingly. The general trend on Guam is a decrease in agricultural land use as development increases. There is a trend of declining interest in farming by younger generations.

3.3.7.3 Comparison of Preferred Alternatives to No Action

The impact of the proposed increases in federal land reverses a 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 and the increase is considered an adverse impact. The impacts of the proposed island-wide increase in federal land are being addressed in the Land Acquisition Impact Study portion of the Socioeconomic Impact Assessment Study that is being developed and would be available as part of the Final EIS.

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; but the number of landowners affected would be smaller than proposed under the preferred alternatives.

The removal of the SDZ on the west coast of NCTS Finegayan has a beneficial impact because there are popular SCUBA sites in the submerged lands. Under no action, the SDZ would remain and submerged land access would continue to be limited to non-training days. Under no action there would not be extensive areas of public access restrictions to submerged land and land restricted and access is restricted during training.

The preferred alternatives land uses are generally consistent and compatible with adjacent land uses and land use plans, with exceptions around the porposed firing ranges on the east coast. 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.

There are gradual declines in agricultural land use on Guam under no action, but the preferred alternatives would not contribute to that decline on Guam, except for an agricultural lease at Andersen South. The preferred alternatives on Tinian would have an impact on agricultural/grazing permits that would not occur

under no action. However, no action does include large-scale development that could also affect agricultural uses.

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 recreation use are mostly long-term impacts, although there are short-term less than significant impacts during construction-related activities impeding 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

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

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

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

The implementation of the preferred alternatives would result in the presence of the new permanent population comprised of the Marines, Army personnel, civilian workers, and their dependents, and temporary population formed by construction personnel, on Guam. These persons would be potential users of Guam's recreational resources and would contribute to an increase in the number of users to the existing DoD, Federal, and public recreational resources on Guam.

The increased number of users at the recreational resources (refer to Appendix G: EIS/OEIS Resource Technical Appendix, Recreational Resources for a list of resources assessed) would result in increased competition for the available opportunities at different recreational resources. Most of the popularly visited recreational resources attract a constant flow of off-island and resident (including military and dependents) users. The degree of impact on the recreational resources is likely to be higher on weekends and holidays, and during summer/winter 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) needs 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 to the military, dependents, and civilian workers, impacts to recreational resources on Guam would be alleviated, benefitting the residents and off-island tourists as well. The implementation of the preferred alternatives would result in the loss of some recreational resources in the lands adjacent to Route 15, which would be acquired for the use for training activities and ranges. Currently, mitigation measures are suggested 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 at Polaris Point involving dredging work, 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 comprising of the visiting sailors would increase competition for the available opportunity 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.

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 recreation activities have kept pace with population shifts while other activities have become more popular. The following outdoor recreation 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 use of the public recreational resources. The impacts to the public recreational resources would continue to be centered on the need for better facilities, more facilities, more funding, and better management (GCORP 2006). Seventeen organizations comprising of various sports associations, civic, and private organizations participated in a survey conducted by the GovGuam, Department of Park 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 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 partnership with federation
- Need for better communication
    - 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 the recreational resources would be largely long-term and singularly affecting the use aspect of each recreational resource. The new permanent population resulting from the implementation of the preferred alternatives would result in users competing for the available recreational opportunity (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 and bicyclists, and equestrians competing for the use of trail), and increased deterioration of recreational resources resulting from frequent use by more persons. The preferred alternatives would not adversely affect the access aspect of recreational resources, short term or long term. An exception exists in the 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. Similar to the preferred alternative, there is no concern for loss of access to the existing recreational resources. 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 on lesser degree under no action. Nevertheless, it is recommended that a recreation 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 preferred alternatives' construction and operation impacts to terrestrial 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 3.3-21. Summary of Preferred Alternatives Construction Impacts - Terrestrial Biology

Potential Impacts	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Vegetation	SI	LSI	LSI	NI	LSI	LSI	NI	LSI	SI	LSI
Wildlife	LSI	SI-M	LSI	NI	LSI	LSI	NI	LSI	SI-M	LSI
Special Status Species	SI-M	SI-M	SI-M	NI	SI-M	NI	NI	SI-M	SI-M	SI-M
Terrestrial Biology Construction Summary:									**SI**	**SI-M**

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

Table 3.3-22. Summary of Preferred Alternatives Operation Impacts - Terrestrial Biology

Potential Impacts	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Vegetation	LSI	NI	NI	NI	NI	NI	NI	NI	LSI	LSI
Wildlife	LSI	SI-M	LSI	NI	NI	NI	NI	NI	SI-M	LSI
Special Status Species	SI-M	LSI	SI-M	NI	NI	NI	NI	NI	SI-M	SI-M
Terrestrial Biology Operation Summary:									**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

A summary of direct impacts for all preferred alternatives in this EIS/OEIS 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 vegetation 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 Impacts on Guam and Tinian Vegetation Communities

Island	*Limestone Forest, Primary (ac)*	*Limestone Forest, Disturbed* (ac)*	*Scrub/Shrub/ Tangan-tangan (ac)*	*Ravine (ac)*	*Savanna (ac)*
Guam vegetation cleared due to preferred alternatives	28	1,549	482	4.3	20
Tinian vegetation cleared due to preferred alternatives	0	173	68	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 (may affect, is likely to adversely affect); the impacts under NEPA would be mitigated to less than significant. [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 (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 - significant impact (may affect but is not likely to adversely affect); the impacts under NEPA would be mitigated to less than significant. [V4]
- Hawksbill sea turtle - significant impact (may affect but is not likely to adversely affect); the impacts under NEPA would be mitigated to less than significant. [V4]
- Fire tree – no impact (no effect). [V2]

ESA Candidate and Guam-Listed Species:

- Guam tree snail - significant impacts mitigated to less than significant. [V2, V5, V6]
- Humped tree snail - significant impacts mitigated to less than significant. [V2]
- Fragile tree snail - significant impacts mitigated to less than significant. [V2]

ESA Candidate Species (not Guam-Listed):

- Mariana eight-spot butterfly - less than significant impacts. [V2]

Guam-Listed Only Species:

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

Tinian

ESA- and CNMI-Listed Species:

- Mariana fruit bat – less than significant impact, (may affect, but is not likely to adversely affect).
- Micronesian megapode - less than significant impact (may affect, but is not likely to adversely affect).
- Mariana common moorhen - significant impact (may affect but is not likely to adversely affect); the impacts under NEPA would be mitigated to less than significant.
- Mariana swiftlet – no impact (no effect).
- Green sea turtle – no impact (no effect).
- Hawksbill sea turtle – no impact (no effect).

ESA Candidate Species:

- Humped tree snail – no impact.

CNMI-Listed Only Species

- Tinian Monarch – significant impacts mitigated to less than significant.
- Micronesian gecko – less than significant impacts.

A summary of direct impacts for all preferred alternatives for special-status species habitat is shown in Table 3.3-24. That table includes an estimate of island-wide acreages. The island-wide loss of special-status species habitat, due to clearing of vegetation required by the proposed construction projects, ranges from 1% to 6%. Because most species currently very restricted in range, such as the Mariana crow with only two individuals known left on Guam, and the Micronesian kingfisher and Guam rail exist only in captivity, only habitat would be affected and not individual species. An exception is the fruit bat which,

although the main colony on Andersen AFB is thought to number 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 and the best estimate of the total number of individuals remaining is several thousand. During operation, there are noise impacts from training that may significantly impact the endangered Mariana fruit bat, Micronesian kingfisher, and Mariana crow either at present or if they re-occupy or are re-introduced to essential habitat in the future.

Table 3.3-24. Potential Impacts on Special-Status Species Habitat - Preferred Alternative

	Guam				*Tinian*
	*Overlay Refuge**	*Essential Habitat – Bat and Kingfisher**	*Essential Habitat – Crow**	*Crow Recovery Zone**	*Tinian Monarch Habitat*
Island Total = no action *ac (ha)*	21,690 (8,778)	24,802 (10,037)	23,004 (9,309)	35,360 (14,310)	11,368 (4,600)
Loss due to Preferred Alternatives Construction *ac (ha)*	1,286 (520)	629 (255)	575 (233)	1,487 (602)	174 (70)
Percent loss on island due to preferred alternative	6%	2.5%	2.5%	4%	1.59%

Note: *Each habitat category is considered independently of others and are not additive.
**Habitat (MLA only) is considered to be native and mixed introduced forest, tangantangan,and Casuarina forrest.

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 directly affected at Andersen AFB because it is present or potentially present in operation areas. The amount of Overlay Refuge affected, using a 492 ft (150 m) distance would be 254 ac (103 ha). Other species and fruit bats at other locations would be indirectly affected because they are not present (or rarely present). The acreage just listed for Andersen AFB would also include all areas indirectly impacted. At Finegayan the Overlay Refuge affected would be greatest for the fruit bat at 254 ac (103 ha), again using the 492 ft (150 m) distance. At NMS, the Overlay Refuge affected would be greatest for the Mariana crow at 366 ac (148 ha), using a 984 ft (300 m) distance. Much of the Overlay Refugeaffected within this distance is savanna.

On Tinian, the acreage affected would potentially remove habitat for 408 Tinian monarchs based on recent bird density estimates. There is limited information available regarding impact of training noise on the Tinian monarch, but there may be a significant impact to areas surrounding proposed ranges. To evaluate this potential, monitoring of the species in areas surrounding the ranges would be conducted to determine potential noise impacts. If this monitoring determined that the Tinian monarchs are being affected, techniques to reduce noise generation, such as noise barriers, would be employed.

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 great concern is the potential unintentional introduction of the brown tree snake (BTS) to other islands throughout the Pacific from Guam. 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.

3.3.9.2 No Action

Under no action, existing stressors that degrade habitat quality would remain and the present declining trends for terrestrial biological resources would continue. These 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. On Guam the introduction of the BTS has been the primary cause of the elimination of 9 of 12 native forest birds of Guam since invading Guam as a stowaway about 50 years ago. 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.

Under no action, limestone forest areas are being degraded by invasive plants, in particular the canopy tree *Vitex*, and this trend would continue. 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 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. During WWII, the sugarcane plantations and most remaining native vegetation were destroyed by military campaigns and military construction. After the war, the DOD may have seeded the island with tangantangan, a rapidly growing tree that is not native to the Marianas, to slow erosion. Currently, the vegetation on Tinian is highly disturbed, with tangantangan thickets being an abundant habitat type. Based pm 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

There are existing DoD and non-DoD conservation measures that would continue under no action. Ongoing efforts to manage terrestrial resources on military lands would continue in accordance with Air Force and Navy Integrated Natural Resource Management Plans (INRMPs), which include measures mandated by Biological Opinions and voluntary DoD conservation measures that are not regulatory requirements. The INRMPs are 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 the following components: 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 stand alone BTS Interdiction and Control Plans that are implemented by the military services.

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

GovGuam agencies captive-breed endangered birds (Guam rail, Mariana crow and Micronesian kingfisher), controls predators and invasive species (mainly snakes and cats) in support of released birds, and promotes 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 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 the monitoring of native species populations on Guam to provide information to guide management activities and review of development project plans.

A biosecurity plan is being prepared that covers basic principles that would be applicable even under no action. The GovGuam would decide whether to implement the plan if there were no Marine Corps relocation.

Threatened and Endangered Species Population Trends

The threatened Mariana fruit Bat (fanihi), a subspecies of a bat found in other areas of Micronesia, once occurred throughout the Mariana Islands including in Guam in forested areas that formerly 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, with 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 on Guam only, in the belief that bats on Guam formed a separate population from those in 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, and consumption of bats represents a significant cultural tradition. Although hunting of bats has been illegal under 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, was close to becoming extinct, along with the majority of Guam's other avifauna. 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 numbered 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 reestablish a wild population.

On Guam, the endangered Mariana crow historically been found throughout forested areas and were considered common, even 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, 2 crows translocated from Rota as eggs and/or chicks, are found in 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 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 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 Tinian monarch is an endemic species that nests in limestone forest, secondary forest, and tangantangan forest habitats. It was federally delisted in 2004 (USFWS 2004) but is still listed as threatened/endangered by the CNMI government. Although the Tinian monarch is no longer ESA-listed, the species is currently being monitored. Native tree species are preferred monarch nesting sites. 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) has estimated essential 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. 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 will not recover. Mitigation for preferred alternatives' impacts to the ESA listed species, as summarized in the volumes of this EIS/OEIS, would 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 have been successes, it is unlikely under no action conditions and funding level 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 Biology

Potential Impacts	*GUAM*									*TINIAN*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste-water*	*Solid-Waste*	*Road-ways*		*Training*
Marine Flora and Invertebrates	LSI	LSI	NI	NI	NI	LSI	NI	LSI	LSI	LSI
Fish and EFH	LSI	SI-M	NI	NI	NI	SI*	NI	LSI	SI-M	LSI
Special-Status Species	LSI	LSI	NI	NI	NI	NI	NI	LSI	LSI	LSI
Non-Native Species	LSI	LSI	NI	NI	NI	NI	NI	LSI	LSI	LSI
Marine Biology Construction Summary:									**SI-M**	**NA**

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact; SI* Preferred Alternatives would result in a significant localized impact near the wastewater discharge because there would be exceedances of Guam Water Quality Criteria (GWQC) standards for multiple constituents, specifically Ammonia Nitrogen. The summary impacts to marine biological resources would be less than significant.

Table 3.3-26. Summary of Preferred Alternatives Operational Impacts - Marine Biology

Potential Impacts	*GUAM*									*TINIAN*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste-water*	*Solid-Waste*	*Road-ways*		*Training*
Marine Flora and Invertebrates	LSI	LSI	NI	NI	NI	NI	NI	NI	LSI	LSI
Fish and EFH	LSI	LSI	NI	NI	NI	NI	NI	NI	LSI	LSI
Special-Status Species	LSI	LSI	NI	NI	NI	NI	NI	NI	LSI	LSI
Non-Native Species	LSI	LSI	NI	NI	NI	NI	NI	NI	LSI	LSI
Marine Biology Operation Summary									**LSI**	**LSI**

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

Construction Impacts

Under the preferred alternatives, in-water and land–based construction related to proposed Marine Corps actions would result in less than significant adverse impacts on marine resources in Inner and Outer Apra Harbor . The impacts would be short-term and localized, assuming implementation of BMPs summarized in Chapter 2. Impacts in Apra Harbor are due to increased sediment in the water column and noise, and increased frequency of construction-related tug and barge traffic.

Land–based construction in other parts of Guam has potential to impact coastal water quality, but BMPs would reduce impacts to less than significant. Impacts to fish, sea turtles and infaunal or epifaunal organisms in the soft sediment would be short-term and localized. The impacts would be less than significant.

The construction for 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 remain unavoidable adverse impacts associated with dredging coral reef ecosystems in Outer Apra Harbor. Sessile reef species, some crustacean management unit species (MUS) and 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. Impacts to fish, sea turtles and organisms in the soft sediment would be short-term and localized and impacts would be less than significant. There are BMPs and mitigation measures proposed for in-water and land-based construction that are listed in Chapter 2.

Operation Impacts

Less than significant impacts from direct and indirect effects associated with an increase in Apra Harbor ship traffic. Marine flora, invertebrates and associated essential fish habitat (EFH) would experience long-term, localized and infrequent minor impacts from increased noise and resuspension of sediment during vessel movements, and the potential for increased discharges of pollutants into the water column. No significant long-term population-level impacts or reduction in the quality and/or quantity of EFH was identified.

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 implementation of BMPs, mitigation measures, and Navy vessel policies.

Less than significant impacts from introduction of non-native species are expected since vessels operating within Apra Harbor would comply with U.S. Coast Guard (USCG) and Navy requirements for ballast water and hull management policies. The Navy is funding a *Regional Biosecurity Plan with Risk Analysis* and will implement components of the plan relevant to Navy actions.

With successful ,compensatory mitigation for direct dredging removal of coral and coral reef habitat associated with the aircraft carrier, the significant adverse affects to fish and EFH (coral and coral reef ecosystems MUS) would be mitigated to less than significant.

Wastewater improvements not related to the preferred alternatives, namely upgrades to secondary treatment, could result in long-term, reduction of significant impacts to fish and EFH from improved water quality. Existing Guam water quality criteria (GWQC) standards are exceeded for multiple constituents, specifically ammonia nitrogen. These preferred alternatives would increase the discharge and impacts are considered to be additive to existing conditions and significant. The impacts are mitigable thorugh wastewater treatment upgrades. There may be a beneficial increase in herbivore foraging area from nutrient loading. Long-term, less than significant impacts on marine flora and invertebrates may result from decreased water quality and siltation. Increased nutrients may improve flora production.

Roadways construction around Apra Harbor has potential to indirectly impact biological resources through runoff or pollutant carried downstream. Implementation of BMPs would reduce the impact to less than significant.

