CHAPTER 11. MARINE BIOLOGICAL RESOURCES

11.1 AFFECTED ENVIRONMENT

11.1.1 Definition of Resource

For the purpose of this Environmental Impact Statement (EIS), marine biological resources are defined as those marine-related organisms (marine flora and fauna), their behaviors, and their interactions with the environment that may be directly or indirectly affected by the proposed action within the established marine region of influence (ROI). The ROI is defined as the nearshore waters of Guam out to the 164 feet (ft) (50-meter [m]) isobath (depth line on a map of the ocean/sea). The ROI was extended appropriately to address potential impacts at project areas (e.g. water outfalls, construction-related sediment discharges). This includes waters offshore of Piti, Asan, Agana, and Finegayan on the west coast, Andersen Air Force Base (AFB) on the north coast, offshore of the Route 15 Lands on the east coast, and all waters of Apra Harbor (Figures 11.1-1, 11.1-2, 11.1-3, 11.1-4; and refer to Figure 11.1-12 later in this chapter for sensitive marine resources for Piti, Asan and Agana Bay). The ROI does not include the Marianas Trench Marine National Monument, which was established in January 2009 by Presidential Proclamation, as the proposed action and alternatives would not impact this area.

The environmental analysis focuses on species or areas that are important to the function of the ecosystem, of special societal importance, or are protected under federal, state, commonwealth or territory law or statutes. For the purpose of this EIS, marine biological resources have been divided into four major categories: marine flora, invertebrates and associated Essential Fish Habitat (EFH); fish and EFH; special-status species; and non-native species.

11.1.1.1 Marine Flora, Invertebrates and Associated EFH

This chapter provides a description of marine flora and macroinvertebrates found within the ROI. The main types of marine flora and invertebrates include macroalgae (or seaweeds), seagrasses, emergent vegetation (plants that are rooted in the substrate beneath water, but grow tall enough to protrude above water or have leaves that float on the water), gastropods (snails), cephalopods (squid and octopus), crustaceans (lobsters and crabs), sponges, and corals. Corals are described in great detail in Volume 4 (Chapter 11) of this EIS. Some species within all of the aforementioned broad types of flora and invertebrates are included within managed fisheries in the Western Pacific under one Fishery Ecosystem Plan (FEP), the Mariana Archipelago FEP. The FEP identifies specific management unit species (MUS) for different life stages of the species managed under the plan (Western Pacific Regional Fisheries Management Council [WPRFMC] 2009a). FEPs and associated EFH are described further below.

11.1.1.2 Essential Fish Habitat

The primary federal laws that comprise the regulatory framework for fish and EFH include the Magnuson-Stevens Fishery Conservation and Management Act or Magnuson-Stevens Act (M-SA), Executive Order (EO) 12962, and the Endangered Species Act (ESA). EFH is defined as those waters and substrate necessary to fish (finfish, mollusks, crustaceans and all other forms of marine animal and plant life other than marine reptiles, marine mammals and birds) for spawning, breeding, feeding, or growth to maturity (WPRFMC 2009a). EFH for managed fishery resources is designated in FEPs prepared by the local regional fisheries management council - WPRFMC - and in conjunction with the Guam Division of Aquatic and Wildlife Resources (GDAWR), which manages the fisheries resources in Guam.

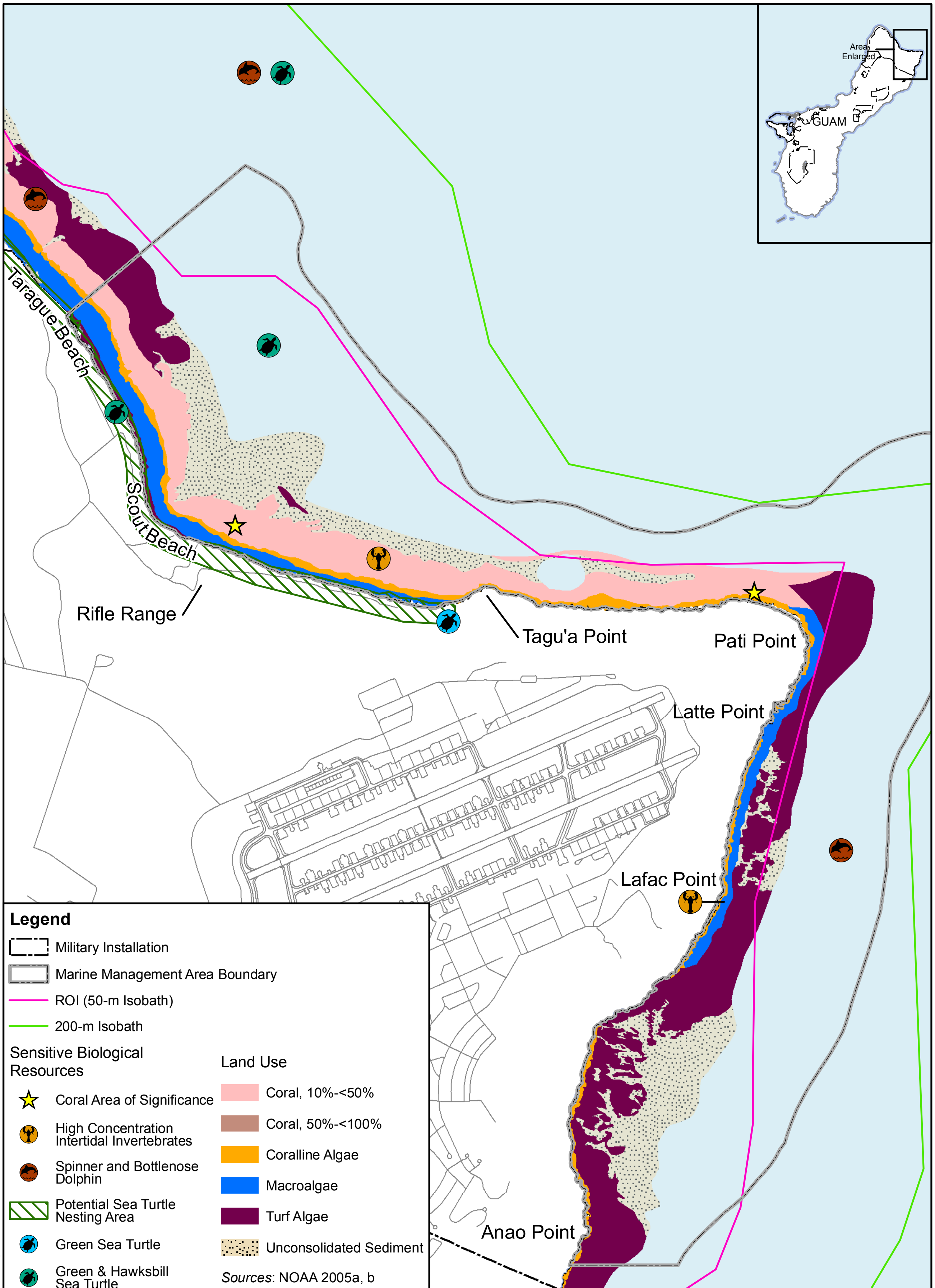


Figure 11.1-1
Overview of Sensitive Marine Biological Resources and Nearshore Habitat Associated with Andersen AFB East

Feet: 0, 1,500, 3,000
Meters: 0, 430, 860

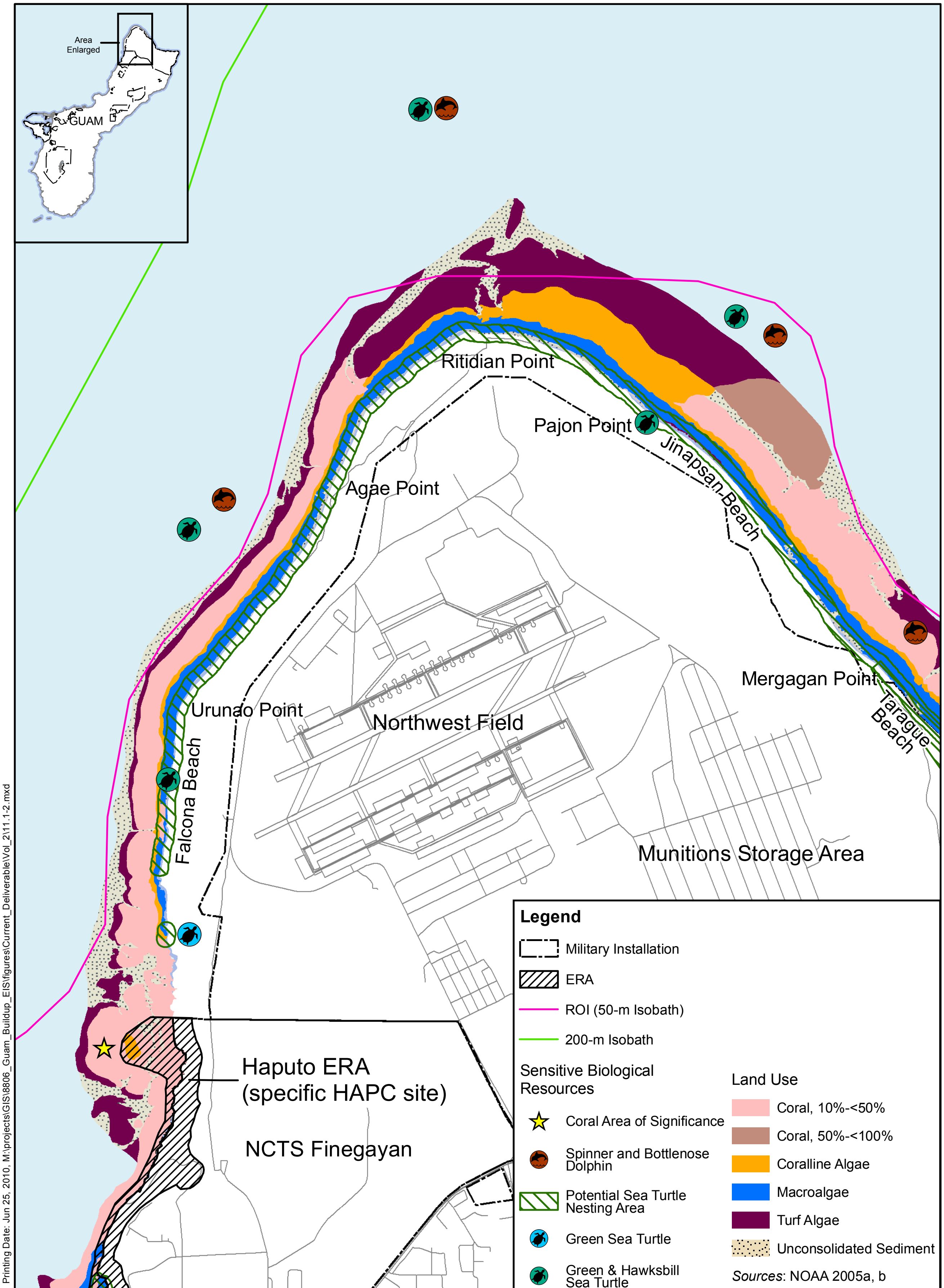


Figure 11.1-2
Overview of Sensitive Marine Biological Resources and Nearshore Habitat Associated with Andersen AFB West

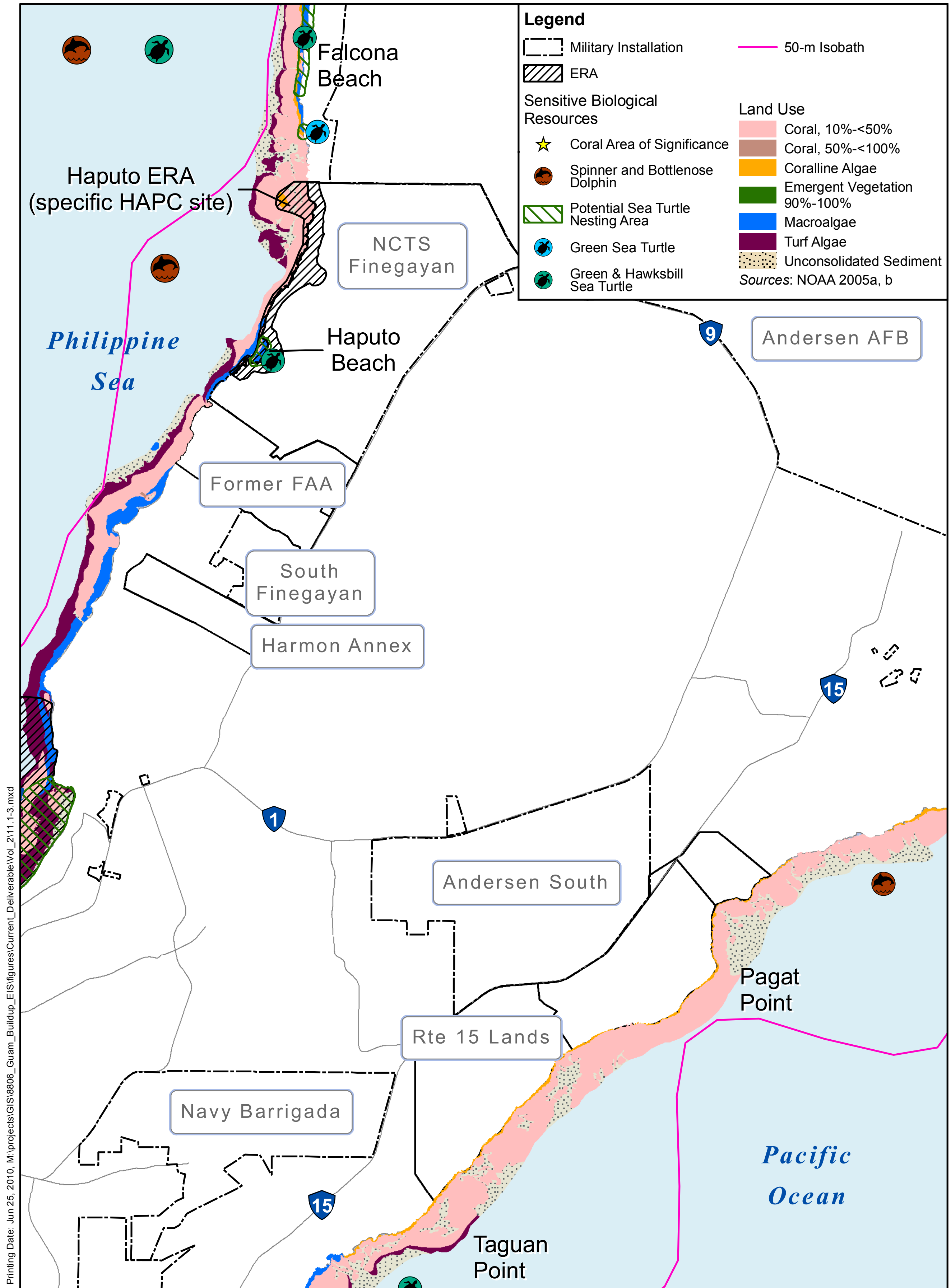
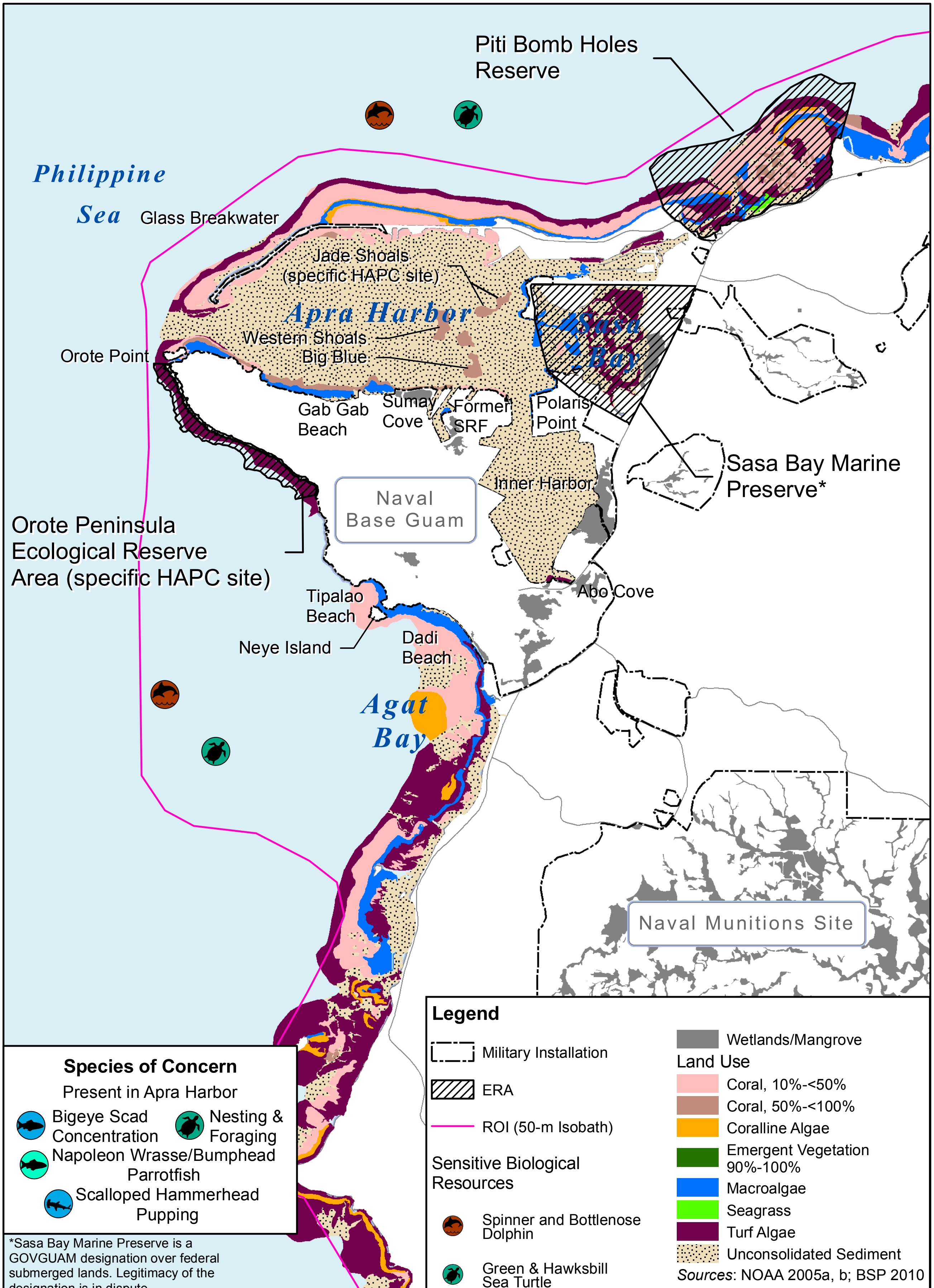


Figure 11.1-3
Overview of Sensitive Marine Biological Resources and Habitats Associated with the Study Areas - NCTS Finegayan and Rte 15 Lands



Printing Date: Jun 25, 2010, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\11.1-4.mxd

Figure 11.1-4
Overview of Sensitive Marine Biological Resources and Habitats Associated with the Study Areas - Apra Harbor and Naval Base Guam

Feet: 0, 3,300, 6,600
Meters: 0, 860, 1,720

N E S W

The WPRFMC recently shifted from its previous Fisheries Management Plans (FMPs) to these regional FEPs developed as FMPs. The shift was implemented with the goal of moving towards ecosystem-based management. The new FEPs do not establish any new regulations at this time, but act to consolidate the existing regulations for demersal species by geographic region within the Pacific region; the former FMPs for Bottomfish and Seamount, Crustaceans, Precious Corals, and Coral Reef Ecosystems are now included in each new Pacific regional FEP (WPRFMC 2009a). Demersal organisms and their habitats in Guam are included in the Mariana Archipelago FEP. Due to the highly migratory nature of some pelagic species, an individual FEP was created for pelagic species in the entire western Pacific region (WPRFMC 2009b). The final rule to restructure the FMPs to FEPs in the western Pacific was effective February 16, 2010 (National Marine Fisheries Service [NMFS] 2010a).

The Navy is consulting with the NMFS on proposed activities that may adversely affect EFH (see Volume 9, Appendix C). There are four steps in the EFH consultation process (NMFS 1999):

1. The federal agency provides a project notification to NMFS of a proposed activity that may adversely affect EFH.
2. The federal agency provides an assessment of the effects on EFH with the project notification. The EFH Assessment prepared as part of this EIS includes: (1) a description of the proposed action; (2) an analysis of the effects, including cumulative effects, of the proposed action on EFH, the managed species, and associated species by life history stage; (3) the federal agency's views regarding the effects of the proposed action on EFH; and (4) proposed mitigation, if applicable.
3. NMFS provides EFH conservation recommendations to the federal agency. These recommendations may include measures to avoid, minimize, mitigate, or otherwise offset adverse effects on EFH and are to be provided to the action agency in a timely manner.
4. The federal agency provides to NMFS a detailed written response, within 30 days of receiving the NMFS EFH conservation recommendations (at least 10 days before final approval of the action for decisions that are rendered in fewer than 30 days).

11.1.1.3 Special-Status Species

For the purpose of this document, special-status species include ESA-listed and candidate species, marine mammals not listed under ESA, species of concern, and Guam-listed species found in the nearshore marine ROI (Table 11.1-1). Brief species descriptions are located in Section 11.1.4, Guam Regional Environment, and within specific study area sections below. Detailed descriptions of all potentially affected special-status species, including life history information, are included in Volume 9, Appendix G.

Table 11.1-1. Special-Status Marine Species Present in the ROI Around Guam

Group	*Common Name/Chamorro Name*	*Status**	
		ESA	*Guam*
MAMMALS	Common bottlenose dolphin/Toninos/	MMPA	SOGCN
	Spinner dolphin/Toninos	MMPA	SOGCN
REPTILES	Green sea turtle/Haggan bed'di	T	T
	Hawksbill sea turtle/Hagan karai	E	E
FISH**	Napoleon wrasse/Tanguisson	SOC	SOGCN
	bumphead parrotfish/Atuhong	C	SOGCN

Legend: ***C = candidate;** E = endangered; T = threatened; MMPA = Marine Mammal Protection Act; SOC = NOAA species of concern, SOGCN = Species of Greatest Conservation Need (GDAWR 2006a).
****** Addressed further under EFH Section.
Sources: NOAA 2005a, NMFS 2009a, USFWS 2009.

ESA-listed species are defined as those plant and animal species currently listed by the United States (U.S.) Fish and Wildlife Service (USFWS) or NMFS under the ESA as threatened, endangered, or proposed as such. Candidate species are plant or animal species for which USFWS or NMFS has on file sufficient information on biological vulnerability and threats to support a proposal to list them as endangered or threatened under the ESA based on the most recent candidate review (USFWS 2009). The Navy has initiated consultation under Section 7 of the ESA regarding the potential effects of the proposed action on endangered and threatened species within the ROI. All special-status marine species, including threatened and endangered marine species, occurring in the ROI are listed in Table 11.1-1 and discussed in more detail below. There is no critical habitat designation for any marine species on Guam.

Eighty-two coral species were identified as NMFS candidate species for potential listing, some of which occur in the ROI (NMFS 2010b; WPRFMC 2009a). Those species that have been positively identified to occur in the ROI are listed in the EFH section of Guam Regional Environment (section 11.1.4.2). In addition, the bumphead parrotfish was changed from a NMFS species of concern (SOC) to candidate species for potential listing (NMFS 2010c). As candidate species are afforded no special protection, corals and finfish are analyzed for potential impacts under the EFH Assessment.

SEA TURTLES

All sea turtles that occur in the U.S. are listed under the ESA as either threatened or endangered. The threatened green sea turtle and the endangered hawksbill sea turtle are the only ESA-listed species that regularly occur in the nearshore marine ROI. Nesting sea turtles are addressed in more detail in Volume 2, Chapter 10, Terrestrial Biological Resources, since they are terrestrial at the nesting stage and are under the jurisdiction of USFWS for consultation purposes.

SPECIES OF CONCERN

Species of concern are those species about which NMFS has concerns regarding status and threats, but for which insufficient information is available to indicate a need to list the species under the ESA. No special protections are afforded to SOC under ESA. The goal is to draw proactive attention and conservation action to these species. One species of fish, the Napoleon wrasse, is listed as species of concern by NMFS (NMFS 2009a) and is expected to occur in the nearshore marine ROI (see Table 11.1-1). This species is discussed in further detail in the EFH section of this EIS, as they are included in the Coral Reef Ecosystems MUS (CREMUS) (WPRFMC 2009a) .

GUAM-LISTED SPECIES

Guam-listed species are defined as those plant and animal species found in the nearshore marine ROI that are not ESA-listed or Candidate species, but are currently designated by legislative authority in the Territory of Guam as endangered or threatened species. There are no Guam-listed marine species other than those that are also ESA-listed (sea turtles), so these Guam-listed marine species are discussed in the ESA-listed species section of this EIS.

MARINE MAMMALS

Marine mammals are discussed in this EIS because several species are known to occur or potentially occur in the waters around Guam. The Marine Mammal Protection Act (MMPA) of 1972 makes it illegal to "take" any species of marine mammal. The definition of take refers to the harassing, injuring or killing of any marine mammal, or the possessing of any marine mammal or part of a marine mammal, without authorization. Some marine mammals are listed under the MMPA as strategic. Strategic refers to a stock of marine mammals that is being negatively impacted by human activities and may not be sustainable.

When a population or stock has fallen below optimum sustainable levels, it is considered depleted. A stock may be considered depleted when the mortality in multiple units exceeds the Potential Biological Removal identified for the species. All marine mammal species listed under the ESA of 1973 are considered depleted. No ESA-listed marine mammals are anticipated in the ROI (Navy 2005, National Oceanic and Atmospheric Administration [NOAA] 2005a).

The National Defense Authorization Act of Fiscal Year 2004 (Public Law 108-136) amended the definition of harassment as applied to military readiness activities or scientific research activities conducted by or on behalf of the federal government, consistent with Section 104(c)(3) [16 U.S. Code (USC) 1374 (c)(3)]. The National Defense Authorization Act (2004) adopted the definition of "military activity" as set forth in the Fiscal Year 2003 National Defense Authorization Act (Public Law 107-314). Military training activities on and around Guam (and Commonwealth of the Northern Mariana Islands [CNMI]) constitute military readiness activities as defined in Public Law 107-314 because training activities constitute "training and operations of the armed forces that relate to combat" and constitute "adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use". For military readiness activities, the relevant definition of harassment is any act that: (1) Injures, or has the significant potential to injure, a marine mammal or marine mammal stock in the wild ("Level A harassment"); or (2) Disturbs, or is likely to disturb, a marine mammal or marine mammal stock in the wild by causing disruption of natural behavioral patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behavioral patterns are abandoned or significantly altered ("Level B harassment") [16 USC 1362 (18)(B)(i)(ii)].

Section 101(a)(5) of the MMPA directs the Secretary of the Department of Commerce to allow, upon request, the incidental (but not intentional) taking of marine mammals by U.S. citizens who engage in a specified activity (exclusive of commercial fishing), if certain findings are made and permits are issued. Permission would be granted by the Secretary for the incidental taking of marine mammals if the taking would have a negligible impact on the species or stock and would not have an unmitigable adverse impact on the availability of such species or stock for taking for subsistence uses.

Marine mammals addressed in this EIS include all species listed under the MMPA found in the marine ROI. Marine mammals are not well-documented in Micronesia. The first compilation of available information for 19 species of marine mammals from Micronesia was provided by Eldredge (1991) with additional records compiled in 2003 (Eldredge 2003b), which took into account marine mammal distribution and habitat preferences, expanding the list to 32 marine mammal species (29 cetaceans [i.e., whales, dolphins, and porpoises], 2 pinnipeds [i.e., seals and sea lions], and the dugong) with confirmed or possible occurrence in oceanic waters around Guam (Navy 2005).

Based on Appendix B's figures and supporting text from the Marine Resource Assessment for the Marianas Operating Area (Navy 2005), spinner dolphins and common bottlenose dolphins are the only marine mammals expected to regularly occur within the nearshore marine ROI (164-ft [50-m] isobath) of Guam (see Table 11.1-1).

In general, the main intentions of the three federal acts (ESA, MMPA, and M-SA) listed above are as follows:

- The ESA established protection over and conservation of special-status species and the ecosystems upon which they depend and requires any federal action (authorized, funded, or carried out) to ensure its implementation would not jeopardize the continued existence of the listed species or adversely modify their critical habitat.

- The MMPA established a moratorium on the "taking" (16 USC 1312[13]) of marine mammals in waters or on lands under U.S. jurisdiction.
- The M-SA was designed to protect and conserve important fish/fisheries habitats, including coral reef associated fisheries.

11.1.1.4 Non-native Species

Non-native species include all marine organisms that have the potential to be introduced from one location or ecosystem to another where it is not native and could potentially cause harm to the receiving ecosystem. This topic is discussed further in Section 11.1.4, and in the subsequent specific study areas. Most of the relevant site-specific research conducted on non-native species to date has been within Apra Harbor, so this topic is discussed thoroughly in that section.

11.1.2 Region of Influence

As previously discussed, the marine ROI encompasses all of Apra Harbor, including Sasa Bay and the submerged lands offshore out to the 164-ft (50-m) isobath (a range 600 ft [185 m] to 2640 ft [805 m] from the shore) that may be directly or indirectly impacted by any component of the proposed action. The proposed action may impact marine biological resources from nearshore land-based ground-disturbing activities, in-water construction and/or benthic (bottom) substrate-disturbing activities (dredging and pile driving), increased noise from these activities, decreased water quality, excess lighting, and other factors.

11.1.3 Study Areas and Survey Methods

For the purposes of this EIS, the project area for marine biological resources has been subdivided into three study areas on Guam (North, Central, and Apra Harbor) and is assessed for potential impacts from implementation of the proposed action within the nearshore marine ROI. Because of either the location or the nature of the action, some components of the proposed action would have very minimal impact on the marine environment, and therefore no impact assessment is provided. In these cases, a brief explanation of why no assessment is required is provided in those site-specific sections.

Existing conditions and environmental consequences associated with marine biological resources are discussed for the following study areas: Naval Computer and Telecommunications Station (NCTS) Finegayan, Route 15 Range Lands, Andersen AFB, and Apra Harbor. The other study areas potentially affected by the proposed action and alternatives do not have a direct conduit to impact the nearshore marine environment. Examples may include the lack of a marine-related construction component (e.g. road work near the coast without in-stream construction (i.e. no bridge work) or no groundbreaking activities or increased footprint) and land-based construction or training activities that would directly, indirectly or cumulatively impact nearshore coastal marine waters (e.g. repaving/resurfacing an inland road, northern and central Guam construction on the limestone plateau, southern and nearshore inland construction activities away from streams with appropriate Best Management Practices [BMPs] and Low Impact Development [LID] implementation).

In addition to existing marine biological resources data for the study areas, project-specific benthic studies and mapping efforts have either been performed for this EIS, are ongoing, or are being planned for areas potentially impacted by the proposed action and alternatives (e.g., a marine benthic survey in the vicinity of the aircraft carrier fairway and turning basin, Outer Apra Harbor). Locations and methods for the survey efforts associated with this EIS are provided in detail in Volume 9 (Appendix J) of this EIS. Table 11.1-2 lists the previously conducted marine biological surveys germane to this EIS.

Table 11.1-2. Summary of Previous and Current Marine Biological Surveys within the Study Areas

Reference	*Type of Work*	*Location*
Paulay 1995-1996	Preliminary Non-indigenous Survey - Focusing on Bivalves	Guam
Paulay 1996	Biodiversity and Monitoring Survey of Marine Faunas	Apra Harbor
Marine Research Consultants (MRC) 1996	Marianas Environmental Impact Statement Marine Environmental Assessment	Guam and Tinian
MRC 1997	Marine Environmental Impact Assessment for Military Training Exercises	Off Tipalao and Dadi Beaches, Guam
Paulay 1998-2000	Introduced Species Survey - Focusing On Hard-bottom Fauna	Guam
Paulay et al. 2000	Marine Biodiversity Resource Survey and Baseline Reef Monitoring Survey	Southern Orote Peninsula and North Agat Bay Area
Paulay et al. 2001	Marine Invertebrate Biodiversity: Significant Areas and Introduced Species	Apra Harbor
Amesbury et al. 2001	Marine Biodiversity Resource Survey and Baseline Reef Monitoring Survey	Haputo ERA – Offshore NCTS Finegayan
MRC 2002	Maintenance Dredging Rapid Ecological Marine Assessment	Inner Apra Harbor
Smith 2004a	Reconnaissance Level Observation – Staff Working Paper. in Commander Navy Region (COMNAV) Marianas 2007b.	Inner Apra Harbor Entrance Channel
Smith 2004b	Field Report of Supplemental Reconnaissance Level Observations in COMNAV Marianas 2007b	Kilo Wharf, Apra Harbor
Smith 2004b	Ecological Assessment of the Marine Community in COMNAV Marianas 2007b	Kilo Wharf, Apra Harbor
MRC 2005a	Marine Resource Assessment in COMNAV Marianas 2007b	Entrance Channel of Inner Apra Harbor
MRC 2005b	Reconnaissance Survey of the Marine Environment, Characterization of the Benthic Habitat in COMNAV Marianas 2007b	Outer Apra harbor
Smith 2006	Assessment of Stony Corals	Orote Point to Sumay Cove, Apra Harbor
NOAA 2005c	Coral reef assessment/monitoring and mapping studies via the NOAA Cruise Report - Oscar Elton Sette	Marianas Archipelago: Island of Guam, Santa Rosa Reef, and Galvez Bank
NOAA 2007	Coral reef assessment/monitoring and mapping studies via the NOAA Cruise Report – *Hi'ialakai*	Guam and CNMI (Rota, Aguijan, Tinian, and Saipan)
Smith 2007	Ecological Assessment of Stony Corals and Associated Organisms	Eastern Portion of Apra Harbor
NAVFAC Pacific 2007	Unpublished Cruise Report - Sea Turtle and Cetacean Survey	Mariana Islands
Smith et al. 2008	Marine Biological Survey	Inner Apra Harbor – areas off Sierra, Tango, X-ray, Uniform, Victor Wharves, and Abo Cove.
Navy 2009a	HEA Remote Sensing Mapping of Coral Communities	Eastern end of Outer Apra Harbor in the vicinity of the CVN channel and turning basin.
Resource Agency	Marine Biological Survey - Spring 2009	Apra Harbor – CVN Fairway

Legend: COMNAV= Commander Navy Region; CVN= Aircraft Carrier-Nuclear; ERA - Ecological Reserve Area; NAVFAC= Naval Facilities Engineering Command.

11.1.4 Guam Regional Environment

Though the focus of this chapter is on marine biological resources within the nearshore ROI, marine ecosystems are also greatly affected by terrestrial inputs (i.e., stormwater runoff, sediments, etc.), anthropogenic (human-induced) inputs (i.e., wastewater treatment plants [WWTPs]), and open ocean currents. An anthropogenic factor that would influence the terrestrial and anthropogenic inputs and potentially affect marine ecosystems is the population increase anticipated from the proposed action and alternatives (see Volume 2, Chapter 16 [Socioeconomics and General Services] for a discussion of coral as it relates to recreational fishing and potential population impacts resulting from the proposed military relocation to Guam). A brief introduction of the marine geology, environmental habitats, and biological oceanography from the shore to the open ocean is presented for this region, which comprises the Mariana Islands chain. WWTP discharges and their effects on water quality and the marine environment are provided at the end of this Section.