The preferred alternatives would result in a significant localized impact near the wastewater discharge exceeds GWQC standards for multiple constituents, specifically ammonia nitrogen. When considered in conjunction with all other preferred alternatives, the overall operational impacts to marine biological

resources are considered less than significant. The summary impacts to marine biological resources would be less than significant.

Tinian

Less than significant impacts could result from runoff causing turbidity in coastal waters from construction and operation activities and increased supply barge traffic in Tinian Harbor supporting construction activities. BMPs would be implemented during construction to provide additional 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 like storms and bleaching. The health of the resources is typically a function of an increase population and associated industrial and commercial operations, which affects 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(mentioned in Section 3.3.10.1), invasive species, recreational activities, diseases, coral bleaching, and storms.

There are construction proposals on Guam and Tinian under no action that may 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, there would be marine biological impacts, but the impacts would extend over a longer period of time.

Reefs

The *State of Coral Reef Systems in Guam* (Burdick et al, 2008) is the source of information provided below on 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, the present trends would most likely 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 taxa greater than 10 inches (>25 cm) are uncommon to rare on Guam, and while their numbers are slightly higher on northern reefs, medium and large fish abundance 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 COTS outbreaks, storms and bleaching events is likely hindered by poor water quality, low target herbivorous fish abundance and low coral recruitment.

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

The reefs of Guam have been spared from severe and widespread coral mortality associated with large-scale bleaching events, but observations in 2006 and 2007 suggest that bleaching events in Guam's reefs

may become more frequent and severe in the coming decades. There were bleaching events in 1994 and 1996, 2006 and 2007 that appear to have coincided with elevations in sea surface temperature. The impact of the recent bleaching events is difficult to assess.

It appears from baseline surveys in 2006 and 2007 that disease may be causing at least partial mortality in a significant number of colonies in Guam's reefs. White syndrome appears to 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 the reef. Storm surge and wave inundation can increase local sea levels by over 40% of the 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," falling to the seafloor and smothering corals and other sessile organisms.

The southern reefs are subjected 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 and recreational off-road vehicle use, as well as grazing by feral ungulates, have accelerated rates of sedimentation and appear to have exceeded the sediment tolerance of coral communities in these areas, resulting in highly degraded reef systems.

SCUBA diving, snorkeling and related activities continue to be very popular for both tourists and residents and some of the more popular sites have exceeded their annual threshold above which coral cover loss and coral colony damage levels may increase 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 both economically and culturally important and target a large number of reef fishes 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 by up to 86% since 1950.

Two fishing methods used on Guam have raised particular concern: the use of SCUBA and artificial light for 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 and 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, including benthic habitat, water quality, biological communities associated with coral reefs (e.g., fishes and macroinvertebrates) and socio-economic information (Burdick et al, 2008).

Soil Erosion/Sediment in Nearshore waters

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 have 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 contributes to the decline of the reefs. Three of the island'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 Hagåtña 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 infiltrates basal groundwater, which discharges into springs along the sea-shore and subtidally on the reefs. Pollutants include nutrients from septic tank systems, sewage spills, and livestock and agricultural areas, as well as chemical discharge from urban runoff, farms and illegal dumping. The U.S. Navy has 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. Most of these sites are on or near shorelines. Algal blooms in Tumon Bay are attributed to fertilizers applied to landscaping.

Dredging

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 US 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 US Naval Administration ran the port until 1951, when command was transferred to the Department of Commerce.

As described in Volume 2, Chapter 2, Section 11, Glass Breakwater was constructed in 1944 of 2 million cubic yards (1.5 million cubic meters [m^3]) of soil and coral extracted from adjacent Cabras Island. This totally 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, it 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 dredge events occur periodically in Inner Apra Harbor. The combined area of coral reef and lagoon in nearshore waters estimated at 26,685 ac (10,800 ha) and 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

Sources: [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

In spite of the alterations to the 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). In addition, the outer harbor supports diverse populations of macro-invertebrates, finfish and moderate numbers of the threatened green sea turtle.

Tinian

The stressors described for Guam would be similar to Tinian, including natural events like storms and bleaching. Stressors on the marine environment are typically a function of an increase population and associated industrial and commercial operations on the natural environment and therefore, although anthropogenic stressors are applicable 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 plants outfalls, invasive species, recreational activities, diseases, coral bleaching, and storms, which all have contributed to the degradation of marine biological resources. There are two resort development proposals for Tinian that could potentially impact marine biological resources.

Existing Plans and Procedures

There are existing DoD and non-DoD conservation measures that would continue under no action. 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.

There are GovGuam marine preserves and DoD coastal reserves including the Haputo and Orote ecological reserve areas. Guam and Tinian both have government agencies responsible for coastal management that draft and implement plans and programs to address the historical impacts and prevent future impacts. 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. These projects 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 the following components: 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.

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 *Micronesian Biosecurity Plan* is 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 ESA-listed and candidate species, and marine mammals not listed under ESA are considered special status species. The species relevant to the EIS/OEIS are green and hawksbill sea turtles, common bottle nose dolphin and spinner dolphin. The baseline condition of these resources is described in Volume 2, Chapter 2, Section 11.

Green sea turtle threats include direct harvesting of eggs or adults, beach cleaning, replenishment, and recreational activities, debris, incidental take from fishing, and seagrass degradation. Fewer than 10 turtles nest in CNMI each year and less than 10 observed on Guam. The survival status in the Pacific Region continues to decline, except for populations in the Hawaiian Islands.

The hawksbill sea turtle is subject to the same threats as the green sea turtle. The population on Guam is almost extirpated There was one sighting in 1991. No testing turtles have been recorded in CNMI.

There is no occurrence records for this species in the Marianas, but the preferred alternatives are within the known distribution range for the species.

The spinner dolphin is expected to regularly occur all around Guam, except Apra Harbor, where there are few occurrences of this species. Spinner dolphins are behaviorally sensitive and avoid areas with much anthropogenic usage

3.3.10.3 Comparison of Preferred Alternatives to No Action

There is no appreciable difference in the preferred alternatives and no action with respect to marine biological resources during operation. There would be additional military transient and commercial ship traffic under preferred alternatives but standard operating procedures would minimize the impact to special status species.

A key assumption is the construction BMPs and compensatory mitigation measures are implemented, with less than significant impacts during operation phase. 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 10 years of deployment (on average - some specific areas may recover faster, others more slowly). There would also be a delay for the recovery under watershed management compensatory mitigation projects. The operation phase impact assumes 100% restoration. There will 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 require compensatory mitigation too.

During operation, the preferred alternatives would have a less than significant impact on marine biological resources. The preferred alternatives would not add to the degradation of marine resources, assuming upgrades to secondary treatment at the northern district wastewater treatment plant. There would continue to be anthropogenic and natural impacts that degrade the marine environment and impacts from historical events that are unrelated to the preferred alternatives. Conservation measures and plans for federally-controlled and GovGuam submerged lands and 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 less than significant for both islands.

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

Potential Impacts	*GUAM*									*TINIAN*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Archaeological Resources	SI-M	NI	SI-M	SI-M	SI-M	SI-M	NA	NI	SI-M	SI-M
Architectural Resources	SI-M	NI	NI	NI	NI	NI	NA	NI	SI-M	NI
Submerged Resources or Objects	NI	NI	NI	NI	NI	NI	NA	NI	NI	NI
Traditional Cultural Properties	SI-M	NI	SI-M	NI	SI-M	NI	NA	NI	SI-M	SI-M
Cultural Construction Summary:									**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

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

Potential Impacts	*GUAM*									*TINIAN*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road -ways*		*Training*
Archaeological Resources	LSI	NI	LSI	NI	NI	NI	NA	NI	LSI	LSI
Architectural Resources	NI	NI	NI	NI	NI	NI	NA	NI	NI	NI
Submerged Resources or Objects	NI	NI	NI	NI	NI	NI	NA	NI	NI	NI
Traditional Cultural Properties	LSI	NI	LSI	NI	NI	NI	NA	NI	LSI	LSI
Cultural Operation Summary:									**LSI**	**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 34 NRHP-eligible or listed archaeological resources on Guam and 10 on Tinian, all of which would be mitigated to less than significant through mitigation. Six architectural resources sites would be impacted. The mitigation would be conducted in accordance with Programmatic Agreement with State Historic Preservation Office (SHPO) that would require avoidance, survey, monitoring during construction, data recovery, building documentation, public education, and training of military personnel.

There would be significant adverse impacts to four traditional cultural properties all mitigated to less than significant through public education and implementation of a preservation plan. Traditional resources such as the dukduk tree, ifit tree, and da'ok tree, are recognized by the DoD and would be made available to local people prior to their removal for construction of the preferred alternative.

There would be no adverse impacts to listed submerged resources or objects during construction or operation for either island. On Tinian, there would be no impacts to architectural resources during operation.

The operations period assumes potential mitigation for impacts was implemented in the construction period and that the significant impacts have been reduced to less than significant. Impacts during operation would include deterioration of archaeological resources due to weather exposure. Overall, recognized sites on DoD-managed lands are better protected from vandalism than sites on non-DoD managed lands because resources on DoD-managed lands are protected by cultural resource management plans and various DoD laws and regulations. Land acquisition by DoD brings more sites under the higher level of protection. There is the potential for impact on resources remaining after construction, but it is less than significant due to DoD management.

Direct impacts within the surface danger zones of the new firing ranges (Guam and Tinian) are unlikely since it is estimated that only 1 in 10,000 rounds would fall outside of the target impact area. On the other hand, land acquisition during the construction phase restricts public access to some cultural sites during operations. There would be indirect impacts to those sites that are within SDZs on Guam and Tinian.

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 lessened burden on SHPO with the preferred alternatives as the DoD would continue to manage large tracts of land on Guam and afford the culture resources on those lands a higher level of protection than if they were not under DoD protection.

3.3.11.2 No Action

The stressors on cultural resources include vandalism, intentional and inadvertent disturbance from construction activities, and deterioration due to weather exposure. Many WWII cultural sites were established on Guam and Tinian, but the war itself resulted in the loss of cultural sites. The trend over time since WWII conclusion is a decline in cultural resources due to the stressors listed.

Currently, there are over a 1,000 archaeological sites identified on Guam. Many archaeological sites on Guam are still relatively intact and there may be others, yet to be identified. Past construction on Guam has resulted in the destruction of archaeological sites, but when data was recovered through the excavation of these sites, their information value remains accessible to the public. Likewise, future intentional removal of archaeological sites (construction) can be mitigated through data recovery. Removal of National Register of Historic Places-eligible buildings can also be mitigated through detailed recordation. These potential impacts to cultural sites would be significant and mitigable in the future.

There are local and federal laws and regulations to protect cultural resources. For example, there are fines for vandalism under no action. There are challenges to 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. The cultural resources would continue to decline in the future.

3.3.11.3 Comparison of Preferred Alternatives to No Action

Cultural sites would be lost during construction of the preferred alternatives, contributing to the ongoing trend in declining number of cultural sites. Once the mitigation is implemented for this loss, cultural impacts would be reduced to a less than significant level. During operation, there would continue to be some vandalism and deterioration by weather, but overall the impact to cultural resources on DoD land would be less than significant due to a high level of protection and site management. Some conditions of the Programmatic Agreement, such as education would continue into the operational phase, but the assessment assumes the mitigation concludes with the construction phase.

Under no-action, in the absence of any aspect of the preferred alternatives, there would continue to be potential for direct significant impacts to cultural resources due to construction activities, vandalism and weather to resources on non-DoD land. The direct impacts would be significant but mitigable, if mitigation measures similar to those in the Programmatic Agreement 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 is less than significant for both islands.

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

Potential Impacts	*GUAM*									*TINIAN*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Visual	NA	NA	NA	*NA*	*NA*	*NA*	*NA*	*NA*	NA	*NA*
Visual Construction Summary:									**NA**	**NA**

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

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

Potential Impacts	*GUAM*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Andersen AFB	LSI	NA	LSI	NA	NA	NA	NA	NA	LSI	NA
NCTS Finegayan	LSI	NA	LSI (with mitigation)	NA	NA	NA	NA	NA	LSI	NA
Non-DoD lands (North)	SI-M	NA	NA	NA	NA	NA	NA	NA	LSI	NA
Andersen South	SI	NA	NA	NA	NA	NA	NA	NA	LSI	NA
Non-DoD lands (Central)	SI-M	NA	NA	NA	NA	NA	NA	NA	LSI	NA
Barrigada	LSI	NA	LSI	NA	NA	NA	NA	NA	LSI	NA
Apra Harbor	LSI	NI	NA	NA	NA	NA	NA	NA	LSI	NA
Naval Base Guam	LSI	NA	NA	NA	NA	NA	NA	NA	LSI	NA
South	LSI	NA	NA	NA	NA	NA	NA	NA	LSI	NA
Views toward upgraded GPA facilities, Cabras Piti, and Potts Junction	NA	NA	NA	LSI	NA	NA	NA	NA	LSI	NA
Views along Highway 3 adjacent to/near Finegayan	NA	NA	NA	NA	LSI	NI	NA	NA	LSI	NA
Views from Route 2, Route 2a, and nearby Afilieje Beach Park	NA	NA	NA	NA	NA	NA	SI-M	NA	LSI	NA
Existing visual quality changes to a more urban visual character	-	-	-	-	-	-	-	SI-M	LSI	NA

Potential Impacts	*GUAM*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Removal of vegetation in residential areas, changing the visual character	-	-	-	-	-	-	-	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 Operation Summary:									**LSI**	**SI-M**

Legend: SI = Significant impact, 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. The preferred alternatives would result in different levels of impacts in different areas.

The military buildup would result in substantial changes to the visual environment at specific locations in Guam. For instance, 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 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 and in cases where impacts were deemed to be significant, mitigation measures would reduce their impacts to less than significant. 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 full suite 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.

3.3.12.2 No Action

Urban development is likely the most notable cause for change in visual environments: the degree and the nature of the proposed development, as well as where 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. 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 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 the 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 subdivision (approximately 400 units) and 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 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.

Tinian

There are new resorts planned for Tinian, and 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 maintain the existing condition.

3.3.12.3 Comparison of Preferred Alternatives to No Action

Under no action for both islands, there is potential for development of large massive facilities in areas that are currently open space. The same is true on Guam under the preferred alternative. 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 set aside areas for open space. Although there would be some changes to the landscape, the preferred alternative would have no island-wide impact on the visual environment. With the implementation of 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. 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 less than significant for both islands. During operation, the overall cultural impact of the preferred alternatives is less than significant for both islands.

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

Potential Impacts	*GUAM*									*TINIAN*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Marine Transportation	LSI	LSI	NI	NI	NI	NI	NI	NI	LSI	LSI
Marine Transportation Construction Summary:									**LSI**	**LSI**

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

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

Potential Impacts	*GUAM*									*TINIAN*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road -ways*		*Training*
Marine Transportation	LSI	LSI	NI	NI	NI	NI	NI	NI	LSI	LSI
Marine Transportation Operation Summary:									**LSI**	**LSI**

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

Marine transportation summary impacts would be at Apra Harbor. The preferred alternatives would result in an increased number of vessels visiting the harbor during the construction that would have a less than significant impact on marine transportation. There are dredging acivites proposed and if ocean disposal is included there may be one to two barge trips per day to the ocean site for a year, depending on construction tempo. Land placement of dredged material would likely require trips to Inner Apra Harbor, Uniform Wharf, where the material would be offloaded and would not impact the Outer Harbor transportation.

The projected average number of containers to be handled each year during the construction period of 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 increased traffic is wiithin the commercial port capacity that is being modernized to support the construction.

The proposed activities that would have an impact on navigation are: 1) the relocation of the buoys, 2) the relocation of the range lights for Outer Apra Harbor, 3) the security barrier installed around the aircraft carrier, and 4) restrictions on navigation during aircraft carrier transits into and out of Apra Harbor in accordance with security requirements. This activity would result in less than significant impacts to marine transportation. The security barrier would only impact Inner Apra Harbor Navy traffic and not impact the commercial transportation. The restriction on transportation during aircraft carrier movement is a temporary short-term (less than 1 day) impact. Noone of the four actions would have a significant impact on marine transport during operations.

Preferred alternatives on Guam would have less than significant effects 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) and 277 trips to the ocean disposal site to transport the dredged material from Sierra Wharf and the new wharf at Polaris Point above the average visiting the Port of Guam over a one year period would result in less than a significant impact on marine transportation in Apra Harbor. The number of military vessels visiting Guam may change if military missions and ships change. These increases are assumed to be less than significant.

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.

In regard to Tinian Harbor, there is no proposed construction or modification of existing facilities as part of the proposed relocation of the Marines. If equipment is moved by barge, one single barge would be able to carry the equipment necessary to support the estimated 200 to 400 Marines training evolution. The movement of this barge would result in no impact to marine transportation in Tinian Harbor.

The Tinian Harbor is in need of repair and the planned resorts and future changes in military mission on Tinian may provide incentive for the improvements. It is assumed that the increase in tourism and potentially military operations would increase the marine traffic to/from Tinian. The impact is assumed to be less than significant.

3.3.13.2 No Action

Under the no action, the number of military vessels visiting Guam may not change from current conditions; however, the number of ships is subject to change based on military mission. The aircraft carrier would continue to visit Apra Harbor at Kilo Wharf with great adverse impacts to ordnance operations. There would be security restrictions, including security barriers, at Kilo Wharf that would restrict navigation at the entrance to the Outer Apra Harbor. As new ships and military missions change, there is potential for an increase in military marine traffic. The number of non-military vessels visiting the Port of Guam would continue to decline or remain at about the current level. Therefore, the no action would result in no impact 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 these improvements would have occurred without the build-up. The timing of the improvements may have been delayed without the preferred alternatives.

There are two large-scale planned resorts for Tinian. Construction of these projects may increase ship traffic at the port. There may be an increase in ferry traffic due the additional tourists drawn to the island to visit these two new resorts. There may be an increase in military use of Tinian in the future that would contribute to the marine traffic. The port needs improvements; they may be provided as part of the projects that propose 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%. 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) and 277 trips to the ocean disposal site to transport the dredged material from Sierra Wharf and the new wharf at Polaris Point above the average visiting the Port of Guam over a one year period would result in less than a 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 capacity to handle the additional traffic.

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

3.3.14 Related Actions (Utilities and Traffic)

For purposes of this EIS/OEIS, the utilities actions and roadway projects are considered "related actions," in that they would be implemented as a result of the overall preferred alternatives.

3.3.14.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-34 and 3.3-35 summarize the preferred alternatives' construction and operation impacts to related actions 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 operations, the overall cultural impact of the preferred alternatives is less than significant for both islands.

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 3.3-34. Summary of Preferred Alternatives Construction Impacts - Related Actions

Resource	*GUAM*									*TINIAN*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Power	SI-M	LSI	LSI	NA	NA	NA	NA	NA	SI-M	LSI
Water	SI-M	LSI	LSI	NA	NA	NA	NA	NA	SI-M	LSI
Wastewater	SI-M	LSI	LSI	NA	NA	NA	NA	NA	SI-M	LSI
Solid Waste	SI-M	LSI	LSI	NA	NA	NA	NA	NA	SI-M	LSI
Roadways	SI-M	NI	LSI	NA	NA	NA	NA	NA	SI-M	LSI
Related Actions Construction 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; BI= beneficial impact; NA = not applicable

Table 3.3-35. Summary of Preferred Alternatives Operational Impacts - Related Actions

Resource	*GUAM*									*TINIAN*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impacts*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Power	SI-M	LSI	LSI	NA	NA	NA	NA	NA	SI-M	NI
Water	SI-M	LSI	LSI	NA	NA	NA	NA	NA	SI-M	LSI
Wastewater	SI-M	LSI	LSI	NA	NA	NA	NA	NA	SI-M	LSI
Solid Waste	LSI	LSI	LSI	NA	NA	NA	NA	NA	LSI	NI
Roadways	LSI	LSI	LSI	NA	NA	NA	NA	NA	LSI	NI
Related Actions Operation 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; BI= beneficial impact; NA = not applicable

The utilities and off-base roadway impacts analysis in this EIS/OEIS are island-wide and based on the total proposed population increases on Guam to meet the purpose and need for the Marine Corps, Navy and Army. Therefore, the utility analysis in Volume 6 is in essence a summary impact analysis. The utility and roadway project-specific impacts are addressed in the resource sections of Volume 6 and the summary impacts of the specific projects are described under the resource sections of Volume 7. This Volume 7 section differs from the other discussions of utilities and roadways in that it focuses on the overall capacity of existing infrastructure and relative to the new demand under the preferred alternatives instead of focusing on the individual projects proposed to meet the additional demand.

The peak construction period population would have a greater demand on utilities than the steady-state operations. Interim solutions and long-term solutions are described in Volume 6, Chapter 2. These solutions are the mitigation for the significant impacts that the population increases would have on utilities and roadways. The population increases during construction and operation are largely due to the Marine Corps preferred alternatives. The impact of other services on related actions is considered less than significant. The potential impacts are significant and mitigable on all related actions for construction and operation, with a few exceptions. Once the roadway improvements are constructed the there would be no

operational impacts. Use of existing or soon to be constructed sanitary landfill reduces the solid waste operational impact to less than significant.

The Tinian data was presented in Volume 3 and utilities' impacts are summarized as follows:

- 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; bivouac 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 municipal water supply.
- 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. 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. Estimated potable water consumption would be 1 gallon per person per day for drinking; additional water would be consumed for cleaning, bathing, etc.
- A contract portable toilet service would be used for human waste. Portable toilets would be contracted from a local company and the wastewater disposed in accordance with all applicable laws and regulations as a requirement of the contract. Potential disposal methods that the contractor could utilize include (1) taking the wastewater to the existing DoD septic tank/leach field system, (2) taking the wastewater to the Dynasty Casino and injecting into their tertiary treatment system, (3) taking the wastewater to the IBB facility and adding it to their septic/leach field system, (4) constructing a new leach field to handle the wastewater, and (5) finding other existing septic tank/leach field systems on Tinian with the capacity to accept this wastewater and with an owner willing to accept it. The preferred approach would be Option 1. Septage from the port-a-potties would be emptied by the on-island portable toilet rental company into and treated at the existing DoD septic tank/leach field.
- Solid waste would be collected and returned with the using unit, pending establishment of a certified landfill on Tinian. Solid waste would 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.

On Tinian, there are no impacts to utilities or roadways and no mitigation (improvements) are proposed.

The proposals (mitigation) to address power and solid waste are Guam-wide solutions.

Power

The current power supply and transmission and distribution (T&D) system for the island-wide power system (IWPS) is adequate to meet demand through 2016. Guam Power Authority's (GPA) demand forecast indicates that the reserve capacity would be exceeded in 2016, based on the GPA load projections for the IWPS without the DoD proposed buildup. GPA's demand forecast is based on an installed generation capacity of 550 megawatts (MW). A review of one year of GPA's actual generation capacity indicates an average daily generation capacity of 490 MW, or nearly 15% less than its stated capacity. This appears to be largely related to units out of service for extended periods of time and units simply not available to be scheduled into the generation capacity for the daily report. The daily-capacity report is a document produced by GPA that was evaluated over a one-year period to determine what GPA's typical

unavailable capacity is on a regular basis. In this report, the existing combustion turbines (CTs) had been out of service with no specific return-to-service date identified. Thus to maintain reliability targets for the power system performance, GPA would be faced with increasing their generation capacity by 2016 even without the DoD buildup.

The existing SOx non-attainment areas for air quality at Cabras-Piti and Tanguisson would continue unless GPA makes some changes to their operations or enhances their monitoring system in order to demonstrate compliance. GPA already automatically switches to low sulphur fuel oil when the winds are blowing onshore to limit SO_x emissions, however they have not been able to show compliance due to an apparent deficiency in monitoring stations. This situation may continue until GPA initiates adequate monitoring and undertakes collection of the required information to demonstrate compliance with current air standards. Another potential approach would be for GPA to switch fuel to liquid natural gas (LNG), but that may cause issues in their power supply as LNG has lower energy content than fuel oil and would reduce power output of current generating units. There currently seems to be no effort to resolve this non-compliance condition, thus the effects of no action would be essentially no impact and no change to the status quo.

Potable Water

The current capacities of the DoD water systems are adequate to meet current DoD demands for the foreseeable future under the no-action scenario.

The projected water demand for the Guam civilian population throughout 2010-2019, not including the effects of the military buildup, 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 even under no action. GWA is apparently pursuing the *Water Resources Master Plan* (WRMP) and making improvements to their potable water system to address the deficiencies.

Should GWUDI treatment become a future requirement, GWA would be faced with compliance.

Wastewater

The current NDWWTP needs some upgrades and deferred maintenance that would be required under no action. Also it appears that EPA would not grant the waiver from secondary treatment for the NDWWTP or the Hagatna WWTP. Thus, in the near future, GWA would very possibly face the requirement to upgrade these treatment plants to secondary treatment.

Solid Waste

The new GovGuam solid waste landfill is currently in construction and funded. It is scheduled to be completed and operational by July 2011. DoD would switch its use from their current landfills at Apra Harbor and Andersen AFB when this new landfill is completed. This new landfill would be fully compliant with current solid waste regulations and have a significant life span to accommodate all of Guam for the foreseeable future. Thus no action would have no impact on the solid waste facilities on Guam.

Roadways

The roadways improvements are distributed throughout the island and described in Volume 6. The implementation of these projects would be an impact to Guam-wide roadway conditions. The improvements would meet (mitigate) the potential significant impact on roadways due to the construction and the operation of the preferred alternative requirements.

3.3.14.2 No Action

The following is a brief summary of information provided in Volume 6, Section 3.1, Affected Environment section.

Power

GPA's demand forecast has indicated that the reserve capacity (or excess capacity to ensure reliability) would be exceeded in 2017, based on GPA's load projections for the IWPS without the DoD proposed buildup.

Water

The baseline condition of the GWA water system is described in GWA's WRMP. The overall condition of the water system's equipment is identified as poor in the WRMP with substantial corrosion in all infrastructure. The water system has a 50% Unaccounted for Water (UFW) rate compared to an acceptable rate of 15% or less. Problems with the GWA infrastructure result from the effects of natural disasters, poor maintenance, and vandalism. According to the WRMP, the water system infrastructure does not meet the basic flow and pressure requirements for all customers. The water system did not consistently comply with regulatory requirements.

Wastewater

GWAs wastewater infrastructure (treatment plants, collection piping, and pump stations) has slowly deteriorated over the years. This, coupled with natural disasters such as typhoons and flooding, has resulted in frequent sewage spills at pump stations and collection piping, collapse of collection piping, and failure of treatment plant equipment. Lack of GWA resources, particularly restrictions on fees that can be collected from the public for sewer services, 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 inability to adequately treat wastewater and exceedances of the allowed pollutant levels in plant discharges. These are outlined in Volume 6, Section

Many of the wastewater and power improvements required under no action are described in the previous section on preferred alternatives. Improvements to the GovGuam infrastructure would be made as funds became available. The new GovGuam landfill would be constructed without the preferred alternatives. There would be no anticipated population increase on the scale of the increase proposed under the preferred alternatives; therefore, there is less pressure to improve facilities in the near term.

A new landfill and WWTP would be constructed on Tinian without the preferred alternatives. No roadway improvements are proposed under the preferred alternatives on Tinian. Periodically, roadways are repaired. The repairs may lag due to insufficient funds resulting in a less than significant summary impact.

Solid Waste

Solid waste from DoD lands 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 and a new landfill will be constructed.

Roadways

The *2030 Guam Transportation Plan* (GovGuam 2008) identified roadway improvement projects that would to required to address the roadway deficiencies on Guam and did not address all of the roadway improvements proposed in this EIS/OEIS. Some of the projects identified in the plan are accelerated by the

military build-up. The rate of planned improvements identified in the plan is tied to the availability of funding. The condition of roadways on Guam has deteriorated, but they are operational. The summary impact on roadway condition is considered less than significant, assuming the improvements would be implemented in the future. If they are not implemented the impacts would be significant.

3.3.14.3 Comparison of Preferred Alternatives to No Action

The preferred alternatives would add to the overburdened utility infrastructure. While many of the improvements required to existing systems are required under no action, the increased population related to the preferred alternatives adds to the significant impact on utilities. Under no action and preferred alternatives, there are viable solutions to meet (mitigate) anticipated short (construction) and long-term (operation) deficiencies.

Roadway improvements are required under the preferred alternative and no action. The improvements are considered less than significant for both scenarios. If either alternative implemented all the Guam roadway improvements in the near future, the summary impact would be beneficial. If roadways under either alternative would be allowed to deteriorate to the point of being closed in the near-term the effect would be significant but mitigable. Mitigation would be the restoration of the roadway.

The preferred alternative would have no impact on utilities and roadways on Tinian. No action includes planned resort developments south of the MLA and the potential for future increases in military use, which would have significant impact on existing facilities and improvements would be required. It is assumed this construction would occur in the long-term. No short term (peak) events were identified on Tinian. There is a landfill planned that presumably would have capacity for the planned resort use. The planned developments on Tinian would dramatically increase the utility demand on–island. The developers may construct their own utilities or use existing pubic systems. It is assumed that capacity could be provided to meet the new demand.

There is no appreciable difference impact on related actions between the no action and the preferred alternatives on Tinian.

3.3.15 Socioeconomics

3.3.15.1 Summary of Preferred Alternatives' Impacts

Overall, socioeconomic impacts of preferred alternatives would be island-wide in nature, with little difference in effects among the various alternatives. Implementation of the proposed actions of the Marine Corps, Navy and Army would result in impacts of sudden activity (and thus both positive and negative impacts) that peak during the 2013-2015 timeframe. Impact significance is increased because of the overlap in the construction and operation phases of the preferred alternatives. The peak growth period would be followed by a period of relatively less significant impact when construction ends and a large part of the population influx (due to construction work) would likely leave the island. 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.

The information provided in the table below provides a summary of the significance, of implementing all of the proposed actions addressed in Volumes 2, 4, 5 and 6 concerning Guam and Volume 3 concerning Tinian. 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 contributions to the various socioeconomic factors made to the total impacts from the transient aircraft carrier visits and Army proposed actions on

Guam. The socioeconomic and general services impacts on Tinian would be anticipated to be independent and distinct from those summary impacts on Guam.

Table 3.3-36. Summary of Preferred Alternatives Construction Impacts - Socioeconomics

Potential Impact Components	*GUAM*						*TINIAN*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*			*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Utilities*	*Road-ways*	*Summary Impacts*	*Training*
Population	SI-M	LSI	SI-M	SI-M	SI-M	SI-M	NI
Economic	BI	BI	BI	BI	BI	BI	LSI
Civilian Housing	SI-M	LSI	LSI	LSI	LSI	SI-M	NI
Tourism	BI	BI	NI	NI	NI	BI	SI-M
Public Services	SI-M	LSI	SI-M	SI-M	SI-M	SI-M	LSI
Crime and Social Order	SI-M	SI-M	NI	NI	NI	SI-M	NI
Chamorro Community	SI-M	NI	NI	NI	NI	SI-M	NI
Community Cohesion	SI-M	SI-M	NI	NI	NI	SI-M	NI
Socioeconomics Construction Summary:						**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, BI = Beneficial impact

Table 3.3-37. Summary of Preferred Alternatives Operation Impacts - Socioeconomics

Potential Impact Components	*GUAM*						*TINIAN*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*			*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Utilities*	*Road-ways*	*Summary Impacts*	*Training*
Population	SI-M	LSI	LSI	NI	NI	SI-M	NI
Economic	BI	BI	BI	NI	NI	BI	LSI
Civilian Housing	SI-M	LSI	LSI	NI	NI	SI-M	NI
Tourism	BI	BI	NI	NI	NI	BI	SI-M
Public Services	SI-M	LSI	LSI	NI	NI	SI-M	LSI
Crime and Social Order	SI-M	SI-M	NI	NI	NI	SI-M	NI
Chamorro Community	SI-M	NI	NI	NI	NI	SI-M	NI
Community Cohesion	SI-M	SI-M	NI	NI	NI	SI-M	NI
Socioeconomics Operation Summary:						**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, BI = Beneficial impact

3.3.15.2 No Action

Guam

Unlike physical resources, socioeconomic systems do not remain completely at baseline conditions if preferred alternatives are not implemented. Economies and population levels change due to other reasons. Furthermore, the announcement of the intended project has already had socioeconomic consequences, such that a 2010 decision not to follow through on the military buildup would have short-term effects associated with a reversal of those consequences.

Population Impacts

Project related population would not occur, nor would the associated demographic and household characteristic impacts. Overall Guam's population could be expected to increase according to baseline trends that are not substantial.

Economic Impacts

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, 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, especially if the current national and international economic crisis has not yet abated. These effects, though, would be attributable to an unstable world economic landscape and poor decision making by investors – not to the preferred alternatives.

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.

Public Service Impacts

The public service agencies would not face pressures to expand professional staffing, and 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.

However, at the broader level, no action and the elimination of prospective long-term revenues expected from the preferred alternatives would still leave GovGuam agencies in 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 the GovGuam.

Sociocultural Impacts

Crime rates would likely rise in the short term to the extent that Guam experiences an economic slowdown without the benefit of DoD increased spending. The political importance of some Chamorro issues would likely recede as the "militarization" of Guam is stabilized at something close to present levels. Military-civilian relations would likely remain at the current generally positive level.

The incentive for increased in-migration from the various Freely Associated States of Micronesia would decrease, reducing sociocultural issues associated with assimilating that population. However, the current incentives for providing those populations – both on Guam and the Micronesian states themselves – would also be lessened, with detrimental implications for those populations.