Marine Geology

The Mariana Islands are volcanic in nature and thus the overall geology reflects this. Coastlines in the study area are generally lined with rocky intertidal areas, steep cliffs and headlands, and the occasional sandy beach or mudflat. Water erosion of rocky coastlines has produced wave-cut cliffs, sea-level benches (volcanic and limestone) and wave-cut notches at the base of the cliffs. Large blocks and boulders often buttress the foot of these steep cliffs in the Marianas. Wave-cut terraces also occur seaward of the cliffs (Navy 2005).

Physical and Biological Oceanography

The North Equatorial Current, which provides the bulk of water passing the Mariana archipelago, is composed primarily of plankton-poor water; however, detailed information on the North Equatorial Current is lacking. Overall, the upper portions of the water column in the western Pacific is nutrient depleted, which greatly limits the presence of organisms associated with primary productivity, such as phytoplankton. Phytoplankton are single-celled organisms that are similar to plants because they photosynthesize using sunlight and chlorophyll. Phytoplankton are at the base of the marine food chain, and are essential to the overall productivity of the ocean. In regions in which the overall nutrient concentrations are low, the phytoplankton communities are dominated by small nanoplankton and picoplankton. This is true for Guam, as phytoplankton communities in the western Pacific are dominated by cyanobacteria (*Synechococcus spp*.), prochlorophytes, haptophytes, and chlorophytes (Higgins and Mackey 2000).

The available studies on plankton (tiny plants [phytoplankton] and animals [zooplankton]) in the neritic zone (also called the sublittoral zone - part of the ocean extending from the low tide mark to the edge of the photic zone) have centered around Apra Harbor and Piti Reef on Guam. In general, abundance of zooplankton is highly variable with respect to location and time (both throughout the day and month to month) (Navy 2005).

Guam tides are semidiurnal with a mean range of 1.6 ft (0.5 m) and diurnal range of 2.3 ft (0.7 m). Extreme predicted tide range is about 3.5 ft (1.1 m). Surface sea temperatures average close to 80 degrees Fahrenheit (°F) year-round (Guam Environmental Protection Agency [GEPA] 2006).

Intertidal Zone

The intertidal zone is the area between low and high tide marks. Approximate tidal ranges on Guam are from -0.6 ft (-0.2 m) at low, low tide to 2.6 ft (0.8 m) at high, high tide (University of Guam [UoG] 2009).

The intertidal zone of the shoreline can be divided into three subzones: the high-tide zone, the mid-tide zone, and the low-tide zone. In the high-tide zone, benthic organisms are covered by water only during the highest high tides. Organisms in this zone spend the majority of the day exposed to the atmosphere. In the mid-tide zone, benthic organisms spend approximately half of the time submerged. Organisms residing in this zone are exposed during periods of low tides, but are covered with water during all high tides. Organisms in the low-tide zone are submerged most of the time but may be exposed to the air during the lowest of low tides (Navy 2005).

Coral Communities and Reefs of the Mariana Islands

Coral reefs support various life stages of many fishes and invertebrates, and as a result, the health of reefs is often an indicator of the overall health of the entire area. They are one of the most diverse and productive ecosystems on earth. The physical reef structures created by corals protect coastlines from erosion, which directly impacts people living, working or recreating near the shoreline. Other benefits to people from coral reefs include those resulting from tourist and commercial industries; lush reefs are a major tourist attraction for divers and snorkelers, and they support commercial and recreational fisheries (NMFS 2010a). From a fisheries perspective, the fishes and other organisms harvested from coral reefs and associated habitats, such as mangroves, seagrass beds, shallow lagoons, bays, inlets and harbors, and the reef slope beyond the limit of coral reef growth, contribute to the total yield from coral reef-associated fisheries (Navy 2005).

The health and abundance of coral reefs worldwide has been steadily declining in recent years from various anthropogenic sources, and in the Indo-Pacific, reefs have seen a decline over the past 40 years; these declines are cause for great concern. The reefs surrounding Guam make it home to one of the most species-rich marine ecosystems among U.S. jurisdictions (Burdick et al. 2008). See Volume 2, Chapter 16, Section 16.1.6 for a discussion of coral as it relates to recreational fishing and an overall increased human population as a result of the proposed action.

Coral communities and reefs are dynamic and changing ecosystems subject to natural and human induced disturbances. Natural disturbances that affect coral communities and reefs in the Mariana Islands include storm-related damage caused by frequent typhoons; El Niño-Southern Oscillation (ENSO) events (a coupled ocean-atmosphere phenomenon that has global effects); outbreaks of the crown-of-thorns starfish, a predator of corals; freshwater runoff; recurrent earthquakes; and volcanic activity. Human-induced disturbances on reefs in the Mariana Islands result from upland erosion and offshore sedimentation, polluted runoff (input of nutrients), exposure to warm water (global warming and thermal effluents) leading to bleaching, overfishing, anchor damage, tourism-related impacts, ship groundings, and certain military activities (Abraham et al. 2004, Birkeland 1997, Paulay 2003b).

The Mariana nearshore environment is characterized by extensive coral bottom and coral reef areas. There are fewer reef-building hard coral species and genera in the northern compared to the southern Mariana Islands: 159 species and 43 genera of hard coral species in the northern islands versus 256 species and 56 genera in the southern islands (Randall 2003, Abraham et al. 2004). There is also a greater species diversity of fishes and mollusks (invertebrates) on the southern islands than on the northern islands (Birkeland 1997).

In general, the coral reefs of the Marianas have a lower coral diversity compared to other reefs in the northwestern Pacific (e.g., Palau, Philippines, Australian Great Barrier Reef, southern Japan, Marshall Islands) but a higher diversity than the reefs of Hawaii. Corals reported in Guam are typically found on shallow reefs and upper forereefs (< 245 ft [<75 m] water depth), and deeper forereef habitats (> 245 ft [>75 m] water depth) (Randall 2003).

With respect to Guam, most of the northern part of the island's shorelines are karstic and bordered by limestone cliffs. In a few areas, the shorelines consist of volcanic substrates. On windward shores, reefs are narrow and have steep forereefs. Narrow reef flats or shallow fringing reefs (approximately 325 to 3,250 ft [100 to 1,000 m wide]) are characteristic of leeward and more protected coastlines. Reefs also occur in lagoonal habitats in Apra Harbor. Reef organisms also occur on eroded limestone substrates including submerged caves and crevices, and large limestone blocks fallen from shoreline cliffs (Paulay 2003b).

Natural Disturbances

Coral communities and reefs on the eastern, windward side of the islands are exposed to dominant winds, strong wave action, and storms (including typhoons). Corals found above the 100-ft (30-m) isobath on windward coasts are conditioned to withstand heavy wave action and would recover if damaged. Typhoons can cause substantial damage to corals on windward coasts. Corals in this exposed area of the reef typically include encrusting or massive growth forms as well as columnar, platy and branching growth forms. Exposed windward reef fronts are dominated by three growth forms of Acropora: corymbose (colonies are composed of horizontal branches and short to moderate vertical branchlets that terminate in a flat top), digitate (colonies are composed of short, nonanastomosing branches like the fingers of a hand), and caespitose (bushy, branching, possibly fused branches) (Navy 2005).

The disruption of the tradewind pattern during ENSO events has caused sea level to drop in the Mariana Islands and expose shallow corals and other reef organisms over prolonged periods, which has caused mass mortality (Birkeland 1997). Further, ENSO events have produced unusually high seawater temperatures that may have caused coral bleaching. The bleaching of corals has been recorded in the Marianas since 1994, and some bleaching events have caused coral mortality. In 1994, corals were bleached on all reefs of Guam. While the coral families Pocilloporidae and Acroporidea incurred severe bleaching on Guam during the 1994 event, no stony coral mortality was observed.

The chronic outbreaks and predation of crown-of-thorns starfish on corals reefs have also caused coral mortality. In the forereef zone in sheltered areas, massive corals (*Porites* and *Favia*) that are more resistant but not immune to crown-of-thorns starfish have replaced the corals decimated by crown-of-thorns starfish (Navy 2005).

Other sources of coral mortality and degradation are freshwater runoff and seismic and volcanic activity. Freshwater runoff naturally affects reefs during the rainy season (Navy 2005). No areas are reported within the ROI that are particularly affected by natural sedimentation following heavy rainfall, although two rivers discharge into Inner Apra Harbor, which is a highly turbid area. Areas impacted by heavy sediment laden stormwater outside the ROI include the Ugum River watershed (southeast Guam) and the south coast of Guam (Abraham et al. 2004). Coral reefs within the ROI have been impacted by recurrent seismic activity as recent as 1993 in Guam (Birkeland 1997).

Human-Induced Disturbances

Increased numbers of people on Guam may adversely affect reefs beyond their current level of impairment. Anthropogenic disturbances to the marine environment surrounding Guam arise from a variety of sources, both direct and indirect. Direct disturbances include deliberate damage to the marine environment by the human population on Guam; examples include inexperienced divers/snorkelers damaging coral. See Volume 2, Chapter 16, Section 16.1.6 for a discussion of coral as it relates to recreational fishing and an overall increased human population as a result of the proposed action. The quality of coastal ocean waters, or nearshore waters, is strongly affected by nonpoint source pollution

(GEPA 2006). The main source and most serious nonpoint, human-induced impacts on marine communities in and around Guam is erosion and high sediment-containing runoff (particularly during storm events in the southern areas) due to increased land clearing and construction of coastal roads, housing, and tourism-related facilities (Paulay 2003b, Abraham et al. 2004). Grading or clearing of land by burning results in significant topsoil loss during heavy rain storms leaving more compact soil behind that makes re-vegetation difficult. Runoff of feedlot waste has also been identified as a nonpoint source of pollution needing mitigation. Urban runoff is one of Guam's most critical nonpoint source problems which impacts both groundwater and coastal waters (GEPA 2006). Sedimentation affects both coral cover and diversity. Sedimentation-impacted sites can further be degraded by the compounding effects of coral predation by crown-of-thorns starfish and overfishing of herbivorous fishes which act to maintain balance in the ecosystem by grazing algae (Abraham et al. 2004). Domestic wastewater associated with population increase is the largest potential source of pollution to all waters of Guam and has a significant anthropogenic impact on corals. See Volume 6, Section 13.2.4 for detailed discussion of nutrient impacts to coral, and Volume 2, Section 4.1.1.4 for nearshore water quality discussion.

Estuarine Habitat

Estuarine habitats on Guam, include lagoons, embayments, and river mouths. They occur in areas of tidal intrusion or brackish water, and consist primarily of mangroves and the lower channels of rivers that are inundated by tides ranging from 30 to 35 inches (in) (75 to 90 centimeters [cm]) in amplitude. Nine of Guam's 46 rivers that empty into the ocean have true estuarine habitats with elevated salinity levels extending upstream (Scott 1993). Guam contains numerous relatively shallow lagoons (depths ranging from 3 to 50 ft [1 to 15 m]). The bottoms of the lagoons are mostly sandy and flat or undulatory (wavy in appearance). Coral rubble, coral mounds (patch reefs), seagrass, and algae are found within the lagoons. Coral mounds tend to be more abundant in the outer lagoons and are widely scattered or absent in the inner lagoons (NOAA 2005a, Navy 2005).

Seagrass Beds

Tropical seagrass meadows typically occur in most shallow, sheltered soft-bottomed marine coastlines and estuaries. Barrier reefs protect coastlines, and the lagoon formed between the reef and the mainland is protected from waves, allowing mangrove and seagrass communities to develop. Tropical seagrasses are also important in their interactions with mangroves and coral reefs. Seagrasses trap sediment and slow water movement, causing suspended sediment to fall out. This trapping of sediment benefits coral by reducing sediment loads in the water. All these systems exert a stabilizing effect on the environment, resulting in important physical and biological support for the other communities. Seagrasses are unique amongst flowering plants in that all but one genus can live entirely immersed in seawater. Ten species are reported from Micronesia. Seagrasses provide a sheltered, nutrient-rich habitat for a diverse range of flora and fauna, including higher vertebrates such as dugongs and green sea turtles. A concise summary of the seagrass species found in the western tropical South Pacific is given by Coles and Kuo (1995).

Mangrove Forests

Mangrove forests are a type of wetland located on the border of estuaries and shores protecting them from the open ocean (Scott 1993). They are composed of salt-tolerant trees and other plant species and they provide essential habitat for both marine and terrestrial life. Mangroves possess large roots that spread laterally and consolidate sediments, eventually transforming local mudflats into dry land. Species diversity is usually high in mangroves, and like seagrasses, they can act as a filter to remove sediments before they can be transported onto an adjacent coral reef. The extensive root system and nutrient rich waters found in mangroves make them among the richest of nursery grounds for marine life, including peneaeid shrimps, inshore fish species, and some commercially important crustaceans (Scott 1993, Myers 1999, Navy 2005, WPRFMC 2009a).

Mangrove forests are native to the Marianas; though they are only present on the islands of Guam and Saipan, with the mangroves of Guam being the most extensive and diverse, totaling approximately 173 acres (ac) (70 hectares [ha]) (Navy 2005). There are 125.3 ac (51 ha) of mangrove forests on 10 sites within Navy lands on Guam. The largest of these mangrove sites (88.7 ac [35.9 ha]) is located along the eastern shoreline of Apra Inner Harbor (Navy 2005). Mangroves/wetlands are discussed in more detail in Volume 2, Chapter 10, Terrestrial Biological Resources.

Wastewater Treatment Plants and the Marine Environment

Volume 6, Chapters 2 and 3 discuss wastewater treatment plants (WWTPs) on Guam and their association with the proposed action. There are three WWTPs associated with the proposed action: Northern District WWTP (NDWWTP), Hagatna WWTP, and Apra Harbor WWTP. Potential impacts from these WWTPs on receiving waters are described in Volume 6, Chapter 13 of this EIS.

Section 3.1.3 and 3.2.4 states that the Guam Water Authority (GWA) NDWWTP would handle most of the increased wastewater treatment demand from the Department of Defense (DoD) buildup. The Navy Apra Harbor WWTP would handle the increased wastewater treatment demand for all increases at Apra Harbor, such as the shipboard transient population.

Outside of the area that would be directly affected by the proposed action, several small GWA WWTP facilities in south Guam could be also indirectly affected by the buildup from induced civilian growth in the region. Based on a socioeconomic analysis, 19% of the induced population could locate to south Guam that would produce 0.76 million gallons per day (MGd) (2.9 million liters per day [MLd)) wastewater at the GWA Agat-Santa Rita WWTP, Baza Gardens WWTP, Umatac-Merizo WWTP, and Inarajan WWTP. These treatment facilities at south Guam currently are not in compliance with their effluent National Pollutant Discharge Elimination (NPDES) permits due to inadequate treatment capacity, deterioration of equipment, and lack of maintenance.

WWTP Effects on the Marine Environment

The following information was summarized from Navy (2009e) unless otherwise stated.

The three components of sewage effluent found to be most detrimental to marine life and coral reefs are nutrients, sediments, and toxic substances. Tropical ocean waters are typically characterized as low in nutrients and particulates. Therefore, the discharge of high levels of nutrients and particulates may have detrimental impacts to the receiving marine waters.

The Navy (2009e) nearfield plume analysis indicates that the discharge from the diffuser rises quickly, with minimal horizontal dispersion before reaching the surface. The elapsed time for this initial mixing and rise of the fluids is short, occurring in minutes. Therefore, there is minimum interaction with the extant assemblage of organisms in the water column.

Phytoplankton may assimilate some nutrients present in the farfield plume. Since phytoplankton requires several days to replicate, and according to plume modeling results, the plume will likely disperse over a wide area in a matter of hours, the increase in biomass is not likely to be a concern. The low initial phytoplankton biomass (based on the low level of chlorophyll α) also suggests that any increase resulting from phytoplankton productivity will be rapidly grazed by herbivorous zooplankters. Therefore, detectable changes in phytoplankton or herbivorous zooplankton biomass are not anticipated.

*Enterococcus*_and ammonia in the surfacing plume will exceed the GWQS *{ground water quality standards}*, however less than the no-action alternative. These anticipated constituent concentrations are based on the modeling results and do not take into account the degradation of constituents, die-off of organisms, or uptake of the pollutants by existing aquatic life which would decrease concentrations.

Enterococcus in the discharge plume will eventually be diluted to near zero. Unfavorable conditions provided by the marine environment will likely destroy these bacteria and most others from the wastewater. Factors such as pH, temperature, solar (ulta-violet) radiation, predation, osmotic stress, nutrient deficiencies, particulate levels, turbidity, oxygen concentrations, and microbial community composition affect bacteria inactivation.

The toxicity of ammonia is dependent on pH. Dissolved in water, ammonia will react with hydrogen ions (H+) to form non-toxic ammonium ions (NH4-). When mixed with the higher pH level of the receiving marine water, ammonia present in the wastewater discharge will increase in toxicity. Toxicity is still a function of concentration and, since the initial dilution of ammonia in the rising primary treatment plume is around 60 µgN/L, this value is nearly two orders of magnitude (or about 1/100) of the concentration found to be toxic to most fishes (U.S. Environmental Protection Agency [USEPA] 1999). Secondary treatment brings this concentration down to just over half of the Guam Water Quality Standard of 20 µgN/L.

Benthic impacts are associated with the sedimentation of particulates entrained in the discharge plume. Sources of the particulates in the wastewater discharge plume include particulates in the effluent, particulates produced in the environment from nutrient enrichment, and natural seston.

Based on several studies performed on deep ocean outfalls off Oahu in the Hawaiian Islands, no significant impacts have been reported on the benthic faunal. Impacts to polychaete assemblage and the crustacean and soft bottom communities were found to be limited. Since the conditions off Tanguisson Point are similar to those off the Oahu deep ocean outfalls, adverse impacts to the receiving marine waters are not anticipated with the discharge of effluent from the NDWWTP outfall. Additionally, the nearfield plume analysis indicates that the discharge from the diffuser rises quickly, with minimal horizontal dispersion before reaching the surface. The elapsed time for this initial mixing and rise of the fluids is short; occurring on a time scale of minutes, so the impact associated with sedimentation and ammonia concentrations is not anticipated to be significant.

In nearshore tropical marine waters, phosphorus appears to be more limiting for primary production (Howarth et al. 1995), while tropical open ocean is nitrogen-limited (Corredor et al. 1999). Nutrients regulated under the Guam Water Quality Standards include ammonia, nitrate, nitrite, and orthophosphate. These nutrients are utilized by phytoplankton for primary production.

11.1.4.1 Marine Flora, Invertebrates and Associated EFH

Algae (seaweeds) occupy a wide range of habitats including but not limited to: sandy bottoms of lagoons; shallow, calm fringing reefs; barrier reef coral bottoms; outer reef flats; and the outer reef slope. Coralline algae are of primary importance in constructing algal ridges that are characteristic of exposed Indo-Pacific reefs preventing oceanic waves from eroding coastal areas (WPRFMC 2001). Over 237 species of algae or seaweed (blue-green, green, brown, and red) occur on Guam (Lobban and Tsuda 2003). Green, brown, and red algae are commonly harvested for sale at local markets or used as bait for rod and reel fishing on Guam (Navy 2005). Since algae are direct contributors to the well-being and protection of fish species, both as a source of food and protection to larvae and small fish species, algae has a EFH designation and is managed as part of the potentially harvested coral reef taxa (PHCRT) by WPRFMC (WPRFMC 2009a).

Seagrass beds cover approximately 917 ac (371 ha) of reef flats in several coastal bays around Guam (WPRFMC 2009a). Three species found there include *Halodule uninervis*, *Enhalus acoroides*, and *Halophila minor* (Lobban and Tsuda 2003). These beds are used as foraging grounds by sea turtles and are an important nursery area for a number of economically important reef fish species including but not limited to emperors, scads, wrasses and goatfish (GDAWR 2006a).

Sponges in the Marianas have a considerable variation in the distribution and composition among neighboring reefs and islands. Their diversity is greatest, regardless of depth, on coral reefs, in caves and vertical areas not colonized by hard corals. They are also abundant in seagrass beds, mangroves, and other environments, providing residence for a huge variety of animal including crustaceans, annelids and echinoderms among others. Over 120 sponge species have been reported from Guam (and CNMI), have EFH designations, and are managed as part of the PHCRT (WPRFMC 2009a).

Guam supports biogenic (produced by a living organism) or hermatypic (reef-building) coral reefs. The degree of reef development depends on a number of environmental controls, including the age of the islands, volcanic activity, the availability of favorable substrates and habitats, weathering caused by groundwater discharge, sedimentation and runoff accentuated by the overgrazing of feral animals, and varying levels of exposure to wave action, trade winds, and storms (Navy 2005). Guam is almost entirely surrounded by fringing reefs, is entirely surrounded by forereefs, and has barrier reefs at Apra Harbor (Luminao Barrier Reef at the western end of Guam) and Cocos Lagoon (southern end of Guam) (Eldredge 2003a, Navy 2005). The fringing reef is interrupted at several locations along the coastline by bays, channels, and areas where the insular shelf is colonized by seagrass. Along the northern coast of the island between Achae Point and the Ritidian Channel, the fringing reef and forereef area transitions from a relatively wide swath of coral (less than 820 ft [250 m] wide) to an area populated by turf algae (approximately 650 to 1,650 ft [200 to 500 m] wide) (NOAA 2005a).

Figures 11.1-1 through 11.1-4 show an overview of sensitive marine biological resources, including benthic habitats associated with the study areas. These habitats are based on NOAA (2005a) Environmental Sensitivity Index Mapping, supplemented by the Guam Coastal Atlas (NOAA 2005b) and may include if present:

- Coral Reef and colonized hardbottom, which are broken into two density categories.
  - Lower Density Live Coral Cover (Sparse cover: 10% - <50%).
  - Higher Density Live Coral Cover (Patchy: 50% - <90% and Continuous: 90%-100%).
- Coralline Algae (one category).
  - Sparse (10% - <50%), patchy (50% - 90%), and continuous (90% - 100%) combined.
- Macroalgae, Turf Algae, and Seagrass (one separate category each).
  - All coverage percentages combined (sparse, patchy, and continuous) combined.
- Turf Algae (one category).
  - All coverage percentages (sparse, patchy, and continuous) combined.
- Seagrass (one category).
  - All coverage percentages (sparse, patchy, and continuous) combined.
- Unconsolidated Sediment, usually sand or mud, uncolonized 90-100%

Reefs in the southern half of Guam have always been subject to more naturally-occurring sedimentation than in the northern half of the island because of the lack of surface water associated with the porous limestone substrate and soil type in the north versus the volcanic substrate in the south. Coral cover and diversity are currently higher on reefs located along the northeastern coast of Guam. Historical surveys suggest that diversity was actually higher in the south before anthropogenic impacts severely impacted those reefs (Navy 2005). The NOAA Environmental Sensitivity Index Map (2005a) and Guam Coastal Atlas (NOAA 2005b), produced from surveys of shallow water benthic habitats of Guam show that the overall coral cover around Guam ranges from 10 to 90%. Most of the reefs surrounding Guam have a coral cover ranging from 10 to 50%.

Natural and anthropogenic disturbances affecting the reefs of Guam have caused a significant decline of coral cover and recruitment since the 1960s. Coral cover on many forereef slopes on Guam has decreased from over 50% to less than 25% (Birkeland 1997). There are; however, several reefs of Guam where coral cover remains high, including reefs in Apra Harbor, Agat Bay, Orote Point Ecological Reserve Area (ERA), and Haputo ERA (Navy 2005). Coral reefs are EFH in Guam, part of the CREMUS (WPRFMC 2009a).

11.1.4.2 Essential Fish Habitat

The 1996 amendments to the M-SA set forth a mandate for NMFS, Regional Fisheries Management Councils, and other federal agencies to identify and protect EFH of economically important marine and estuarine fisheries. To protect EFH in accordance with the law, suitable fishery habitats must be maintained. Guam is within the jurisdiction of the WPRFMC, which has designated the marine waters around Guam as EFH, and adopted a precautionary approach to EFH designation due to the lack of scientific data (COMNAV Marianas 2007a).

EFH for CREMUS covers all the waters and habitats at depths from the sea surface to 328 ft (100 m) extending from the shoreline (including state and territorial lands and waters) to the outer boundary of the exclusive economic zone (EEZ). This broad EFH designation ensures that enough habitat is protected to sustain managed species. In addition to EFH, the WPRFMC also identified Habitat Areas of Particular Concern (HAPC) for CREMUS. Within the EFH, HAPC are specific areas that are essential to the life cycle of important coral reef species. At least one or more of the following criteria established by NMFS must be met for HAPC designation: (1) the ecological function provided by the habitat is important; (2) the habitat is sensitive to human-induced environmental degradation; (3) development activities are, or would be, stressing the habitat type; or (4) the habitat type is rare. It is possible that an area can meet one HAPC criterion and not be designated an HAPC. The WPRFMC used a fifth criterion, not established by NMFS, in HAPC designation of areas that are already protected, such as wildlife refuges (WPRFMC 2009a).

As described earlier, the WPRFMC recently shifted to managing fisheries in the Western Pacific under FEPs, and those which pertain to Guam include the Mariana Archipelago FEP and Pacific Pelagic Fisheries FEP. The Mariana Archipelago FEP includes demersal organisms grouped in the same categories as past FMPs, including the Bottomfish and Seamount, Crustaceans, Precious Corals, and Coral Reef Ecosystems. Due to the highly migratory nature of some pelagic species, an individual FEP was created for pelagic species in the entire western Pacific region (WPRFMC 2009b). The new FEPs identify areas of EFH and HAPC for different life stages of species managed under the respective plan in the same fashion as the FMPs did (WPRFMC 2009a, 2009b). There is no designated EFH or HAPC for precious corals or seamount groundfish around Guam, but designations for bottomfish, crustaceans, and coral reef ecosystems have been made (COMNAV Marianas 2007a).

EFH habitats include mangrove, estuarine, seagrass beds, soft substrate, coral reef/hard substrate, patch reefs, surge zone, deep-slope terraces, and pelagic/open ocean; these habitats can be viewed in relation to the species-specific life stages in the FEP for Mariana Archipelago (WPRFMC 2009a). Specific EFH habitats occurring in waters within the study areas that are described within the text or depicted on figures include the following:

- *Intertidal Zones.* This habitat includes a small margin of seabed existing between the highest and lowest extent of the tides extending around Guam and is present in all ROI.
- *Seagrass Beds.* Seagrass beds occur in patches within Outer and Inner Apra Harbor and other isolated areas around Guam (e.g., Agat Bay).
- *Macroalgae.* Located within most habitats associated with the ROI and around Guam.
- *Mangrove Forests/Wetlands.* These forests are located in the intertidal zone along the coast of Outer and Inner Apra Harbor.
- *Coral Reefs and Colonized Hardbottom.* Coral reefs are located along the coast of the ROI, on shoals (Big Blue Reef, Western Shoals, Middle Shoals, and Jade Shoals) and the coasts of Outer and Inner Apra Harbor.
- *Estuarine Water Column.* Includes the open water areas within Sasa Bay and river mouth areas.
- *Marine Water Column.* Many managed species occur in this habitat and rely on this for development, dispersal, or feeding.
- *Unconsolidated Bottom.* This includes benthic substrates along the coast or within Apra Harbor such as clay and silt, sand, gravel, rubble and boulders.

EFH or HAPC occur throughout the ROI. The geographic extent of the habitat types varies, but is generally a key portion of each Alternative if discussed.

Figure 11.1-5 and Table 11.1-3 summarize and portray the EFH and HAPC designations for Guam. Each of the MUS in Table 11.1-3 has an associated figure listed in the right column that illustrates them.

Table 11.1-3. Guam EFH and HAPC

FEP MUS Group	*EFH (Juveniles and Adults)*	*EFH (Eggs and Larvae)*	*HAPC*	*Figure*
Coral Reef Ecosystems	Water column and benthic substrate to a depth of 328 ft (100 m)	Water column and benthic substrate to a depth of 328 ft (100 m)	All marine protected areas identified in an FEP, all PRIAs, many specific areas of coral reef habitat (see FEP)	11.1-6
Bottomfish	Bottomfish: Water column and bottom habitat down to 1,312 ft (400 m)	Bottomfish: Water column down to 1,312 ft (400 m)	Bottomfish: All escarpments and slopes between 130 – 920 ft (40-280 m)	11.1-7
Crustaceans	Bottom habitat from shoreline to a depth of 328 ft (100 m)	Water column down to 490 ft (150 m)	None	11.1-8
Pelagics	Water column down to 3,280 ft (1,000 m)	Water column down to 655 ft (200 m)	Water column above seamounts and banks down to 3,280 ft (1,000 m)	11.1-9

Note: All areas are bounded by the shoreline and the outer boundary of the EEZ, unless otherwise indicated.
Source: WPRFMC 2009a, b.

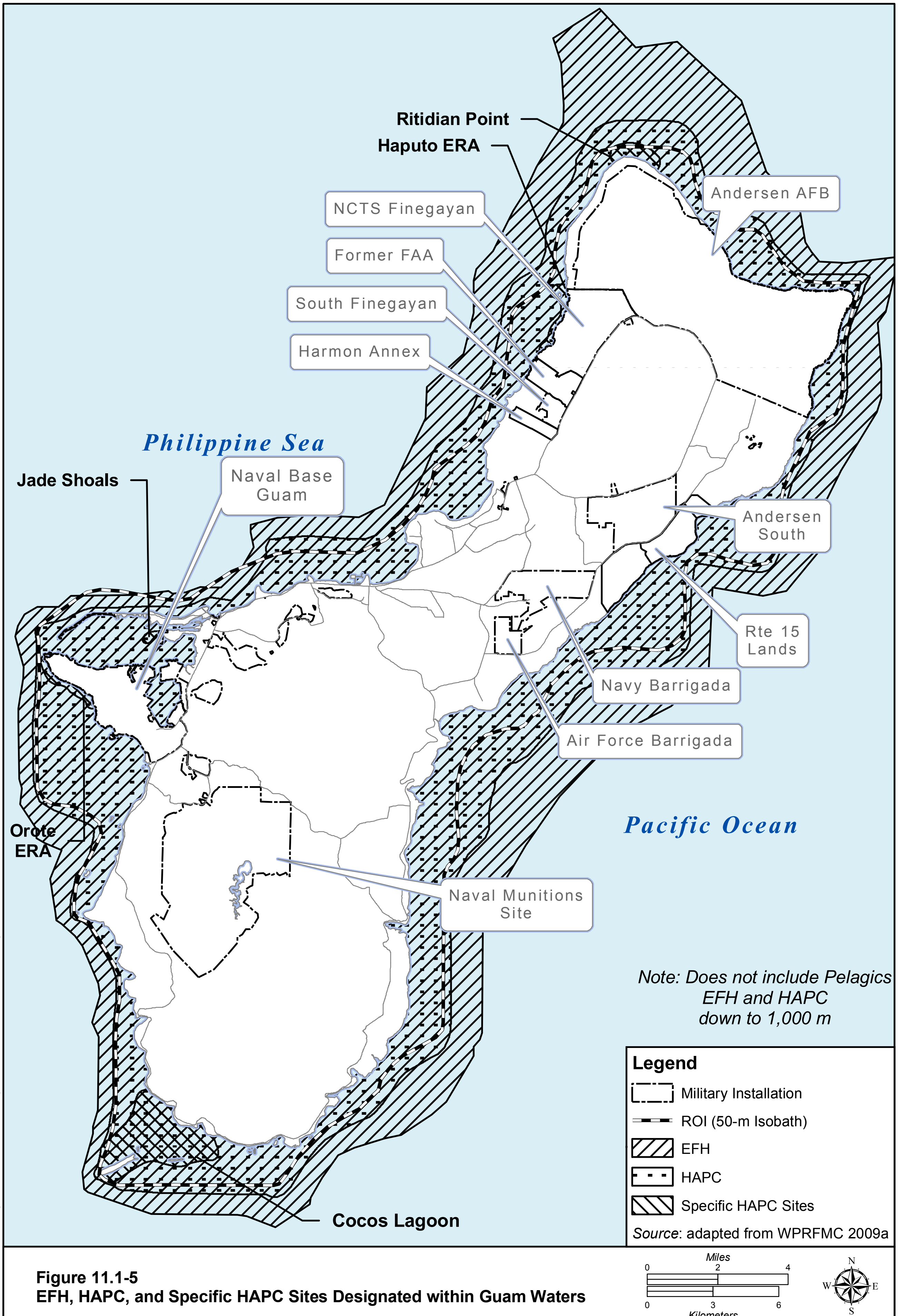


Figure 11.1-5
EFH, HAPC, and Specific HAPC Sites Designated within Guam Waters

Printing Date: Jun 25, 2010, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\11.1-5.mxd

EFH for at least one life stage of a managed species group extends from the shoreline to the outer extent of the EEZ from the surface to a water depth of 3,280 ft (1,000 m) and includes bottom habitat to a depth of 1,312 ft (400 m). Thus, the entire coast of Guam is considered EFH.

HAPC within submerged lands around Guam includes seamounts and banks to depths of 3,280 ft (1,000 m), escarpments and slopes between 130 and 920 ft (40 and 280 m), and specific areas around Ritidian Point, Haputo ERA, Jade Shoals in Apra Harbor, and Orote ERA.

EFH life stage, status, and life history for each of these management units are summarized below. See the FEP for Mariana Archipelago (WPRFMC 2009a) for a detailed listing of all FEP MUS.

Coral Reef Ecosystem Management Unit Species (CREMUS)

In designating EFH for CREMUS, the WPRFMC linked MUS to specific habitat "composites" (e.g., sand, live coral, seagrass beds, mangrove, open ocean) for each life history stage, consistent with the depth of the ecosystem.

For several of the major coral reef associated species, very little is known about their life histories, habitat utilization patterns, food habits, or spawning behavior. For this reason, the WPRFMC, through the FMP, designated EFH using a two-tiered approached based on the divisions of MUS into the currently harvested coral reef taxa (CHCRT) (this also includes likely targeted species in the near future) and PHCRT categories. The Mariana Archipelago FEP identifies the species that may occur in this particular region, and these species are included in Tables 11.1-4 and 11.1-5, grouped by designations as CHCRT or PHCRT (WPRFMC 2009a).

Table 11.1-4. Mariana Archipelago Coral Reef Ecosystem CHCRT MUS

Family Name	*Scientific Name*	*English Common Name*	*Chamorro Name*
Acanthuridae (surgeonfishes)	*Acanthurus olivaceus*	orange-spot surgeonfish	NA
	Acanthurus xanthopterus	yellowfin surgeonfish	hugupao dangulo
	Acanthurus triostegus	convict tang	kichu
	Acanthurus dussumieri	eye -striped surgeonfish	NA
	Acanthurus nigroris	blue-lined surgeon	NA
	Acanthurus leucopareius	whitebar surgeonfish	NA
	Acanthurus lineatus	blue-banded surgeonfish	hiyok/filaang
	Acanthurus nigricauda	blackstreak surgeonfish	NA
	Acanthurus nigricans	whitecheek surgeonfish	NA
	Acanthurus guttatus	white-spotted surgeonfish	NA
	Acanthurus blochii	ringtail surgeonfish	NA
	Acanthurus nigrofuscus	brown surgeonfish	NA
	Acanthurus pyroferus	mimic surgeonfish	NA
	Zebrasoma flavescens	yellow tang	NA
	Ctenochaetus striatus	striped bristletooth	NA
	Ctenochaetus binotatus	twospot bristletooth	NA
	Naso unicornus	bluespine unicornfish	tataga
	Naso lituratus	orangespine unicornfish	hangon
	Naso tuberosus	humpnose unicornfish	NA
	Naso hexacanthus	black tongue unicornfish	NA
	Naso vlamingii	bignose unicornfish	NA
	Naso annulatus	whitemargin unicornfish	NA
	Naso brevirostris	spotted unicornfish	NA
	Naso brachycentron	humpback unicornfish	NA

Family Name	Scientific Name	English Common Name	Chamorro Name
	Naso caesius	gray unicornfish	NA
Balistidae (triggerfishes)	*Balistoides viridescens*	titan triggerfish	NA
	Balistoides conspicillum	clown triggerfish	NA
	Balistapus undulatus	orangstriped triggerfish	NA
	Melichthys vidua	pinktail triggerfish	NA
	Melichthys niger	black triggerfish	NA
	Pseudobalistes fuscus	blue triggerfish	NA
	Rhinecanthus aculeatus	Picassofish	NA
	Balistoides rectanulus	wedged Picassofish	NA
	Sufflamen fraenatus	bridled triggerfish	NA
Carangidae (jacks)	*Selar crumenophthalmus*	bigeye scad	atulai
	Decapterus macarellus	mackerel scad	NA
Carcharhinidae (sharks)	*Carcharhinus amblyrhynchos*	grey reef shark	NA
	Carcharhinus albimarginatus	silvertip shark	NA
	Carcharhinus galapagensis	Galapagos shark	NA
	Carcharhinus melanopterus	blacktip reef shark	NA
	Triaenodon obesus	whitetip reef shark	saksak
Holocentridae (soldierfish/ squirrelfish)	*Myripristis berndti*	bigscale soldierfish	sagamelon
	Myripristis adusta	bronze soldierfish	sagamelon
	Myripristis murdjan	blotcheye soldierfish	sagamelon
	Myripristis amaena	brick soldierfish	sagamelon
	Myripristis pralinia	scarlet soldierfish	sagamelon
	Myripristis violacea	violet soldierfish	sagamelon
	Myripristis vittata	whitetip soldierfish	sagamelon
	Myripristis chryseres	yellowfin soldierfish	sagamelon
	Myripristis kuntee	pearly soldierfish	sagamelon
	Sargocentron caudimaculatum	tailspot squirrelfish	sagamelon
	Sargocentron microstoma	file-lined squirrelfish	NA
	Sargocentron diadema	crown squirrelfish	chalak
	Sargocentron tiere	blue-lined squirrelfish	sagsag
	Sargocentron spiniferum	saber or long jaw squirrelfish	sisiok
	Neoniphon spp.	spotfin squirrelfish	sagsag
Kuhliidae (flagtails)	*Kuhlia mugil*	barred flag-tail	NA
Kyphosidae (rudderfish)	*Kyphosus biggibus*	rudderfish	guili
	Kyphosus cinerascens	rudderfish	guili
	Kyphosus vaigienses	rudderfish	guilen puengi
Labridae (wrasses)	*Cheilinus chlorourus*	floral wrasse	NA
	Cheilinus undulates[1]	Napoleon wrasse	tangison
	Cheilinus trilobatus	triple-tail wrasse	lalacha mamate
	Cheilinus fasciatus	harlequin tuskfish or red-breasted wrasse	NA
	Oxycheilinus unifasciatus	ring-tailed wrasse	NA
	Xyrichtys pavo	razor wrasse	NA
	Xyrichtys aneitensis	whitepatch wrasse	NA

Family Name	Scientific Name	English Common Name	Chamorro Name
	Cheilio inermis	cigar wrasse	NA
	Hemigymnus melapterus	blackeye thicklip	NA
	Hemigymnus fasciatus	barred thicklip	NA
	Halichoeres trimaculatus	three-spot wrasse	NA
	Halichoeres hortulanus	checkerboard wrasse	NA
	Halichoeres margaritacous	weedy surge wrasse	NA
	Thalassoma purpureum	surge wrasse	NA
	Thalassoma quinquevittatum	red ribbon wrasse	NA
	Thalassoma lutescens	sunset wrasse	NA
	Hologynmosus doliatus	longface wrasse	NA
	Novaculichthys taeniourus	rockmover wrasse	NA
Mullidae (goatfishes)	*Mulloidichthys* spp.	yellow goatfish	NA
	Mulloidichthys vanicolensis	yellowfin goatfish	satmoneti
	Mulloidichthys flavolineatus	yellowstripe goatfish	ti'ao (juv.) satmoneti (adult)
	Parupeneus spp.	banded goatfish	
	Parupeneus barberinus	dash-dot goatfish	satmonetiyo
	Parupeneus bifasciatus	doublebar goatfish	satmoneti acho
	Parupeneus heptacanthus	redspot goatfish	NA
	Parupeneus ciliatus	white-lined goatfish	ti'ao (juv.) satmoneti (adult)
	Parupeneus cyclostomas	yellowsaddle goatfish	ti'ao (juv.) satmoneti (adult)
	Parupeneus pleurostigma	side-spot goatfish	ti'ao (juv.) satmoneti (adult)
	Parupeneus multifaciatus	multi-barred goatfish	ti'ao (juv.) satmoneti (adult)
	Upeneus arge	bantail goatfish	NA
Mugilidae (mullets)	*Mugil cephalus*	striped mullet	aguas (juv.) laiguan (adult)
	Moolgarda engeli	Engel's mullet	aguas (juv.) laiguan (adult)
	Crenimugil crenilabis	fringelip mullet	aguas (juv.) laiguan (adult)
Muraenidae (moray eels)	*Gymnothorax flavimarginatus*	yellowmargin moray eel	NA
	Gymnothorax javanicus	giant moray eel	NA
	Gymnothorax undulatus	undulated moray eel	NA
Octopodidae (octopi)	*Octopus cyanea*	octopus	gamsun
	Octopus ornatus	octopus	gamsun
Polynemidae	*Polydactylus sexfilis*	threadfin	NA
Pricanthidae (bigeye)	*Heteropriacanthus cruentatus*	glasseye	NA
	Priacanthus hamrur	bigeye	NA
Scaridae (parrotfishes)	*Bolbometopon muricatum*[2]	humphead parrotfish	atuhong
	Scarus spp.	parrotfish	palakse

Family Name	Scientific Name	English Common Name	Chamorro Name
	Hipposcarus longiceps	Pacific longnose parrotfish	gualafi
	Calotomus carolinus	stareye parrotfish	palaksin chaguan
Scombridae	*Gymnosarda unicolor*	dogtooth tuna	white tuna
Siganidae (rabbitfish)	*Siganus aregentus*	forktail rabbitfish	hiting
	Siganus guttatus	golden rabbitfish	hiting
	Siganus punctatissimus	gold-spot rabbitfish	hiting galagu
	Siganus randalli	Randall's rabbitfish	NA
	Siganus spinus	scribbled rabbitfish	hiting
	Siganus vermiculatus	vermiculate rabbitfish	hiting
Sphyraenidae (barracuda)	*Sphyraena helleri*	Heller's barracuda	NA
	Sphyraena barracuda	great barracuda	NA
Turbinidae (turban/green snails)	*Turbo* spp.	green snails turban shells	aliling pulan

Source: NMFS 2010a. 1=NMFS Species of Concern. 2= NMFS Candidate species. NA=not applicable

Table 11.1-5. Mariana Archipelago Coral Reef Ecosystem PHCRT MUS

Scientific Name	English Common Name
Labridae	wrasses[1]
Carcharhinidae Sphyrnidae	sharks
Dasyatididae Myliobatidae	rays and skates
Serrandiae	groupers[1]
Carangidae	jacks and scads[1]
Holocentridae	solderfishes and squirrelfishes[1]
Mullidae	goatfishes[1]
Acanthuridae	surgeonfishes[1]
Ephippidae	batfishes
Monodactylidae	monos
Haemulidae	sweetlips
Echeneidae	remoras
Malacanthidae	tilefishes
Lethrinidae	emperors[1]
Pseudochromidae	dottybacks
Plesiopidae	prettyfins
Muraenidae Chlopsidae Congridae Ophichthidae	eels[1]
Apogonidae	cardinalfishes
Zanclidae	moorish idols
Aulostomus chinensis	trumpetfish
Fistularia commersoni	cornetfish
Chaetodontidae	butterfly fishes
Pomacanthidae	angelfishes
Pomacentridae	damselfishes
Scorpaenidae	scorpionfishes
Caracanthidae	coral crouchers
Anomalopidae	flashlightfishes
Clupeidae	herrings
Engraulidae	anchovies

Scientific Name	*English Common Name*
Gobiidae	gobies
Blenniidae	blennies
Sphyraenidae	barracudas[1]
Lutjanidae	snappers[1]
Balistidae	trigger fishes[1]
Siganidae	rabbitfishes[1]
Pinguipedidae	sandperches
Gymnosarda unicolor	dog tooth tuna
Kyphosidae	rudderfishes[1]
Bothidae Soleidae	flounders and soles
Ostraciidae	trunkfishes
Caesionidae	fusiliers
Cirrhitidae	hawkfishes
Antennariidae	frogfishes
Syngnathidae	pipefishes and seahorses
Tetradontidae	puffer fishes and porcupine fishes
Heliopora	blue corals
Tubipora	organpipe corals
Azooxanthellates	ahermatypic corals
Echinoderms	sea cucumbers and sea urchins[1]
Gastropoda	sea snails
Trochus spp.	
Opistobranchs	sea slugs
Pinctada margaritifera	black lipped pearl oyster
Tridacnidae	giant clam
Other Bivalves	other clams
Fungiidae	mushroom corals
	small and large coral polyps
Millepora	fire corals
	soft corals and gorgonians
Actinaria	anemones
Zoanthinaria	soft zoanthid corals
Hydrozoans and Bryzoans	
Tunicates	sea squirts
Porifera	sponges
Cephalopods	octopi
Crustaceans	lobsters, shrimps/mantis shrimps, true crabs and hermit crabs[2]
Stylasteridae	Lace corals
Solanderidae	Hydroid corals
Algae	Seaweed
Annelids	Segmented worms
Live rock	
All other coral reef ecosystem management unit species that are marine plants, invertebrates, and fishes that are not listed in the preceding tables or are not bottomfish management unit species, crustacean management unit species, Pacific pelagic management unit species, precious coral or seamount groundfish.	

Source: NMFS 2010a. 1= those species not listed as CHCRT. Those species not listed as CMUS.

In the first tier, EFH has been identified for various life stages of CHCRT, and it includes the water column and all benthic substrate to a depth of 328 ft (100 m) from the shoreline to the outer limit of the EEZ (Figure 11.1-6). HAPC for important coral reef species includes all no-take marine protected areas identified in the Mariana Archipelago FEP, all Pacific remote islands, and numerous other existing marine protected areas, research sites, and coral reef ecosystems throughout the western Pacific (WPRFMC 2009a).

HAPC for all life stages of the CREMUS includes all hardbottom substrate between 0 and 328 ft (100 m) depth in the study area. Five individual HAPC sites (see Figure 11.1-5) have been identified for the island of Guam:

- Jade Shoals, which occurs within Apra Harbor
- Orote Point ERA, which lies immediately outside of Apra Harbor
- Ritidian Point, located in northern Guam, along the shoreline of Andersen AFB
- Haputo ERA, in northwestern Guam along the shoreline of NCTS Finegayan
- Cocos Lagoon, southern Guam

CHCRT includes fish such as surgeonfishes, unicornfishes, triggerfishes, jacks/scads, sharks soldierfishes, squirrelfishes, flagtails, rudderfishes, wrasses, goatfishes, octopi, mullets, moray eels, threadfins, bigeyes, parrotfishes, rabbitfishes, tuna/mackerel, barracudas, turban shells, and various aquarium species/taxa (Table 11.1-4).

EFH has also been designated for the second tier, PHCRT, and includes literally thousands of species encompassing almost all coral reef flora and fauna. An example of some of these PHCRT MUS/taxa are additional fish MUS/taxa, hard and soft corals, anemones, zooanthids, sponges, hydrozonans, bryozoans, tunicates, feather duster worms, sea cucumbers/urchins, mollusks, sea snails/slugs, other bivalves, other lobsters and crabs, shrimp/mantis, annelids, algae, and live rock (WPRFMC 2009a) (Table 11.1-5).The Napoleon wrasse and bumphead parrotfish are potentially sensitive CHCRT MUS, and were designated SOC and candidate species, respectively, by NMFS. These fish are briefly described below, and areas of EFH and HAPC are depicted in Figure 11.1-6. Factors contributing to their decline and additional information on these species are included in Volume 9, Appendix G.

Potentially Sensitive CREMUS in the EFH of Guam

Napoleon Wrasse

The Napoleon wrasse is the largest species of the Labridae family, with the males exceeding 6 ft (2 m) in length and 420 pounds (lbs) [190 kilograms {kg}] (Sadovy et al. 2003). Females rarely exceed 3 ft (1 m) in length (Choat et al. 2006). This species is slow-growing and long-lived, with delayed reproduction, and consequently, low stock replenishment rates. Individuals become sexually mature at 5 to 7 years old and can live at least 30 years (Choat et al. 2006). Its generation time is expected to be in excess of 10 years. They primarily eat mollusks, fish, sea urchins, crustaceans, and other invertebrates and are one of the few predators of toxic animals such as sea hares, boxfishes and crown-of-thorns starfish (NMFS 2009b).

This species is believed to be uncommon to rare wherever it occurs, and natural densities are never high even in preferred habitats. Once an economically important species in Guam, it is now rarely seen on reefs there, and is infrequently reported on inshore survey catch results.

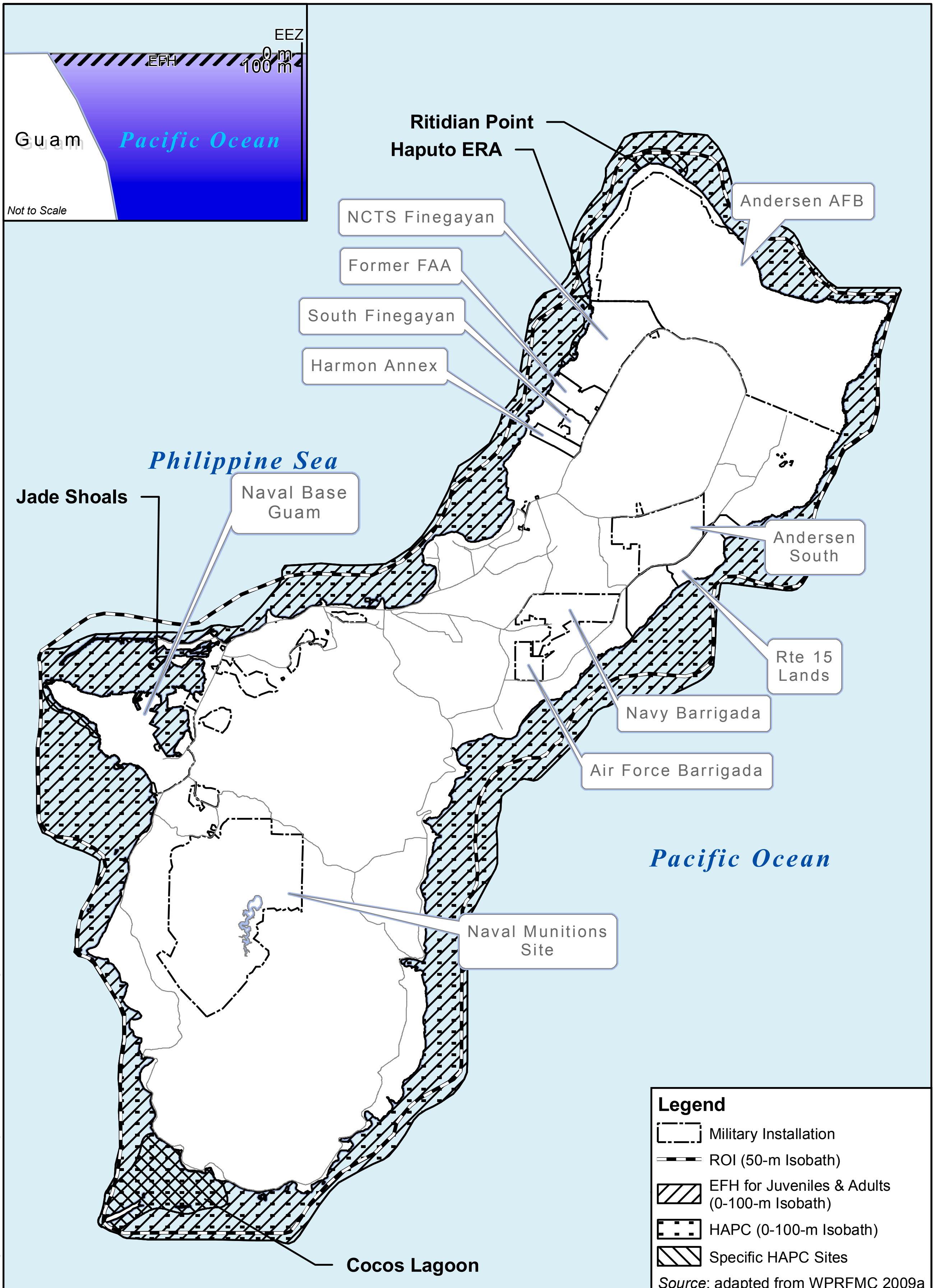


Figure 11.1-6
EFH and HAPC Designated within Guam Waters for Various Life Stages of CHCRT and PHCRT

Bumphead Parrotfish

The bumphead parrotfish is the largest of all parrotfishes, growing to 4 ft (1.2 m) in length and 100 lbs (46 kg) in weight. This species is slow growing, with delayed reproduction and low replenishment rates, and may live to 40 years of age (NMFS 2009b). Bumphead parrotfish primarily eat coral, but also eat benthic algae. The bumphead parrotfish has a very wide range, but population sizes have been declining due to overfishing. Additionally, their slow growth and delayed reproduction make them susceptible to stressors (Donaldson and Dulvy 2004). The species has nearly disappeared from Guam's reefs (NMFS 2009).

Other Potentially Sensitive EFH Fish Species

Two other potentially sensitive EFH fish species are addressed in this EIS: the adult bigeye scad, a CHCRT MUS, is identified in seasonally high concentrations (June – December) at two locations within Apra Harbor; and the scalloped hammerhead shark, a PHCRT MUS, is found during seasonal pupping events at one location (NOAA 2005a, BSP 2010). Both of these species' locations are in proximity to the proposed action and alternatives within Apra Harbor and are addressed further in that section. Additionally, a "sessile benthic" PHCRT MUS, mainly addressing hard corals (although it includes algae, sponges, hard and soft corals, etc.) within the study area is discussed throughout this EIS and in further detail in Volume 4, Chapter 11 (Table 11.1-6).

Table 11.1-6. Sensitive MUS present in the EFH of Guam

Group	*Common Name / Chamorro Name*	*Status** Federal*	*Guam*
Fishery Ecosystem Plan- Coral Reef Ecosystem (FEP-CRE)			
Fish MUS	Napoleon wrasse / Tanguisson	CHCRT and SOC	SOGCN
	Bumphead parrotfish / Atuhong	CHCRT and SOC	SOGCN
	Bigeye scad / Atulai	CHCRT	SOGCN
	Scalloped hammerhead / halu'u (general term)	PHCRT	SOGCN
Sessile Benthic MUS**	Hard coral / cho' cho'	PHCRT	SOGCN

Legend: SOC = NOAA Species of Concern; EFH; SOGCN = Species of Greatest Conservation Need.
Notes: ** includes algae, sponges, hard and soft corals, etc. Only a hard coral example is given for the table and is the main focus of this EIS (WPRFMC 2009a).
Sources: NOAA 2005a, BSP 2010, WPRFMC 2009a, GDAWR 2006a, USFWS 2009.

Bigeye Scad

The bigeye scad or atulai can be found off the coast of Guam year-round, but is scarce in July and August, which may be due to spawning activities. This species tends to spawn in the pelagic environment in large aggregations. Larvae and juveniles remain offshore for the first several months, then migrate to the nearshore habitat (see Figure 11.1-4). Small schools are typically found inshore or in shallow water and occasionally over shallow reefs in turbid water. Large schools of atulai appear seasonally in Guam from August to November in shallow sandy lagoons, bays, and channels (Navy 2005).

This species is an economically important food fish and a small seasonal fishery is present in Guam (WPRFMC 2009a). Atulai reach a size of 15 in (38 cm), but are rarely more than 10 in (25 cm) at Guam. On moonless nights atulai, beyond the reef, can be attracted to lights set in the water beneath fishing boats and caught with hook and line. When inshore, atulai are harvested by nets and hook and line during the daytime. Sometimes a large net is set across an entire bay to trap the atulai. A large group of people help close the net and harvest the atulai. Several thousand pounds can be harvested this way. Atulai may also move between islands or island groups since they are not always present near Guam. Little is known of these offshore movements (GDAWR 2009).

Scalloped Hammerhead

Scalloped hammerheads are found in a wide variety of coral reef habitats. They are very active swimmers, occurring in pairs, schools, or solitary, ranging from the surface, surfline, and intertidal region down to at least 900 ft (275 m) (Compagno 1984). Juveniles often occur in schools inhabiting inshore areas such as bays, seagrass beds, and lagoon flats, foraging near the bottom before moving into deeper waters as adults (WPRFMC 2009a). As adults they can be found in shallow inshore areas during mating or birthing events (Compagno 1984). The scalloped hammerhead produces an offspring of 15 to 31 pups per litter and utilizes shallow, turbid coastal waters (e.g., Guam's Inner Apra Harbor) as nursery areas (see Figure 11.1-4). The pups may remain in these shallow areas for several months, and then venture to coastal waters (Compagno 1984, Myers 1999). The scalloped hammerhead is reported to pup in January through March outside the Inner Apra Harbor Entrance Channel (NOAA 2005a, BSP 2010), although data are limited on this event, their occurrence is reported as extremely rare (personal communication with Steve Smith, [Navy 2009b]).

Sessile Benthic MUS

In general, the Haputo ERA and Outer Apra Harbor (two of the three study areas addressed in this chapter) are vibrant thriving coral reef communities with a diverse biota of algae, invertebrates and fish. Both locations have well-developed coral reefs containing some of the highest coral cover on Guam (Paulay et al. 1997, Amesbury et al. 2001) (see Figures 11.1-3 and 11.1-4). Coral species identified as NMFS candidate species known to reside in the Guam ROI include *Acropora aspera* and *Pavona cactus* (Dollar and Hochberg 2009; Minton et al. 2009), and *Leptoseris incrustans*, and *Porites horizontalata* (Minton et al. 2009) – all four located in the Apra Harbor project area. Addtionally, Amesbury (2001) identified 16 NMFS Candidate coral species at Haputo ERA. They include *Acropora acuminate, Acropora globiceps, Acropora paniculata* – Fuzzy Table Coral, *Acropora striata, Acropora verweyi, Cyphastrea agassizi* – Agassiz's Coral, *Heliopora coerulea, Leptoseris incrustans, Millepora tuberosa, Montipora lobulata, Pavona Venosa, Pocillopora danae, Pocillopora elegans, Porites Horizontalata, Seriatopora aculeate, and Turbinaria reniformis.* In addition, the Haputo ERA and Jade Shoals of Apra Harbor are identified as Specific HAPC sites, which are defined as "areas that are essential to the life cycle of important coral reef species" (WPRFMC 2009a). More detailed information regarding the sessile benthic community at these two locations and the sensitivity of the coral reef community is described within the site-specific sections.

Bottomfish Management Unit Species (BMUS)

EFH for egg and larval life stages includes the water column extending from the shoreline to the outer limit of the EEZ down to a depth of 1,310 ft (400 m) and encompasses both the shallow-water (0 to 328 ft [100 m]) and deep-water complexes (328 to 1310 ft [100 to 400 m]) (COMNAV Marianas 2007a). EFH for juvenile and adult life stages encompasses the water column and all bottom habitat extending from the shoreline to a depth of 1,310 ft (400 m) and includes the shallow-water and deep-water complexes (WPRFMC 2009a). All life stages of the BMUS have HAPC designated in the ROI that includes all slopes and escarpments between 131 and 920 ft (40 and 280 m) (Figure 11.1-7) (Navy 2005, WPRFMC 2009a).

There are currently 16 BMUS in the Mariana Archipelago FEP managed by the WPRFMC (Table 11.1-7). In Guam, the BMUS is divided into a shallow-water complex and a deep-water complex based on depth and species composition. The juvenile and adult deep-water complex is outside the ROI, therefore will not be addressed in this document. All species have viable recreational, subsistence, and commercial fisheries with none of the BMUS approaching an overfished condition (WPRFMC 2009a).

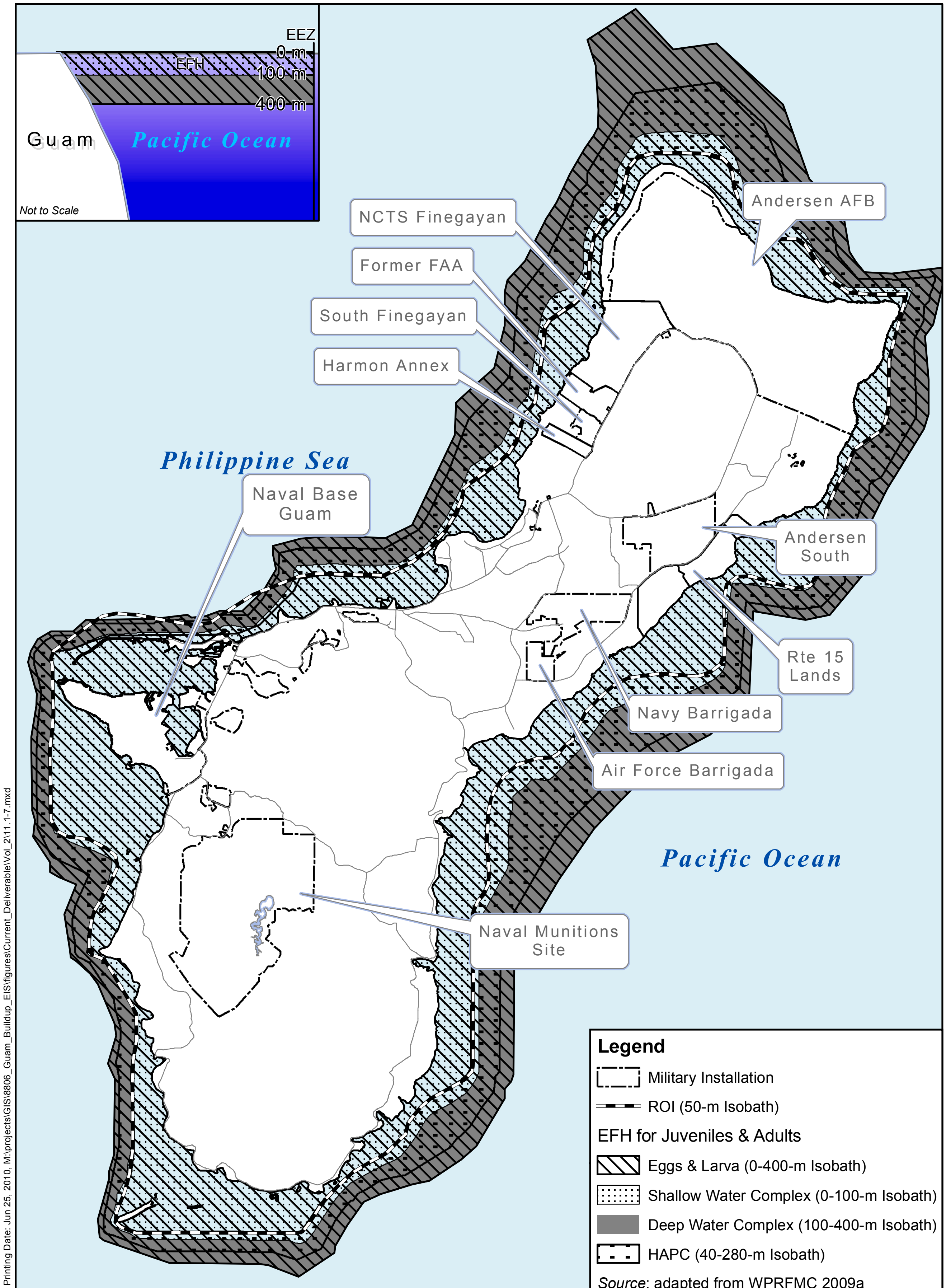


Figure 11.1-7
EFH Designated within Guam Waters for Egg, Larval, Juvenile, and Adult Life Stages of Bottomfish

Table 11.1-7. Mariana Archipelago Bottomfish MUS

Scientific Name	*English Common Name*	*Chamorro Name*
Aphareus rutilans	red snapper/silvermouth	lehi
Aprion virescens	gray snapper/jobfish	gogunafon
Caranx ignobilis	giant trevally/jack	tarakitu
C. lugubris	black trevally/jack	tarakiton attelong
Epinephelus fasciatus	blacktip grouper	gadao
Variola louti	lunartail grouper	bueli
Etelis carbunculus	red snapper	buninas agaga
E. coruscans	red snapper	buninas
Lethrinus rubrioperculatus	redgill emperor	mafuti
Lutjanus kasmira	blueline snapper	funai
Pristipomoides auricilla	yellowtail snapper	buninas
P. filamentosus	pink snapper	buninas
P. flavipinnis	yelloweye snapper	buninas
P. seiboldii	pink snapper	N/A
P. zonatus	snapper	buninas rayao amiriyu
Seriola dumerili	amberjack	tarakiton tadong

Source: WPRFMC 2009a

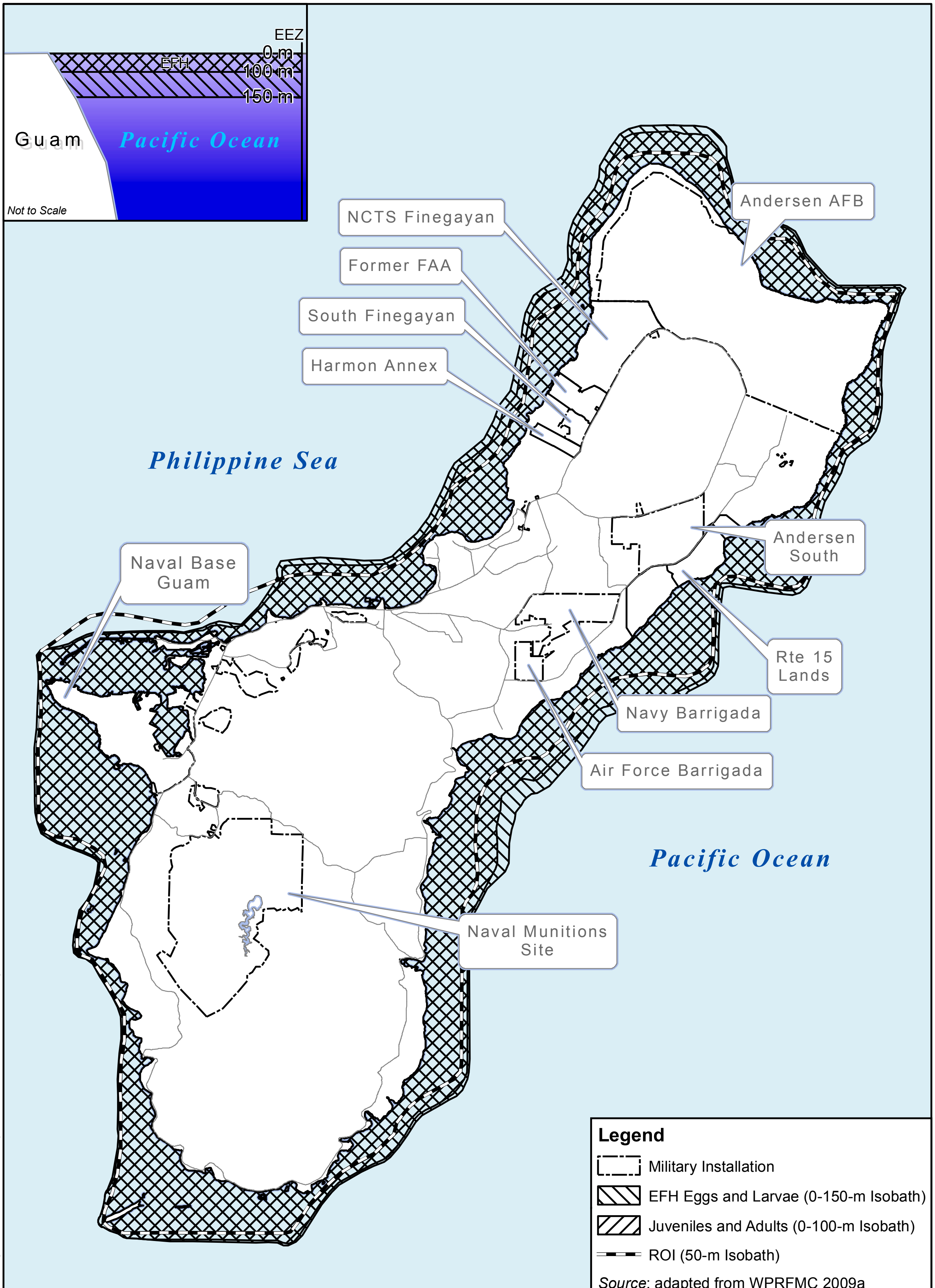
The shallow-water complex is distributed throughout the tropical and subtropical waters of the insular and coral reef-bordered coastal areas of the Pacific Islands (Myers and Donaldson 2003). The proxy used to calculate how much bottomfish habitat is available (comprising the shallow-water and deep-water complexes) is the length of the 100-fathom contour (183-m contour) (index of bottomfish habitat) that surrounds Guam and CNMI (WPRFMC 2009a). Juvenile and adult bottomfish are typically found in habitats characterized by a mixture of sandy bottoms and rocky areas of high structural complexity (WPRFMC 2009a). Habitats encompassing the shallow-water complex includes various habitats such as: mangrove swamps; seagrass beds; shallow lagoons; hard, flat coarse sandy bottoms; coral and rocky substrate; sandy inshore reef flats; and deep channels (WPRFMC 2009a).

Within the shallow-water complex, snappers form large aggregations and groupers/jacks occur in pairs within large aggregations near areas of prominent relief. Spawning coincides with lunar periodicity corresponding with new/full moon events (Amesbury and Myers 2001). Groupers have been shown to undergo small, localized migrations of several kilometers to spawn. Large jacks are highly mobile, wide-ranging predators that inhabit the open waters above the reef or swim in upper levels of the open sea (Navy 2005).

Crustacean Management Unit Species (CMUS)

EFH for the larvae life stages is the water column from the shoreline to the outer limit of the EEZ down to a depth of 492 ft (150 m). All bottom habitat from the shoreline to a depth of 328 ft (100 m) is designated as EFH for juveniles and adults (Figure 11.1-8). No HAPC is designated for Guam waters.

Four CMUS, three lobster and one crab are currently in the Mariana Archipelago FEP, specifically, spiny and slipper lobsters, a deepwater shrimp, and Kona crab (Table 11.1-8) (WPRFMC 2009a). There are 839 species of crustaceans in the Marianas and 13 species of spiny lobster that occur in the tropical and subtropical Pacific between 35 degrees North and 35 degrees South (WPRFMC 2009a). Of the five species of spiny lobsters that occur within the Marianas, *Panulirus penicillatus* is the most commonly found and fished. (Paulay 2003b, WPRFMC 2009a).