Utility Impacts

No action would not result in greater contributions from DoD funding share for needed upgrades in wastewater treatment systems on Guam. The lack of increased demand for water under no action would not put pressure on tapping 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.

Roadway Construction Impacts

Under no action, only roadway projects needed for organic growth on Guam would be constructed. No action would not result in intensive construction activities; therefore, there would be no potential for effects on neighborhoods and businesses. No action may result in impacts from property acquisition and relocation associated with the GovGuam planned projects. Mitigation by GovGuam can be identified and implemented to reduce possible impacts to a less than significant level.

Tinian

Tinian-wide analysis for this section is provided in Chapter 16 of Volume 3. There would likely be significant mitigable impacts associated with the construction and operation phase, specifically impacts to tourism. There is likely to be restricted public access to primary tourist points of interest during training and possibly during construction.

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. The summary socioeconomic impacts would impact the whole island and its people. The military spending for its facilities and infrastructure would generate substantial economic and social consequences that would peak in the middle of next decade. The summary impacts over the longer term would return basically to current conditions with the exception of a larger presence of the permanent military than has existed on Guam in recent years.

The following provides an analysis of the impacts on the various socioeconomic sub-categories introduced above.

Population Impacts

Table 3.3-38 presents the estimated annual population increase from off-island that would result from the preferred alternatives.

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 both opportunities and problems. In the short term, there could be significant impacts caused by rapid population growth that would need 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.

Table 3.3-38. Estimated Total Population Increase on Guam from Off-Island (Direct, Indirect and Induced)

	Construction	*Operation*
Direct DoD Population[1]		
Active Duty Marine Corps	10,552	10,552
Marine Corps Dependents	9,000	9,000
Active Duty Navy2	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**

Economic Impacts

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 3.3-39 demonstrates that the preferred alternatives would generate the summary impacts of 43,278 workers at the 2014 peak that would decline to about 6,930 after construction abates by 2017. This number of jobs would be considered a significant beneficial impact on Guam. However, this rapid swing in the amount 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 need to cut back, and many workers would have to out-migrate due to job loss.

Table 3.3-39. 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 3.3-40 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 3.3-40. Impact on Civilian Labor Force Income (Millions of 2008 $) – Summary Impacts

Impacts	*Construction*	*Operation*
Direct	$1,095	$217
Indirect	$416	$60
Total	**$1,510**	**$278**

Civilian Housing Demand and Supply

Demand

The housing unit demand (required number of homes) in this section represents an approximate 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, 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 3.3-41 indicates the summary impacts on housing demand of the preferred alternatives 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 3.3-41. Demand for New Civilian Housing Units – Summary Effects

Impacts	*Construction*	*Operation*
Direct	7,856	1,720
Indirect	4,037	1,485
Total	11,893	3,205

Supply

Guam has excess vacant available housing (about 2,800 units) to absorb 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 3.3-42.

Table 3.3-42. Demand and Supply Needed for New Civilian Housing Units – Summary Impacts

	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	2,452	0

	Construction	*Operation*
Housing Deficit		
Over-Supply Future: Surplus Units if Supply Increases to Eliminate Deficit	0	8,688

The housing unit numbers reflected in Table 3.3-42 shows the estimated housing surplus in subsequent years, if the market were to provide all the needed construction-period housing, and assuming that no alternative uses (such as conversion to commercial use) are found for them.

The estimates in Table 3.3-42 are theoretical and meant to suggest the amount of housing construction needed to satisfy increased demand. The numbers in the table are not meant 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 to demand. Nevertheless, this substantial increase in demand for housing and the probable response in supply of houses and then decline in demand would be significant summary impacts of implementing the preferred alternatives.

Effects on Tourism

Summary impacts on the island's primary private-sector industry would likely be mixed. Hotels should 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 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 3.3-43 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 3.3-43. Impact on Selected GovGuam Tax Receipts (Millions of 2008 $) - Summary Impacts

Impacts	*Construction*	*Operation*
Direct	$312.6	$69.4
Indirect	$110.7	$34.8
Summary Total	$423.3	$104.3

These 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 3.3-44 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 3.3-44. Impact on Gross Island Product (Millions of 2008 $) – Summary Impacts

Impacts	*Construction*	*Operation*
Direct	$544	$100
Indirect	$536	$87
Summary Total	$1,080	$187

Public Service Impacts

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 Appendix F SIAS). For public education services – 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 3.3-45 summarizes the combined requirements for these five educational programs due to the preferred alternatives. It indicates a requirement for 619 teachers/faculty at the 2014 construction peak, and a more stable 148 total teacher/faculty for the steady-state operational phase.

Table 3.3-45. Additional Combined Public Education Professional Staff Required - Summary Impacts

Impacts	*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 follows (Table 3.3-46).

Table 3.3-46. 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 3.3-47 summarizes the impacts on all of these agencies due to the preferred alternatives. It indicates the requirement for 245 professionals at the 2014 construction peak, and a more stable 56 total professionals for the steady-state operational phase.

Table 3.3-47. Additional Combined Public Health and Social Service Professional Staff Required – Summary Impacts

Impacts	*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 3.3-48).

Table 3.3-48. 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 3.3-49 summarizes the combined requirements for all such agencies due to the total preferred alternatives action. It indicates the requirement for 307 professionals at the 2014 construction peak, and a more stable 109 total professionals for the steady-state operational phase.

Table 3.3-49. Additional Combined Public Safety Professional Staff Required – Summary Impacts

Impacts	*2014*	*2020*
Direct	246	93
Indirect	61	16
Total	307	109

Additional analysis indicates that the construction and operational phase requirements for the individual agencies are as follows (Table 3.3-50).

Table 3.3-50. 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	33	20

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 3.3-51 summarizes the combined requirements for these agencies due to the preferred alternatives. It indicates the requirement for 56 professionals at the 2014 construction peak, and a more stable 23 total professionals for the steady-state operational phase.

Table 3.3-51. Combined Additional Professional Staff Required for Other Selected General Service Agencies – Summary Impacts

Impacts	*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 3.3-52).

Table 3.3-52. 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

Growth Permitting and Regulatory Agency Impacts

These agencies 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 3.3-53 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 permitting related FTEs will be 104; this requirement will decline to a more stable 23 total FTEs for the steady-state operational phase.

Table 3.3-53. Additional Combined Professional Staff (FTE) Required for Development Permitting Agencies

	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 follows (Table 3.3-54).

Table 3.3-54. 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
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 rounding.

Sociocultural Impacts

Crime and Serious Social Disorder

While there is particular concern on Guam because of media reports about Marine Corps personnel accused of rapes and other crimes in Okinawa, the available evidence suggests that military crime rates have been generally low. Isolated incidents have tapped a deeper vein of issues related to "foreign" military occupation, noise, accidents, and a disproportionate presence of all American forces in Japan, particularly in Okinawa.

However, military forces in general do appear to have high rates of alcohol/substance abuse (though some of this may be related to youth) and family-related offenses against women and children. Older Guam residents remember violent military-civilian conflicts when the military presence was greater during the Vietnam War era. Construction "booms" are often associated with a sense of disorder and sometimes

actual crime. Although the exact extent of in-migration from the Freely Associated States (FAS) of Micronesia (in response to expanded economic opportunity) can be neither predicted nor controlled, Guam police data indicate disproportionate arrests from that in-migrant group, reflecting issues of adjustment to different cultural norms. To the extent that the non-Chamorro Micronesians become a greater percentage of the population, crime rates would probably rise to some extent until acculturation progresses.

Chamorro Issues

Guam's indigenous Chamorro population has strong concerns about whether incoming military populations would recognize them as both American by nationality and also as a unique ethnic culture worthy of respect and preservation. This could be mitigated by orientation programs designed in cooperation with the Department of Chamorro Affairs. However, an expansion in non-Chamorro voting population could eventually affect the proportion of Chamorro office-holders and government workers; thereby affecting the current government budgets and activities dedicated to cultural issues and practices. It could also affect outcomes of any future plebiscites about Guam's political status.

Community Cohesion

"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. The negative interactions related to the incoming new population discussed here do not rise to the level of major issues previously discussed under "Crime and Disorder", but are more likely to be irritants that may undermine a sense of mutual respect among groups. However, the arrival of new populations can also bring positive benefits that infuse communities with opportunities for more meaningful interactions.

Issues involving relationships between longtime residents and in-migrant Micronesians from the FAS would probably be the most critical side effect of the military-related economic and population expansion on the island. Military-civilian relationships always bear monitoring, and some period of adjustment would be likely to require the attention of both military and civilian leaders. However, well-established and successful military outreach programs to the local community would likely lead to stable relationships in the long run.

Roadway Construction Impacts

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 right 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 owners of 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.

3.3.15.4 Comparison of Preferred Alternatives' Impacts to No Action

As has been illustrated in the above 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 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, 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 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.
- The increase in different branches of the military on Guam, as a result of the Carrier Berthing, as well as the Army AMDTF component would increase the potential for fighting between different branches of the military.

Over the long term, Guam's economy and quality of life should be significantly enhanced by the preferred alternatives.

Table 3.3-55 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 3.3-55. Summary of Preferred Alternatives Impacts, Guam

Resource	*Guam*		*Tinian*	
	Preferred Alternatives	*No Action*	*Preferred Alternatives*	*No Action*
Population Impact				
Population	SI/BI	NI	NI	NI
Economic Impact				
Labor Force	BI	NI	NI	NI
Labor Force Income	BI	NI	NI	NI
Cost of Living	SI	NI	NI	NI
Housing	SI	NI	NI	NI
Local Government Revenue	BI	NI	NI	NI
Local Business Opportunities	BI	NI	NI	NI
Tourism	SI/BI	NI	SI/BI	NI
Gross Island Product	BI	NI	NI	NI
Public Service Impact				
Public Education Services	SI	NI	NI	NI
Public Health and Social Services	SI	NI	NI	NI
Public Safety Services	SI	NI	NI	NI
Other Selected General Services	SI	NI	NI	NI
Growth Permitting and Regulatory Agencies	SI	NI	NI	NI
Sociocultural Impact				
Crime and Social Order	SI	NI	NI	NI
Chamorro Issues	SI	NI	NI	NI
Community Cohesion	SI/BI	NI	NI	NI
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

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

3.3.16 Hazardous Materials and Waste

3.3.16.1 Summary of Preferred Alternatives' Impacts

Tables 3.3-56 and 3.3-57 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 3.3-56. Summary of Preferred Alternatives Construction Impacts - Hazardous Materials and Waste

Potential Impacts	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Soils	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI
Waters (Ground & Surface)	LSI	NI	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 Summary:									**LSI**	**LSI**

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

Table 3.3-57. Summary of Preferred Alternatives Operation Impacts - Hazardous Materials and Waste

Potential Impacts	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Pow er*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Soils	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI	LSI
Waters (Ground &Surface)	LSI	NI	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 Summary:									**LSI**	**LSI**

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

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 in 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., soils, waters, air, and biota) as a result of increases of the use of these substances on Guam from the preferred alternative 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 assumption that BMPs and standard operating procedures (SOPs) as discussed in Volumes 2 through 7 would be implemented 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

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 in Guam.

For similar reasons as described for Guam above, 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

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, 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 similar reasons as described for Guam, the Tinian no action 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 as 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 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, resulting in impacts to the environment. Subsequently adopted regulations have served to control the number of unauthorized spills, leaks, or release occurrences in 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 in 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 3.3-58 and 3.3-59 summarize the preferred alternatives' construction and operation impacts to public health and safety 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.

There are very few health and safety issues that would be adversely impacted by the preferred alternatives on Guam or Tinian. Any ground disturbance has potential to disturb unexploded ordnance (UXO); however, there are established SOPs that are implemented prior to and during construction that would mitigate the impact to less than significant at the project sites. Increases in Guam population result in proportionate increases in incidence of traffic incidents and notifiable diseases. The population increase would also have a potential effect on health care service providers and public services (i.e., police and fire service); however, anticipated personnel increases for these services would allow current service levels to be maintained. The proposed Marine Corps and Army actions would increase the island population. There is no population increase proposed for Tinian.

Table 3.3-58. Summary of Preferred Alternatives Construction Impacts - Public Health and Safety

Potential Impacts	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Operational Safety	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Aircraft Mishaps	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Explosive Safety	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Electromagnetic Safety	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Noise	LSI	NI	NI	NI	NI	NI	NI	NI	LSI	NI
Water Quality	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Air Quality	LSI	NI	NI	LSI	NI	NI	NI	NI	LSI	NI
Health Care Services	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Notifiable Diseases	LSI	NI	NI	NI	NI	NI	NI	NI	LSI	NI
Mental Illness	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Hazardous Substances	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Traffic Incidents	LSI	NI	NI	NI	NI	NI	NI	NI	LSI	NI
UXO	LSI	LSI	LSI	LSI	LSI	LSI	NI	LSI	LSI	LSI
Radiological	NI	LSI	NI	NI	NI	NI	NI	NI	LSI	NI

Potential Impacts	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Substances										
Public Services	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Public Health and Safety Construction Summary:									**LSI**	**LSI**

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

Table 3.3-59. Summary of Preferred Alternatives Operation Impacts - Public Health and Safety

Potential Impacts	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Operational Safety	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Aircraft Mishaps	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Explosive Safety	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Electromagnetic Safety	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Noise	LSI	NI	NI	NI	NI	NI	NI	NI	LSI	NI
Water Quality	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Air Quality	LSI	NI	NI	LSI	NI	NI	NI	NI	LSI	NI
Health Care Services	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Notifiable Diseases	LSI	NI	NI	NI	NI	NI	NI	NI	LSI	NI
Mental Illness	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Hazardous Substances	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Traffic Incidents	LSI	NI	NI	NI	NI	NI	NI	NI	LSI	NI
UXO	LSI	NI	NI	NI	NI	NI	NI	NI	LSI	LSI
Radiological Substances	NI	LSI	NI	NI	NI	NI	NI	NI	LSI	NI
Public Services	NI	NI	NI	NI	NI	NI	NI	NI	NI	NI
Public Health and Safety Operation Summary:									**LSI**	**LSI**

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

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, when the estimates in this table were made.

From 1970 to 2000 the population on Tinian increased, but 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, radiological risks or 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. Tourism and 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 and 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 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.

UXO. There is UXO on non-federal lands in Guam as a result of WWII. The amount of UXO would not change appreciably overtime. 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 and response to inadvertent discovery of UXO would be included. The appropriate response would be to cease construction, clear the area, and call the police and DoD explosive safety personnel. If UXO is 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 invasion, occupation, and defense of the island by Japanese forces and the assault by Allied/American forces to retake the island, unexploded military munitions remain. The risks are as described for Guam.

Radiological Substances. Hospitals and medical clinics use radiology as a diagnostic tool. The transport handling and disposal is 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 3.3-60 and 3.3-61.

Table 3.3-60. 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

Notes: AIDS= Acquired Immune Deficiency Syndrome, STD= Sexually Transmitted Disease (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 3.3-61. Potential Traffic Accident Increase, Guam

	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.

There are no other notable increases in health and safety risk anticipated on Guam in the absence of the preferred alternative. Under no action, there would 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 in 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 and 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 alternative 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. Although there is no significant construction planned under no action, 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 measured increases in noise and pollutants are considered less than significant. Because Guam clinics and hospital will increase staffing to meet current health care service ratios and will 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

Most of the anticipated impacts in terms of Environmental Justice relate to cultural resources, noise, traffic, recreational resources, and socioeconomics (particularly availability of public health and social services). The populations of interest are low income, racial minority and children.

Construction impacts may affect the unique historic and cultural resources of a racial minority group, and would affect access to these valued resources. With implementation of mitigation measures summarized the anticipated impacts to cultural resources would be reduced to less than significant.

Construction-related traffic and noise can be mitigated with implementation of noise and traffic reduction BMPs as described in the noise and traffic chapters of each volume and summarized in Volume 7 Chapter 2.

Table 3.3-62. Summary of Preferred Alternatives Construction Impacts - Environmental Justice

Potential Impacts	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Cultural Resources	SI-M (RM) NI (LI, C)	NI (ALL)	SI-M (RM) NI (LI, C)	NI (ALL)	NI (ALL)	NI (ALL)	NI (ALL)	NI (ALL)	SI-M (RM)	NI (ALL)
Traffic	SI-M (RM) NI (LI, C)	LSI (RM, LI) NI (C)	SI-M (RM, LI) NI (C)	NI (ALL)	SI-M (RM, LI) NI (C)	NI (ALL)	NI (ALL)	SI-M (RM, LI) NI (C)	SI-M (RM, LI)	NI (ALL)
Noise	SI-M (RM) NI (LI, C)	LSI (RM, LI) NI (C)	SI-M (RM, LI) NI (C)	NI (ALL)	SI-M (RM, LI) NI (C)	NI (ALL)	NI (ALL)	LSI (RM, LI) NI (C)	SI-M (RM, LI)	NI (ALL)
Environmental Justice Construction Summary:									**SI-M**	**NI**

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact on the entire island, RM = Racial Minorities, LI = Low-Income, C = Children, ALL = All 3 disadvantaged groups, N/A = Not Applicable;

Operational noise related to the training range in Volume 2 could also have a significant impact that could be mitigated with implementation of the noise reduction measures described in the noise chapter of Volume 2 and summarized in Volume 7 Chapter 2.

Loss of access to and use of recreational resources, such as the Guam International Raceway, Marbo Cave, Pagat Trail and associated trails in the vicinity, cultural gathering activities (*suruhana*), and off-shore fishing near Marbo Cave, would have a disproportionate effect on minority groups that would be significant and unmitigable.

Population growth associated with the preferred alternatives would increase the number of uninsured and underinsured people attempting to access the free services of public health and social services agencies. Without a substantial increase in staff and other resources, this increase in demand for GDPHSS and GDMHSA would strain existing services and therefore have a significant but mitigable disproportionate impact to the low-income population of Guam.

The proposed action would have disproportionate impacts to racial minorities on the island of Tinian in terms of recreational and cultural resources, socioeconomics, and terrestrial biology. People with low incomes are likely to be adversely affected by restricted access to historic and cultural sites in the currently leased areas of the island. Further, Tinian ranchers and locals who pick and sell wild chili-peppers from the leased land would be restricted from accessing the land needed to perform their work.

Table 3.3-63. Summary of Preferred Alternatives Operation Impacts - Environmental Justice

Potential Impacts	*Guam*									*Tinian*
	Volume 2	*Volume 4*	*Volume 5*	*Volume 6*					*Summary Impact*	*Volume 3*
	Marine Corps	*Navy Aircraft Carrier*	*Army AMDTF*	*Power*	*Potable Water*	*Waste water*	*Solid Waste*	*Road-ways*		*Training*
Cultural Resources	SI-M (RM) NI (LI) NI (C)	N/A	SI-M (RM) NI (LI) NI (C)	N/A	N/A	N/A	N/A	N/A	SI-M (RM)	SI-M
Traffic	N/A	N/A	SI-M (RM, LI) NI (C)	N/A	N/A	N/A	N/A	BI	SI-M (RM, LI)	N/A
Noise	SI-M (RM, LI) NI (C)	N/A	N/A	N/A	N/A	N/A	N/A	NI (ALL)	SI-M (RM, LI)	N/A
Recreational Resources	SI (RM) NI (LI, C)	LSI (RM, LI) NI (C)	N/A	N/A	N/A	N/A	N/A	N/A	SI-M (RM)	SI (RM, LI) NI (C)
Socio-economics	SI-M (RM, LI) NI (C)	SI-M (RM, LI) NI (C)	N/A	N/A	N/A	N/A	N/A	NI (ALL)	SI-M (RM, LI)	SI (RM, LI)
Environmental Justice Operation Summary:									**SI-M**	**SI**

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact on the entire island, RM = Racial Minorities, LI = Low-Income, C = Children, ALL = All 3 disadvantaged groups, N/A = Not Applicable.

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 those 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. So no action would facilitate the continued existence and accessibility of several cultural and historic resources valued by residents of Guam.

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 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. The preferred alternative would affect several Chamorro archaeological sites and access to some cultural sites that are currently accessible to the public. This would adversely affect Chamorros island-wide. On the other hand, recognized sites on DoD-managed lands are often better protected than sites on non-DoD managed lands because these resources are protected by DoD cultural resource management plans and various DoD laws and regulations.

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 to all residents of Guam. No action would include some of the roadway improvements described under the preferred alternatives, but the project schedule would be gradual and 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 3.3-64 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 five resource areas on Guam and three on Tinian (as indicated by bold typeface in the table).

Table 3.3-64. Summary of Operational Impacts of Preferred Alternatives

Resource	*Guam*	*Tinian*
Geology and Soils	LSI	LSI
Water Resources	LSI	**SI-M**
Air Quality	LSI	LSI
Noise	**SI**	LSI
Airspace	LSI	LSI
Land/Submerged Land Ownership	**SI-M**	NI
Land/Submerged Land Use	LSI	**SI**
Recreational Resources	LSI	LSI
Terrestrial Biology	**SI-M**	**SI-M**
Marine Biology	LSI	LSI
Cultural	LSI	LSI
Visual	LSI	**SI-M**
Transportation-Marine	LSI	LSI

Resource	*Guam*	*Tinian*
Related Actions (Utilities and Roadways)	**SI-M**	LSI
Socioeconomics	**SI-M**	**SI-M**
Hazardous Materials and Waste	LSI	LSI
Public Health and Safety	LSI	LSI
Environmental Justice and the Protection of Children	**SI-M**	**SI**

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

3.4 SECONDARY EFFECTS

The Guam military relocation and buildup would have direct, indirect and cumulative effects on the natural and build environment of the islands of Guam and Tinian. This section addresses indirect effects that are also referred to "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]).

It is reasonable to envision that the military buildup including short term construction related and longer term expanded facilities and military activities would have consequences beyond the immediate footprints of the proposed construction projects and extend in time beyond the buildup program period.

The secondary effects on Tinian are not as great as those anticipated for Guam. Key resources areas that are likely to be affected by secondary effects are described. The following discussion focuses on Guam, but may be applicable to Tinian as well.

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 funded through a grant provided by DoD and 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 meeting will be held to collect public input into the process. More information is available online at the following address: http://www.one.guam.gov/.

3.4.1 Socioeconomics

Forecasts of economic activities prepared for this EIS/OEIS 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 as 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 continuing of the 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 between 7,000 to 7,500 workers in 2010. At the peak of the construction and buildup, total civilian labor is projected to range between 43,000 to 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 be consisted 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. These are elements that are likely to be addressed in the CSS.

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 need 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 need 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 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/OEIS. The ongoing CSS planning effort will address these secondary impacts.

The zoning code and building code may need to be updated to include design and building height, and mass 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 overtime by natural and man-made events. The natural systems that would be potentially impacted by secondary growth provide functionally viable and valuable forest, coastal and marine ecosystems. A secondary impact of the buildup on federal lands is the increased pressure to restore, protect and preserve natural resources on non-federal lands. Local legislation may need to be more aggressive in providing environmental protection and enforcement. Local and federal agencies may need 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 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/OEIS. 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

Assuming increases in civilian populations and development on Guam, there would 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 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 need 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 need to be updated. Plans for providing emergency utilities, shelter, and food based on the anticipated increases in the civilian population would need 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 need 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 need staffing and budget to prepare and implement a recreation plan. Additional dive/snorkeling sites and other recreational facilities may need 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.

3.5 SUMMARY OF CLEAN WATER ACT SECTION 404 ACTIONS - ALL PROPOSED ACTIONS AND ALTERNATIVES

The summary impacts on wetlands and jurisdictional waters of the U.S. for the preferred alternatives are described in the Water Resources sections in Volume 2 through 6 of this EIS/OEIS by geographic locations and action proponent. A summary of all potential impacts to wetlands jurisdictional waters of the U.S. is summarized in this section. There are no anticipated secondary effects such as the (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 fill of wetlands and 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 areas. BMPs and 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 is insufficient data to assess potential impacts. The impact would be associated with all alternatives. On Tinian, the preferred alternative may impact wetlands and additional studies are planned to verify location of the wetlands.

Table 3.5-1. 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.*	
	All	**LCAC Ramps (2)**	**0.02 ac (<0.01 ha) fill**			●	Inner Apra Harbor
	All	**Dredging –Sierra Wharf (1)**	**509,000 cy (386,000 m^3)**	**ND**	●	-	**Inner Apra Harbor**
	Option A (improved)	**NMS Access Road**	**No impacts**				
	Option B (unimproved)	NMS Access Road Option B	No impacts				
	3, 8	AF Barrigada	0.4/0.16	-	-	●	sink hole wetland
Tinian-Training (Vol. 3)	**1**	**Platoon Battle Course (8)**	**0.3/0.12**	**-**	**-**	●	**Palustrine wetland**
	2	No impacts					
	3	No impacts					
Navy Wharf (Vol. 4)	**1**	**Dredging (3)**	**608,000 cy (466,000 m^3)**	**-**	**-**	**25 ac (10 ha) coral loss-**	**Outer Apra Harbor**
	1	**Wharf Pilings & Riprap (3)**	**3.6 ac (1.4 ha) fill**	**-**	**-**	●	**Outer Apra Harbor**
	2	Dredging	479,000 cy (366,000 m^3)	●	●	24 ac (10 ha) coral loss	Outer Apra Harbor
Army (Vol. 5)	**1**	**No impacts**					
	2	No impacts					
	3	No impacts					
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**

Volume	*Alternative*	*Component (Figure 3.5-1 ID#)*	*Type and Area (ac/ha) of Impact*				*Impacted Feature*
			Direct	*Indirect*	*Temp.*	*Perm.*	
	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**					
	Roads 1-3, 8	**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.**
		Fonte Bridge- GRN # 35 (4)	**0.27/ 0.11**	**ND**	●	●	**Fonte River between Anantano 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.

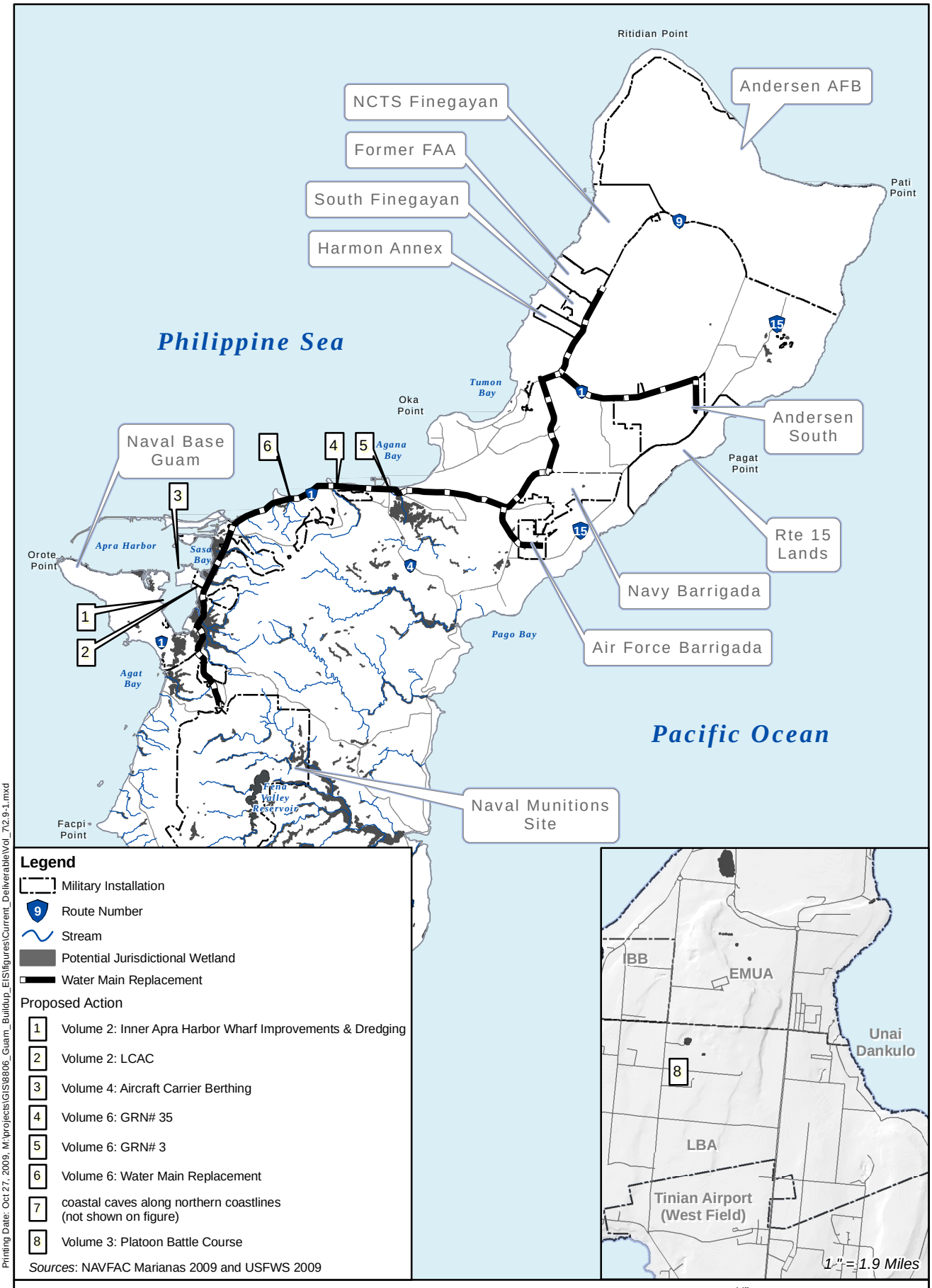

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Figure 3.5-1
Proposed Actions with Potential to Impact Wetlands and Jurisdictional Waters

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CHAPTER 4. CUMULATIVE IMPACTS

4.1 CONSISTENCY WITH CEQ CUMULATIVE EFFECTS ANALYSIS GUIDANCE

CEQ guidance on cumulative impacts analysis described in *Considering Cumulative Effects Under the National Environmental Policy Act* (CEQ 1997) and *Guidance on the Consideration of Past Actions in Cumulative Effects Analysis* (CEQ 2005). Eleven steps were identified in the guidance documents. They are grouped according to the three main components of the NEPA process: Scoping (Steps 1-4); describe the affected environment (Steps 5-7); and determination of environmental consequences (Steps 8-11).

This EIS/OEIS is consistent with the CEQ guidance. The following is a list of the CEQ steps and an indication of where the step is implemented in the EIS/OEIS:

1. **Identification of significant effects issues associated with the proposed action and definition of assessment goals.** The impacts analysis for each of the alternatives is presented in Volumes 2 through 6, under each resource. The direct and indirect and construction and operational impacts are described. Under each resource, the significance criteria and methodology for assessing significance is described. The same methodology is applied in Volumes, 2 through 6. There are exceptions in Volume 6 where the off-base roadways' impact analyses conform to federal Highways Administration requirements for impact analysis.
2. **Establishment of geographic scope for the analysis**. The geographic scope is described in the impact assessment methodology for each resource's impact assessment as a region of influence (ROI). The same methodology is applied across Volumes 2 through 6. The ROI varies by resource. In Volume 7, the discussion is expanded to island-wide (Guam and Tinian).
3. **Establishment of the time frame for analysis**. In Volumes 2 through 6, the affected environment is based on best available information, with the intent of capturing the environmental baseline conditions as of 2009. The impacts are based on two phases: construction and operation. Volume 7 considers projects that have occurred in the past, present and reasonably foreseeable projects and the timeframe begins three years before the proposed action (2004) and ends five years after the completion of construction (2019).
4. **Identification of other actions affecting the resources, ecosystems and human communities of concern.** Volume 7 Chapter 4 presents the findings of the cumulative impact analysis that includes past, present and reasonably foreseeable projects.

5&6. **Characterization of resources in terms of their responses to change and capacity to withstand stresses; and characterize the stresses affecting these resources, ecosystems, and human communities and regulatory thresholds.** Volume 7, Chapter 2 describes preferred alternatives impacts in the context of the trends in resource health.

7. **Definition of baseline conditions for resources, ecosystems and human communities.** The affected environment sections, primarily in Volumes 2 and 3, establishes a baseline for the resources. Volume 7, Chapter 2 describes the future without the preferred alternatives.
8. **Identify important cause and effect relationships between human activities and resources, ecosystems and human communities.** In Volumes 2 though 6, the direct and indirect impacts of the human activities of the preferred alternatives on resources are described.

9. **Determination of the magnitude and significance of cumulative effects on the resources.** Volume 7, Chapter 4 presents the findings of the cumulative impacts assessment.
10. **Modification or addition of alternatives to avoid, minimize or mitigate significant impacts**. Volumes 2 through 6 describe the alternatives screening analyses. Many alternatives were eliminated from the reasonable alternatives because of environmental impacts. Others were modified to avoid and minimize impacts. For those impacts that were unavoidable, BMPs and mitigation measures are described. They are summarized in Volume 7, Chapter 3.
11. **Monitor effects of the proposed action and adaptive management.** Volume 7, Chapter 3 describes management actions that could mitigate impacts.

4.2 CUMULATIVE IMPACT METHODOLOGY

CEQ guidance observes that "no universally accepted framework for cumulative effect analysis exists", while noting that certain general principles have gained acceptance.

The analysis of cumulative impacts (or cumulative effects) was initiated in Chapter 3, where the impacts of the preferred alternative were assessed within the context of resource trends. The preferred alternative was compared to no-action, which is the island (Guam or Tinian) without any component of the preferred alternatives. Trends in resource health and stressors were identified. Future projects that may impact general trends were described.