Printing Date: Jun 25, 2010, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\11.1-8.mxd

Figure 11.1-8
EFH Designation within Guam Waters for Egg, Larval, Juvenile, and Adult Life Stages of Crustaceans

Table 11.1-8. Mariana Archipelago Crustacean MUS

Scientific Name	*English Common Name*	*Known Occurrence in Project Area*
Panulirus penicillatus	spiny lobster	Common
Family Scyllaridae	slipper lobster	Common
Ranina ranina	Kona crab	No occurrence
Heterocarpus spp.	deepwater shrimp	No occurrence- beyond depth of project area

Source: WPRFMC 2009a

In general, adults of the CMUS prefer sheltered areas with rocky substrates and/or sandy bottoms. There is a lack of published data pertaining to the preferred depth distribution of decapod (invertebrate animal with 10 legs [e.g., lobsters, crabs and shrimp]) larvae and juveniles in this region (WPRFMC 2009a). Spiny lobsters are mainly found in windward surf zones of oceanic reefs but some are also found on sheltered reefs (Pitcher 1993). Adult spiny lobsters are typically found on rocky substrate in well-protected areas, such as crevices and under rocks (Holthuis 1991, Pitcher 1993). Some species of spiny lobsters prefer depths less than 33 ft (10 m), while others are found to depths of around 360 ft (110 m) (Holthuis 1991, Pitcher 1993, WPRFMC 2009a). Small juvenile spiny lobsters are found only in the same habitat as larger individuals (Pitcher 1993). The depth distribution of the Chinese slipper lobster is 0 to 33 ft (10 m) and some are taken as incidental catch in the spiny lobster fishery (Polovina 1993). Slipper lobsters prefer to live in coral or stone reefs with a sandy bottom (Holthuis 1991).

Decapods exhibit a wide range of feeding behaviors, but most combine nocturnal predation with scavenging; large invertebrates are the typical prey items. Both lobsters and crabs are ovigerous―the females carry fertilized eggs on the outside of their bodies. The relationships between egg production, larval settlement, and stock recruitment are poorly understood. Spiny lobsters produce eggs in summer and fall. The larvae have a pelagic phase lasting about one year and can be transported up to 2,300 miles (mi) (3,700 kilometers [km]) by prevailing ocean currents (WPRFMC 2009a). Spiny lobsters are nocturnal, hiding during the daytime in crevices in rocks and coral reefs. At night, this lobster moves up through the surge channels to forage on the reef crest and reef flat (Pitcher 1993).

<u>Pelagic Management Unit Species (PMUS)</u>

EFH for the egg and larval stages includes the water column down to a depth of 655 ft (200 m) from the shoreline to the outer limit of the EEZ. EFH for juveniles and adults includes the water column down to a depth of 3,280 (1,000 m) from the shoreline to the outer limit of the EEZ. All life stages of the PMUS have HAPC designated and that includes the entire water column to a depth of 3,280 ft (1,000 m) above all seamounts and banks with summits shallower than 6,560 ft (2,000 m) within the EEZ (Figure 11.1-9) (Navy 2005).

Although certain pelagic MUS are known to occur within the boundary of the Mariana Archipelago FEP, they are currently managed under a separate Pacific Pelagic FEP. Thirty species are currently managed as PMUS by the WPRFMC through the FEP for the Pelagic Fisheries of the Western Pacific Region. These are identical to the species managed in the previous Pelagic FMP (Table 11.1-9) (Navy 2005, WPRFMC 2009a). According to the WPRFMC (2009b), of the thirty PMUS, the five most commonly caught near Guam include the following: mahimahi (*Coryphaena hippurus*), wahoo (*Acanthocybium solandri*), bonita or skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*), and Pacific blue marlin (*Makaira mazara*). Sailfish and sharks are also caught, although not as frequently.

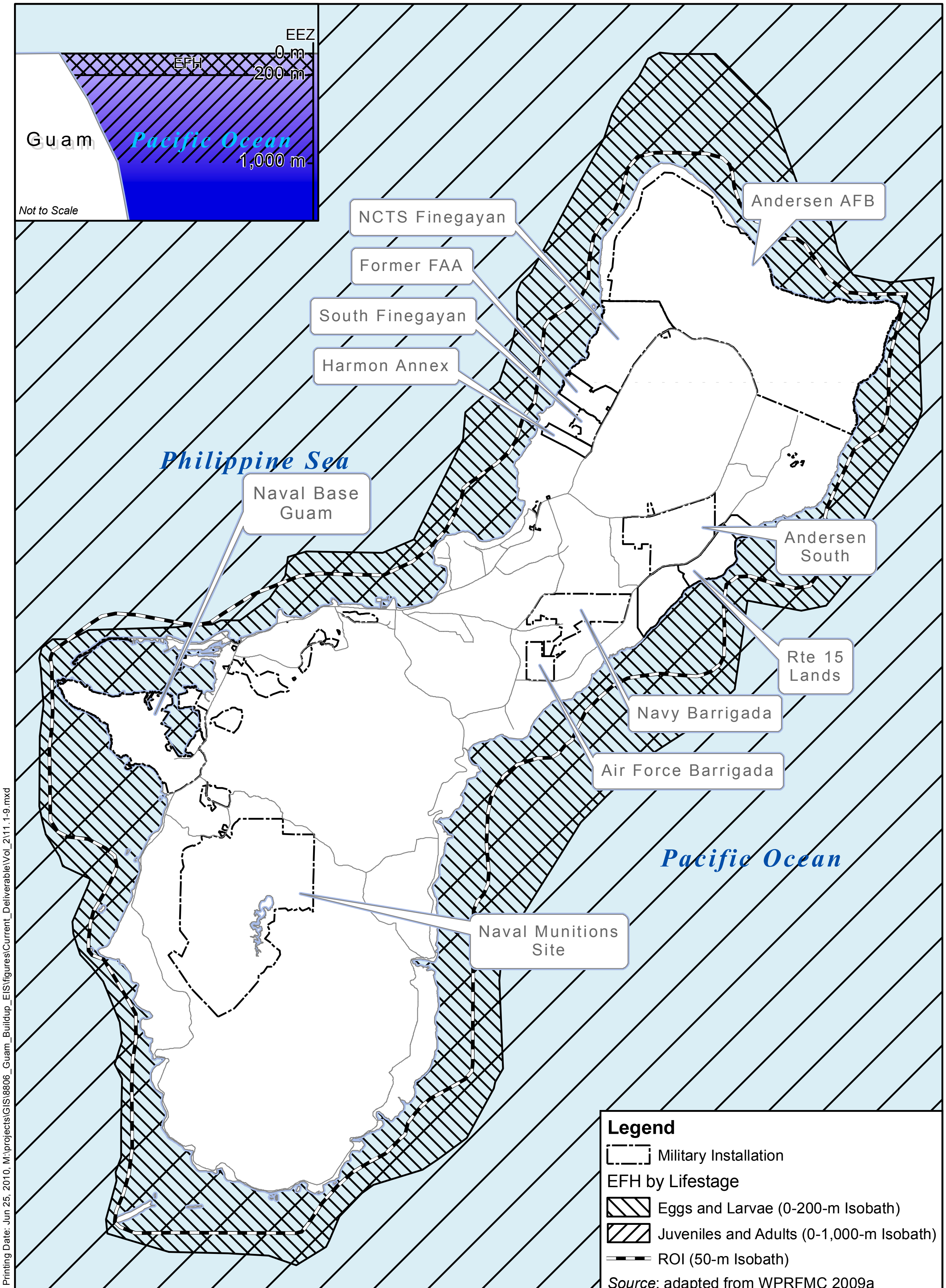


Figure 11.1-9
EFH and HAPC Designated within Guam Waters for all Life Stages of Pelagic Fish

Table 11.1-9. Pacific Pelagic Fisheries MUS

Scientific Name	*English Common Name*
TUNAS	
Thunnus alalunga	albacore
T. obesus	bigeye tuna
T. albacores	yellowfin tuna
T. thynnus	northern bluefin tuna
Katsuwonus pelamis	skipjack tuna
Euthynnus affinis	kawakawa
Auxis spp. *Scomber* spp. *Allothunus* spp.	other tuna relatives
BILLFISHES	
Tetrapturus audax	striped marlin
T. angustirostris	shortbill spearfish
Xiphias gladius	swordfish
Istiophorus platypterus	sailfish
Makaira mazara	blue marlin
M. indica	black marlin
SHARKS	
Alopias pelagicus	pelagic thresher shark
A. superciliousus	bigeye thresher shark
A. vulpinus	common thresher shark
Carcharhinus falciformis	silky shark
C. longimanus	oceanic whitetip shark
Prionace glauca	blue shark
Isurus oxyrinchus	shortfin mako shark
I. paucus	longfin mako shark
Lamna ditropis	salmon shark
OTHER PELAGICS	
Coryphaena spp.	mahimahi (dolphinfish)
Lampris spp.	moonfish
Acanthocybium Solandri	wahoo
Gempylidae	oilfish family
Bramidae	pomfret family
Ommastrephes Bartamii	neon flying squid
Thysanoteuthis Rhombus	diamondback squid
Sthenoteuthis oualaniensis	purple flying squid

Source: WPRFMC 2009b

PMUS are divided into the following species complex designations: marketable species, non-marketable species, and sharks. The designation of these complexes is based on the ecological relationships among the species and their preferred habitats (Navy 2005). The marketable species complex has been further divided into temperate and tropical assemblages. The temperate species complex includes those PMUS that are found in greater abundance outside tropical waters at higher latitudes (e.g., broadbill swordfish, bigeye tuna, northern bluefin tuna, and albacore tuna) (Navy 2005, WPRFMC 2009a).

PMUS are typically found in epipelagic (upper ocean zone or the surface to 720 ft [220 m]) to pelagic (open-ocean zone) waters; however, shark species can be found in inshore benthic, neritic (shallow coastal) to epipelagic, and mesopelagic (intermediate ocean depths) waters. Factors such as gradients in temperature, oxygen, or salinity can affect the suitability of a habitat for pelagic fishes. Skipjack tuna, yellowfin tuna, and Indo-Pacific blue marlin prefer warm surface layers, where the water is well mixed and relatively uniform in temperature. Species such as albacore tuna, bigeye tuna, striped marlin, and broadbill swordfish, prefer cooler temperate waters associated with higher latitudes and greater depths. Certain species, such as broadbill swordfish and bigeye tuna are known to aggregate near the surface at night. However, during the day broadbill swordfish can be found at depths of 2,620 ft (800 m) and bigeye tuna around 900 to 1,800 ft (275 to 550 m). Juvenile albacore tuna generally concentrate above 295 ft (90 m) with adults found in deeper waters (295 to 900 ft [90 to 275 m]) (Navy 2005, WPRFMC 2009a).

Migration and life history patterns of most PMUS in the Pacific Ocean are poorly understood. Additionally, very little is known about the distribution and habitat requirements of the juvenile lifestages of tuna and billfish prior to recruitment into fisheries. Seasonal movements of cooler-water tunas such as the northern bluefin and albacore are more predictable and better defined than billfish migrations. Tuna and related species tend to move toward the poles during the warmer months and return to the equator during cooler months. Most pelagic species make daily vertical migrations, inhabiting surface waters at night and deeper waters during the day. Spawning of pelagic species generally occurs in tropical waters, but may occur in temperate waters during warmer months (Navy 2005, WPRFMC 2009a).

<u>Guam Fishery Distribution, Abundance and Composition</u>

Distribution and abundance of fishery species depends greatly on the physical and biological factors associated with the ecosystem, as well as the individual species. Physical parameters include habitat quality variables such as salinity, temperature, dissolved oxygen, and large-scale environmental perturbations (e.g., ENSO). Biological factors affecting distribution are complex and include variables such as population dynamics, predator/prey oscillations, seasonal movements, reproductive/life cycles, and recruitment success. Rarely is one factor responsible for the distribution of a species; usually it is a combination of factors. For example, pelagic species optimize their growth, reproduction and survival by tracking gradients of temperature, oxygen, or salinity (Helfman et al. 1999). Additionally, the spatial distribution of food resources is variable and changes with prevailing physical habitat parameters. Another major component in understanding species distribution is the location of highly productive regions such as frontal zones. These areas concentrate higher trophic-level predators such as tuna and provide visual clues for the location of target species for commercial fisheries (NMFS PIR 2001).

Coral reef communities surrounding Guam are typically uniform and stable year-round. However, there are exceptions, as seasonal variations in pelagic species distributions in the area are understood. Several of the reef fish species (juvenile rabbitfish, juvenile jacks, juvenile goatfish, and bigeye scad) targeted in Guam show strong seasonal fluctuations, usually related to juvenile recruitment (Amesbury et al. 1986).

Fish species composition in Guam is typical of most Indo-Pacific insular, coral reef-bordered coastal areas: 73% of the total number of species belong to 20 families (Myers and Donaldson 2003). The geographic location of the study area suggests a more diverse ichthyofauna than areas such as the Hawaiian Islands. However, the recorded species diversity in the Guam/Marianas Islands chain is lower than that of the Hawaiian archipelago. Actual diversity may be higher and the recorded diversity may be an artifact of insufficient sampling (Paulay 2003b). However, many other factors, such as larval recruitment and frequent natural disturbances, have dramatic impacts on species diversity. Myers and Donaldson (2003) noted the occurrence of 1,019 fish species (epipelagic and demersal species found to 655 ft [200 m]) in the Mariana Islands. Inshore species are composed primarily of widespread Indo-Pacific species (58%) with the remainder consisting of circumtropical species (3.6%) and nearly equal numbers of species with widespread distributions primarily to the west, south, and east of the islands. Ten species of inshore and epipelagic fishes are currently considered endemic to the Marianas. However, this number is probably too high due to the observations of transient species in the area.

Recreational Fishing

Recreational fishing on Guam is typically divided into three types: coral reef fishing, bottom fishing and pelagic fishing. All three of these types of fishing are influenced directly or indirectly by the health of the coral reef ecosystem; fishes that actually use the reef during one or more life stages directly rely on this resource, and as ecosystem boundaries are open and components of ecosystems are inherently linked, neighboring ecosystems (e.g. pelagic) are indirectly reliant on the coral reef ecosystem (WPRFMC 2009b). Recreational sport fishing began to grow on Guam in the 1980's (Davis and Clarke 1998). Guam's fisheries have been in decline for many years. Part of this is due to fishing pressure, and part is due to ecosystem impacts from stormwater and wastewater (Davis and Clarke 1998). According to a 2005 study, Guam's shoreline fishery saw a drop in catch-per-unit-effort in the 1980s and has still not returned to pre-1980s levels (Porter et al. 2005). GovGuam, in an attempt to help the fisheries, established five marine preserves in 1997 that included limits on fish takes and the types of fishing allowed. Dip netting, gill netting, drag netting, surround netting spear fishing, and the use of gaffs is prohibited in all five preserves. These preserves cover 10% of Guam's coastline and have been met with some public resistance (Porter et al. 2005, Allen and Bartram 2008).

Coral reefs support various life stages of many fishes and invertebrates, and as a result, the health of reefs is often an indicator of the overall health of the entire area. They are one of the most diverse and productive ecosystems on earth. The physical reef structures created by corals protect coastlines from erosion, which directly impacts humans living, working or recreating near the shoreline. Other benefits to humans from coral reefs include those resulting from tourist and commercial industries; lush reefs are a major tourist attraction for divers and snorkelers, and they support commercial and recreational fisheries (NMFS 2010). The health and abundance of coral reefs worldwide has been steadily declining in recent years from various anthropogenic (human-based) sources, and in the Indo-Pacific, reefs have seen a decline over the past 40 years; these declines are cause for great concern. The reefs surrounding Guam make it home to one of the most species-rich marine ecosystems among U.S. jurisdictions (Waddell et al. 2008).

Historically, the highest-used fishery on Guam has been the coral reef fishery (WPRFMC 2009b). There are historical as well as practical reasons for this. In 1956 the first pelagic fish species was included in the catch reports. Prior to that all fish species reported on in the catch reports were species associated with the reefs. According to the Western Pacific Regional Fishery Management Council (WPRFMC), shore-based harvesting of fish and invertebrates accounts for most of the resources taken from coral reefs. Some species that have been impacted by heavy fishing are the bumphead parrot fish (*Bolbometopon muricatum*), Napoleon wrasse (*Cheilinus undulates*), and stingrays (*Batoidea sp*.). One family of fish, the Lethrinidae, accounts for over 36 percent of the reef species total catch, including the emperor fishes (WPRFMC 2009b). The WPRFMC (2009b) has indicated that, at present, the coral reefs at Guam have not been determined to be overfished or subject to overfishing.

Pelagic fishing started to gain a foothold on Guam during the 1950s along with the growth of the tourist industry. During the 1980s, it gained even more popularity with both tourists and the local population; as household incomes grew, Guamanians could now afford the boats and motors required for trolling (Davis and Clarke 1998). The five most common pelagic species caught on Guam waters are mahi-mahi (*Coryphaena hippurus*), wahoo (*Acanthocybium solandri*), skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnua albacores*), and Pacific blue marlin (*Makaira mazara*). There have been large fluctuations in the number of these species caught from year to year. For example, from 2003 to 2004 the mahi-mahi catch increased 134% and the wahoo catch increased 83%. Meanwhile, blue marlin landings were down 24% in the same timeframe, and below the 23 year average for the species (WPRFMC 2009a). Pelagic fish tend to be highly migratory and at the top trophic level of oceanic predators. The pelagic fishing fleet numbered 386 boats in 2006 (Allen and Bartram 2008). This was an increase of roughly 8% from 2005 (Allen and Bartram 2008). Meanwhile, harvest levels have decreased from 922,000 pounds in 1996 to just 500,000 pounds in 2006 (Allen and Bartram 2008). Similarly, the number of fishing trips taken by these vessels fell from 16,000 in 1996 to 6,414 in 2006 (Allen and Bartram 2008). Approximately 7% of this fleet is comprised of charter boats with the remainder comprised of Guam residents using owner-operated boats, mostly towed to launch sites, as opposed to semi-permanent marina docking (Allen and Bartram 2008). The charter industry is most widely used by tourists and U.S. military personnel (Allen and Bartram 2008). Pelagic charter trips totaled roughly 2,000 in 2006, with an estimated 67,000 pounds of catch with mahi-mahi, skipjack, and wahoo accounting for the top three species (Allen and Bartram 2008).

Bottom fishing on Guam is divided into two types: shallow water (<500 ft) and deepwater (>500 ft). Smaller operator-owned boats (i.e. recreational fisherman) tend to target shallow water, while the commercial fishermen tend to target deeper water (WPRFMC 2009b). Bottom fishing on Guam is highly seasonal, taking place mainly in the warmer months, which coincides with calmer weather months allowing more fishermen to visit the offshore banks (WPRFMC 2009b). The WPRFMC (2009b) states that less than 20% of shallow water harvests are taken outside the three mile limit. This is largely due to deeper depths and stronger currents farther out to sea. Bottom fishing charters have come to account for between 15% and 20% of bottom fishing trips since 1995 (WPRFMC 2009b), and they have increasingly become catch-and-release operations. This is especially true for the larger charters carrying up to and over 30 passengers per trip; generally only the larger fish are kept to serve as sashimi for guests. WPRFMC (2009b) estimates that there were roughly 1,700 charter trips in 1999.

11.1.4.3 Special-Status Species

As noted in Section 11.1.1.3, this section includes NMFS and USFWS ESA-listed and candidate species, and marine mammals not listed under ESA, but protected under the MMPA. The Napoleon wrasse and bumphead parrotfish are NMFS SOS and candidate species, respectively, and are described in the EFH section above.

The threatened green sea turtle and the endangered hawksbill sea turtle are the only two ESA-listed species that are anticipated to be in the nearshore marine environment and adjacent beaches. The Navy, in cooperation with USFWS and GDAWR, monitors for sea turtle nesting on Navy land throughout the sea turtle nesting season (April – July for the green sea turtle and January – March for the hawksbill sea turtle) (Navy 2005, Grimm and Farley 2008). There is no critical habitat designation for any marine species on Guam.

The spinner dolphin and common bottlenose dolphin are the only two marine mammals anticipated in the nearshore (<164-ft [50-m] isobaths) ROI for the study areas (Navy 2005). Table 11.1-10 identifies the special-status species that are addressed in this EIS.

Table 11.1-10. Special-Status Species for Guam

Group	Common Name/Chamorro Name	Status* Federal	Status* Guam
MAMMALS	Common bottlenose dolphin/Toninos	MMPA	SOGCN
	Spinner dolphin/Toninos	MMPA	SOGCN
REPTILES	Green sea turtle/Haggan bed'di	T	T
	Hawksbill sea turtle/Hagan karai	E	E

Legend: *E = endangered; SOGCN = Species of Greatest Conservation Need; T = threatened.
Sources: Navy 2005, GDAWR 2006a, USFWS 2009, NMFS 2009a.

The special-status species are briefly described below. Information about these species, including status, habitat preferences, distribution, behavior and life history, can be found in Volume 9, Appendix G.

Green Sea Turtle

The green sea turtle is by far the most abundant sea turtle found around Guam; aerial surveys by GDAWR indicate a year-round resident population. The green sea turtle occurrences are listed as "concentrated" and the hawksbill as "expected" in nearshore waters of Guam. The green sea turtle is ESA-listed as threatened and is the largest of the hard-shelled turtles, with adults commonly exceeding 39 in (100 cm) in carapace length and 220 lbs (100 kg) in weight. As hatchlings, they are only about 2 in (50 cm) long and weigh less than 1 ounce (25 grams). Adult carapaces range in color from solid black to gray, yellow, green and brown in muted to conspicuous patterns (Navy 2005, WPRFMC 2009a).

Late juveniles and adults feed primarily on seagrass and macroalgae of the genera *Codium, Amansia, Pterocladia, Ulva, Gelidium, Acanthophora,* and *Hypnea*, and other reef-associated organisms in nearshore waters and within harbors and lagoons. Early juveniles are omnivorous and feed on a variety of algae, invertebrates, and small fishes (COMNAV Marianas 2007a).

Hawksbill Sea Turtle

The hawksbill turtle is a small to medium-sized sea turtle. Adults range between 25 and 35 in (65 and 90 cm) in carapace length and typically weigh around 176 lbs (80 kg). Hawksbill sea turtles are distinguished from other sea turtles by their hawk-like beaks, posteriorly (near the back) overlapping carapace scutes (bony plates), and two pairs of claws on their flippers. The carapace of this species is often brown or amber with irregularly radiating streaks of yellow, orange, black, and reddish-brown (Navy 2005, WPRFMC 2009a).

The hawksbill sea turtle is far less abundant than the green sea turtle, and as a result, debate exists on its occurrence (rare versus regular) within the ROI. There are however, historic reports of hawksbill nesting activity on beaches in northern and central (Apra Harbor) Guam (Navy 2005).

Upon recruitment to benthic feeding habitats, hawksbills are known to become omnivores and feed on encrusting organisms such as sponges, tunicates, bryozoans, algae, mollusks, and a variety of other items such as crustaceans and jellyfish. Older juveniles and adults are more specialized and feed primarily on sponges. Sponges comprise as much as 95% of their diet in some locations (Navy 2005, WPRFMC 2009a).

Common Bottlenose Dolphin

There are no occurrence records for this species in the Marianas, but this is within the known distribution range for the species. Bottlenose dolphins are expected to occur from the coastline to the 6,550-ft (2,000-m) isobaths (Navy 2005).

Bottlenose dolphins are medium-sized, relatively robust dolphins that vary in color from light gray to charcoal. The common bottlenose species *Tursiops* is named for its short, stocky snout. There is striking regional variation in body size; adult body length ranges from 6.2 to 12.4 ft (1.9 to 3.8 m). They can be found in groups of two to 15 individuals, although groups (pods) of up to 100 or more have been reported (Navy 2005).

Common bottlenose dolphins are opportunistic feeders, taking a wide variety of fishes, cephalopods, and shrimp using a wide variety of feeding strategies. Near the shore, these species prey predominantly on coastal fish and cephalopods (Navy 2005).

<u>Spinner Dolphin</u>

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 (Navy 2005).

Spinner dolphins are a slender species that have a very long, slender beak. Adults can reach 7.8 ft (2.4 m) in length and generally have a dark eye-to-flipper stripe and dark lips and beak tip. They typically have a three-part color pattern (dark gray cape, light gray sides, and white belly) (Navy 2005).

Spinner dolphins residing around islands and atolls rest during the daytime hours in shallow, wind-sheltered nearshore waters and forage over deep waters at night. They feed primarily on small mesopelagic (intermediate ocean depths of 328 to 3,280 ft [100 to 1000 m]) fishes, squids, and shrimps, diving to at least 655 to 984 ft (200 to 300 m). Group sizes around Guam range from one to 120 individuals, with most groups consisting of less than 30 individuals (Navy 2005).

11.1.4.4 Non-Native Species

Marine organisms, pathogens, or pollutants may be taken up with ship ballast water (or attached to vessel hulls) and be transferred to a different location or ecosystem and cause harm to the receiving ecosystem. These organisms and pollutants are in greater concentration within 3 nm of the coast (COMNAV Marianas 2007a).

Guam is the administrative and economic hub of Micronesia, hosts one of the largest and expanding U.S. military bases in the Pacific, and lies at the crossroads among Pacific islands, the U.S., and Asia. Although terrestrial introductions, exemplified by the brown tree snake, have received much attention, marine introductions have been little studied until five major marine biodiversity surveys were performed on Guam in the mid-1990s to 2001 (Paulay et al. 2002). Approximately 5,500 non-native species were recorded in these surveys, of which most remain restricted to Apra Harbor (Paulay et al. 2002). According to the Global Invasive Species Database , nine marine and 12 estuarine marine invasive alien species (IAS) have been identified associated with Guam habitats (Global Invasive Species Database 2009). The database printout can be viewed in Volume 9, Appendix G. Paulay et al. (2002) describes 85 nonindigenous species (mainly sessile organisms [75%]) within Apra Harbor (see Outer Apra Harbor non-native species section).

In general, these marine studies have documented a diverse assemblage of marine species, dominated by sessile organisms, which have been transported to Guam by humans. The main potential sources of nonindigenous species to Guam are purposeful introductions for fisheries and agriculture together with species that inadvertently arrived with such seed stock and hull and ballast transport with shipping traffic. The nature and extent of purposeful introductions of marine species is relatively well-documented because they have been carried out largely by government agencies (Eldredge 1994), although accidental introductions of species hitchhiking on purposeful introductions (such as the parasitic gastropod *Tathrella iredalei* on tridacnines [giant clams]) have occurred. Most of the marine invasive species survey work, although limited, has been conducted in Apra Harbor and is discussed in that section.

Marine IAS are poorly addressed in most national frameworks, although they are now considered as great a problem as terrestrial IAS. Information on marine IAS is needed as scientists are only just beginning to look at the issue in depth. Management of invasive marine species (IMS) is non-existent in the Austral-Pacific Region. Level of awareness is very low and there are no legal and institutional structures in place to effectively address the issue (IAS 2002).

In the South Pacific Regional Environment Programme's draft Regional Strategy on Invasive Species, prepared in 1999, it was decided to address IMS separately. This was due to two main reasons: IAS participants were not fully aware of the issues (most coming from the traditional quarantine and terrestrial invasive species backgrounds) and IMS issues were seen as sufficiently different to invasive terrestrial species issues to warrant separate treatment.

The ballast water situation in Pacific Island countries and territories needs further analysis. Most PICTs do not know if they are acting as exporters and/or importers of marine IAS in ballast water. Pacific Island countries and territories need to assess the risks they face and the risks they may pose to other countries. Australia's experience of tackling the incursion and eradication of Black Striped mussel (*Mytilopsis* sp.) in the Northern Territory was discussed in the IAS Workshop (2002). The competent authorities used pre-existing powers to implement mandatory inspection of all yachts arriving in specific ports in the Northern Territory. As the mussel had not reoccurred in Darwin, the inspection regime does demonstrate that it is possible to prevent marine IAS incursions, provided that there is political willingness to bear the cost of the prevention mechanisms. In this case, the prevention was cost-effective: the Northern Territory pearl industry is worth Aus $50 million per year and could have been severely affected by the IAS.

As reported by *Managing Marine Protected Areas: A TOOLKIT for the Western Indian Ocean, Alien invasive species, sheet K5*, many Marine Protected Areas (MPAs) are located adjacent to ports and shipping lanes, or to sites that would eventually become ports. These MPAs are at risk from non-native species carried on the hull of yachts and fishing boats, as has been discovered in Guam.

In order to minimize the risk associated with the various introduction pathways of potentially invasive marine organisms, the Navy is participating in the development of a Micronesia Biosecurity Plan (MBP). The MBP will provide a plan for a comprehensive regional approach to manage, control, eradicate invasive species, with a particular focus on reducing the number of invasive species within the various introduction pathways discussed above (primarily ballast water and hull fouling). The MBP's focus on marine invasive species is discussed in more detail in Section 11.2.2.6. More information on the MBP and invasive species issues is provided in Volume 2, Chapter 10, Terrestrial Biological Resources of this EIS.

Managing Natural Resource Pathways

In natural resource management work, equipment and organisms are often moved from one location to another. The specific equipment or organism being moved is called the target. Targets could include animals for relocation or stocking for recreation, equipment such as dredging equipment, ships, bulldozers and backhoes, sampling gear such as nets or traps, and even people. Transporting targets provide potential vectors for the spread of non-target species that could potentially invade new habitats. Non-target species are the plants, animals, diseases, pathogens and parasites that are not intended to be moved (HACCP-NRM 2009).

As described, natural resource management work often creates open pathways that could spread non-native species to unique and critical habitats for already endangered species. Next to habitat loss, non-native species are natural resource management's biggest challenge. On February 3, 1999, EO 13112 was signed establishing the National Invasive Species Council. The EO requires that a Council of Departments dealing with non-native species be created and directs agencies to prevent the spread of non-native species in their work, but few management tools exist to implement this directive. Hazard Analysis and Critical Control Points (HACCP) planning has been modified from the food industry for natural resource work. Around the world, industry uses the HACCP planning tools to avoid product contamination. In natural resource pathways, "hitchhiking" species are considered contaminants. HACCP's comprehensive planning identifies these species and the risk of contamination while documenting the BMPs used to prevent and remove hitchhikers. HACCP planning is an international standard (ASTM E2590-08) for reducing or eliminating the spread of unwanted species during specific processes or practices or in materials or products. HACCP planning focuses attention on critical control points where non-target species can be removed. Documenting risks and methods used to remove non-target species gives managers a strategic method to make consistent decisions based on identified risks. Planning builds a logical framework of information to weigh risks for species spread against management benefits. A standard guide for conducting a HACCP evaluation is provided at the website included with the reference (HACCP-NRM 2009).

Navy Policy and Ballast Water Management

If it is necessary for a surface ship to load ballast water in an area that is either potentially polluted or within 3 nm from the shore, it is Navy policy for the ship to pump the ballast water out when outside an area 12 nm from shore and twice rinse the ballast tank(s) with clean sea water prior to the next entry within 12 nm of shore. Surface ships perform a ballast exchange twice in clean water, even if the ballast water was pumped out before exiting the polluted waters or 3 nm limit, as residual water remaining in a tank after emptying it may still contain unwanted organisms that could be transferred during the next ballasting evolution (Navy 2003).

This policy is based on the U.S. Coast Guard's (USCG) "Ballast Water Management for Control for Nonindigenous Species in Waters of the U.S." (33 Code of Federal Regulations [CFR] §151 Subpart D), which is applicable to all foreign and U.S. vessels, equipped with ballast tanks that enter a U.S. port. The USGC's published guidelines are based on guidelines developed by the Marine Environmental Protection Committee of the International Maritime Organization for the control of ship ballast water to prevent the introduction of unwanted aquatic organisms and pathogens. In addition, the Navy, in cooperation with US EPA, fully complies with the Uniform National Discharge Standards. These Standards regulate discharges incidental to normal operations and apply to the ocean water out to 12 nm. All vessels are required to maintain a ballast water management plan that is vessel-specific. The Vessel Master is responsible for understanding and executing the management plan (COMNAV Marianas 2007a).

11.1.5 North

11.1.5.1 Andersen AFB

Baseline marine biology information for the Andersen AFB study area was not analyzed for direct impacts as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment. However, indirect impacts from an increase in recreational activities associated with the proposed military relocation may affect the marine environment, so information was evaluated commensurate with these potential effects. The following specific study area information is provided in addition to that presented in Section 11.1.4, Guam Regional Environment.

At Andersen AFB, the marine environment supports a rich diversity of species associated with the coral reef complex including fish, corals and other invertebrates, and algae. The Andersen AFB Marine Resource Preserve (MRP) was designated in 1993 to conserve and manage important seed stock resources for recreational, commercial, and other marine species. The Government of Guam (GovGuam) established the Pati Point Marine Preserve in 1999 per Public Law 24-21. Prohibitions on spearfishing and the use of gill nets or throw nets protect fish and enhance marine fisheries production in these areas. The collection of any marine organisms (dead or alive) is prohibited except by fishing with a hook and line from designated areas of the shoreline. Threats to marine resources include overfishing, shell collecting, pollution, human impacts (such as breaking and trampling the marine environment), and introduced species that outcompete, displace, or prey on native species (Andersen AFB 2008a). In general, this area of Guam's coast is a high-energy environment with strong currents inside and outside the reef margin. With respect to Guam as a whole, coral cover and diversity are typically highest in the area beginning roughly at Falcona Beach on the northwest coast, continuing clockwise around the northern coast and extending down to Pagat Point on the eastern side of the island. Although the reefs between Tanguisson Point and Falcona Beach also have high coral cover and diversity, they are heavily fished and have higher recreational use than the reefs to the north (COMNAV Marianas 2007a).

Navy submerged lands includes an area north of Falcona Beach on the northwest coast of Guam around Ritidian Point and east to the border of Tarague Beach. The USFWS manages 401 acres of submerged lands bordering the Guam National Wildlife Refuge (GNWR) at Ritidian Point from the high tide mark out to the 100 ft bathymetric contour. East of the section of Navy submerged lands begins the submerged lands under the jurisdiction of the Air Force (see Chapter 8, Figure 8.1-2) (COMNAV Marianas 2007a).

MARINE FLORA, INVERTEBRATES AND ASSOCIATED EFH

The area as a whole contains a narrow fringing reef, much of which is an algal reef. The northern tip of Guam is bordered by a nearshore narrow fringing reef composed primarily of coralline algae on the eastern end and corals on the western end. The shallow parts of the reef flat are primarily populated by macroalgae with the intertidal area colonized by seagrasses. Corals increase moving towards the reef margin with between 10 and 50% coral cover. The fringing reef is bisected in several locations by bays and channels as well as areas of seagrass. Along the coast between Achae Point and Ritidian Channel, the fringing reef and fore reef area transitions from a 250-m (820-ft) wide swath of coral to an area populated by turf algae approximately 200-m to 500-m (656- to 1,649-ft) wide. Seagrasses are especially abundant in a small bed in the Ritidian area (COMNAV Marianas 2007a) (see Figure 11.2-3 and 11.2-4).

In the *Andersen Air Force Base Marine Resources Preserve Baseline Survey of Marine Resources* conducted in 1993 and 1994 (Andersen AFB 1995), two surveys were conducted on the reef flats and reef slopes within the boundaries of the MRP for each of the major groups of marine organisms (marine plants, corals, macroinvertebrates, and fish) (Andersen AFB 2008a). Forty-eight marine plant and algal species were observed during the first survey and 44 species were observed during the second survey. The species cataloged consisted of the phyla Cyanophyta (so called blue-green algae that are actually photosynthetic bacteria), Chlorophyta (green algae, a photosynthetic true algae), Phaeophyta (brown algae, not a true algae but a photosynthetic protist), and Rhodophyta (red algae, a true algae commonly found associated with coral). The algae diversity in the inner reef area was higher than in the midreef. The abundance of marine plants and algal diversity diminished in the midreef area between surveys, but it was surmised that this resulted from a seasonal effect (Andersen AFB 1995).