Chapter 4, Cumulative Impacts, continues the analysis by assessing the preferred alternative impacts from Chapter 3, in the context of specific past, present, and reasonably foreseeable future actions. This 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).

The following approach was used in assessing cumulative impacts:

1. Develop a list of past, present, and reasonably foreseeable future actions, referred to as "cumulative projects", within a designated timeframe beginning three years before 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. 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
    d. The project was categorically excluded (CATEX) under NEPA

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 development

g. Project impacts would be localized and geographically distinct from preferred alternatives and unlikely to have cumulative impacts

3. Based on the short-list of cumulative projects, identify the resources that would potentially experience an additive effect when combined with the operational (long-term) preferred alternative (Section 4.4).

4. If an additive effect is determined, assess the level of impact (Section4.4).

4.3 PAST, PRESENT, AND REASONABLY FORESEEABLE ACTIONS

The Past, Present, and Reasonably Foreseeable Actions herein referred to as the cumulative projects list was developed from 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 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 (if readily available) for the four regions on Guam are shown in Figure 4.3-1, Figure 4.4-2, and Figure 4.4-3 and Figure 4.3-4. Project locations on Tinian are shown in Figure 4.3-5.

Sizeable projects on Guam include the planned Port Authority of Guam commercial harbor improvements, the Establishment and Operation of an Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Capability Project on Andersen Air Force Base (AFB), Guam and the Marianas Islands Range Complex (MIRC) improvements, all of which have either had master plans or NEPA documents prepared describing the proposed actions. A brief description of these projects is described before the cumulative project tables and figures.

4.3.1 Commercial Port Improvements

The commercial port improvements were identified in Volume 6 as a non-DoD decision point action. Please see Volume 6 for a more detailed description.

4.3.2 Intelligence, Surveillance, Reconnaissance, and Strike (ISR/Strike) Capability

The proposed action would establish an ISR/Strike operational capability in four phases over an approximate 16-year period in the western Pacific, beginning in fiscal year 2007. The ISR/Strike capability would consist of fighter, aerial refueling, bomber, unmanned aerial vehicle aircraft, and support personnel. The EIS was finalized and a Record of Decision (ROD) was issued 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. The increase in aircraft events out of and into 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. No land acquisition is 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 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 mitigation for impacts to biological resources. An ungulate control plan would be developed and ungulate exclusion fencing is proposed. 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 preparation there was insufficient project description on the project addressed in this draft Guam and CNMI Military Relocation EIS/OEIS to include the Air Force cumulative impact project list. The Air Force was able to address the cumulative impacts of establishing an ISR/Strike Capacity in their EIS (PACAF 2006) relative to a host of other cumulative projects identified.

4.3.3 MIRC

The MIRC EIS has not been finalized nor has a ROD been issued. The Draft EIS proposed action is ongoing and proposed military training activities within the Mariana Islands (Navy 2009). 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 EIS 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 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. The proposed action does not involve the redeployment of Marine Corps, Air Force personnel or assets, carrier berthing capability, or deployment of strategic missile defense assets to the Marianas. The proposed action focuses on the development and improvement of existing training capabilities in the MIRC and would not include any military construction projects. 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 including 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 are required that would warrant new procedures in the MIRC.

Table 4.3-1. Past, 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	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.	Past	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.	Present	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	Outside the geographical region of influence
4	Commander Navy Region (COMNAV) Pacific	Nora Macariola-See Naval Facilities Engineering Command (NAVFAC) Pacific	MIRC EIS	Guam/CNMI	2011	Pending Record of Decision (ROD) in March 2010	Covers proposed action and alternatives for continued use of the Marianas Islands Range Complex	Future	Retain
5	Department of Public Works (DPW)	GovGuam	2030 Guam Transportation Plan	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.	Future	Retain
6	DPW	GovGuam	Territorial Transportation Improvement Plan TTIP)	Guam	2008-2011	In place	Short-term federally-funded transportation projects (65).	Present	FONSI or Categorical Exclusion anticipated with no significant impacts.
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.	Future	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	FONSI or Categorical Exclusion 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
Guam - Offshore (not mapped)									
11	PIPE Networks	Bevan Slattery, CEO	"Project Runway" Australia – Guam submarine cable (private)	Guam-Offshore	2009-2010	Pending	Submarine cable link from Australia to Guam.	Past	Outside the geographical region of influence
12	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.	Present	Outside the geographical region of influence .

#	*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*	*Reason for Dismissal*
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.	Past	Impacts are included in EIS/OEIS 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.	Past	Impacts are included in EIS/OEIS affected environment
N-3	Air Force/GEPA	Air Force	Urunao Dump Clean Up	Guam-North	2005	Unknown	The U.S. Air Force is ongoing remediation project to clean-up the two-year-long job of removing waste from the Urunao Dumpsite 1 & 2, a private property. West of Andersen AFB, Northwest Field (NWF), Guam.	Present	Retain
N-4	unknown	Air Force	unknown	Guam-North	2007	Unknown	Removal and Control of Vegetation at Runway, in accordance with AICUZ Program	Past	*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.	Future	*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.	Present	Retain
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.	Present	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.	Present	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.	Future	Retain
N-10	36 WG of the PACAF	Air Force/ Navy	Unknown	Guam-North	TBD	Unknown	Additional FY10-FY15 MILCON Projects: Antiterrorism/Force Protection (AT/FP) Perimeter Fence/Road, relocate Main Gate, War Readiness Materials Storage Warehouse, Education/Library Complex, Permanent Party Enlisted Dorm, Consolidate Youth Programs, Postal Service Center	Future	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).	Past	*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, and Wing Safety, and 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,	Past	*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	New munitions igloos are required to enable the 36 WG's existing mission and ongoing military operations. Phase 1 to construct 12	Present	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*	*Reason for Dismissal*
						and Phase 2 NEPA EA prepared. FNOSI pending.	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.		
N-14	GLUC[2,3]	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.	Future	Insufficient information, but retain because is in the north, in proximity to preferred alternatives
N-15	GLUC[2,3]	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.	Future	
N-16	GLUC[2,3]	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.	Future	
N-17	GLUC[2,3]	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.	Future	Retain
N-18	GLUC[2,3]	Terry Perez, Guam Coastal Management Program, Bureau of Statistics and Plans	Zone Change Request	Guam-North	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.	Future	Insufficient data
N-19	Private Development	Vantage Group	Villa Pacita Estates	Guam-North	TBD	Under construction	Private housing division along Rt. 15 in Yigo on the west side of Mt. Santa Rosa	Present	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.		Insufficient data.
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.	Past	May not be required after EIS/OEIS 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).	Past	Geographically and localized impacts.
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).	Past	Geographically and localized impacts.
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.	Present	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).	Present	Retain
C-6	Core Tech		Workforce housing	Guam-Central	2008-2010	Completed	Facility at Tinian that is to include housing for up to 1,600 workers; currently Core Tech in discussions with GovGuam for possible temporary use of facility for John F. Kennedy High School students.	Present	Retain
C-7	Private Development	Access Development	Ypao Resort	Guam-Central	2010-2012	Pending	700 units full-service resort condominium; Under GLUC review.	Future	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*	*Reason for Dismissal*
		Company							
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.	Present	Retain
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.	Present	Retain
C-10	CNM	Navy	Defense Access Road	Guam-Central	2010	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.	Future	Retain
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.	Present	*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.	Present	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.	Present	Retain.
C-14	Private Development	Access Development Company	Hemlani Apartments	Guam-Central	TBD	Planning	300 unit apartments (behind Acanta Mall, Tumon Bay).	Future	Retain
C-15	Guam International Airport Authority (GIAA)	GovGuam	Guam International Airport Improvements	Guam-Central	TBD	TBD	Various upgrades to airport property, main terminal, industrial park, airfield, and south ramp.	Future	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.	Future	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.	Future	Retain
C-18	GLUC[2,3]	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.	Future	Retain
C-19	GLUC[2,3]	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.	Future	Retain
C-20	GLUC[2,3]	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.	Future	Retain
C-21	GLUC[2,3]	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.	Future	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*	*Reason for Dismissal*
C-22	GLUC[2,3]	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.	Future	Retain
C-23	GLUC[2,3]	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.	Future	Retain
C-24	GLUC[2,3]	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.	Future	Retain
C-25	GLUC[2,3]	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.	Future	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.		No longer viable.
C-27	unknown	unknown	unknown	Guam-Central	TBD	Unknown	Subdivision on Ypao Road, in construction.	Future	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 SasaValley 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.	Future	*De minimus* impacts.
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 protection, lighting, and steam utilities at Kilo Wharf.	Past	Geographically distinct and included in affected environment of EIS/OEIS.
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.	Past	Included in affected environment of EIS/OEIS..
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 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.	9,350 ft^2 pads (8)	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.	Future	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.	Past	*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*	*Reason for Dismissal*
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.	Present	Categorical exclusion (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.	Present	Adverse impacts (explosive safety) were mitigated through design. No cumulative impacts
AH-8	Port Authority of Guam (PAG)	GovGuam	Guam Port	Guam-Apra Harbor	2009-2013	Request for Proposal issued, proposals reviewed and in process of awarding	Owners/agent for construction at the Guam Commercial Port.	Future	Retain
AH-9	PAG	MARAD/GovGuam	Guam Port	Guam-Apra Harbor	2009-2013	Request for Proposal issued and proposals have been submitted	Construction and commissioning of the facilities, equipment and amenities ($195 million) that are required to implement the preferred concept "Break-Bulk West" in order to meet minimum requirements of the military buildup construction logistics requirements.	Future	Retain
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.	Present	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.	Future	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 at Sumay Cove, equipment storage facility at Polaris Point, and installation of two surface approach radar systems.	37,900 ft^2	Cancelled.
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.	Future	CATEX completed.
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.	Future	CATEX completed.
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.	Future	CATEX completed.
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.	Future	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.	Future	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*	*Reason for Dismissal*
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.	Future	Retain
AH-19	PAG	GovGuam	Commercial Port Improvements	Guam-Apra Harbor	2021-2025	Draft EIS (Notice of Availability [NOA] published in *Federal Register* on 8-10-07)	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.
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	Unknown	Mitigation to provide 188-376 acre-years of coral services.	Present	Retain
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.	Present	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.	Future	Retain
S-3	GLUC[2,3]	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.	Future	Insufficient information on location or magnitude
S-4	GLUC[2,3]	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.	Future	Insufficient information on location or magnitude
S-5	GLUC[2,3]	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.	Future	Insufficient information on location or magnitude
S-6	GLUC[2,3]	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.	Future	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*	*Reason for Dismissal*
S-7	GLUC[2,3]	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.	Future	Retain.
S-8	GLUC[2,3]	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.	Future	Insufficient information on location or magnitude

Notes:
[1] Projects included in this list were/would be constructed between 2005 and 2017.
[2] Projects included from the GLUC database by GLUC Request Type (e.g. Zone Variance, Seashore Clearance, Tentative Development Plan, etc.) were/would be permitted between 2000 and 2015.
[3] Projects from the GLUC database by GLUC Request Type (provided in column D) prior to inclusion in this Cumulative Project List. The native file of GLUC projects is available and can be queried by project location, if necessary.
Navy projects last updated 9/09; Air Force Projects updated 10/09
Bold: projects are shown on Guam figures
* 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/OEIS.

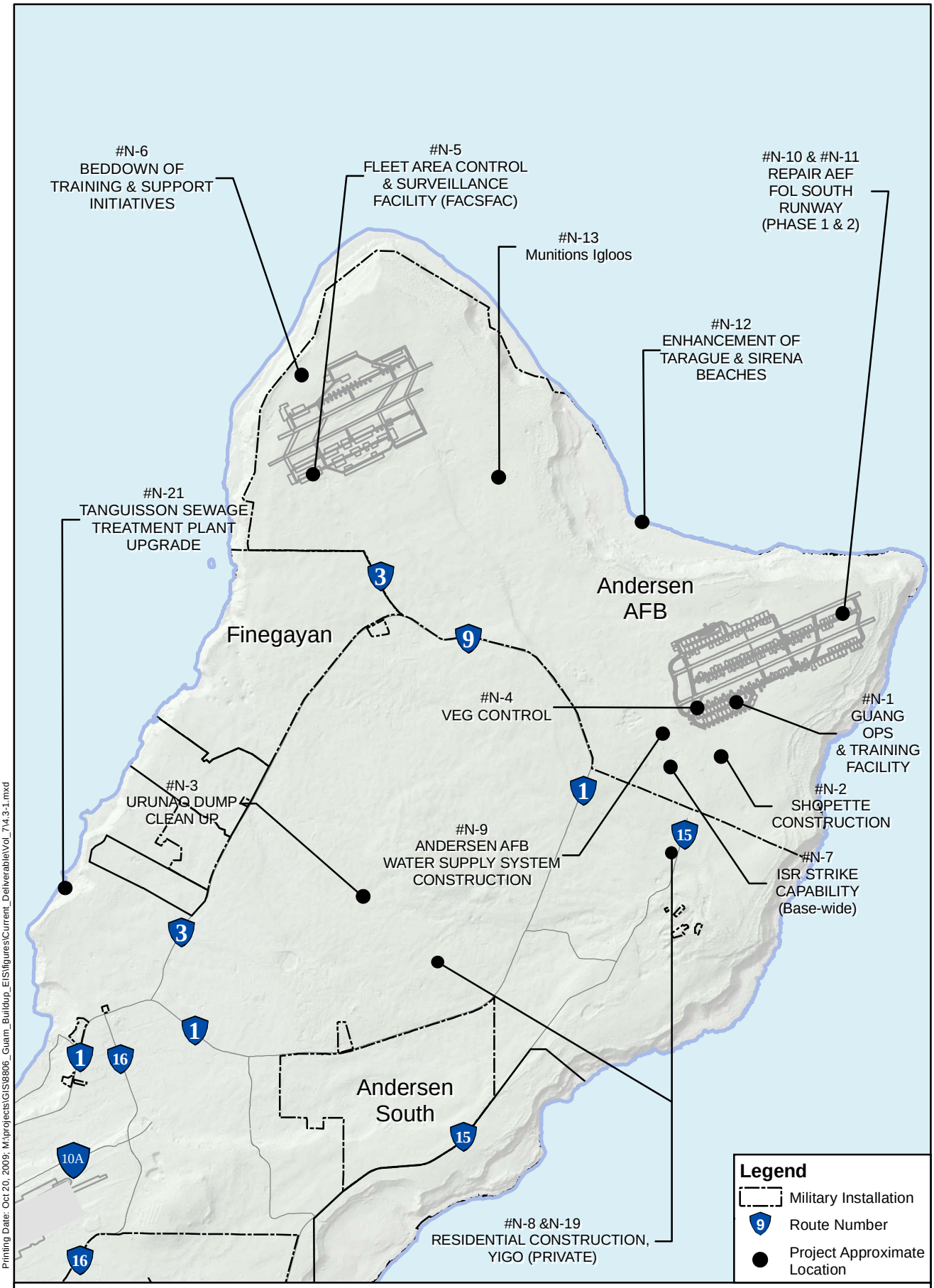

Figure 4.3-1
Anticipated Locations of some Past, Present and Reasonably Foreseeable Projects on Guam (North)