These surveys also identified an abundance of non-coral macroinvertebrates, which formed an obvious dominating number of species on the coral reef. Forty-one species were identified during this survey and were common and generally widespread western IndoPacific species. Holothorids were the most numerous invertebrate and reached heavy densities either near shore or near the seaward reef margin. Ninety percent of the enumerated species and estimated biomass were of the species *Holothuria atra*. Echinoderms composed the most numerous component of the fauna. Another common species echinoderm *Echinothrix diadema*, was found in crevices near the reef margin. Along with another herbivorous echinoderm, *Echinometra mathaei*, these species were the main bioeroders responsible for heterogeneous substrate. Molluscs were also found to be diverse, with *Conus* sp. predominating. Many of these species (*C. sponsalis*, *C. hebraeus*, and *C. flavidus*) are vermivores, indicating that there are probably high densities of polychaete annelids. The remaining species *C. cattus*, is a piscivore, commonly preying on small blennies which are abundant in the coral grooves. Crustaceans were less numerous, primarily the xanthid *Aectodes tomentosus* and the hermit crabs *Calcinus* sp. and *Dardanus* sp. Intertidal crabs of the family Grapsidae were common on wave-splashed emergent limestone and could be seen scraping the thin layer of algae from the surface of this rock. No clear east to-west trend existed on the reef flats for either overall abundance or species richness. The distributions of the invertebrates followed patterns typical for such species on fringing coral reefs; most individuals of a species were clustered either nearshore or towards the seaward reef margin (Andersen AFB 1995).

ESSENTIAL FISH HABITAT

During the Andersen AFB (1995) surveys, 39 coral species were observed on the reef flat and 40 species were observed on the fore-reef. Coral coverage was least nearest the shore and increased towards the beach side of the reef crest. The number of colonies and density of corals was highest on the near-crest. There was a decrease in both density and percent coverage values in the nearshore and mid-reef zones of about 50% between the first and second surveys. The mean colony size per zone increased between surveys while density and total number of corals across zones decreased substantially. Overall, the surveys found a great deal of variability of coral size within species (based on age), between species within transects (based on age, position, or exposure due to topographic relief), and between species across zones (based on topographical relief and exposure). Size of corals recorded during the surveys varied from 1 square centimeter (.16 square inch) to 20,000 square centimeter (3,100 square inches) and is most apparent in the branching coral species, *Acropora aspera* (a NMFS Candidate species [NMFS 2010]). In protected waters, in depressions of the nearshore and mid-reef zones, this coral can form large thickets. It also fragments easily into pieces as small as a few centimeters. The percent coverage value given for each transect can be greatly affected by the inclusion of just a few of these large colonies (Andersen AFB 1995).

One hundred thirteen species of fish were observed during the first survey and 188 species in the second survey; the two surveys combined yielded a total of 204 species. The species were distributed among 28 families of fish, representing a wide variety of forms from the small reef-dwelling gobies and blennies to large midwater jacks and parrotfishes. Few fish species were seen in the shallow intergroove areas ("flats"), and fish abundance was low along these transects. The highest fish abundance was found in the groove habitats near Tagua point (Explosive Ordinance Disposal [EOD] area). Fish species richness was greatest at both the east and west ends of the Preserve and lowest in the central areas. Fish abundance and species richness on the reef slope transects were comparable to those on the reef flat transects; both abundance and species richness were lower toward the east off the EOD area (Andersen AFB 1995).

Sediment samples collected during the first survey indicated the finest sediments were located in the two EOD sediment sample sites and the remaining sites were similar in sediment size and coarser than the EOD sample sites. During the second survey, results were similar with the exception of a decrease in the sediment grain size at the Scout Beach and Site C Groove Inner Reef sample sites (Andersen AFB 1995).

Marine Protected Areas and Reserves

In February 1993, the Air Force established the Andersen AFB MRP to protect marine habitats and marine species, and enhance Guam's marine resources (see Figure 11.2-3 and 11.2-4). The seaward boundary of the Andersen AFB MRP extends to any distance where spear or net fishing is observed and the inland boundary extends landward 66 ft (20 m) from the shoreline. The MRP supports a considerable variety of marine plants, fish, corals, and other invertebrates. The ocean currents in northern Guam carry fish, coral, and other invertebrate larvae to seed Guam's central and southern reefs. There is a permanent ban on any form of spearfishing, and any form of fishing from land, taking of marine life (dead or alive) except for game fish trolling or spin casting from shore, and a ban on possessing spearfishing equipment within the area and adjacent beaches (Andersen AFB 2008a). By controlling fishing in the MRP and by limiting the take of large fish that produce many more eggs than smaller individuals, the MRP serves to replenish Guam's island waters with valuable marine life for generations. In June 1999, a Legacy Program-funded marine resources survey, including an ocean current assessment, was contracted by the UoG Marine Laboratory to gather baseline data that will later support a marine resources management plan at Andersen AFB (Andersen AFB 2008a).

The Pati Point Preserve was established on 16 May 1997 by Guam Public Law 24-39 21. The seaward boundary of the preserve extends to the 600 ft (183 m) contour and the inland boundary of the preserve extends landward 10 m (33 ft) from the mean high tide mark or to the nearest edge of a public right-of-way, whichever comes first. The Pati Point Preserve and the Andersen AFB MRP overlap in the nearshore area and approximately 10 m (33 ft) along the onshore area.

SPECIAL-STATUS SPECIES

The threatened green sea turtles forage in offshore waters and nest on beaches at Andersen AFB. The majority of nesting by this species occurs in northern Guam. Historically, the EOD beach at Andersen AFB has one of highest incident of sea turtle nesting. The *Sea Turtle Management Plan* (AAFB 2008b) summarizes in detail nests recorded strictly at Andersen AFB from June 1984 until June 2006. Data were not available from 1985 through 1990, 1992, 1994, and 2002 through 2004 (Andersen AFB 2008b).

The endangered hawksbill sea turtle has been recorded nesting near Achae point and as far south as Falcona Beach, and could be expected in the coastal waters (Navy 2005, Grimm and Farley 2008), however it is not anticipated to nest at Andersen AFB (Andersen AFB 2008a). No other marine ESA-listed species are known to frequent the nearshore environement (Navy 2005, Grimm and Farley 2008).

Spinner dolphins occur in relatively high concentrations (pod sizes of ~100) and bottlenose dolphins are identified as present in the coastal waters (Navy 2005, NOAA 2005a) (see Figure 11.2-3 and 11.2-4).

NON-NATIVE SPECIES

The following discussion of non-native species was presented in Pauley et al. 2002: "Only 23% of the nonindigenous species recognized by Guam have been found in natural habitats outside Apra Harbor: six introduced and 14 cryptogenic species. These include three purposeful introductions: two brackish-water fish species and the gastropod *Trochus niloticus*. This gastropod species is now abundant around Guam and is the basis of a local fishery. Fifty percent of the nonindigenous species that have been encountered outside Apra Harbor are ascidians (sea squirts), none of which are abundant. Cryptic hydroids (related to jellyfish, sea anemones and corals) common outside Apra Harbor include *Pennaria disticha* and *Thyroscyphus fruticosus*". Consequently, non-native marine species information is lacking for this specific study area.

11.1.5.2 Finegayan

The following specific study area information is provided in addition to that presented in Section 11.1.4, Guam Regional Environment.

The northwest coast of Guam is steep and karstic, with limited marginal reef development. The coast faces west/northwest and thus it is relatively sheltered, with usually low to moderate wave impact and weak currents. Relatively narrow reef flats are developed along the northern portion of this coast, south to Falcona Beach, and again south of Ague Point. The central section of the northwest coast is largely devoid of reef flats, bounded mostly by narrow, supratidal (pertaining to the shore area immediately above the high-tide level) benches, or by rock faces lacking any reef protection.

MARINE FLORA, INVERTEBRATES AND ASSOCIATED EFH

Off-shore habitat includes fringing, patch, submerged and barrier reefs, and offshore banks (COMNAV Marianas 2007a). Macroalgae lines the southern portion of the coast from Harmon Annex north to Haputo Beach; turf algae fringes the outer portions of the coral reef in the same area. The majority of the coral reef areas offshore of Finegayan are included in the Haputo ERA, which extends offshore on Navy land to a depth of 121 ft (37 m) (Navy 2005). There are two small, localized reef flats (flat reef, usually exposed at low tide) located outside the ERA off Haputo Beach and inshore of Pugua Patch Reef or Double Reef, which is considered a coral area of special significance (COMNAV Marianas 2007a, NOAA 2005a). Double Reef is the most striking offshore feature along the entire northwest coast of Guam. It is an incipient (just beginning) barrier reef that breaks the surface (Amesbury et al. 2001). Double Reef is one of Guam's few remaining examples of a healthy leeward fringing reef community and enhances this area as a nursery for species of subsistence and commercial fishery value (Navy 2005) (Figure 11.1-10).

ESSENTIAL FISH HABITAT

EFH-designated habitat areas for Finegayan would include the same descriptions as those provided in Section 11.1.4. EFH in the Mariana Archipelago is defined for bottomfish, crustaceans, coral reef ecosystems, precious corals, and Pacific pelagics (see Figure 11.1-5 through Figure 11.1-9). The extent to which the coastal waters off Finegayan are used for commercial, recreational or subsistence fishing has not been determined. NOAA (71 Federal Register (FR) 212, November 2006) reported that there is no evidence that shallow water bottomfish stocks around Guam are subject to overfishing or are being overfished.

The Double Reef EFH in northwest Guam was described in Amesbury et al. (2001) as follows: "Double Reef, an area noteworthy for its unusually high coral cover and coral diversity, lies on a shelf that extends considerably further from the coast than adjacent areas of forereef of Finegayan. The area around Double Reef is highly heterogeneous (varied), both because of topographic variation created by reef growth and the erosive action of the large freshwater aquifer discharge in the area, and because the bulk of Double Reef creates sufficient shelter in its lee to host a distinct backreef community. Otherwise, the fore reef of northwest Guam shows relatively little variation in macrohabitat, although fine-scale variation in benthic communities is widespread" (Amesbury et al. 2001).

Printing Date: Jun 25, 2010, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\11.1-10.mxd

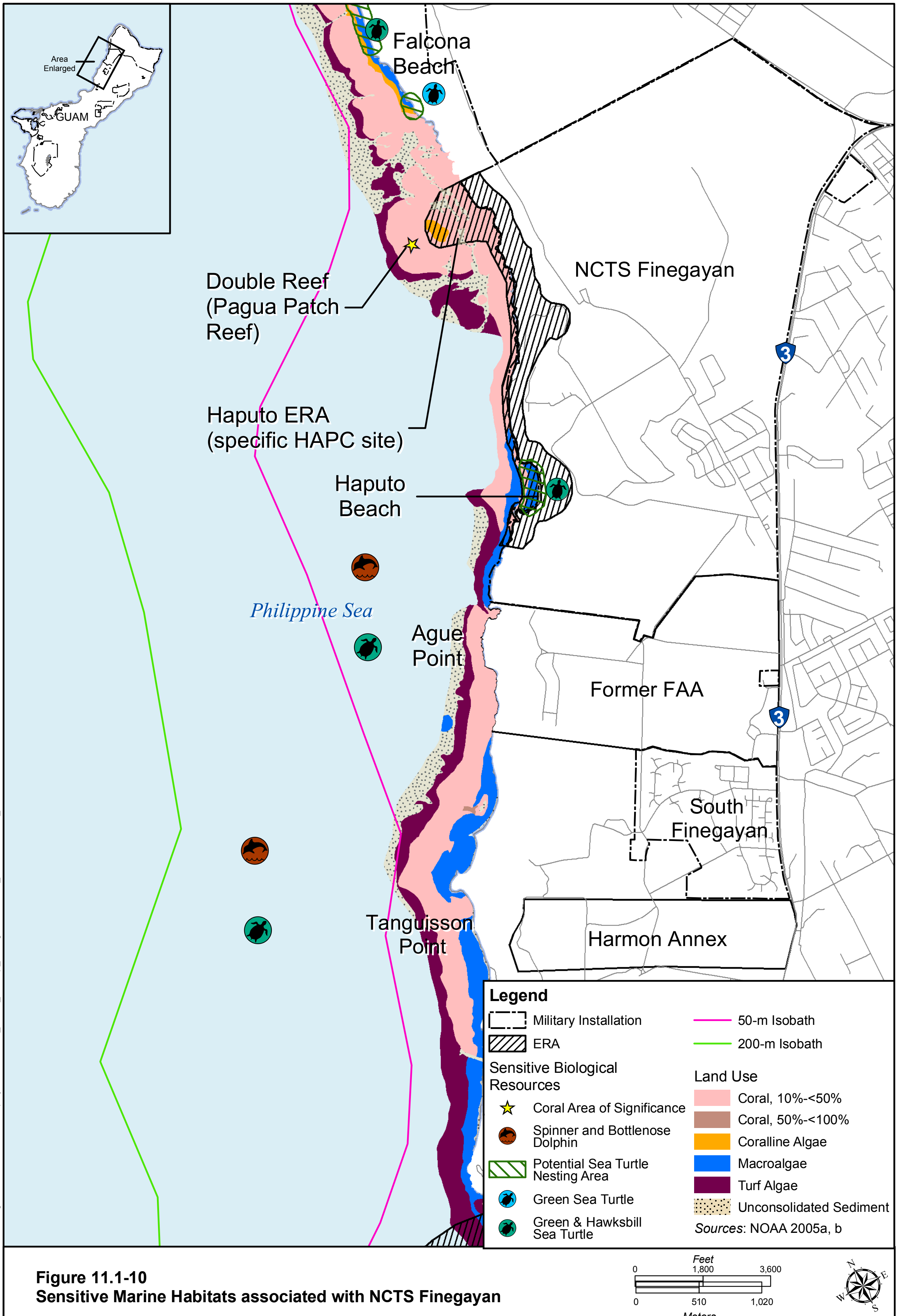


Figure 11.1-10
Sensitive Marine Habitats associated with NCTS Finegayan

"Coral cover around most of Guam is <20%, but in the Double Reef area it averages 46%. High coral cover on Guam is largely associated with reefs dominated by the weedy coral *Porites rus*. Such high cover *P. rus* reefs dominate Apra Harbor, and occur locally at a number of other locations around the island. Although *P. rus* dominated the reef tract immediately to the south of Double Reef, it was rare elsewhere. The high coral cover of the area is typical throughout, and not only of this locally *P. rus* dominated section…The lee of Double Reef supports highly heterogeneous coral communities with patches of unusual corals" (Amesbury et al. 2001).

Another noteworthy area is the reef front off Haputo Beach, where unusually large colonies of faviid and mussid corals dominate very high coral cover. No other site on Guam has been reported where such large coral heads, other than *Porites*, dominate the coverage.

Coral diversity in the area around Finegayan is very high, "…with approximately 60% of the known coral fauna of Guam encountered during a limited survey on this short reef section" (Amesbury et al. 2001). "In contrast to the great abundance and diversity of corals, the local fish fauna was depauperate (lacking species variety and not fully grown), of low population density, and had especially few fishes belonging to taxa targeted by fisheries. All these factors indicate that overfishing is a serious problem in the area. The Haputo ERA had considerably lower fish diversity and lesser abundance of large fish than the Orote-Agat reef section surveyed earlier" (Paulay et al. 2000). Some of the differences between these areas are clearly the result of very different habitats. The southern Orote coast is washed by relatively strong currents that bring abundant food for fishes and also provides greater structural complexity with its dropoffs and giant boulder fields. "Nevertheless, the low abundance of large fish in the Haputo ERA is striking" (Amesbury et al. 2001).

"Specific macro- and micro-habitats are noteworthy for the diversity of unusual species they harbor. The reef front of Haputo Bay and the lee of Double Reef have already been mentioned for their striking coral communities. The back reef at Double Reef also holds a diverse cryptofauna (hidden or not easily detected). The caverns, fissures and frequently associated freshwater seeps along the steep portion of the coast from the north end of Haputo to Pugua Point are also noteworthy, they hold numerous species not previously seen on Guam, some of which may be endemic. These include crabs associated with freshwater seeps, sponges associated with the caverns, and likely numerous other species of cryptofauna" (Amesbury et al. 2001).

Haputo ERA

The Haputo ERA, a specific EFH HAPC site, was established by the Chief of Naval Operations on March 15, 1984, as one of several mitigation measures implemented by the Navy to obtain approval from federal and GovGuam agencies for the construction of a munitions wharf (Kilo Wharf) at Adotgan Point in outer Apra Harbor, Guam. This ERA is 252 ac (102 ha) in area and was also established to protect two separate biological units, a terrestrial and marine unit. The terrestrial unit supports a remnant native limestone forest providing important habitat for forest birds. The marine unit, which includes the Double Reef area, a valuable fringing reef, provides a nursery for marine species of subsistence and commercial fishery value. (NAVFAC Pacific 1986). The 72-ac (29-ha) marine unit originates at the mean lower low water (MLLW) line and extends to the edge of the outer coral reef line to a depth of 120 ft (37 m) (see Figure 11.1-10).

As stated in Amesbury et al. (2001): "There are six main macrohabitats supporting corals in the Haputo ERA within the 3 to 60 ft (1 to 18 m) water depth range: exposed benches, protected reef flats, Double Reef Top, the back reef, the shallow forereef, and the deep forereef. Macrohabitats on the forereef 3 to 60 ft (1 to 18 m) in depth support more diverse assemblages of corals, macroinvertebrates, and fish than the three shallow macrohabitats. Corals, however, have the greatest diversity in shallow water on Double Reef. Coral cover ranged from 37 to 64% in the Haputo ERA. Coral cover is higher along transects taken at an 26 ft (8 m) depth compared to those taken at 50 ft (15 m), and coral species with the highest coverage in the Haputo ERA include Porites (deep area), Montipora (shallow area), and Leptastrea".

Amesbury et al. (2001) documented 21% of the known marine fauna of Guam, approximately 4,500 species, within the Haputo ERA. These organisms consisted of 154 species of corals, 583 species of other macroinvertebrates (>0.4 in [1 cm]), and 204 species of fish. The 154 coral species found in the Haputo ERA correspond to approximately 60% of the coral species known on Guam, and the 204 fish species, 22% of the fish known on Guam: "The marine unit of the Haputo ERA is therefore an area of relatively high biodiversity, yet because of overfishing, the fish in the ERA are not very diverse or abundant." (Amesbury et al. 2001).

"Shallow splash pools found on the exposed benches support low diversities of corals, fishes, and cryptic organisms. Shoreward of the benches and at the base of the cliffs are erosional notches created by wave action on the rock face where habitat-specific species of limpets, chitons, slugs, and shore crabs can be found. The seaward edge of the benches is a steep subtidal face typically burrowed by echinoids that supports corals, macroinvertebrates and fishes. A freshwater seep microhabitat associated with this area had three species not encountered elsewhere within the study area: the barnacle *Balanus eburneus* and two grapsid crabs. The crabs are likely undescribed and endemic to the Marianas" (Amesbury et al. 2001).

"Two narrow, protected reef flats off Haputo Beach and shoreward of Double Reef are intertidal habitats supporting numerous species that are found only in sheltered reef flat or shallow lagoon habitats, such as the coral *Pavona divaricata*, several species of hermit crabs and crabs, sea slugs, and sea cucumbers that can withstand the rigors of an exposed habitat. Corals and fishes are more common and diverse at the seaward margin of these reef flats" (Amesbury et al. 2001).

"The shallow forereef substrate within the Haputo ERA includes a steep reef front and gently sloping forereef starting at a water depth of 13 to 26 ft (4 to 8 m). Numerous cuts and channels normal to the shoreline run through the fore reef and create abundant structural complexity and increased biodiversity. Coral and macroinvertebrate diversity peaked at this macrohabitat, with 54 and 116 species, respectively. Three new sponge species that had not been seen elsewhere on Guam were also identified in this macrohabitat (*Neofibularia hartmani*, "yellow tough sponge," and "puff sponge"). Branching corals (*Acropora*, *Pocillopora*) dominate the 3 to 10-ft (1 to 3-m) depth range on the fore reef. Coral composition within the 13 to 30-ft (4 to 9-m) depth range varies within the Haputo ERA, including several areas dominated by encrusting species of *Montipora* while other areas are dominated by the massive *Porites*. The cryptofauna of the rubble fields is highly diverse and includes several species (*xanthid* crab *Atergatis granulates*, the flatworm *Pseudoceros bimarginatus* and the hermit crab *Pylopaguropsis kiejii*). The ahermatypic coral, *Dendrophyllia gracilis*, a rare coral species on Guam, was observed in one of the small caverns" (Amesbury et al. 2001).

The napoleon wrasse and bumphead parrotfish may be found offshore of Finegayan associated with the Haputo ERA; however, these two species were not identified in biodiversity checklist surveys (Amesbury et al. 2001).

Special-Status Species

The threatened green sea turtle nests on beaches in the area and can be anticipated in nearshore waters. The endangered hawksbill sea turtle has been recorded nesting near Achae point (north of this area) and as far south as Falcona Beach, and could be expected in the coastal waters. No other marine ESA-listed species are known to frequent the area (Navy 2005, Grimm and Farley 2008).

Spinner dolphins occur in relatively high concentrations (pod sizes of ~100) and bottlenose dolphins are identified as present in the coastal waters (Navy 2005, NOAA 2005a) (see Figure 11.1-10).

NON-NATIVE SPECIES

Pauley et al. (2002) describe non-native species in the area as follows: “Only 23% of the nonindigenous species recognized by Guam have been found in natural habitats outside Apra Harbor: six introduced and 14 cryptogenic species. These include three purposeful introductions: two brackish-water fish species and the gastropod *Trochus niloticus*. This gastropod species is now abundant around Guam and is the basis of a local fishery. Fifty percent of the nonindigenous species that have been encountered outside Apra Harbor are ascidians (sea squirts), none of which are abundant. Cryptic hydroids (related to jellyfish, sea anemones and corals) common outside Apra Harbor include *Pennaria disticha* and *Thyroscyphus fruticosus*”.

More comprehensive non-native marine species information is lacking for this specific study area.

11.1.5.3 Non-DoD Land

Baseline marine biology information for the Non-DoD Land study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.1.5.4 Off-Base Roadways

The proposed actions include on-base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off-base roadway construction projects that would be implemented by the Federal Highway Administration (FHWA).

Marine biological resources considered in the analysis of the proposed roadway improvement projects include (1) Marine Flora, Invertebrates and Associated EFH, (2) Essential Fish Habitat, (3) special-status species, and (4) invasive species. These resource definitions are analyzed within areas where the construction and use of proposed road projects could directly or indirectly affect marine resources. Figure 4.1-6 in Volume 2, Chapter 4.1.2.4 presents a map of the surface waters and affected watersheds in each region of the proposed roadway projects that discharge to coastal areas.

The proposed roadway projects in the North Region include pavement strengthening and road widening, as well as access point construction for facilitating access to Finegayan and Andersen AFB. None of the proposed roadway improvement projects within the North Region are located near or are anticipated to affect marine biological resources; therefore, no affected environment component pertains to marine biological resources within this region associated with the proposed roadway improvements projects.

Because of the high permeability of the limestone substrate, no perennial streams exist on the northern end of the island. Runoff from roadways usually sheet flows off the pavement to grassy swales or flat strips of grass, and the runoff from the roadway is generally filtered prior to its conveyance to offsite drainages. Volume 6, Chapters 4 and 6, provide a detailed description of the surface water resource environment that would be impacted by the proposed roadway improvement projects.

11.1.6 Central

11.1.6.1 Andersen South

Baseline marine biology information for the Andersen South study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.1.6.2 Barrigada

Baseline marine biology information for the Barrigada study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.1.6.3 Non-DoD Land

The following specific study area information is provided in addition to that described in Section 11.1.4, Guam Regional Environment. The proposed training activities associated with Route 15 Range Lands does not contain any surface water resources (seeVolume 2, Figure 4.1-2). Impervious areas on the Route 15 parcel amount to 71 ac (28.73 ha), or 3.5% of the total Route 15 project area of 2,031 ac (822 ha). The Route 15 Range Lands may include increased access to the shoreline areas by foot and boat, and the presence of range surface danger zones (SDZs) that extend over the coastal waters. Therefore, this study area has been analyzed for potential threat to the resources below, especially special-status species that may occur in waters off-shore.

MARINE FLORA, INVERTEBRATES AND ASSOCIATED EFH

The coastline off the Route 15 Range Lands consists of exposed rocky shores and an intertidal bench providing habitat for many intertidal invertebrate species, including octopi, sea cucumbers, swimming crabs, slipper and spiny lobsters. Little evidence of marine flora (seagrasses, macro algae, or turf algae) is seen in the area (NOAA 2005a).

Coral communities and reefs are exposed to dominant trade winds, strong wave action, and storms (including typhoons). From Pagat Point south to Taguan Point, coral reef and colonized hard bottom (live coral 10 to 50%) are present seaward of the exposed wave-cut platforms. Corals found above the 100-ft (30-m) isobath in this area typically include encrusting or massive growth forms of corals as well as columnar, platy and branching growth forms conditioned to withstand heavy wave action and would recover if damaged (Navy 2005).

Exposed windward reef fronts are dominated by three growth forms of *Acropora*: corymbose (colonies are composed of horizontal branches and short to moderate vertical branchlets that terminate in a flat top), digitate (colonies are composed of short branches like the fingers of a hand), and caespitose (bushy, branching, possibly fused branches) (Navy 2005).

ESSENTIAL FISH HABITAT

EFH-designated habitat areas in this ROI would be the same as those described in Section 11.1.4, Guam Regional Environment (see Figure 11.1-5 through Figure 11.1-9). The extent to which the coastal waters off Route 15 are used for commercial, recreational or subsistence fishing has not been determined.

Site-specific information is limited for this study area (Pagat Point); however, general fish and invertebrate information would be similar to that described in Section 11.1.4, and includes a host of juvenile and adult fish and invertebrate MUS with year round residence.

SPECIAL-STATUS SPECIES

There are no reported sea turtle nesting beaches or foraging areas in this vicinity based on NOAA (2005a) mapping; however, green sea turtles, and to a lesser degree, hawksbill turtles may be present in the coastal waters. The nearest reported nesting beach from Pagat Point is located south of Pago Bay, approximately 5 mi (8 km) away. The nearest potential foraging area appears to begin at Tanguan Point approximately 2 mi (3 km) south.

There are no regularly reported marine mammals offshore of this study area, however spinner dolphins (pod sizes ~80) are reported in association with the Pati Point reserve and south past Anao Point, approximately 2 mi (3 km) north of Pagat Point (NOAA 2005a). Their range could be expected to extend south to the offshore waters of the study area. As mentioned in Section 11.1.4, spinner dolphins and bottlenose dolphins occur within the marine ROI around Guam. The bathymetry off this coast transitions rapidly through the island-arc margin toward the trench system (Navy 2005). The 655-ft (200-m) isobath is within 1 mi (1.6 km) of the shoreline just southeast of Pagat Point. Consequently, the marine mammals that normally inhabit oceanic waters may be present closer to the shoreline off Pagat Point. These additional species are identified on Figure 11.1-11.

NON-NATIVE SPECIES

Non-native species would be similar to those described in Section 11.1.4 and in the Finegayan non-native species section. It is likely that this coastline has seen minimal impact from non-native species due to the distance from Apra Harbor; however, data are limited.

PITI/NIMITZ HILL

The following specific study area information is provided in addition to that described in Section 11.1.4, Guam Regional Environment. Baseline marine biology information for the Piti/Nimitz Hill study area was analyzed commensurate with the land-based road construction projects (e.g., bridge replacement) along Route 1, which may affect the nearshore marine environment (see Section 11.1.6.4 for details). There is no in-water or land-based training activities proposed that would affect the marine environment.

MARINE FLORA, INVERTEBRATES AND ASSOCIATED EFH

The three embayments (Piti, Asan and Agana Bay) along this coastline have similar benthic habitats consisting of a nearshore unconsolidated sediment (sandy, uncolonized 90-100%) intermixed with rubble, seagrass, macroalgae and coral as you continue offshore. The coral communities are approximately 1,650 ft (500 m) from the Fonte and Agana Rivers where bridge replacement projects would be occurring (NOAA 2005b). These areas, including the Piti Bay MPA, provide habitat for intertidal invertebrate species including octopus, sea cucumbers, swimming crabs, giant clams, and spiny lobsters, and are considered EFH (NOAA 2005a, WPRFMC 2009a).

ESSENTIAL FISH HABITAT

EFH-designated habitat areas in this ROI would be the same as those described in Section 11.1.4, Guam Regional Environment (see Figure 11.1-5 through Figure 11.1-9). The extent to which the coastal waters of this area are used for commercial, recreational or subsistence fishing has not been determined.

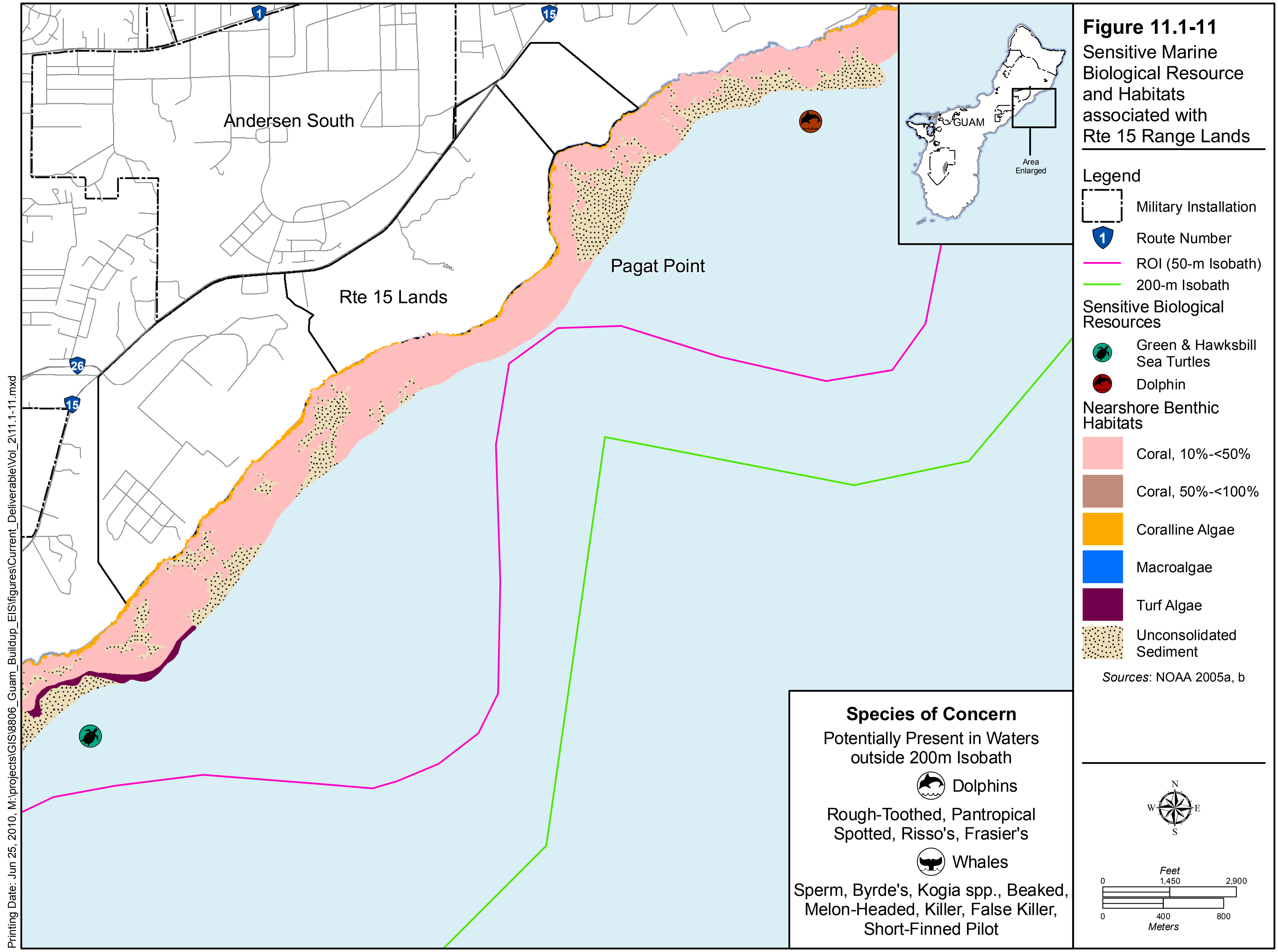


Figure 11.1-11 Sensitive Marine Biological Resource and Habitats associated with Rte 15 Range Lands

General fish and invertebrate information would be similar to that described in Section 11.1.4, and includes a host of juvenile and adult fish and invertebrate MUS with year round residence. High concentrations of fish species noted include juvenile rabbitfish (April and May), adult bigeye scad (June through December), giant manta rays (January through December). The bumphead parrotfish, an ESA candidate species, is reported within Piti Bay MPA (NOAA 2005a) (Figure 11.1-12).

SPECIAL-STATUS SPECIES

There are no reported sea turtle nesting beaches. Green sea turtles, and to a lesser degree, hawksbill turtles may be present in the coastal waters and the seagrass beds provide potential foraging habitat (NOAA 2005a and Figure 11.1-12).

Spinner dolphins (pod sizes ~80-100) may be present in coastal waters (NOAA 2005a). As mentioned in Section 11.1.4, spinner dolphins and bottlenose dolphins occur within the marine ROI around Guam.

NON-NATIVE SPECIES

Non-native species would be similar to those described in Section 11.1.4 and in the Finegayan non-native species section. It is likely that Piti Bay has seen additional influence from non-native species due to the canal connecting the power plant near the commercial port at Apra Harbor to Piti Bay; however, data are limited.

OFF-BASE ROADWAYS

The proposed actions include on-base roadway construction projects that would be implemented by the DoD. An affected environment description for on-base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off-base roadway construction projects that would be implemented by the FHWA.

The central region covers a relatively large area of the island that encompasses two different hydrologic regimes – the northern broad sloping limestone plateau in the north area and the southern mountainous region composed of eroded volcanic formations in the south area. Descriptions of potentially affected coastal water resources have therefore been split into the northern and southern parts of the central region. Roadway projects located in the north central area include improvements along Routes 1, 8, 8A, 10, 15, 16, 26, and 27. Roadway projects in the south central area include improvements to several bridges along Route 1 along the west side of the island.

Specifically, roadway projects in the Central Region include pavement strengthening, road widening, intersection improvements, and bridge replacements (on Route 1), as well the rerouting of Route 15. The proposed new location of Route 15 would redirect the road onto DoD property (Andersen South) so that the public road would not be within any firing range danger zones. These projects include: (1) pavement strengthening between Asan River and Route 11 along Route 1; (2) pavement strengthening between Asan River and Route 6 along Route 1; (3) pavement strengthening between Route 6 and Route 4 along Route 1; (4) pavement strengthening between Route 6 and Route 4 along Route 1; and (5) the replacement of bridges over the Atantano, Laguas, Agana, Sasa, and Fonte rivers.

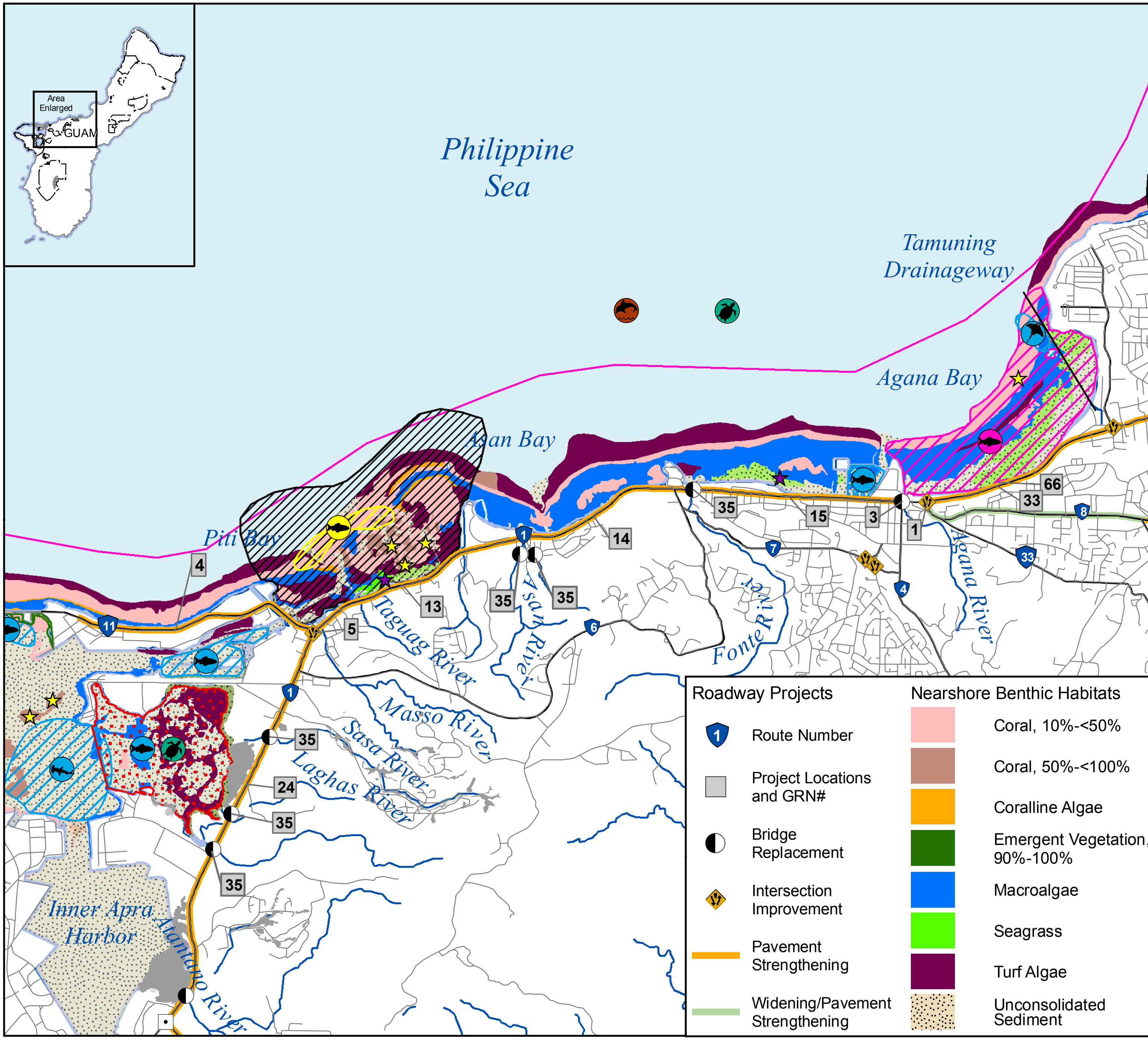


Figure 11.1-12
Sensitive Marine Biological Resources and Habitats Associated with the Proposed Road Projects in the Apra Harbor Region and Central Region Study Areas

Legend

- Mangrove/Wetland
- ERA
- Stream
- 50-m Isobath
- Coral Area of Significance
- Sea Grass Area of Significance
- Spinner Dolphin
- Potential Sea Turtle Nesting Area
- ESA-listed Species & EFH MUS High Concentration Area
- Green & Hawksbill Sea Turtles
- Giant Manta High Concentration
- Bumphead Parrotfish (Jan-Dec)
- Bigeye Scad Adult High Concentration (Jun-Dec)
- Rabbit Fish Juvenile High Concentration (Apr-May)
- Scalloped Hammerhead Spawning (Jan-Mar)

Sources: NOAA 2005a, b; COMNAV Marianas 2007b

N E S W

Feet: 0, 2,625, 5,250
Meters: 0, 690, 1,380

Printing Date: Jun 25, 2010, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\11.1-12.mxd

The north central region has similar characteristics to those of the North Region, with few streams and several sinks. In general, new development in this area is required to treat surface water generated from impervious surfaces by utilizing BMP treatment schemes, such as oil water separators and detention basins that allow pollutants and settleable solids to separated and settle out prior to entering a storm drainage system, to protect surface, ground and coastal waters. Other roadways in this area are curbed and convey concentrated flow to low points in the roads that connect directly to some of the sinks located in the vicinity. There are no coastal resources or coastal barriers near the roadway projects in the north central area.

Proposed Guam Road Network (GRN) projects within the southern part of the central region are generally on the west side of the island characterized by eroded volcanic formations with streams that are short with steep gradients and drainage areas of less than 3 square miles (mi^2) (777 ha) each. These streams are generally deeply channeled within the volcanic slopes that outlet into shallow fringing coral reefs at the mouths of the streams. Route 1 is located very close to the mouths of several of these streams that outlet into several bays connected to the Philippine Sea or Apra Harbor in the Piti/Nimitz and Apra Harbor areas.

Figure 11.1-12 identifies road projects locations and GRN# (see Volume 6, Section 13.2.6 for GRN# details), including bridge replacements over streams, with respect to sensitive marine biological resources in the nearshore environment. The streams and outlets include: (1) the Agana River that outlets into Agana Bay; (2) the Fonte River that outlets into Hagatna Bay; (3) the Asan River with two tributaries that outlet into Asan Bay; (4) the Matgue, Taguag, and Masso Rivers that outlet into Piti Bay; (5) the Sasa, Laguas, and Aguada Rivers that outlet into the Sasa Bay Marine Preserve; and (6) the Atantano and Apalacha Rivers that outlets into the Apra Inner Harbor. See Volume 4, Chapter 4.1.3.4 for the field investigation descriptions of issues with the nine bridges and figures/photos associated with these structures. Erosion along the upstream side of these bridges is common and contributes to downstream sedimentation that is a continual issue along the shoreline. Sediments have been found to contain heavy metals, such as copper and zinc, in Agana (Hagatna) Bay.

There are no areas subject to the Coastal Barrier Act near the roadway projects in this area. Coastal resources within this area include (1) Agana Bay, located at the outlet of the Agana River and Tamuning Drainageway; (2) Asan Bay, located at the outlet of the Asan River; and (3) Piti Bay, located at the outlet of the Masso and Taguag Rivers. These areas are within the Coastal Zone Management Program (GEPA 2000) and fall under Section 309 of the CZMA, which evaluates and regulates dredging activities within the harbors and bays of Guam.

As shown in Figure 11.1-12, Route 1 parallels the coastline from Apra Harbor northward to Agana Bay. Along this section of roadway, several locations are designated within Federal Emergency Management Agency (FEMA) Flood Hazard Zone V or VE, which is defined as a coastal flood zone with velocity hazard due to wave action. Currently, these areas are protected from erosion by gabion walls or riprap slope protection (See Volume 2, Figure 4.1-24 and 4.1-25).

11.1.7 Apra Harbor

11.1.7.1 Harbor

Apra Harbor, located along Guam's southwestern coast, is the largest and busiest U.S. deepwater port (>100 ft [33 m] deep) in the Western Pacific and Micronesia. Orote Peninsula borders most of the southern boundary of the outer harbor while the Glass Breakwater and Cabras Island form the northern borders.

The 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 (COMNAV Marianas 2007a). In addition, fill operations that developed Dry Dock Island, Polaris Point and artificial shorelines of the northeastern and southeastern boundaries also altered the lagoon (Paulay et al. 1997).

For the purposes of this EIS Apra Harbor was divided into two study areas: Outer Apra Harbor (including Sasa Bay), and Inner Apra Harbor. Section 4.2.2.3 describes water quality and sediment sampling information for Apra Harbor. The following specific study area information is provided in addition to that described in Section 11.1.4, Guam Regional Environment.

OUTER APRA HARBOR AND SASA BAY

In spite of the alterations to the harbor since the liberation of Guam during World War II, 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 (COMNAV Marianas 2007b).

Outer Apra Harbor contains the port operations for both the Navy and civilian commercial port, which is currently operated by the GovGuam. In addition, the outer harbor has fringing and patch reefs with some of the highest percentages of coral cover on the island, and these reefs are important recreational sites for residents and tourists alike. The Port Authority of Guam maintains the Commercial Port of Guam facilities on Cabras Island. Much of the remainder of the outer harbor contains both port and recreational facilities owned by the Navy. The outer harbor supports well developed reefs, with diverse populations of algae, macro-invertebrates, fish and moderate to high numbers of the threatened green sea turtle (Paulay et al. 1997) (Figure 11.1-13).

Sasa Bay, located in the eastern portion of the outer harbor, is a shallow estuarine lagoon containing patchy corals and an extensive mangrove habitat. Sasa Bay's waters are generally extremely turbid because of rivers emptying fine sediments into the bay. The bottom substrate is mostly fine muds to rocky and sandy habitats (Scott 1993). GovGuam has set aside over 10% of Guam's coastline in five marine preserves, one of which is Sasa Bay. The Sasa Bay Marine Preserve Area (1.2 mi^2 [311 ha]) extends from Dry Dock Island to Polaris Point and ends at the public right of way bordering Marine Corps Drive (Route 1). Route 18 runs along its northern end while the road to Polaris Point borders its southern end.

Although the southern portion of Sasa Bay is within the Navy's submerged lands, the Navy does not recognize its preserve status (COMNAV Marianas 2007a) (Figure 11.1-13).

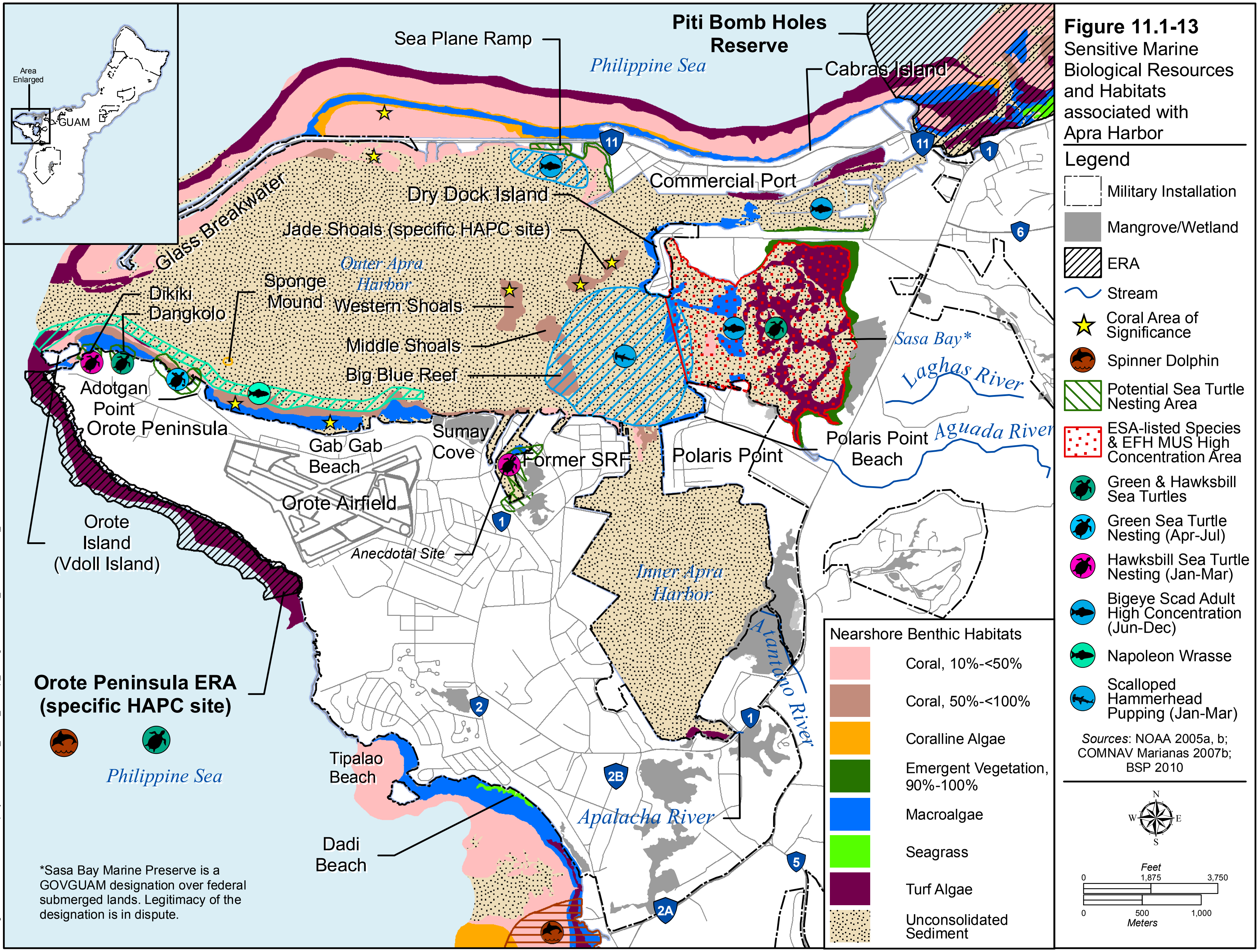


Figure 11.1-13
Sensitive Marine Biological Resources and Habitats associated with Apra Harbor
Legend
Military Installation
Mangrove/Wetland
ERA
Stream
Coral Area of Significance
Spinner Dolphin
Potential Sea Turtle Nesting Area
ESA-listed Species & EFH MUS High Concentration Area
Green & Hawksbill Sea Turtles
Green Sea Turtle Nesting (Apr-Jul)
Hawksbill Sea Turtle Nesting (Jan-Mar)
Bigeye Scad Adult High Concentration (Jun-Dec)
Napoleon Wrasse
Scalloped Hammerhead Pupping (Jan-Mar)
Sources: NOAA 2005a, b; COMNAV Marianas 2007b; BSP 2010
N
E
S
W
Feet
0
1,875
3,750
0
500
1,000
Meters
Nearshore Benthic Habitats
Coral, 10%-<50%
Coral, 50%-<100%
Coralline Algae
Emergent Vegetation, 90%-100%
Macroalgae
Seagrass
Turf Algae
Unconsolidated Sediment
Area Enlarged
GUAM
Piti Bomb Holes Reserve
Sea Plane Ramp
Philippine Sea
Cabras Island
Commercial Port
Dry Dock Island
Jade Shoals (specific HAPC site)
Glass Breakwater
Outer Apra Harbor
Sponge Mound
Western Shoals
Middle Shoals
Big Blue Reef
Dikiki
Dangkolo
Adotgan Point
Orote Peninsula
Gab Gab Beach
Sumay Cove
Former SRF
Polaris Point
Polaris Point Beach
Sasa Bay*
Laghas River
Aguada River
Orote Airfield
Anecdotal Site
Orote Island (Vdoll Island)
Inner Apra Harbor
Atantano River
Orote Peninsula ERA (specific HAPC site)
Philippine Sea
Tipalao Beach
Dadi Beach
Apalacha River
11
11
1
6
1
2
2B
1
5
2A
*Sasa Bay Marine Preserve is a GOVGUAM designation over federal submerged lands. Legitimacy of the designation is in dispute.
Printing Date: Jun 25, 2010, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\11.1-13.mxd

Sasa Bay contains a large, diverse mangrove habitat, one of few such habitats on Guam. Mangroves are typically found in estuaries or shores protected from the open ocean throughout the tropical and subtropical regions of the world (Scott 1993). They are composed of salt-tolerant woody trees and shrubs and other plant species and provide habitat for both marine and terrestrial life. Species diversity tends to be high in functioning mangrove communities. Mangrove habitats, like seagrass beds, can also act as water filters by removing sediments and nutrients from waters that flow through them. When mangrove communities are damaged and not providing ecosystem functions, sediments and nutrients flow into and can damage fragile coral reef ecosystems (Scott 1993). This may account for the limited coral reef habitat (4.5 ac [2 ha]) in Sasa Bay. Two rivers, the Sasa and Aguada Rivers, dump large quantities of sediment-laden water into the bay, which lowers visibility and overwhelms most corals (GDAWR 2006a).

There are 125.3 ac (50.7 ha) of mangrove forests on 10 sites on Navy lands on Guam. The largest of these mangrove sites (88.7 ac [35.9 ha]) is located along the eastern shoreline of the Inner Apra Harbor. There are four mangrove areas near Abo Cove at the southern tip of the Inner Apra Harbor, two mangrove sites near Dry Dock Island, two more sites near Polaris Point and one mangrove area along the southern shore of Apra Harbor (Navy 2005) (Figure 11.1-13).

Sasa Bay is also a loafing and feeding habitat for migratory shore birds and is visited by foraging ESA-listed sea turtles; green sea turtles are reported in high concentrations in this area (NOAA 2005a, Smith 2007). Hawksbill sea turtles were not sighted in this area during recent surveys by Smith 2007.

Estuarine areas like Sasa Bay are particularly important to both the native land hermit crabs and coconut crabs, both of which begin life in the sea. Adult females return to the sea to lay eggs. After a planktonic larval stage, small crabs emerge from the ocean to live on land (COMNAV Marianas 2001).

Estuarine communities (e.g., mangroves/wetlands) are described further under the Essential Fish Habitat section below, and Volume 2, Chapters 4 and 10, Water Resources and Terrestrial Biological Resources, respectively.

A detailed descriptive tour of Outer Apra Harbor benthic habitats summarized from the Marine Resources Assessment for the Marianas Operating Area (Navy 2005) can be found in Volume 9, Appendix G, Outer Apra Harbor Benthic Habitat Summary. The descriptive tour begins with the Glass Breakwater on the north, continuing to the south in the area from Orote Point to the Entrance Channel of Inner Apra Harbor, and finally to the mounds and shoals (e.g., Big Blue Reef, Middle Shoals, and Western and Jade Shoals) located throughout the lagoon (Navy 2005).

Marine Flora, Invertebrates and Associated EFH

Outer Apra Harbor provides habitats for unique and diverse coral reef ecosystems and floral communities, including EFH. For example, most of the sponges and ascidians found in Apra Harbor (48 species of sponges and 52 species of ascidians) are unique to Apra Harbor, and many are indigenous to Guam. Indigenous (native and restricted to the area) species generally occupy natural substrates while introduced and cryptogenic species generally occupy artificial substrata (e.g., wharf walls, concrete revetments, moorings, and navigational buoys). Some of the species (one sponge and 16 ascidians) were introduced via ship traffic (Paulay et al. 1997). Macroalgae species are dominant around the perimeter of Outer Apra Harbor, but are present on the shoal areas. These species are discussed further under special-status species as potential foraging habitat.

Essential Fish Habitat

EFH-designated habitat areas for Outer Apra Harbor are the same as those described in Section 11.1.4, Guam Regional Environment (see Figure 11.1-5 through Figure 11.1-9). Accordingly, all of Apra Harbor has been designated as EFH, including Sasa Bay on its eastern edge. Jade Shoals, approximately 4,692 ft (1,430 m) north of the entrance channel, is a specific HAPC site. The extent to which Apra Harbor and coastal waters outside the harbor are used for commercial, recreational or subsistence fishing has not been determined. NOAA (71 FR 212, November 2006) reported that there is no evidence that shallow water bottomfish stocks around Guam are subject to overfishing or are being overfished (COMNAV Marianas 2007b) (see Figure 11.1-13).

In Apra Harbor, the commercial port area contains the highest levels of zooplankton with copepods being the dominant taxa. Other organisms in the harbor include planktonic stages of finfish larvae, decapod zoeae (free-swimming larvae), and pteropods (oceanic gastropod mollusks) (Navy 2005).

Along the southern boundary of Apra Harbor between Orote Point and Gab Gab Beach, including areas east and west of Kilo Wharf, coral cover on fringing reefs is high (Smith 2004b, NOAA 2005a) as described in detail in the Apra Harbor Benthic Habitat Summary in Volume 9, Appendix G. The areas adjacent to Kilo Wharf are close to 100% coral cover, consisting mainly of *P. rus* (>90% of the cover) and other stony corals including *P. lichen*, *P. lobata*, *Platygyra pini*, *Leptoseris* spp., *Lobophyllia corymbosa*, and *Acanthastrea echinata*. Reefs located further in the harbor (excluding the Inner Apra Harbor) have been severely impacted by freshwater runoff, siltation, and polluted discharges (Smith 2004b, Navy 2005).

Sasa Bay and the mangroves provide refuge for high concentrations of many species, and serve as nursery grounds for jacks, barracudas, snappers, and groupers, as well as numerous burrowing invertebrates including bivalves, small crabs and worms.

NOAA (2005a) identifies two sensitive fin fish MUS: the adult bigeye scad occurs in seasonally high concentrations June through December at two locations within Apra Harbor; and the scalloped hammerhead, which occurs during seasonal spawning (January – March) at one location extending from the entrance channel to the western edge of Big Blue reef, north to Jade Shoals (a HAPC), and easterly into Sasa Bay (see Figure 11.1-13). The hammerhead pupping event is reported to be extremely rare (personal communications with Steve Smith, [Navy 2009b]). In addition, the shoal areas, which contain numerous CREMUS including high live coral coverage (50% to <100%) and coral areas of special significance, fringe the navigational channel bend and fairway for the approach into Inner Apra Harbor. The six coral areas of special significance within Outer Apra Harbor, were designated by NOAA resource experts as those areas that should be highly prioritized for protection following spills due to various reasons (e.g., species diversity, abundance of soft coral species, high percent cover, sensitive habitat for fish/invertebrates, having structure-building potential that may lead to high diversity/high coral cover in the future, etc.) (NOAA 2005a).

Special-Status Species

In general, the threatened green sea turtle is frequently sighted in Outer Apra Harbor, while the endangered hawksbill sea turtle has been recorded rarely. The green and hawksbill sea turtles are the only special-status species reported in Apra Harbor.

Sea turtles have been observed to nest during all months of the year on Guam, however the peak of nesting activity occurs from April to July. Sea turtles nesting activity has been reported from three Apra Harbor locations: Adotgan Dangkolo (Dangkolo) (green sea turtles), Adotgan Dikiki (Dikiki) (hawksbill sea turtle), and Kilo Wharf (green sea turtle) (Grimm and Farley 2008). Historic records of sea turtle nesting include a hawksbill reported at a beach near Sumay Cove in 1997 and a general report of nesting at a beach near the Sea Plane Ramp (COMNAV Marianas 2007b) (see Figure 11.1-13). No activity has occurred at these areas since this reported event (Grimm and Farley 2008, Navy 2009a). In general, turtles nest and hatch at night. They cue in on natural light to orient toward the ocean; however the bright lights from the dredging platforms may confuse adult nesting turtles and hatchlings into orienting away from the open ocean (COMNAV Marianas 2007b).

The Navy and its contractors have logged over 530 man dives within the project dredge area over the past seven years without a single green turtle or hawksbill turtle sighting. Approximately 220 man-dives were completed by the Navy Facilities Engineering Service Center by a biologist within the action area, between November 2003 and November 2009, for a total of over 6,600 diver minutes, without a single sea turtle sighting. Additionally, during a two-week coral survey period in April 2009, Navy contracted divers logged approximately 300 man-dives, a total of over 4,300 diver minutes, within the proposed Carier Vessel Nuclear (CVN) action area without a single green or hawksbill sea turtle sighting. The closest sighting of a sea turtle during all these dive events occurred approximately one half mile (2,640 ft [805 m]) west north-west of the proposed Turning Basin (Navy 2010a). During the Smith (2007) survey dives in the eastern Outer Apra Harbor area, nine green sea turtles were observed, five of which were on the western portion of Big Blue Reef. All turtles sighted were between 15 to 23 in (40 to 60 cm) in length, with no visible fibropapilloma tumors or other signs of injury. Additionally, over the course of twenty dives between 7 December 2008 and 29 January 2010, nine green turtles were observed in Zone 1 (see Navy 2010a, Figure 2) during in-water construction activities at Kilo Wharf. All turtles sighted were normal in both appearance and behavior (*e.g.*, swimming or resting), and gave no indication of being disturbed by the dredging or chiseling operations despite being in close proximity of 100 m – 200 m (328 ft – 656 ft) to the operation. In particular, during the dives of 17-21 March 2009, the diver reported that although no sound pressure levels measurements were made, the sounds from chisel drop impacts onto the fossilized reef bed qualitatively were of sufficient impulsive energy to make his body noticeably vibrate physically, yet nearby observed turtles, including a female ~100 m (328 ft) from the operation, were exhibiting normal resting and swimming behaviors (Navy 2010a).

Balazs et al. (1987) identified ten genera of algae that he considered preferred forage for green sea turtles in Hawaii. Although algal surveys were not conducted, Smith (2007) "suggests that more potential sea turtle resting habitat and preferred algal forage species were present on Big Blue Reef and the Fairway areas, where most turtle sightings occurred. Preferred forage genera observed included: Chlorophyta (green algae), *Dictyospheria* and *Ulva;* Phaeophyta (brown algae) *Sargassum;* Rhodophyta (red algae) *Gracillaria, Jania, Hypnea, Acanthophora* and *Laurencia.* Green sea turtles are probably opportunistic feeders; however, within preferred food items listed above, three specific species (*Dictyospheria versluysii, Sargassum obtusifolium and Acanthophora spicifera)* have been reported from Guam (Lobban and Tsuda 2003) and were tentatively field identified on Big Blue Reef west and the Fairway Shoals. During the observation periods, none of the algae listed above were abundant at any of the study sites."

Spinner and common bottlenose dolphins are not expected to regularly occur within Apra Harbor (Navy 2005, NOAA 2005a). However, spinner dolphins are noted on a rare, but somewhat regular basis within Apra Harbor. Dolphin tours are run throughout Guam's waters and it is estimated that spinner dolphins are seen up to four times a year within the outer harbor, as they enter the harbor in a small group for a few hours and then exit (COMNAV Marianas 2007a).

Critical Habitat

There is no critical habitat designation for any marine species on Guam.

Non-native species

"Guam, particularly Apra Harbor, has been invaded by numerous nonindigenous species. However the spread and impact of the nonindigenous species to outside areas on Guam have been relatively limited. These species are relatively rare on natural reef bottoms, but abundant on artificial substrata" (Paulay et al. 2002). See Section 11.1.4.4 for further detail.

"Opportunities for ballast transport of nonindigenous species has been fairly limited, and hull transport appears to have been the predominant avenue of invasion identified in Apra Harbor. A study of the fauna associated with two dry docks hauled from Hawaii and the preponderance of sessile organisms supports this conclusion" (Paulay et al. 2002).

Paulay et al. (2002) recognized 85 nonindigenous species on Guam (see Volume 9, Appendix G). Forty-one species can be categorized as introduced and 44 as cryptogenic (unknown origin). Fourteen percent represent purposeful introductions, the rest accidental. Sessile organisms comprise 76% of the total and 86% among accidental introductions. Sessile nonindigenous species include numerous sponges, hydroids, anemones, bivalves, barnacles, bryozoans, and ascidians. Over half of these nonindigenous species (46) were restricted to artificial substrata (e.g., moorings, wharf structural supports, etc.).

Paulay et al. (2002) noted "…the lack of spreading to areas outside the harbor of well-established species in Apra Harbor, such as the Caribbean barnacle and the sponge *Ianthella basta*. The differences between invasion and impact on Guam and those in other locations (e.g., Pearl Harbor) is associated with several factors: shipping traffic is lower; Apra Harbor's reefs are still relatively intact with a diverse community, and therefore resistance to invasion by nonindigenous communities is higher." This was also observed by Lambert (2002), who found "…nonindigenous ascidians were extremely abundant on artificial surfaces in harbors and marinas around the world, however they rarely colonized adjacent natural benthic ecosystems." She also noted, along with Paulay et al. (2002), "…the specific confinement of nonindigenous ascidians to Apra Harbor without significant colonization on the outside reefs. This is quite different from other harbors and marinas around the world (e.g., Pearl Harbor, San Francisco Bay), where coastal areas have been invaded by nonindigenous species" (Paulay et al. 2002, Lambert 2002).

INNER APRA HARBOR

Randall and Holloman (1974) describe Inner Apra Harbor as "…a natural embayment formed by tectonic activity along the Cabras Fault, separating the volcanic Tenjo Block in central Guam from the limestone Orote Block immediately to the west. Two rivers, the Apalacha and Atantano, drain the volcanic mountain land to the east of Apra Harbor and discharge into the inner harbor waters" (Randall and Holloman 1974).

Although naturally formed, Inner Apra Harbor was dredged in the 1940s and used exclusively by the Navy. The only portion of the inner harbor remaining unchanged is the mangrove area at the mouth of the Atantano River (Smith et al. 2008). Inner Apra Harbor is approached through the Inner Apra Harbor entrance channel (Entrance Channel) between Polaris Point and the former Ship Repair Facility (SRF), which allows entrance by vessels with a maximum draft of 33 ft (10 m). The eastern side of the Entrance Channel extends for approximately 1,804 ft (550 m) while the western side extends approximately 1,312 ft (400 m). The width of the entrance channel is 984 ft (300 m). The bottom of the inner or southern portion of the Entrance Channel is comparable to the floor of the inner harbor and is composed of fine calcareous sand. Moving seaward in a northerly direction the channel sediments become increasingly coarse, rock outcrops appear and hard corals become more common (COMNAV Marianas 2007b).

Inner Apra Harbor was dredged to a maximum depth of approximately 36 ft (11 m) in the 1940s. More recent maintenance dredging in 1978 and 2004 has maintained the original dredged depths that allow for safe navigation by seagoing vessels. Primarily because of the original and continued dredging, Inner Apra Harbor is dramatically different from Outer Apra Harbor. While Outer Apra Harbor supports a diverse community of corals, algae, fish and other organisms, Inner Apra Harbor is relatively devoid of marine life (COMNAV Marianas 2007b).

Marine Flora, Invertebrates and Associated EFH

Smith et al. (2008) describe the bottom of Inner Apra harbor as follows: “The floor of Inner Apra Harbor is composed predominantly of sticky, fine sand and silty/muddy-type sediment that is easily resuspended” Marine biota is not abundant. Most common are burrowing benthic invertebrates, which are visible only by the mounds they build. No algae, sponges, soft corals, hard corals or gorgonianshave been observed on the floor of the inner harbor or inner portions of the entrance channel. The closest area to the Inner Apra Harbor where corals occur on the seafloor is in the outer reaches of the entrance channel as described above. In this area corals present include *P. rus* and *P. cylindrica* (Navy 2005), which do well in highly turbid conditions. Most corals, both soft and hard, algae and most other sessile organisms typically require hard substrata on which to attach. The lack of hard substrata on the floor of the inner harbor may explain the rarity of these groups (COMNAV Marianas 2007b). For further detail on the Inner Apra Harbor Entrance Channel habitat, please see Volume 9, Appendix G, Outer Apra Harbor Benthic Habitat Summary.

Randall and Holloman (1974) reported living Pocillopora and Porites corals on the wharf and dock structures in the inner harbor. Paulay et al. (1996) found that artificial surfaces in the inner harbor supported diverse fouling communities, including both indigenous and introduced species. They noted the presence of *Porites convexa*, known in Guam from only a few locations. They also remarked on the abundance of the hammer oyster on wharf faces in Inner Apra Harbor. Three species of hard corals are dominant on these vertical surfaces: *Porites rus, P. lutea* and *Pocillopora damicornis*, all of which are common on Guam’s reefs. These vertical surfaces act like artificial reefs and provide the hard substrata needed for attachment (COMNAV Marianas 2007b). These coral species were also found encrusting rocks and concrete debris, in addition to sheet pilings (Navy 2005).

A 2008 marine benthic survey of Inner Apra Harbor recorded 70 benthic taxa. As reported in Smith et al. (2008): “Twenty eight of these species were corals and related organisms. Species richness was highest at X-ray Wharf, where eight species occurred on the transect; only four species occurred at the other wharves and Abo Cove. Few corals were present on the inner harbor floor transects, and only small colonies of *Porites lutea* were observed on scattered pieces of debris and old pilings that provided the only hard substrata available for larval attachment. Thirty species of solitary macroinvertebrates were encountered; all were suspension feeders but three, those being detritus feeders. The greatest diversity was found at Victor Wharf, where bivalve mollusks and ascidians dominated in terms of diversity and density. These numbers, along with average species richness were low compared to results of similar surveys in other areas”.

“The most ‘natural’ site (Abo Cove) is significantly less taxon-rich than the wharf sites due to its mostly flat sediment-covered bottom and highly turbid conditions. Large specimens of *Caulerpa verticillata*, a green alga that copes well with increased sedimentation levels and low salinity, were found in Abo Cove, probably a result of relatively low herbivore pressure. The distribution of the seagrass species *Halophila japonica* also seems to be restricted to Abo Cove" (Smith et al. 2008).

"The benthic assemblages of the wharves contain interesting but very different taxa from Abo Cove. For example, the very abundant *Celleporaria sibogae* and the rather uncommon *Lichenopora* sp. are most likely new bryozoan records for Guam, although this group has been virtually unstudied in the region" (Paulay 2003a).

Corals represent the majority of biotic assemblages at Abo Cove, while the wharves predominantly include encrusting macroalgae and sponges (Smith et al. 2008) (Figure 11.1-14).

Essential Fish Habitat

EFH-designated habitat areas in Inner Apra Harbor are described in Section 11.1.7.1, Outer Apra Harbor. All of Apra Harbor is considered EFH; however, neither Inner Apra Harbor nor the entrance channel are cited as being significant from an EFH perspective (COMNAV Marianas 2007b).

Finfishes, although present, are not abundant or diverse, and are represented primarily by three families: Pomacentridae (damselfishes), Chaetodontidae (butterflyfishes), and Carangidae (jacks). The waters of the inner harbor are highly turbid with some areas having a visibility of less than a few feet. High turbidity in the inner harbor makes surveying fish difficult, and also decreases the amount of sunlight available to algae and corals (COMNAV Marianas 2007b). Smith et al. (2008) made limited qualitative assessments of habitat utilization by fish in the turbid waters: "Overall, man-made structures (i.e., wharves) provided relatively considerable habitat for a diverse array of fishes compared to the reef at Abo Cove or the harbor floor offshore from the wharves. Benthic species, such as cardinalfishes, damselfishes, and gobies favored hard corals, debris, sand, soft corals, and the wharf wall and pilings. Species that were active swimmers, such as butterflyfishes, emperors, snappers, surgeonfishes, sweetlips, trevallys and jacks,were found in the water column directly adjacent to the wharves."

On the reef at Abo Cove, cardinalfishes were associated with corals or rock, gobies with sand, mullet with rubble or sand, and a snapper was observed in the sand community. Visibility was very poor during this survey and it is expected that additional species would be present along the wharf transects as well, particularly at high tide. The harbor floor transects were surveyed under conditions of poor visibility, but burrowing gobies associated with the fine sand were observed.

Special-Status Species

No marine mammals are expected in Inner Apra Harbor and sea turtles are not expected on a regular basis, and considerably less frequent and in smaller numbers than in Outer Apra Harbor. A green turtle was observed on a recent marine benthic survey of Inner Apra Harbor (Smith et al. 2008) in waters between Abo Cove and the southern end of Victor Wharf, most likely foraging at the seagrass bed in Abo Cove. The individual observed was small (18 to 36 in [50 to 100 cm] carapace length). Considering the sponge community and other soft body invertebrates present on the wharves, the hawksbill sea turtle could also forage at this site, however the prey items are not preferred species for hawksbill sea turtles. "No sea turtle nesting habitats have been identified and because of the fine-grained, muddy composition of the shoreline of Inner Apra Harbor, the beaches at this study area are not considered potential nesting sites for threatened and endangered sea turtles known to occur in Apra Harbor" (Smith et al. 2008).