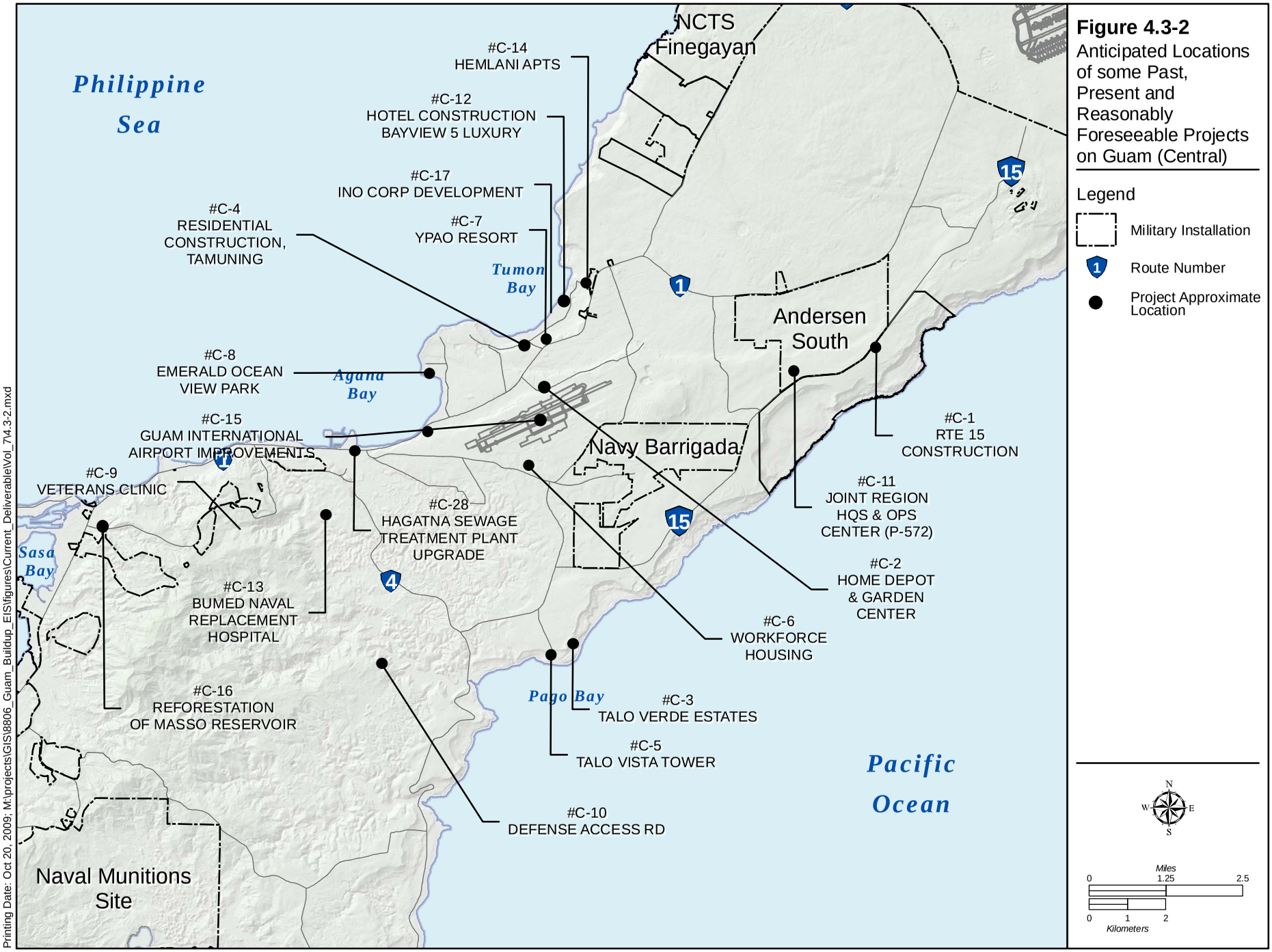

Figure 4.3-2
Anticipated Locations of some Past, Present and Reasonably Foreseeable Projects on Guam (Central)

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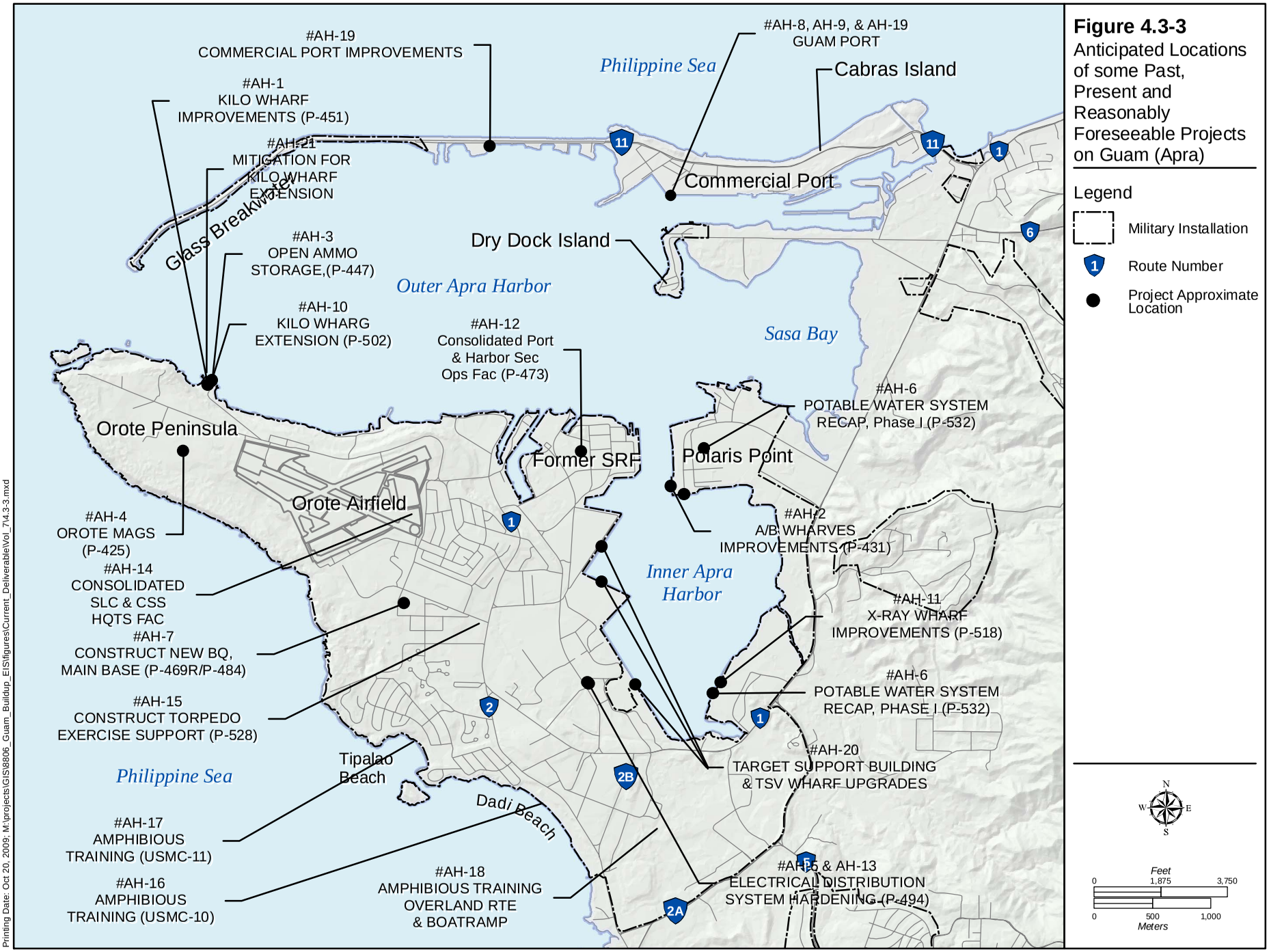

Figure 4.3-3
Anticipated Locations of some Past, Present and Reasonably Foreseeable Projects on Guam (Apra)

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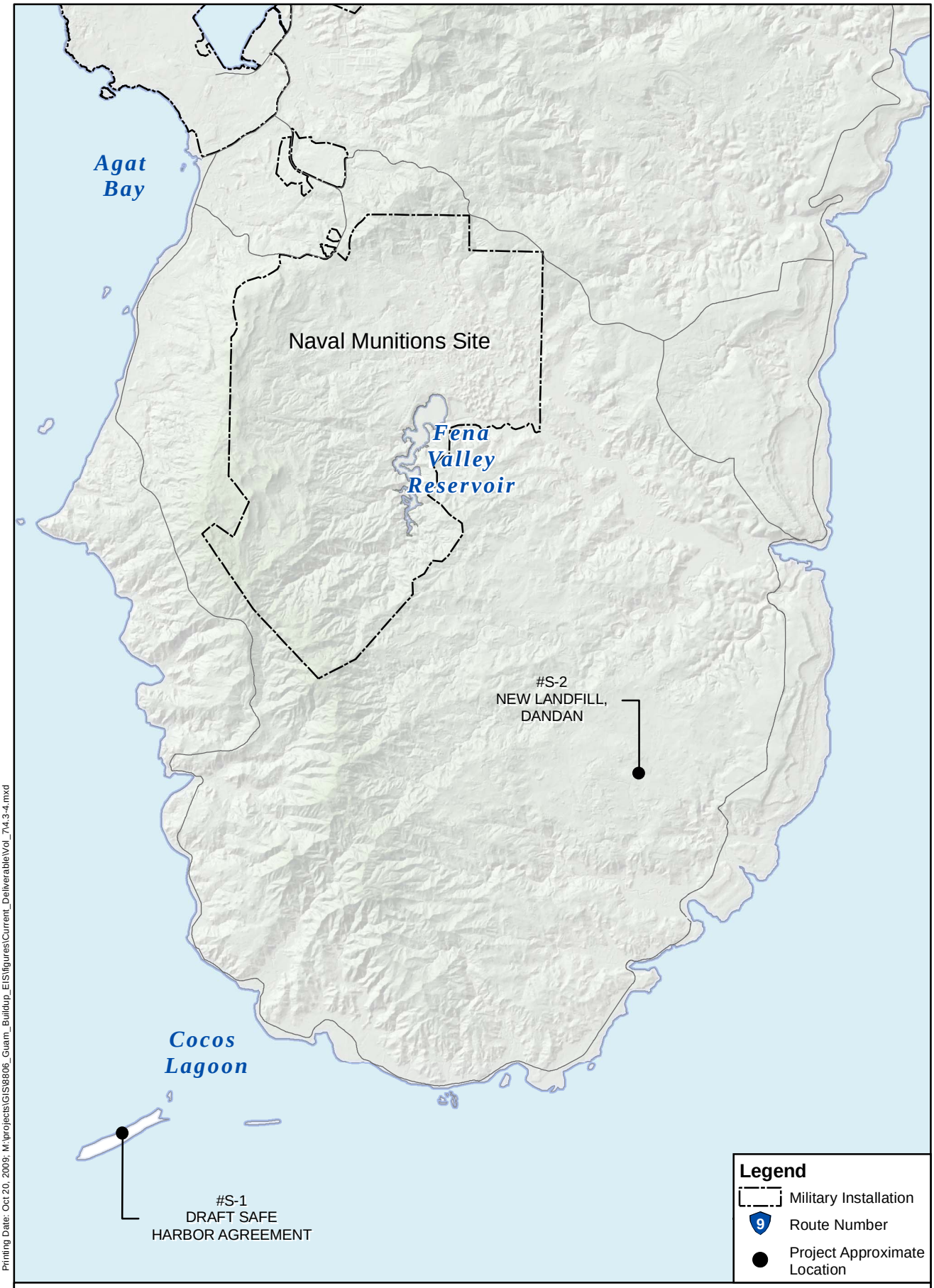

Figure 4.3-4
Anticipated Locations of some Past, Present and Reasonably Foreseeable Projects on Guam (South)

Table 4.3-2. Past, Present and Reasonably Foreseeable Projects in the CNMI

#	*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*	*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)	CNMI-Tinian	2014+	unknown	Additional construction to accommodate up to 3,000 personnel.	Future	Retain
T-3*	Marine Corps Proj. 14	Marine Corps	Ammunition Storage (Marine Corps Proj. 14)	CNMI-Tinian	2014+	unknown	Ammunition storage facility. Includes six igloo magazines, a segregation facility, operations building, security systems, and a road network.	Future	
T-4*	Marine Corps Proj. 15	Marine Corps	Automated Multipurpose Range (Marine Corps Proj. 15)	CNMI-Tinian	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.	Future	
T-5*	Marine Corps Proj. 16	Marine Corps	Combined Arms Live Fire Training Area (Marine Corps Proj. 16)	CNMI-Tinian	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.	Future	
T-6*	Marine Corps Proj. 17	Marine Corps	Company Level Live-Fire and Movement Range (Marine Corps Proj. 17)	CNMI-Tinian	2014+	unknown	2,000 x 4,000-ft area for live-fire and movement training. Supports up to 7.62-mm infantry weapons.	Future	
T-7*	Marine Corps Proj. 18	Marine Corps	Mortar and Artillery Ranges (Marine Corps Proj. 18)	CNMI-Tinian	2014+	unknown	Areas for mortar and artillery firing points.	Future	
T-8*	Marine Corps Proj. 19	Marine Corps	North Field Helicopter Operations (Marine Corps Proj. 19)	CNMI-Tinian	2014+	unknown	Paved area at North Field for helicopter landings, weekly aviation training. Includes fire protection and bermed area for fuel bladder.	Future	
T-9*	Marine Corps Proj. 20	Marine Corps	Small Arms and Machine Gun Ranges (Marine Corps Proj. 20)	CNMI-Tinian	2014+	unknown	6 pistol and rifle firing ranges, including stationary/automated targets, standard set of range support facilities.	Future	
T-10*	Marine Corps Proj. 21	Marine Corps	Stationary Target Range (Marine Corps Proj. 21)	CNMI-Tinian	2014+	unknown	100 x 300-foot area for tank/fighting vehicle training. one firing point, central dubbed impact area.	Future	
T-11*	Marine Corps Proj. 22	Marine Corps	Waterfront Upgrades (Marine Corps Proj. 22)	CNMI-Tinian	2014+	unknown	Breakwater repair, pier face structures repair, loading ramp, holding yard for customs, storage/transfer area, harbor dredging. Includes demolishing finger pier.	Future	
T-12*	Marine Corps Proj. 23	Marine Corps	Infrastructure Upgrades (Marine Corps Proj. 23)	CNMI-Tinian	2014+	unknown	Roadway improvements, electrical distribution changes, fire protection facilities, and access to Unai Dankulo.	Future	
T-13*	Marine Corps Proj. 24	Marine Corps	Voice of America Relocation (Marine Corps Proj. 24)	CNMI-Saipan and Tinian	2014+	unknown	Relocate Voice of America facility to northern portion of Saipan.	115	Cancelled
T-14	Commonwealth Ports Authority (CPA)	unknown	Harbor Rehabilitation Project	CNMI-Tinian	Ongoing	Ongoing	Power Builders International is presently upgrading dock surfaces, bulkheads, and bollards.	Present	*De minimus* impacts
T-15	DPW	unknown	Marpo Valley Quarry (government)	CNMI-Tinian	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.	Present	Retain
T-16	Bridge Investment Group	Bridge Investment Group Mr. Phillip Long	Tinian Oceanview Resort	CNMI-Tinian	2009 (FY)	CRM permit issued January 2008; construction has been	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.	Present	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*	*Potential Impacts*
						initiated			
T-17	Marianas Resort Development Group	MRDG, Mr. David Choi 670.235.0020	Matua Bay Resort and Golf Course	CNMI-Tinian	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 doubled phased project will 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 will include the completion of the facility.	Present	Retain
T-18	DPW	unknown	Landfill Project, western Tinian	CNMI-Tinian	TBD	NEPA final	Relocation of current landfill was pending DoD approval. As of November 2008, DoD was not taking action and CNMI was researching other potential locations.	Future	Retain
T-19	CUC	unknown	WWTP Project (government) , western Tinian	CNMI-Tinian	TBD	Awaiting final NEPA	Proposed Tinian WWTP to be co-located with proposed landfill.	Future	Retain
T-20	CPA	unknown	Tinian Airport	CNMI-Tinian	TBD	Ongoing	Project and construction specifics TBD.	unknown	Too speculative
T-21	CPA	unknown	Tinian Airport Instrument Landing System	CNMI-Tinian	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.	Future	There are no anticipated cumulative impacts
T-22		unknown	Reconstruction of Roads	CNMI-Tinian	TBD	Ongoing	Reconstruction of Broadway and 8th Avenues along existing alignments	Past	*De minimus* impacts
T-23	Neo Goldwings Paradise	unknown	Neo Goldwings Paradise Casino on Tinian	CNMI-Tinian	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.	Future	Retain
T-24	unknown	unknown	Tinian and Rota Seaport Rehabilitation	CNMI-Tinian 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 will 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	GovGuam	2030 CNMI Transportation Plan	Tinian	TBD	This plan guides federally - funded transportation projects from 2010 to 2030	This plan involves repairs and upgrades of Tinian transportation network. Projects are funded by FHWA and other sources.	Future	There are no anticipated cumulative impacts
T-26	CNMI DPW	GovTinian	Territorial Transportation Improvement Plan (TTIP)	Tinian	2008-2011	In place	Short-term federally-funded transportation projects (two projects).	Present	Both projects are CATEX. There are no cumulative impacts

Notes:

* Identified in the *Training Concept Plan (Marine Forces Pacific 2009),* but siting of the projects would need to be revisited after the ROD is issued for this EIS/OEIS. The project locations are too conceptual to site on a figure but they generally would be within the Military Lease Area

Bold: project identified on Figure 4.3-5.