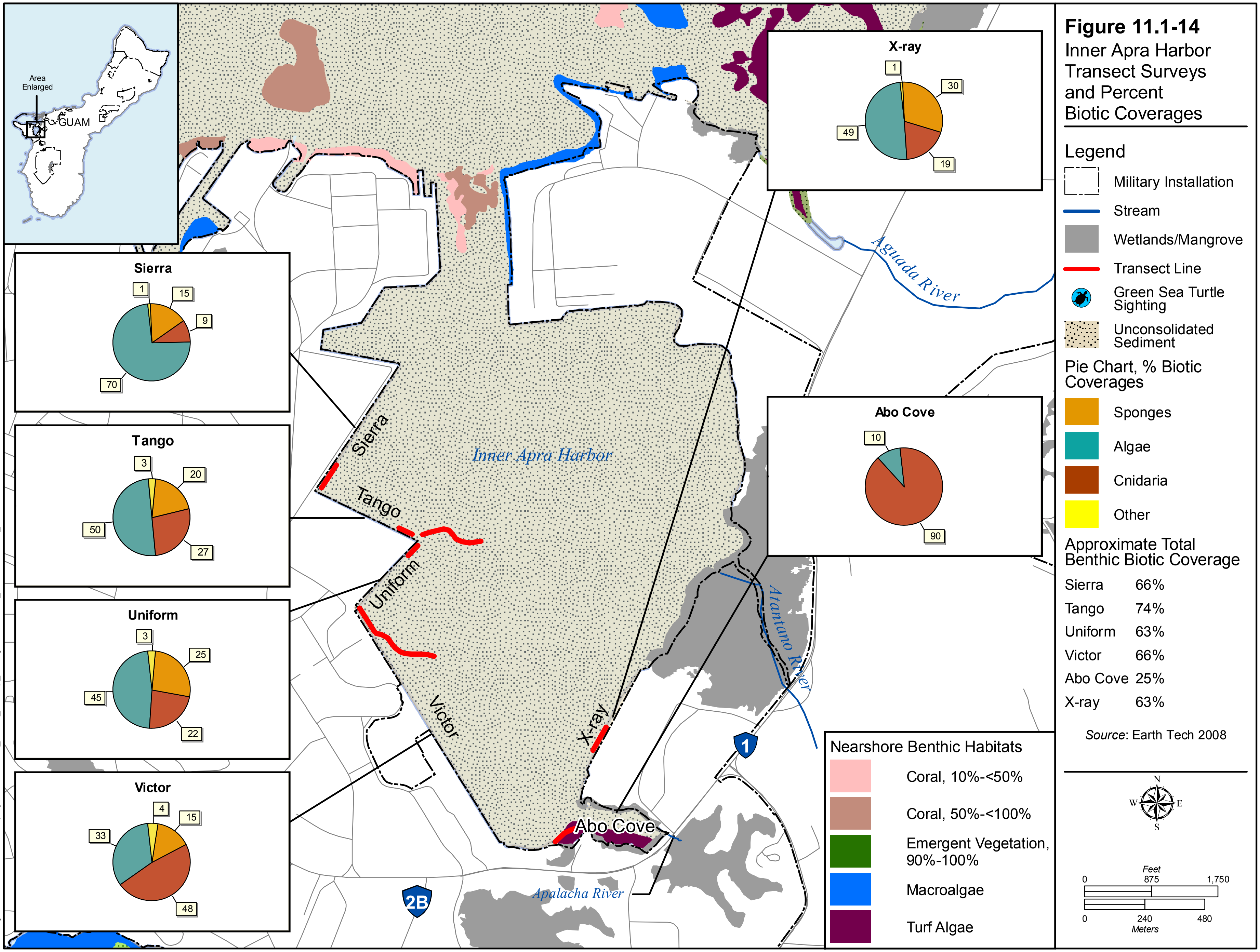


Figure 11.1-14
Inner Apra Harbor Transect Surveys and Percent Biotic Coverages

Printing Date: Jun 25, 2009, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\11.1-14.mxd

The Inner Apra Harbor area does not represent a preferred habitat for sea turtles in comparison to the entire Outer Apra Harbor reef complex, and does not contain an abundance of algal or seagrass species that represent a major food source for sea turtles that cannot be found elsewhere in Outer Apra Harbor. "Aside from the recent green sea turtle observation (identified above) no other observations have been reported and no density information is available for Apra Harbor" (Smith et al. 2008). Considering the turbidity of this project area, submerged sea turtles may go unnoticed by observers.

There have been limited studies on green sea turtle hearing capabilities, but the available data suggests a hearing in the moderately low frequency range, and have relatively low sensitivity within the range they are capable of hearing (Bartol et al. 1999, Ketten and Bartol 1995). NOAA (2005 [pp 3-88 and 3-89]) identifies sea turtle hearing sensitivity, and includes the following information. The range of maximum sensitivity for sea turtles is 100 to 800 hertz (Hz), with an upper limit of about 2,000 Hz. Hearing below 80 Hz is less sensitive but still potentially usable to the animal (Lenhardt 1994). Green turtles are most sensitive to sounds between 200 and 700 Hz, with peak sensitivity at 300 to 400 Hz. They possess an overall hearing range of approximately 100 to 1,000 Hz (Ridgway et al. 1969). Sensitivity even within the optimal hearing range is apparently low—threshold detection levels in water are relatively high at 160 to 200 decibel (dB) with a reference pressure of one dB re 1 µPa-m (Lenhardt 1994).

TEI (2006) gathered unpublished data on hearing thresholds for green sea turtles from an Office of Naval Research hearing threshold study at the New England Aquarium and combined this data with other information (Ruggero and Temchin 2002) to present the hearing thresholds in Table 11.1-11. These data show similar results as above and provides the best available estimates for green sea turtle. The hearing bandwidth was relatively narrow, 50 to 1,000 Hz with maximum sensitivity around 200 Hz. And these animals have very high hearing thresholds at over 100 dB re 1 µPa in low frequencies where construction sound is concentrated.

Table 11.1-11. Hearing Thresholds and Bandwidth for Sea Turtles

Hearing Bandwidth 1/3 Octave Band (Hz)	*Hearing Threshold Sea Turtle (dB re 1 µPa)*
50	149
63	142
80	131
100	119
125	118
160	117
200	115
250	119
315	123
400	130
500	136
630	144
800	154
1,000	166

Source: TEI 2006 and Ruggero and Temchin 2002.

Further information on in-water sound, as it relates to impacts on sea turtles, can be found in the Biological Assessment prepared for Section 7 consultation with NMFS.

In general, sea turtle nesting and hatching activities occur at night. They cue in on natural light to orient toward the ocean; however, the bright lights from the dredging platforms may confuse adult nesting turtles and hatchlings so that they orient away from the open ocean (COMNAV Marianas 2007b). Thought to be a historic site, Seaplane Ramp, along with Adotgan Point and Kilo Wharf, is a sea turtle nesting area, and nesting activity was confirmed there in 2006 (GDAWR 2006b). The Sumay Cove historic nesting site is in close proximity and adult nesting or hatchlings entering the water have the potential to be disturbed or disoriented by lights used during night-time activities. However, as mentioned previously, this site has not been active since an anecdotal reporting of a hawksbill nesting event in 1997.

Non-native Species

Non-native species information for Inner Apra Harbor would be similar as described in Section 11.1.4.4 and 11.1.7.1. In general, nonindigenous species are abundant on artificial substrata (e.g., moorings, steel pile wharf supports).

11.1.7.2 Naval Base Guam

The LCAC/AAV laydown area, which includes amphibious operations facility and marine ramp, is proposed for construction on Polaris Point. The benthic community associated with the AAV's marine ramp would be the same as described under the Inner Apra Harbor section above. In summary, the inner harbor floor is composed predominantly of fine sand and silty sediment that is easily resuspended. Marine biota is not abundant. Most common are burrowing benthic invertebrates, which are visible only by the mounds they build. No algae, sponges, soft corals, hard corals or gorgonian corals have been observed on the floor of the inner harbor or inner portions of the entrance channel (Smith et al. 2008).

11.1.7.3 Off-Base Roadways

The proposed actions include on-base roadway construction projects that would be implemented by the DoD. An affected environment description for on-base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off-base roadway construction projects that would be implemented by the FHWA.

Roadway projects in the Apra Harbor region include pavement strengthening and intersection improvements and bridge replacements (on Route 1). Figure 11.1-15 shows representative photographs along Route 11 to the commercial port that are areas of proposed road improvement projects adjacent to marine environments within the Apra Harbor region study area.

Left: View from Route 11 to northeast.

Right: Cooling water canal (Approximately 5 ac (2 ha) with rip rap lining the sides. This canal connects the power plant near the Commercial Port along Route 11 to Piti Bay and the Philippine Sea.

Figure 11.1-15. Photographs of Marine Environmental Features along Route 11 (Commercial Port)

These projects include (1) rehabilitation of Route 11 from the commercial port to the Route 1 intersection, and (2) pavement strengthening along Route 1 from the intersection with Route 11 and Route 2A. Figure 11.1-10 shows the roadway projects, including bridge replacement locations, that may affect sensitive marine biological resources and habitats associated with the downstream or adjacent nearshore environment.

11.1.8 South

11.1.8.1 Naval Munitions Site

Baseline information for the areas in and adjacent to Naval Munitions Site (NMS) was analyzed for land-based construction projects (e.g., bridge replacement) in relation to the roadway projects described below. There are no in-water construction, dredging, or training activities proposed that would affect the marine environment.

11.1.8.2 Non-DoD Land

Baseline information for the areas in and adjacent to potential access road options A, B, and C was analyzed for land-based construction projects (e.g., bridge replacement) in relation to the roadway projects described below. There are no in-water construction, dredging, or training activities proposed that would affect the marine environment.

11.1.8.3 Off-Base Roadways

The proposed actions include on base roadway construction projects that would be implemented by the DoD. An affected environment description for on-base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA.

Roadway projects in the southern portion of Guam include pavement strengthening and roadway modifications. None of the proposed roadway improvement projects within the South Region includes in-water construction, dredging, or land-based construction projects that would affect streams and/or marine biological resources; therefore, marine biological resources were not evaluated.

11.2 Environmental Consequences

This description of environmental consequences addresses all components of the proposed action for the Marine Corps on Guam. The components addressed include: Main Cantonment, Training, Airfield, and Waterfront. Since some of these project components would not affect the marine environment, their potential impacts on marine biology would be negligible and are not addressed in detail. There are multiple alternatives for the Main Cantonment, Training-Firing Range, Training-Ammunition Storage, and Training-NMS Access Road. Airfield and Waterfront do not have alternatives. Although organized by the Main Cantonment alternatives, an analysis of each alternative, Airfield, and Waterfront is presented beneath the respective headings. A summary of impacts specific to each alternative, Airfield, and Waterfront is presented at the end of this chapter. An analysis of the impacts associated with the off base roadways is discussed in Volume 6.

11.2.1 Approach to Analysis

11.2.1.1 Methodology

The methodology for identifying, evaluating, and mitigating impacts to marine biological resources was based on federal laws and regulations including the ESA, MMPA, M-SA, Section 404(b)(1) of the Clean

Water Act (CWA), and EO 13089, *Coral Reef Protection*. Significant marine biological resources include all special-status species such as species that are ESA-listed as threatened and endangered or candidates for listing under ESA, species protected under the MMPA, or species with designated EFH or HAPC established under the M-SA. The M-SA defines EFH as "...those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." 'Waters' include aquatic areas and their associated physical, chemical, and biological properties that are used by fish. 'Substrate' includes sediment, hard bottom, structures underlying the waters, and associated biological communities. 'Necessary' means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem, and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle (16 USC 1801 et seq.). Additionally, at least one or more of the following criteria established by the NMFS must be met for HAPC designation: 1) the ecological function provided by the habitat is important; 2) the habitat is sensitive to human-induced environmental degradation; 3) development activities are, or will be, stressing the habitat type; or 4) the habitat type is rare. It is possible that an area can meet one HAPC criterion and not be designated an HAPC. The WPRFMC used a fifth HAPC criterion, not established by NMFS, that includes areas that are already protected, such as Overlay Refuges (WPRFMC 2009a).

The Guidelines of the CWA 404(b)(1) are federal regulations developed between the USEPA and the Army to articulate policies and procedures to be used in the determination of the type and level of mitigation necessary to demonstrate CWA compliance, with the objective to restore and maintain the chemical, physical, and biological integrity of the Nation's waters, including special aquatic sites (SAS). SAS are those sites identified in 40 CFR 230, Subpart E (i.e., sanctuaries and refuges, wetlands, mud flats, vegetated shallows, coral reefs, and riffle and pool complexes). The guidelines are binding on the U.S. Army Corps of Engineers (USACE) as the agency charged with implementing the Section 404 permitting program. The USACE is prohibited from issuing a permit for any discharge of dredged or fill material in waters of the U.S. that does not comply with the CWA Guidelines.

SAS are geographic areas, large or small, possessing special ecological characteristics of productivity, habitat, wildlife protection, or other important and easily disrupted ecological values. These areas are generally recognized as significantly influencing or positively contributing to the general overall environmental health or vitality of the entire ecosystem of a region.

In general, the main intentions of the three federal acts listed above are as follows:

- The ESA establishes protection over and conservation of threatened and endangered species and the ecosystems upon which they depend, and requires any action that is authorized, funded, or carried out by a federal entity to ensure its implementation would not jeopardize the continued existence of listed species or adversely modify critical habitat.
- The MMPA was established to protect marine mammals by prohibiting take of marine mammals without authorization in U.S. waters and by U.S. citizens on the high seas, and the importation of marine mammals and marine mammal products into the U.S.
- The M-SA requires NMFS and regional fishery management councils to minimize, to the extent practicable, adverse effects to EFH caused by fishing activities. The M-SA also requires federal agencies to consult with NMFS about actions that could damage EFH.
- The CWA Guidelines set forth a goal of restoring and maintaining existing aquatic resources, including SAS (i.e. coral reefs, wetlands etc.).

The ESA, MMPA, and M-SA require that NMFS and/or USFWS be consulted when a proposed federal action may adversely affect an ESA-listed species, a marine mammal, EFH or HAPC. In addition, while all habitats are important to consider, 'coral reef ecosystems' are perhaps the most important habitats and the analysis of this SAS is included under EFH. As a note, EO 13089 also mandates preservation and protection of U.S. coral reef ecosystems that are defined as "… those species, habitats and other natural resources associated with coral reefs in all maritime areas and zones subject to the jurisdiction and control of the U.S." This guidance is intended to clarify and reemphasize the protection afforded the Nation's valuable coral reef ecosystems under the CWA Section 404 regulatory program, the Marine Protection, Research, and Sanctuaries Act (MPRSA) Sections 102 and 103 provisions, Rivers and Harbors Act Section 10 requirements, and Federal Projects conducted by the Corps.

For dredging activities, USACE first makes a determination that potential impacts have been avoided to the maximum extent practicable (striving to avoid adverse impacts); remaining impacts would be mitigated the extent appropriate and practicable by requiring steps to reduce impacts; and finally, compensate for aquatic resource values. This sequence is considered satisfied where the proposed mitigation is in accordance with specific provisions of a USACE and USEPA approved comprehensive plan that ensures compliance with the compensation requirements of the Guidelines Determination of Significance.

Best Management Practices and Protective Measures

The implementation of appropriate resource agency (USFWS/NOAA/NMFS) BMPs, construction and industrial permit BMPs, Navy LID concept plans and Integrated Management Practices (IMPs), USACE permit conditions, and general maritime measures in place by the military and USCG is assumed for each resource and anticipated to reduce any construction- and operation-related impacts to marine biological resources. With respect to possible construction impacts on the nearshore marine environment, the implementation and management of such plans would reduce/eliminate any construction-related stormwater runoff into the nearshore environment. The LID concept plan would support master planning activities, and through these joint efforts, a sustainable development strategy would be implemented where pre-construction site hydrology would be equal or nearly equal to post- construction hydrology. Stormwater would be treated for pollutants prior to discharge to the porous ground surface. Other avoidance and minimization measures employed during operations may include the use of "green bullets" composed of non-toxic alloys and periodic benthic cleanup. Considering the small percentage of bullets that pass the bermed areas due mainly to ricochets, and the even smaller percentages that make it into the marine environment, these measures are not anticipated to be necessary.

General maritime protective measures in place by the military (which may apply to ranges with SDZs overwater) include lookouts trained to sight marine mammals or sea turtles. Specific duties include the following (U.S. Fleet Forces 2007):

- All commanding officers, executive officers, lookouts, and officers of the deck (or range) complete the NMFS-approved Navy Marine Species Awareness Training, which is a DVD-based instructional course. All bridge (or range) watchstanders/lookouts would complete both parts one and two of the Marine Species Awareness Training; part two is optional for other personnel. This training addresses the lookout's role in environmental protection, laws governing the protection of marine species, Navy stewardship commitments and general observation information to aid in avoiding interactions with marine species.
- Navy lookouts undertake extensive training in order to qualify as a watchstander in accordance with the *Lookout Training Handbook* (NAVEDTRA 12968-B).
- Lookout training includes on-the-job instruction under the supervision of a qualified, experienced watchstander. Following successful completion of this supervised training

period, lookouts complete the Personal Qualification Standard Program, certifying that they have demonstrated the necessary skills (such as detection and reporting of partially submerged objects).

- Lookouts are trained in the most effective means to ensure quick and effective communication within the command structure in order to facilitate implementation of protective measures if marine species are spotted.

The *Environmental Handbook for Trainers* further states the following:

- Survey the area after each exercise for any harmful objects, abandoned wire, netting and other debris that poses a danger to people and wildlife.

A detailed listing of BMPs is provided in Volume 7 of this EIS.

11.2.1.2 Determination of Significance

This section analyzes the potential for impacts to marine biological resources from implementation of the action alternatives and the no-action alternative. Factors considered in the analysis of potential impacts to marine biological resources include: (1) importance (i.e., legal, commercial, recreational, ecological, or scientific) of the resource; (2) proportion of the resource that would be affected relative to its occurrence in the region; (3) sensitivity of the resource to proposed activities; and (4) duration of ecological ramifications. The factors used to assess significance of the effects to marine biological resources include the extent or degree that implementation of an alternative would result in permanent loss or long-term degradation of the physical, chemical, and biotic components that make up a marine community. The following significance criteria were used to assess the impacts of implementing the alternatives:

- The extent, if any, that the action would diminish suitable habitat for a special-status species or permanently lessen designated EFH or HAPC for the sustainment of managed fisheries.
- The extent, if any, that the action would disrupt the normal behavior patterns or habitat of a federally listed species, and substantially impede the Navy's ability to either avoid jeopardy or conserve and recover the species.
- The extent, if any, that the action would diminish population sizes or distribution of special-status species or designated EFH or HAPC.
- The extent, if any, that the action would be likely to jeopardize the continued existence of any special-status species or result in the destruction or adverse modification of habitat of such species or designated EFH or HAPC.
- The extent, if any, that the action would permanently lessen physical and ecological habitat qualities that special-status species depend upon, and which partly determines the species' prospects for conservation and recovery.
- The extent, if any, that the action would result in a substantial loss or degradation of habitat or ecosystem functions (natural features and processes) essential to the persistence of native flora or fauna populations.
- The extent, if any, that the action would be inconsistent with the goals of the Navy's Integrated Natural Resources Management Plan (INRMP).

The MMPA generally defines harassment as Level A or Level B, and these levels are defined uniquely for acts of military readiness such as the proposed action. Public Law 108-136 (2004) amended the MMPA definition of Level A and Level B harassment for military readiness events, which applies to this action.

- Level A harassment includes any act that injures or has the significant potential to injure a marine mammal or marine mammal stock in the wild.
- Level B harassment is now defined as "any act that disturbs or is likely to disturb a marine mammal or marine mammal stock by causing disruption of natural behavioral patterns including, but not limited to, migration, surfacing, nursing, breeding, feeding, or sheltering to a point where such behaviors are abandoned or significantly altered." Unlike Level A harassment, which is solely associated with physiological effects, both physiological and behavioral effects may cause Level B harassment.

ESA specifically requires agencies not to "jeopardize" the continued existence of any ESA-listed species, or destroy or adversely modify habitat critical to any ESA-listed species. Under Section 7, "jeopardize" means to engage in any action that would be expected to reduce appreciably the likelihood of the survival and recovery of a listed species by reducing its reproduction, numbers, or distribution. Section 9 of the ESA defines "take" as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect.

Effects determinations for EFH assessments are either "no adverse effect on EFH" or "may adversely affect EFH" (WPRFMC 2009a). Pursuant to 50 CFR 600.910(a), an "adverse effect" on EFH is defined as any impact that reduces the quality and/or quantity of EFH. Adverse effects to EFH require further consultation if they are determined to be permanent versus temporary (NMFS 1999). To help identify Navy activities falling within the adverse effect definition, the Navy has determined that temporary or minimal impacts are not considered to "adversely affect" EFH. 50 CFR 600.815(a)(2)(ii) and the EFH Final Rule (67 FR 2354) were used as guidance for this determination, as they highlight activities with impacts that are more than minimal and not temporary in nature, opposed to those activities resulting in inconsequential changes to habitat. Temporary effects are those that are limited in duration and allow the particular environment to recover without measurable impact (67 FR 2354). Minimal effects are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions (67 FR 2354). Whether an impact is minimal would depend on a number of factors (Navy 2010c):

- The intensity of the impact at the specific site being affected
- The spatial extent of the impact relative to the availability of the habitat type affected
- The sensitivity/vulnerability of the habitat to the impact
- The habitat functions that may be altered by the impact (e.g., shelter from predators)
- The timing of the impact relative to when the species or life stage needs the habitat

The analysis of potential impacts to marine biological resources considers direct, indirect, and cumulative impacts (see Volume 7 of this EIS for the cumulative impacts analysis). The *Council on Environmental Quality* , *Section 1508.08 Effects,* defines direct impacts as those that are caused by the action and occur at the same time and place, while indirect impacts occur later in time or farther removed in distance, but are still reasonably foreseeable. Direct impacts may include: the removal of coral and coral reef habitat, the "taking" of special-status species, increased noise, decreased water quality, lighting impacts resulting from construction or operation activities. Indirect impacts, for the purposes of this evaluation, may include any sedimentation/siltation of coral reef ecosystems resulting from construction or operational activities (i.e., dredging, resuspension of sediment via propeller wash), or recreational activities in the vicinity of the resource that may lead to impacts to special-status species and EFH.

If marine biological or aquatic resources could be significantly impacted by proposed project activities, potential impacts may be reduced or offset through implementation of appropriate BMPs and/or mitigation measures. "Significantly" as used in National Environmental Policy Act (NEPA) Per (per 43 FR 56003, November 29, 1978; 44 FR 874, January 3, 1979) requires considerations of both context and intensity:

- Context. This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.
- Intensity. This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. Impacts associated with the fouling communities within Inner Apra Harbor (repair of waterfront facilities) were not included in the Habitat Equivalency Analysis (HEA) Volume 9. These communities are not considered to be coral reef (per 40 CFR Section 230.44) definition of what constitutes a coral reef), and therefore are not subject to compensatory mitigation.

11.2.1.3 Issues Identified during Public Scoping Process

The following analysis focuses on possible effects to marine biological resources that could be impacted by the proposed action. As part of the analysis, concerns relating to marine biological resources that were mentioned by the public, including regulatory stakeholders, during scoping meetings were addressed. A general account of these comments includes the following:

- Potential impacts on the Apra Harbor marine environment from CVN berthing, fully documenting impacts from dredging (acreage and ecosystem characteristics of affected area, depth of dredging operations, duration of affects)
- Potential impacts to endangered species (including nesting habitats), species of concern, and federal trust species such as corals and marine mammals
- Potential impacts from military expansion from all project sites on the marine resources, including removal or disturbance of the marine habitat
- Impacts to culturally significant marine-related areas for subsistence fishing and beliefs
- Increased "high impact" recreational use that would damage the ecosystem and impact fish habitat (e.g., Sasa Bay Marine Reserve)
- Increased land runoff impacting beaches and marine life (erosion and sediment stress)
- Increased anthropogenic factors impacting the coral reef ecosystem and concerns about the education and training that would be provided for newly arriving military personnel and their dependants regarding reef protection
- Mitigation measures and non-structural alternatives to avoid and minimize impacts to coral reefs

11.2.2 Alternative 1

11.2.2.1 North

<u>Andersen AFB</u>

Construction

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities associated with the proposed action that would impact the marine environment; therefore, no impacts to marine biological resources would occur from construction.

Operation

Potential operation effects of implementing the proposed action includes indirect recreational and subsistence harvesting impacts from the increase in military personnel to the Andersen AFB area, including surrounding waters and beaches. Because the shore area is relatively accessible to military personnel and their dependents, many of the marine biological resources discussed in this chapter may experience indirect long-term adverse effects from increased recreational activities due to the substantial increase of people potentially using the intertidal and coastal waters. Recreational activities such as snorkeling, scuba diving, boating (anchoring, fishing, diving, snorkeling), and fishing practices (pole, gill/throw net, and spear fishing) may result in indirect loss of sensitive marine habitat (Figure 11.2-1 and 11.2-2).

Consistent with the Andersen AFB INRMP, the outdoor recreation program on base strives to provide opportunities for quality passive recreational experiences. The program also strives to promote an understanding and develop support for environmental programs by enhancing public awareness and appreciation of the natural environment at Andersen AFB. Providing adequate opportunity for personnel to enjoy quality passive recreational activities in the Tarague Beach area supports the outdoor recreational goals established in the Andersen AFB INRMP. Where impacts on aquatic habitats occur as a result of mission activities, management objectives provide for the timely mitigation of the impacts (Pacific Air Forces [PACAF] 2008).

The Pati Point Natural Area and the Andersen AFB Marine Resources Preserve were established to protect and enhance coastal resources on base. Within the Pati Point Marine Preserve there are prohibitions on spearfishing and the use of gill nets or throw nets to protect fish and enhance marine fisheries production in the area. The collection of any marine organisms (dead or alive) is prohibited except by fishing with a hook and line from designated areas of the shoreline. The MPA boundary extends seaward to any distance where spear or net fishing is observed.

Marine Flora, Invertebrates and Associated EFH

These resources have the potential to be significantly impacted by increased recreational use of the intertidal and nearshore environment as described above. The increased usage is anticipated to be managed appropriately with continued proactive natural resource management actions as mentioned above, and as described in the Andersen AFB INRMP and Conservation Management Plan. Potential significant impacts to marine biological resources are anticipated to be reduced prior to impact by these existing plans. Therefore, Alternative 1 would result in less than significant impacts to marine flora or invertebrates. There would be no adverse effect on associated EFH.

Essential Fish Habitat

Considering the increase of operation-related (military) personnel and their dependents ability to gain access to Andersen AFB, an increased usage of adjacent coastal waters for recreational activities is expected. This increased usage has a minor potential for long-term reduction of the quality and/or quantity of CREMUS (specifically coral) (Table 11.2-1). The WPRFMC FEP for the Mariana Archipelago (2009a) identifies "fishing related and non-fishing related impacts that may adversely affect EFH." One or more of the impacts described may apply to this study area.

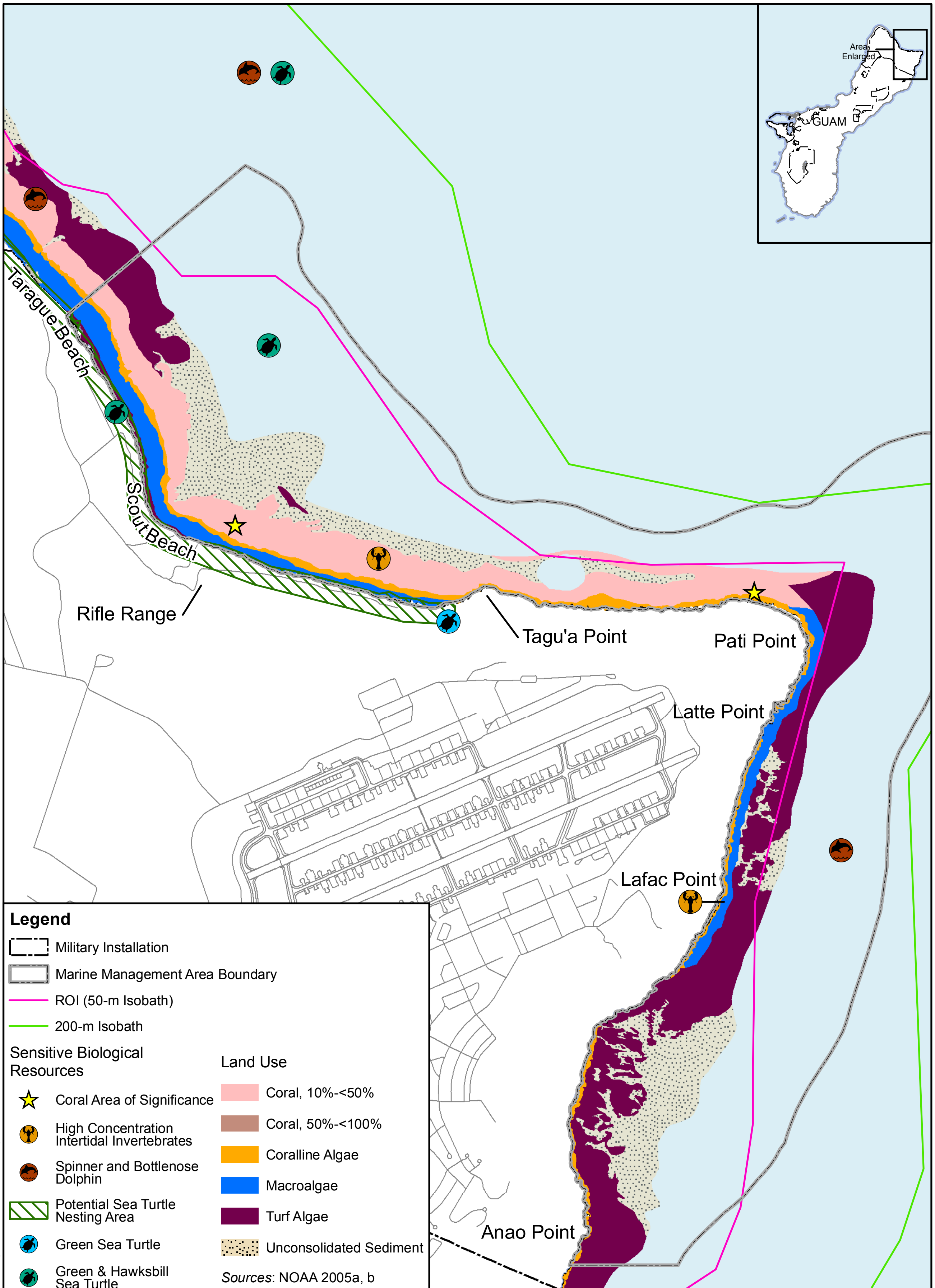
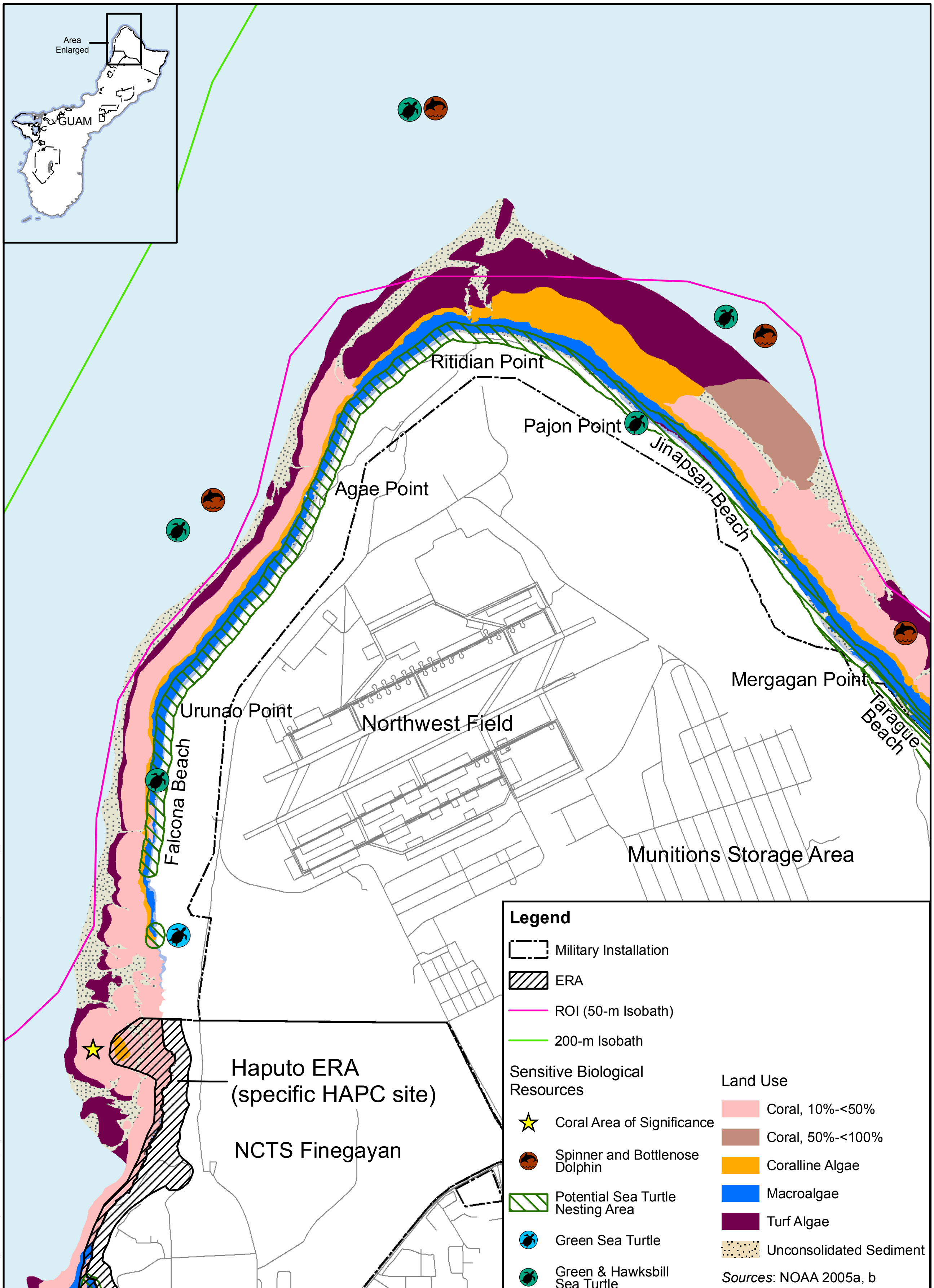


Figure 11.2-1
Sensitive Marine Biological Resources and Nearshore Habitat Associated with Andersen AFB East



Printing Date: Apr 8, 2010, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\11.2-2.mxd

Figure 11.2-2
Sensitive Marine Biological Resources and Nearshore Habitat Associated with Andersen AFB West

Direct impacts to fishing due to the growth in the military population and dependents are expected to be less than significant and would not adversely affect EFH. This is based partly on studies indicating that military personnel do not play a large role in recreational fishing (Allen and Bartram 2008). As noted, military personnel tend to use charter services and these made up only 7% of the fleet. The majority of recreational fishing is done by local residents, with a much smaller group made up of tourists, military personnel, and residents associated with the military (Allen and Bartram 2008). Given these factors, it is not expected that impacts to recreational fishing or the near shore environment would be significant. Recreational fishing has been in decline since the mid 1990s, in both trip numbers and catch levels, trends also suggest that community dependence on seafood is waning (Allen and Bartram 2008). In addition, the WPRFMC (2009b) indicates that the fish resources surrounding Guam are not being over fished. Current levels of recreational fishing are well below the historic highs of the 1990's, and the military relocation on Guam is not likely to contribute directly to further decline of this resource. Therefore, long-term impacts of the proposed action would be less than significant and would not adversely affect EFH.