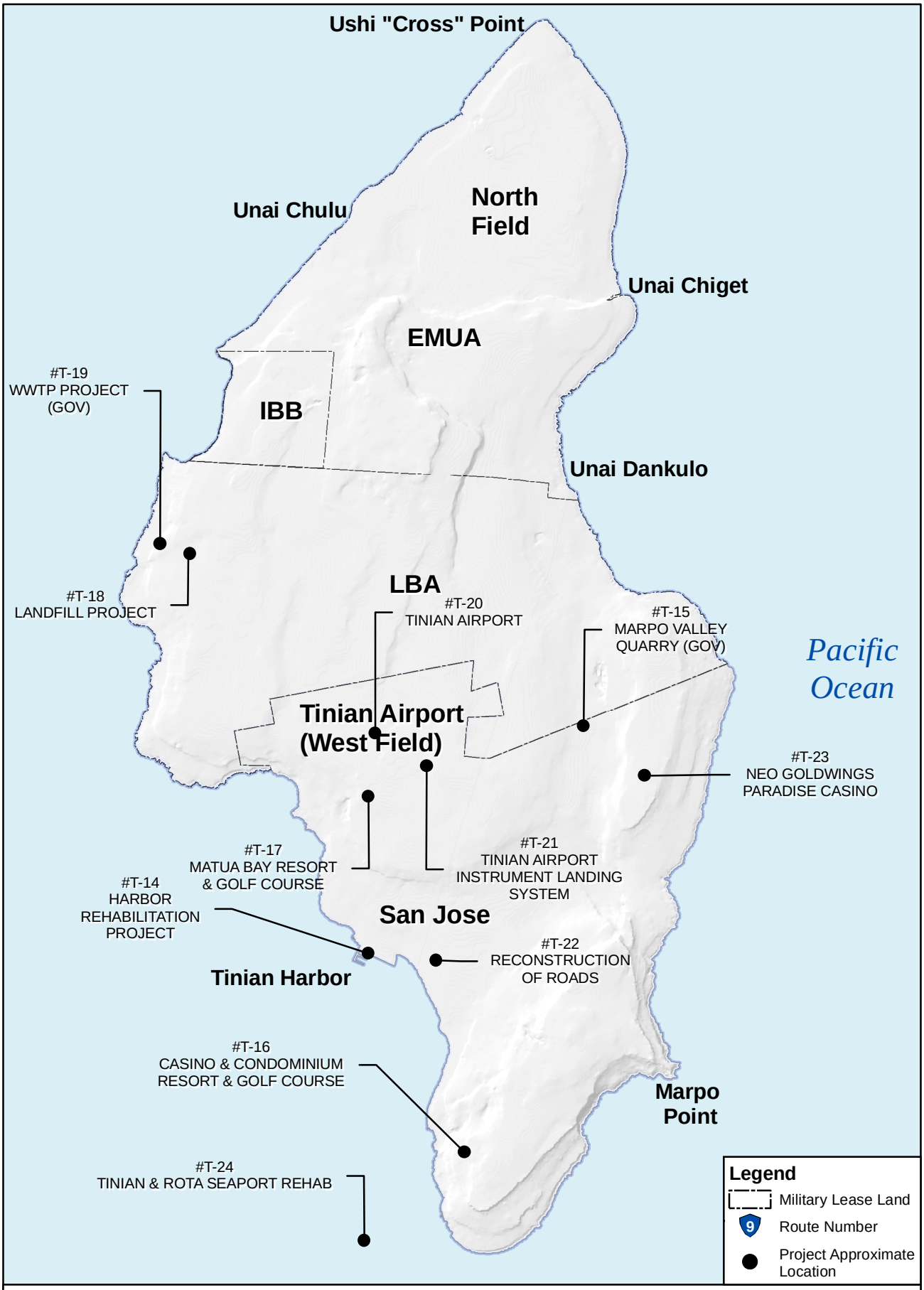

Figure 4.3-5
Anticipated Locations of some Past, Present and Reasonably Foreseeable Projects on Tinian

4.3.4 Cumulative Impact Assessment

The projects identified on Guam and Tinian as cumulative projects have some impacts or are likely to have some level of impact on virtually all of the resource areas identified in the EIS. Guam Cumulative Impacts

4.3.4.1 Guam Cumulative Impacts Assessment

The cumulative projects that were retained following the screening of the total cumulative project list (Table 4.3-1) for relevance are listed in Table 4.4-3. 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. No attempt was made to distinguish between less than significant and significant adverse impacts. 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 project list. This number of projects with potential impacts may be an indicator of the magnitude of the cumulative project impact on that resource. 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 an additive impact on the resource is anticipated and whether the additive impact due to the preferred alternative is strong, moderate or low.

The preferred alternatives are likely to have an additive adverse cumulative impact to five resources: noise, land use/ownership, terrestrial biology, utilities and roadways, and socio-economics. The preferred alternatives noise impacts are due to roadways primarily but there are also localized nuisance noise impacts associated with the training ranges on the east coast. The additive impact is low because noise impacts are by nature localized. The cumulative projects and preferred alternatives are geographically distinct.

The preferred alternatives significant impacts were largely due to the forced sale of private land to the federal government there are also some land use inconsistencies notably around the proposed east coast firing ranges. None of the cumulative projects listed involved acquisition of land by a government entity; therefore cumulative impact is low. The assumption is that new land development projects are being approved and developed in accordance with local master plans and zoning; therefore the preferred alternatives would have low additive impact on cumulative projects' impacts.

Without site specific terrestrial biology data for all the proposed development areas, the assumption is that all projects would adversely impact terrestrial biological resources. The preferred alternatives would have an additive cumulative impact that is considered strong because of the magnitude of area disturbed.

Most developments would increase demand on utilities and use of specific roadways. The preferred alternatives would have an additive adverse impact on utilities and roadways. The additive impact would be strong due to the large population increase on island. The cumulative project subdivisions would shift the location of existing island population and not necessarily be due to new populations. An exception is new hotels that would support an increased transient population.

The socioeconomic impacts of the preferred alternatives would have a strong additive impact on the cumulative projects impact. As described under the utilities and roadways discussion it is the influx of population to support the preferred alternatives that triggers the socioeconomic impacts. Most of the cumulative projects are not growth-inducing.

Table 4.3-3. Summary of Potential Impacts to Resource Area – Guam Projects

#	Lead Agency or Proponent	Project Name/ Location	Potential Impacts to Resources															
			Water / Wetlands	Air Quality	Noise	Air Space	Land Use/Ownership	Recreation	Terrestrial Biology	Marine Biology	Cultural	Visual	Marine Transportation	Utilities/Roadways	Socio-economics	Hazardous Materials	Public Health & Safety	Environmental Justice & Protection of Children
Guam – General Actions																		
1	Core Tech	Ironwood Estates (affordable housing)	X				X		X		X	X		X	B			B
4	Commander Navy Region (COMNAV) Pacific	MIRC EIS	X	X	X				X	X	X				X			
5	Department of Public Works (DPW)	2030 Guam Transportation Plan	X	X	X				X	X	X				X			
7	Guam Department of Corrections	Territorial Prison							X		X			X	X		B	
Guam - North																		
N-3	Air Force/GEPA	Urunao Dump Clean Up	B				B					B				B	B	
N-6	36 WG of the Pacific Air Forces (PACAF)	Beddown of Training and Support Initiatives at NWF		X					X		X			X	X			
N-7	36 WG of the Pacific Air Forces (PACAF)	ISR Strike Capability, Andersen AFB	X	X	X				X	X	X				X			
N-8	Base Corp.	Paradise Estates, Yigo					X		X		X		X	X				
N-10	36 WG of the PACAF	Various small scale- projects at Andersen AFB					X		X		X		X	X				
N-14	GLUC[2,3]	Conditional Use Request	X				X		X		X		X	X				
N-15	GLUC[2,3]	Subdivision Variance Request	X				X		X		X		X	X				
N-16	GLUC[2,3]	Tentative Subdivision Approval	X				X		X		X		X	X				
N-17	GLUC[2,3]	Wetland Permit	X							X								
N-19	Private	Villa Pacita Estates	X				X		X		X		X	X				

#	Lead Agency or Proponent	Project Name/ Location	Potential Impacts to Resources															
			Water / Wetlands	Air Quality	Noise	Air Space	Land Use/Ownership	Recreation	Terrestrial Biology	Marine Biology	Cultural	Visual	Marine Transportation	Utilities/Roadways	Socio-economics	Hazardous Materials	Public Health & Safety	Environmental Justice & Protection of Children
	Development																	
Guam - Central																		
C-4	TBD	Residential construction, Tamuning (private)	X				X	X	X		X	X	X	X	X			
C-5	Private Development	Talo Vista Tower					X	X	X		X	X	X	X	X			
C-6	Core Tech	Workforce housing					X		X		X	X	X	X	X			
C-7	Private Development	Ypao Resort	X				X		X		X	X	X	X	X	X		
C-8	Private Development	Emerald Ocean View Park	X				X		X		X	X	X	X	X			
C-9	Unknown	Veterans Clinic					X		X		X		X	X	B	X	B	B
C-10	Navy	Defense Access Road	X	X			X		X		X			X				
C-12	Private Development	Hotel Construction Bayview 5 Luxury Project, Tumon Bay	X				X	X	X		X	X	X	X	X	X		
C-13	BUMED	Bureau of Medicine Naval Replacement Hospital Project					X				X			X		X	B	
C-14	Private Development	Hemlani Apartments					X		X		X		X	X	X			
C-15	Guam International Airport Authority (GIAA)	Guam International Airport Improvements	X		X									B				
C-16	GovGuam and the U.S. Navy	Reforestation of Masso Reservoir	B						B	B								
C-17	Private Development	Ino Corp Development	X				X		X		X		X	X	X			
C-18	GLUC[2,3]	Conditional Use Request	X	X		X	X		X		X		X	X	X			

#	Lead Agency or Proponent	Project Name/ Location	Potential Impacts to Resources															
			Water / Wetlands	Air Quality	Noise	Air Space	Land Use/Ownership	Recreation	Terrestrial Biology	Marine Biology	Cultural	Visual	Marine Transportation	Utilities/Roadways	Socio-economics	Hazardous Materials	Public Health & Safety	Environmental Justice & Protection of Children
C-19	GLUC[2,3]	PUD - Amendment	X	X		X	X	B	X		X		X	X	X			
C-20	GLUC[2,3]	Seashore Clearance Request	X					B		X	X		X	X	X			
C-21	GLUC[2,3]	Subdivision Variance Request	X	X		X	X		X		X		X	X	X			
C-22	GLUC[2,3]	Tentative Development Plan Application	X	X		X	X		X		X		X	X	X			
C-23	GLUC[2,3]	Tentative Subdivision Approval	X	X		X	X		X		X		X	X	X			
C-24	GLUC[2,3]	Wetland Permit	X						X									
C-25	GLUC[2,3]	Zone Change Request	X			X	X	B	X		X		X	X	X			
C-27	unknown	Subdivision	X			X		X	X		X		X	X	X			
Guam - Apra Harbor																		
AH-4	CNM	Orote Magazines (P-425)					X		X							B	X	
AH-8	Port Authority of Guam (PAG)	Guam Port	X	X		X	X			X			B	X	B	X		
AH-9	PAG	Guam Port	X	X		X	X			X			B	X	B	X		
AH-10	CNM	Kilo Wharf Extension (P-502)	X				X			X			B	X			X	
AH-11	CNM	X-Ray Wharf Improvements (P-518)	X				X			X			B					
AH-16*	MARFORPAC	Amphibious Training, Dadi Beach (Marine Corps Proj. 10)	X		X		X	X		X		X						
AH-17*	MARFORPAC	Amphibious Training, Tipalao Beach (Marine Corps Proj. 11)	X		X		X	X		X		X						
AH-18*	MARFORPAC	Amphibious Training, Boat Ramp and Overland Route	X		X		X	X	X	X		X						
AH-21	CNM	Mitigation for Kilo Wharf Extension	B						B	B								
Guam - South																		
S-1	USFWS	Draft Safe Harbor Agreement, Cocos Island							B									
S-2	DPW	New Landfill, Dandan	X		X		X		X			X		X			B	

#	Lead Agency or Proponent	Project Name/ Location	Potential Impacts to Resources															
			Water / Wetlands	*Air Quality*	*Noise*	*Air Space*	*Land Use/Ownership*	*Recreation*	*Terrestrial Biology*	*Marine Biology*	*Cultural*	*Visual*	*Marine Transportation*	*Utilities/Roadways*	*Socio-economics*	*Hazardous Materials*	*Public Health & Safety*	*Environmental Justice & Protection of Children*
S-7	GLUC[2,3]	Wetland Permit	X						X									
Number of Cumulative Projects potentially adversely impacting resources island-wide			35	12	8	9	32	7	34	12	31	11	23	31	21	6	2	0
Summary Impacts: Preferred Alternatives significant impacts (from Chapter 3)					**SI**		**SI**		**SI-M**					**SI-M**	**SI-M**			**SI-M**
Preferred Alternatives impacts may be additive to cumulative project impacts? yes[Y]/no[N]			N	N	**Y**	N	**Y**	N	**Y**	N	N	N	N	**Y**	**Y**	N	N	N
Degree of additive impact? S-strong; M-moderate; L= low					**L**		**L**		**S**					**S**	**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

4.3.4.2 Tinian Cumulative Impacts Assessment

The cumulative projects that were retained following the screening for relevance are listed in Table 4.4-4. 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. The number of cumulative projects that potentially have an adverse impact on each resource is totaled at the bottom of the cumulative project list. This number of projects with potential impacts may be an indicator of the magnitude of the cumulative project impact on that resource. 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 due to the preferred alternative is strong, moderate or low.

Four resources on Tinian would be subject to additive impacts due to preferred alternatives. The impacts identified to land use in the preferred alternatives is related to the potential loss of agricultural leases and decline is agricultural lands available. The resorts' development would remove additional land from potential agricultural use.

Any ground disturbance could potentially result in terrestrial biological impacts and the preferred alternatives could be moderately additive to the impacts from the cumulative projects, which disturb far greater land area than the preferred alternative.

Visual impacts under the preferred are limited to the view from Mt Lasso. The planned resorts would have a much more substantial impact on visual resources than the preferred alternatives; therefore the additive impact of the preferred alternatives on the cumulative project impact on visual resources would be minor.

The socioeconomic impacts of the preferred alternatives would be additive to the cumulative projects' impacts. The impact would be strong due to restricted public access to key tourist sites on Tinian, while the cumulative projects would have largely beneficial impacts on socioeconomics.

The impact to wetlands under the preferred alternatives would be a significant mitigable impact, but the cumulative projects may not impact wetlands. There would be no additive impact.

The preferred alternatives would have a significant impact on environmental justice issues. The proposed action would have disproportionate impacts to racial minorities on the island of Tinian in terms of recreational and cultural resources, socioeconomics, and terrestrial biology. People with low incomes are likely to be adversely affected by restricted access to historic and cultural sites in the currently leased areas of the island. Further, Tinian ranchers and locals who pick and sell wild chili-peppers from the leased land would be restricted from accessing the land needed to perform their work. The cumulative projects would not likely impact environmental justice; therefore there is no additive cumulative impact.

Environmental justice significant mitigable impacts were identified under the preferred alternatives related to traffic and limited access to cultural and recreational resources. The cumulative projects did not have obvious environmental justice issues; therefore, the cumulative impacts are not additive.

Table 4.3-4. Summary of Potential Impacts to Resource Area – Tinian Projects

#	Lead Agency or Proponent	Project Name/ Location	Potential Impacts to Resources																
			Geology and Soils	Water / Wetlands	Air Quality	Noise	Air Space	Land/submerged land Use	Recreation	Terrestrial Biology	Marine Biology	Cultural	Visual	Marine Transportation	Utilities / Roadways	Socio-economics	Hazardous Materials	Public Health & Safety	Environmental Justice & Protection of Children
CNMI-Tinian																			
T-2 to T-13	Marine Corps	Various training ranges	X	X		X	X	X	X	X	X	X	X	X	X	X	X	X	
T-15	DPW	Marpo Valley Quarry (government)	X		X	X		X		X		X							
T-16	Bridge Investment Group	Tinian Oceanview Resort	X						B	X			X	X	X	B	X		
T-17	Marianas Resort Development Group	Matua Bay Resort and Golf Course	X					X	B	X			X	X	X	B	X		
T-18	DPW	Landfill Project, western Tinian	X	X	X			X		X		X					X	B	
T-23	Neo Goldwings Paradise	Neo Goldwings Paradise Casino on Tinian	X	X	X	X		X	X	X	X	X	X	X	X	B	X		
Number of Cumulative Projects potentially adversely impacting resources island-wide			6	3	3	3	1	5	2	6	2	4	4	4	4	1	5	1	0
Summary Impacts: Preferred Alternatives significant impacts (from Chapter 3)				**SI-M**				**SI-M**		**SI-M**			**SI-M**			**SI-M**			**SI**
Preferred Alternatives impacts additive to cumulative project impacts? yes[Y]/no[N]			N	N	N	N	N	**Y.**	N	**Y**	N	N	**Y**	N	N	**Y**	N	N	N
Degree of additive impact? S-strong; M-moderate; L= low								**S**		**S**			**L**			**S**			

Legend: X= potential adverse impact; B= potential beneficial impact; blank cell = no or minimal impact

CHAPTER 5. REFERENCES

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