Impacts to the coral reef ecosystem surrounding Guam would be minor, long-term, and localized. Coral reef ecosystems are threatened by human activities such as direct damage to reefs from anchors, increased fishing pressures, including destructive fishing methods, reef walking by beach goers at low tide, and floundering snorkelers and divers, and indirect damage from coastal runoff and pollution. All of these potential impacts are directly related to increased population size. DoN plans to educate its service members, dependants and construction workers on the importance of coastal ecosystems and the proper way to interact with those resources to avoid and minimize damage to reefs typically caused by anchors, reef-walkers, or reckless diving, snorkeling, and fishing activities. The DoN anticipates increased coastal resource management from local and federal agencies with the pending induced population growth.

Considering current enforcement of Andersen AFB INRMPs and natural resource management actions (e.g.,no intertidal taking of marine animals and hook and line fishing at designated locations), including designated swimming and snorkeling areas, this potential increased indirect impact is anticipated to be minimal. Additionally, the increased ocean-related recreational activites would be spread among several DoD (and non-DoD) locations.

Based on this assessment, Alternative 1 would result in no adverse effects on EFH. Any effects would be further reduced with the implementation of BMPs and mitigation measures as described in Volume 7, including an update to the Guam Comprehensive Outdoor Recreation Plan, which would provide data facilitating an estimation of potential marine environment impacts due to marine recreational activities on Guam (see Volume 2, Chapter 9 and Volume 7 for further information

Special-Status Species

No direct impact on this resource is expected with the implementation of the natural resource management plans described above.

There may be long-term, indirect impacts on this resource due to the potential for a considerable increase of operational personnel and their dependents traveling to Andersen AFB to use the coastal waters for recreational activities. Increased dive boat operations have the potential for increased turtle and marine mammal harassment and strikes, impacting special-status species. However, considering the mobility of sea turtles and dolphins in the water, and the protective measures currently in place (i.e., by dive boat operators and the Air Force), these increased recreational activities may affect, but are not likely to adversely affect sea turtles with the implementation of Alternative 1 actions. No serious injury or mortality of any marine mammal species, specifically spinner and bottlenose dolphins, is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1. Therefore, Alternative 1 would result in less than significant impacts to special-status species.

Potential impacts to nesting sea turtles are addressed in this EIS in Volume 2, Chapter 10, Terrestrial Biological Resources.

Non-Native Species

There would be no direct impact to this resource. No in-water operation or training activities are proposed in the marine environment; therefore, no major conduit exists for introduction of non-native species into the marine environment.

Increased indirect impacts may result from boating-related recreational activities (e.g., personnel boats and dive tours) associated with operations-based personnel, which have the potential for transport of non-native species to and from other locations within the Mariana Islands chain.

Table 11.2-1 identifies the potential effects associated with fish and EFH.

Table 11.2-1. EFH Areas Associated with Andersen AFB and Potential Effects

EFH Habitat Description	*Area of Occurrence*	*Associated Activity*	*Effect*
Corals/Coral Reef Ecosystem	Pati Point MPA, including coral reef ecosystem with high coral coverage off-shore of Jinapsan, Tarague, and Scout Beaches, which may be outside MPA	Potential increase in nearshore, ocean-related recreational activites	No adverse effect. Minor potential for long-term reduction in the quality and/or quantity of EFH through long-term, periodic and localized degradation.
Marine Water Column	Piti Point MPA and coral reef ecosystem outside MPA	Potential increase in nearshore, ocean-related recreational activites	No adverse effect. Minor long-term, periodic and localized.
Intertidal Zones	Andersen AFB Coastline	Potential increase in nearshore, ocean-related recreational activites	No adverse effect. Minor, long-term, periodic and localized.

This increase above existing conditions (no-action alternative) is expected to be minimal. Any potential introduction/transport of non-native species may be lessened or even prevented through appropriate BMPs and existing Navy and USCG policies as discussed in the existing conditions section. Additionally, a MBP is expected to bring a new level of regulation, monitoring, and mitigation to the movement of invasive species in the South Pacific. Therefore, Alternative 1 would result in a less than significant impacts regarding non-native species introductions.

<u>Finegayan</u>

Construction

Construction of the main cantonment, family housing, and community support facilities would take place at Finegayan under Alternative 1. The main cantonment land use functions include bachelor housing, supply warehouses, maintenance facilities, various headquarters and administrative support facilities, community support functions (e.g., retail, education, recreation, medical, day care, etc.), some training areas, and open space.

Marine Flora, Invertebrates and Associated EFH

These resources would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permit BMPs and IMPs discussed in Section 11.2.1.1. Therefore, Alternative 1 would result in less than significant impacts to marine flora and invertebrates, and there would be no adverse effect on associated EFH.

Potential impacts to species included in a regional FEP are addressed accordingly under Essential Fish Habitat.

Essential Fish Habitat

No direct impact on these resources are expected. There would be no adverse effects on EFH from stormwater, sedimentation, or other non-point source pollution from construction projects since appropriate BMPs and LID would be implemented.

Depending on the amount of fishing and diving done by constructions workers and other induced population, there could be indirect impacts to recreational and traditional fishing during the construction period. Most temporary workers would be at work during daylight hours, and therefore only able to participate in recreational fishing at night, on weekends, or during holidays, which would reduce the anticipated increase in fishing activity. The impacts will be short-term and localized, and therefore minimal. No adverse effect to EFH is expected from the increase in recreational activites of construction workers and other induced growth.

Impacts to the coral reef ecosystem located near the project area may occur from increased use of this resource by construction workers; the magnitude of impacts is directly related to the increase in recreational use. DoN plans to educate its service members, dependants and construction workers on the importance of coastal ecosystems and the proper way to interact with those resources to avoid and minimize damage to reefs typically caused by anchors, reef-walkers, or reckless diving, snorkeling, and fishing activities. Construction personnel or their dependents would not be permitted to have direct land-based access to the Haputo ERA and adjacent coastal waters for recreational activities. However, an increase in recreational use of Haputo ERA may be seen through such activities as dive boat tours. To prevent disturbance of sensitive species in recreational areas, restrictions on the use of Haputo Beach and ERA would be included within the joint region INRMP.

Indirect and inducted impacts as a result of actions associated with Alternative 1 would not be significant and there would be no adverse effect on EFH. Impacts are expected to be short-term and localized, and therefore minimal. No adverse effect to EFH is expected from the proposed action.

Special-Status Species

No direct impact on this resource is expected with the implementation and management of appropriate construction permits BMPs and IMPs.

This resource would not be appreciably modified from existing conditions by indirect impacts. Construction personnel or their dependents would not be permitted to have direct land-based access to the Haputo ERA and adjacent coastal waters for recreational activities. No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1. Green sea turtles may be disturbed by increased activity in the area, but potential impacts would be short-term and minimal; therefore, Alternative 1 may affect, but is not likely to adversely affect the green sea turtle.

Non-Native Species

There would be no direct impact in relation to non-native species caused by activities associated with. No in-water construction, dredging, or training activities are proposed in the marine environment; therefore no major conduit exists for introduction of non-native species into the marine environment.

There may be increased recreational boating activities (e.g., personnel boats and dive tours) associated with construction personnel, which has the potential for transport of non-native species to and from other locations within the Mariana Islands chain. The potential increase of non-native speces introduction/transport is directly proportional to the increased boating trips. The introduction and/or transport of non-native species may be lessened or even prevented through appropriate BMPs and existing Navy and USCG hull management and ballast water policies as discussed in the existing conditions section. Additionally, a MBP is expected to bring a new level of regulation, monitoring, and mitigation to the movement of invasive species in the South Pacific. Therefore, Alternative 1 would result in a less than significant impact regarding non-native species introduction.

Operation

Potential operations effects of implementing the proposed action in the Finegayan area would occur in the Haputo ERA. Because the Haputo shore area is relatively accessible, many of the marine biological resources discussed in this chapter may experience indirect affects from increased recreational activities due to the increase of people potentially using Haputo ERA and coastal waters as a result of the proposed action (Figure 11.2-3). Increased subsistence harvesting, recreational activities such as snorkeling, scuba diving, boating (anchoring, fishing, diving, snorkeling), and fishing practices (pole, gill/throw net, and spear fishing), may occur and result in indirect impacts to Haputo ERA. Any potential impact would be mitigated to less than signficant through implementation of the existing Navy Interim Final INRMP (COMNAV Marianas 2008b) and including restrictions on the use of Haputo Beach within the Joint Region INRMP. Additional preventative measures may include marine biological resource education and training on ESA, MMPA and EFH to military personnel and public outreach; controlled access (a short video and access pass required before entry); informational documents (i.e., preparation of a *Military Environmental Handbook);* distribution of natural resource educational materials to dive boat operators; multiple designated mooring areas offshore; and increased efforts toward ERA enforcement (starting with Haputo).

Marine Flora, Invertebrates and Associated EFH

These resources would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline. Access to Haputo Beach from the upper plateau area (i.e. Finegayan housing) is by trail only and would limit access to most personel and dependants due to the difficulty in traversing the steep trail. Additonally, the minimal runoff from the limestone landscape, and the implementation and management of appropriate industrial stormwater pollution prevention plans and preventative measures as mentioned above. Therefore, Alternative 1 would result in no impacts to marine flora or invertebrates. There would be no adverse effect on associated EFH.

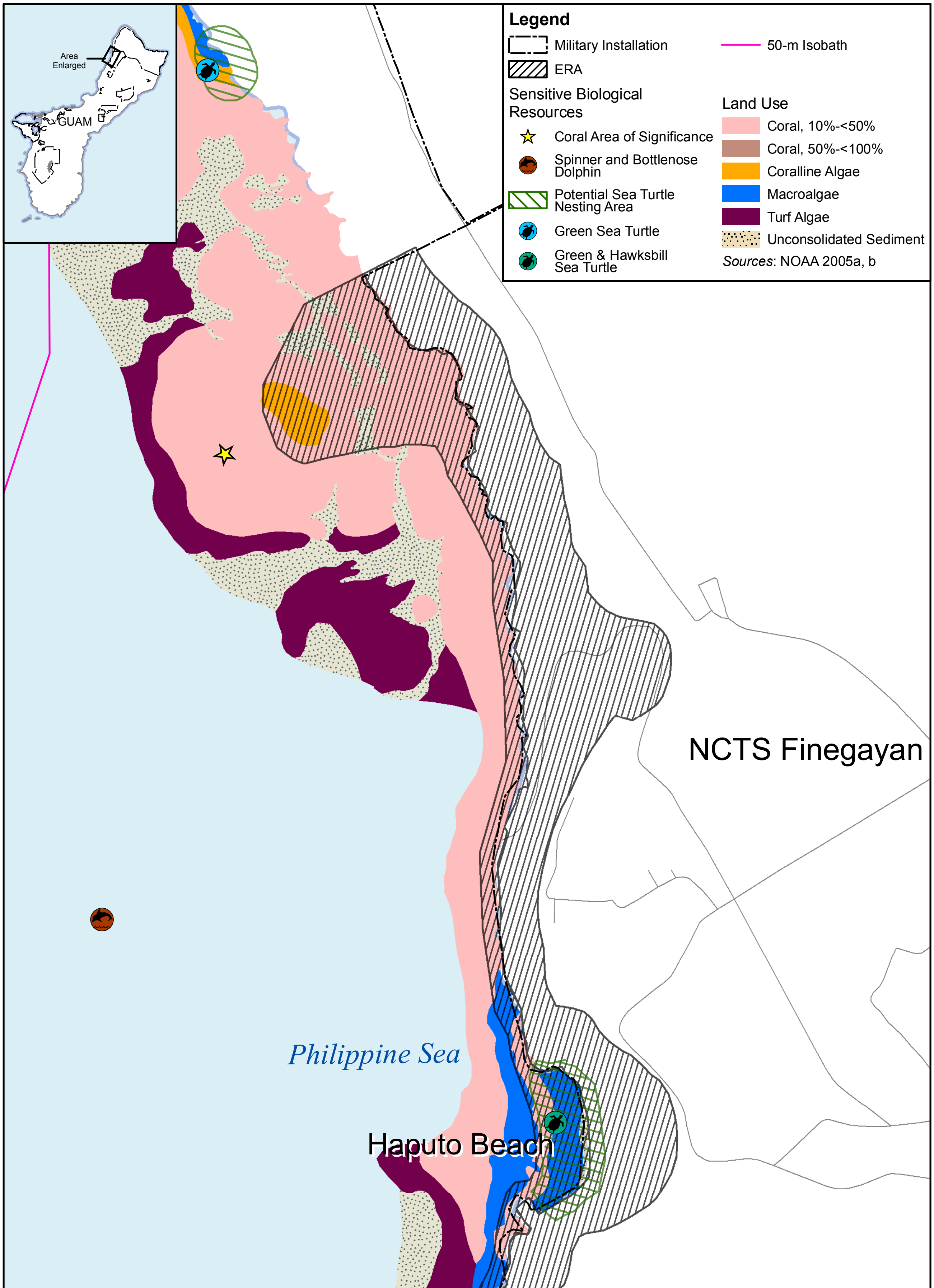


Figure 11.2-3
Sensitive Marine Biological Resource and Habitat impacts associated with NCTS Finegayan

Essential Fish Habitat

Considering the increase of operation-related (military) personnel and their dependents working and living at Finegayan (see Volume 2, Section 2.1), an increased usage of Haputo ERA and adjacent coastal waters for ocean recreational activities is anticpated. This increased usage has a minor potential for long-term reduction of the quality and/or quantity of CREMUS (specifically coral) (Table 11.2-3). As described in the affected environment section, the coral within the Haptuo ERA is considered some of the most pristine on the island. The WPRFMC FEP for the Mariana Archipelago (2009a) identifies "fishing related and non-fishing related impacts that may adversely affect EFH," in Sections 6.4 and 6.5, respectively, of the FEP. One or more of these impacts described may apply to this study area. Direct impacts to fishing due to the growth in the military population and dependents are expected to be less than significant and would not adverstly affect EFH. This is based partly on studies indicating that military personnel do not play a large role in recreational fishing (Allen and Bartram 2008). As noted, military personnel tend to use charter services and these made up only 7% of the fleet. The majority of recreational fishing is done by local residents, with a much smaller group made up of tourists, military personnel, and residents associated with the military (Allen and Bartram 2008). Given these factors, it is not expected that impacts to recreational fishing or the near shore environment would be significant. Recreational fishing has been in decline since the mid 1990's, in both trip numbers and catch levels, trends also suggest that community dependence on seafood is waning (Allen and Bartram 2008). In addition, the WPRFMC (2009b) indicates that the fish resources surrounding Guam are not being over fished. Current levels of recreational fishing are well below the historic highs of the 1990's, and the military relocation on Guam is not likely to contribute directly to further decline of this resource. Therefore, long-term impacts of the proposed action would be less than significant.

Impacts to the coral reef ecosystem surrounding Guam would be minor, long-term, and localized. Coral reef ecosystems are threatened by human activities such as direct damage to reefs from anchors, increased fishing pressures, including destructive fishing methods, reef walking by beach goers at low tide, and floundering snorkelers and divers, and indirect damage from coastal runoff and pollution. All of these potential impacts are directly related to increased population size. DoN plans to educate its service members, dependants and construction workers on the importance of coastal ecosystems and the proper way to interact with those resources to avoid and minimize damage to reefs typically caused by anchors, reef-walkers, or reckless diving, snorkeling, and fishing activities. The DoN anticipates increased coastal resource management from local and federal agencies with the pending induced population growth.

Access to Haputo Beach is difficult due to the steep jungle trail. Implementation and enforcement of appropriate BMPs and mitigation measures, including an update of the Guam Comprehensive Outdoor Recreation Plan that would provide data for estimating potential marine environment impacts due to marine recreational activities on Guam (see Volume 2, Chapter 9 and Volume 7 for further information), would minimize effects.

It is anticipated that the popular dive sites at Haptuo ERA may experience increased usage outside of DoD control, however mitigation measures would minimize these effects.

Based on the analysis above, Alternative 1 would result in no adverse affect to EFH. Alternative 1 would result in less than significant impacts to fish and EFH; Table 11.2-2 identifies the potential effects associated with fish and EFH.

Table 11.2-2. EFH Areas Associated with Finegayan and Potential Effects

EFH Habitat Description	*Area of Occurrence*	*Associated Activity*	*Effect*
Corals/Coral Reef Ecosystem	Haputo ERA, including Double Reef, coral reef ecosystem outside ERA, including off-shore of Haputo Beach	Potential increase in nearshore, ocean-related recreational activites	No adverse effect. Potenital long-term, minimal periodic and localized degradation of the quality and/or quantity of EFH.
Marine Water Column	Haputo ERA and coral reef ecosystem outside ERA	Potential increase in nearshore, ocean-related recreational activites	No adverse effect. Minor long-term, periodic and localized impacts.
Intertidal Zones	NCTS Finegayan Coastline	Potential increase in nearshore, ocean-related recreational activites	No adverse effect. Minor long-term, periodic and localized impacts.

Special-Status Species

No direct impact on this resource is expected with the implementation and management of appropriate industrial permits and BMPs described above and in Volume 7.

There may be long-term, indirect impacts on this resource due to an increase of operational personnel and their dependents using the Haputo ERA and adjacent coastal waters for recreational activities. Increased dive boat operations have the potential for increased turtle and marine mammal harassment and strikes, impacting special-status species. Considering the mobility of sea turtles and dolphins in the water, and the protective measures anticipated to be in place (i.e., by dive boat operators and Navy), these increased recreational activities may affect, but are not likely to adversely affect sea turtles with the implementation of Alternative 1 actions. No serious injury or mortality of any marine mammal species, specifically spinner and bottlenose dolphins, is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1. Therefore, Alternative 1 would result in less than significant impacts to special-status species.

Potential impacts to nesting sea turtles are addressed further under Volume 2, Chapter 10, Terrestrial Biological Resources.

Non-Native Species

There would be no direct impact to this resource. No in-water operation or training activities are proposed in the marine environment, therefore no major conduit exists for introduction of non-native species into the marine environment.

There may be increased recreational boating (e.g., personnel boats and dive tours) associated with operations-based personnel which have the potential for transport of non-native species to and from other locations within the Mariana Islands chain. The potential increase of non-native speces introduction/transport is directly proportional to the increased boating trips. The introduction and/or transport of non-native species may be lessened or even prevented through appropriate BMPs and existing Navy and USCG hull management and ballast water policies as discussed in the existing conditions section. Additionally, a MBP is expected to bring a new level of regulation, monitoring, and mitigation to the movement of invasive species in the South Pacific. Therefore, Alternative 1 would result in a less than significant impacts regarding non-native species introductions.

Non-DoD Land

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities that would impact the marine environment; therefore, no impacts to marine biological resources would result from the proposed action.

11.2.2.2 Central

Andersen South

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities that would impact the marine environment; therefore, no impacts to marine biological resources would result from either construction or operations associated with the proposed action.

Non-DoD Land

Construction

As described in Section 2.3.1 Alternatives Development, Volume 2, to minimize the non-DoD land required, planning density assumptions were re-evaluated. There are two alternatives for the Route 15 Range Lands firing range complex:

- Alternative A. All ranges would be on the plateau area of the Route 15 lands. This training option would require realignment of Route 15 to accommodate the machine gun range. Land available for other land uses at Andersen South would be reduced (see Figure 2.3-6).
- Alternative B. The machine gun range would be sited in the valley and all other ranges would be sited on the plateau area of the Route 15 Range Lands. There would be no realignment of Route 15, no impact to available land at Andersen South, and would not require more land acquisition or long term leasing than training Alternative A (see Figure 2.3-7).

The impacts described below would be similar for either Alternative A or B.

Marine Flora, Invertebrates and Associated EFH

These resources would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, and the minimal runoff from the limestone landscape. Therefore, Alternative 1 would result in no impacts to marine flora and invertebrates; there would be no adverse effect on associated EFH.

Essential Fish Habitat

Impact analysis would be similar to previous NCTS and AAFB construction-related sections. There would be short-term and localized, negligible indirect impacts to fish and EFH due to the increase of construction personnel and their dependents that may use the adjacent coastal waters for recreational activities. The potential for long-term reduction of the quality and/or quantity of CREMUS (specifically corals) of the EFH does not exist for the following reasons: the shoreline is exposed to dominant winds, wave action and storms and is not readily accessible by land or boat; and the construction project is not as large as other areas (e.g., NCTS Finegayan), As a result, no adverse indirect effects are expected to EFH, therefore Alternative 1 would have no adverse effect on EFH.

Special-Status Species

A less than significant indirect impact to this resource is expected from construction-related recreational activities for similar reasons as described above in EFH. Additionally, special-status species are not as common on this coast compared to others around Guam and there are no sea turtle nesting areas (NOAA 2005a [see operation description below for elaboration]). No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1. Activities associated with Alternative 1 may affect, but are not likely to adversely affect sea turtles. Therefore, Alternative 1 would result in a less than significant impact to special-status species.

Non-Native Species

There would be no direct impact to this resource. No in-water construction, dredging, or training activities are proposed in the marine environment. Increased recreational boating may have the potential for transport of non-native species to and from other locations within the Mariana Islands chain. Access to this rough water coast is difficult during the winter months, however during the summer the waters are fairly calm resulting in increased boating activities. Therefore there are opportunities for increased introduction of non-native species into the marine environment.

Any potential introduction/transport of non-native species would be lessened or even prevented through appropriate BMPs and existing Navy and USCG ballast water policies and the DoD-funded MBP, as discussed in the existing conditions section. The MBP is expected to bring a new level of regulation, monitoring, and mitigation to the movement of invasive species in the South Pacific Consequently, Alternative 1 would result in a less than significant impact regarding introduction of non-native species.

Operation

Increased recreational activities and subsistence harvesting such as snorkeling, scuba diving, boating (anchoring, fishing, diving, snorkeling), and fishing practices (pole, gill/throw net, and spear fishing), may occur and result in indirect loss of habitat offshore if not properly mitigated. However, because the Route 15 Range Lands shore area is not readily accessible, it is anticipated that marine biological resources would be minimally impacted by indirect, long-term ocean-related recreational activities from increased personnel using the coastal waters (Figure 11.2-4). Range activities, specifically the SDZs, are analyzed for potential impacts on marine mammals in the offshore waters in the following special-status species subsection below.

Marine Flora, Invertebrates and Associated EFH

These resources would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate industrial permits and BMPs as mentioned above. Therefore, Alternative 1 would result in no impacts to marine flora or invertebrates; there would be no adverse affect on associated EFH.

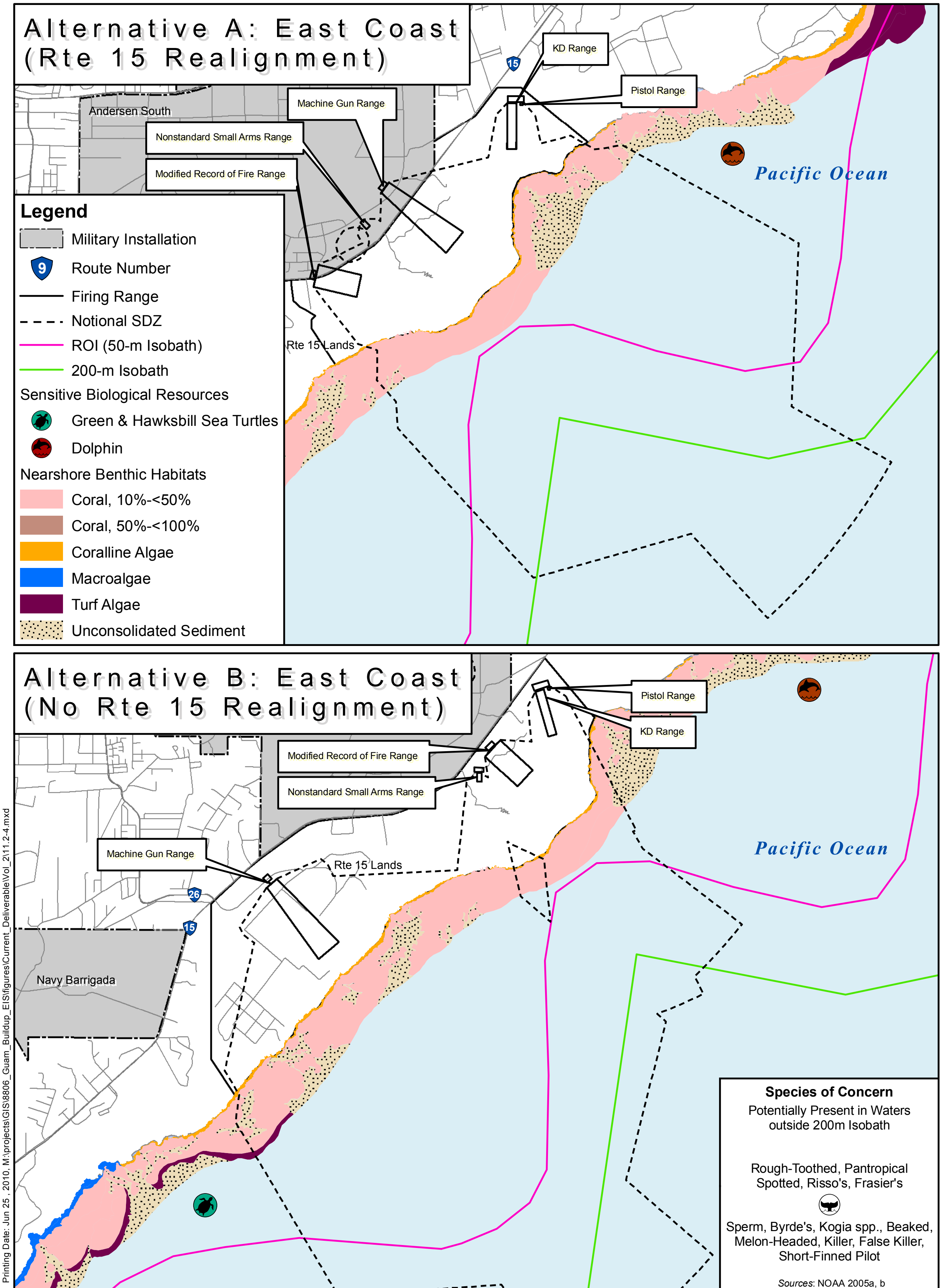


Figure 11.2-4
Sensitive Marine Biological Resource and Habitat impacts associated with Rte 15 Range Lands, Guam

Essential Fish Habitat

Impact analysis would be similar to previous NCTS and AAFB operation-related sections.There would be no direct impact on these resources, as described above.

There would be minimal indirect impacts to EFH from ocean-related recreational activities of operations personnel and their dependents. Impact assessment reasoning is similar as that as described above under Construction. Additionally, there may be a beneficial impact to nearshore communities due to limited and controlled access at the coastline during training operations.

There would be long-term, localized accumulation of small arms (.50 caliber and MK19 TP) expended materials in the benthic habitat from the firing range operations. However, there would be limited potential for ingestion by fish considering the number of bullets that would enter the water and that they would sink to the bottom quickly (Navy 2010c). Avoidance and minimization measures (see Section 11.2.1.1), including the potential use of "green bullets" and periodic benthic cleanup, may be employed to decrease potential impacts. The "green bullets" are composed of non-toxic alloys and would not contaminate the surrounding areas or marine benthic habitat if munitions land in the water or were ingested. Therefore, considering the minimal amount of bullets that carry past the bermed areas and enter the marine environment, Alternative 1 would result in less than significant impacts to fish; there would be no adverse effect on EFH.

Table 11.2-3 includes information on the EFH types present in the study area and potential effects.

Table 11.2-3. EFH Areas Associated with Route 15 Range Lands and Potential Effects

EFH Habitat Description	*Area of Occurrence*	*Associated Activity*	*Potential Effect*
Coral and Coral Reefs	Pagat Point, live coral coverage area (10% -<50%).	Increased indirect recreational activities	No adverse effect. Minor potential for reduction in the quality and/or quantity through long-term, periodic and localized degradation offset by limited access during training activities and mitigation.
Intertidal Zone	Route 15 Lands Coastline	Increased recreational activity and range fire w/in SDZ	No adverse effect
Benthic Habitat	Pagat Point	Range Activities	No adverse effect. Minimal effect from expended munitions in the marine environment.

Special-Status Species

There would be a less than significant direct impact to special-status species from range operations based on the assessment below. Activities associated with range operations may affect, but are not likely to adversely affect sea turtles. No serious injury or mortality of any marine mammal species, specifically spinner and bottlenose dolphins, is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected. Figure 11.2-4 identifies the special-status species potentially present in coastal waters (Navy 2005), and depicts the surface danger zones SDZs for the training area. The potential for range training activities to lead to Level B harassment as defined by the MMPA (Section 11.2.1.2) or impact the ESA-listed sea turtle would be negligible for the following reasons:

special-status species, although potentially present within the ROI and offshore, are not common according to NOAA (2005a), which does not list any of these special-status species (dolphins or sea turtles) as commonly present within these coastal waters. However, according to GDAWR (2010) "…83 sea turtles were identified in the water (ocean and fore reef slope) foraging. Dolphins were seen on the aerial surveys (2000 thru 2009) with 260 estimated individuals." General maritime measures and range operations in place by the military include lookouts to keep vessels out of the SDZs and trained personnel to sight marine mammals or sea turtles. It is also anticipated that preventative measures would be developed by the military for activities at Route 15 Range Lands (among other areas) and would be described in Range and Training Regulations, Standing Operating Procedures for Range Control and revised Navy INRMPs. Actions described in these documents are Standard Operating Procedures (SOPs) that would be used in the future for all activities being analyzed in this EIS. Activities at the Route 15 Range Lands on Guam would use up to .50 caliber and MK19 TP, which are essentially inert, so there would be no explosive projectiles involved. All projectiles would be contained within the range footprint by bullet traps or backstops, with the exception of ricochets, which by statistical analysis could escape the range but would be contained within the SDZs.

Although the SDZs extend off the cliff and over the water (see Figure 11.2-4), all anticipated rounds would impact and be contained within the range. However, as these waters support visits by the special-status species and potential impacts may include direct strike or debris ingestion, estimates of the annual level of munitions and those that statistically may land in the water from the Route 15 Range Land are provided below. As only smaller munitions (in effect, .50 caliber) would be used, this would pose an even lower magnitude of risk to special-status species.

Table 11.2-4 summarizes the areas encompassed by the range footprint and SDZs associated with the firing ranges. Table 11.2-5 presents the daily and annual proposed use of the five proposed outdoor small arms qualification ranges. Table 11.2-6 presents summary data on the daily and annual use estimates for the demolition and explosive ranges (and small arms fire associated with the shooting house) under the proposed action. All live-fire training and support facilities that are part of the proposed action are described in the text that follows.

Table 11.2-4. Size of Proposed Firing Ranges and Associated Notional SDZs

Weapons Range	*Range Footprint (ac/ha)*	*Notional SDZ (ac/ha)*
Rifle KD	13/5	992/401
Pistol	0.2/.08	190/77
Square-Bay	1.3/0.5	722/292
Modified Record of Fire Range	31/13	728/295
Machine Gun	56/23	7,434/3,008

Table 11.2-5. Daily and Annual Use of Proposed Small Arms Outdoor Qualification Ranges

Range	*Weapon*	*Ammunition Type*	*Typical Use Estimate*			*Ammunition Expenditure Estimates*		
			Crews or Personnel	*Hours*	*Days Per Yr*[(a)]	*Busy Day*[(b)] *Day*	*Busy Day*[(b)] *Night*[(c)]	*Annual*[(d)]
KD	Rifle	5.56mm	250	0800-1200 1900-2200	200	10,000	2,250	2,450,000
Pistol	Pistol (M9)	9mm	100	0800-1200 1900-2200	225	7,000	3,000	2,250,000
Nonstandard Small Arms	Rifle	5.56mm	125	0800-1600 1900-2200	225	4,523	2,227	1,518,750
	Pistol	9mm	25	0800-1600 1900-2200	225	4,500	750	1,181,250
Modified Record of Fire	Rifle	5.56mm	64	0800-1600 1900-2200	225	5,440	750	1,392,750
Machine Gun	MMG	7.62mm	32	0800-1600	225	4,000	2,400	920,000
	HMG	.50 cal	32	0800-1600	225	4,000	2,400	340,000
	HMG	40mm TP	32	0800-1600	225	1,120	480	82,000
							Total	**10,134,750**

Legend: cal = caliber, mm = millimeters, HMG = heavy machine gun, MMG = medium machine gun.

Notes:

(e) The figures for number of days of use are determined from estimated down time for maintenance and weather. Typical use is estimated at 5 days/week, 45 weeks/year for most ranges and 5 days/week, with the exception of the KD range that is adjusted to account for weather (i.e., if 1 or 2 days of training at the KD range is lost due to weather, the whole week is rescheduled; scheduling of the other ranges is more flexible). Range use would occur periodically throughout the year, with no predictably busy or non-use periods.

(f) The estimates for the KD, Pistol, Nonstandard Small Arms Range, and Modified Record of Fire Range are based on the maximum number of shooters per day who could make use of each proposed range (calculated by multiplying the number of firing points or lanes by the number of firing relays), firing the number of rounds prescribed for a standard string of fire. This estimate is consistent with the munitions allocation for the relocated AIP units. For the machine gun range, the AIP munitions allocation is considerably less than the range capacity.

(g) Night refers to non-daylight hours that are generally 1900-0600 on Guam. Range use is not expected to extend beyond 2200 (2200-0700 is considered night-time for community noise analysis)

(h) The annual numbers of rounds expended are consistent with the AIP munitions allocation.

Table 11.2-6. Daily and Annual Use of Proposed Demolition and Explosive Ranges

Range	Explosive/ Munitions	Typical Use Estimate			Expenditure Estimates		
		Crews or Personnel	Hours	Days Per Yr [(a)]	Busy Day[(b)] Day	Busy Day[(b)] Night[(c)]	Annual [(d)]
Demolition	TNT (<20 lb)	80	0800-1600	48	10 lb	0	500 lb
	C-4	20	0800-1600	48	20 lb	0	682 lb
	Other (20 lb TNT equiv.)	20	0800-1600	48	40 lb	0	1,920 lb
Breacher and Shooting House[(e)]	TNT (¼ lb blocks)	40	0800-1200 1900-2200	36	5	1	300
Hand Grenade	M67 Fragmentation Grenade	48	0800-1600	96	48	0	4,608
Hand Grenade House	M67 Fragmentation Grenade	24	0800-1600	96	24	0	2,304

Legend: lb = pound, TNT = trinitrotoluene.

Notes:

(f) Typical use of ranges: demolition range 4 non-consecutive days per month; breacher and shooting house 3 consecutive days per month; hand grenade range and hand grenade house 2-3 times per week, 45 weeks per year. Range use would occur periodically throughout the year, with no predictably busy or non-use periods.

(g) Estimates are based on the number of personnel that would train at each range times the number of explosives / grenades that would be used in a high-use training day. This estimate is consistent with the munitions allocation for the relocated AIP units.

(h) Night refers to non-daylight hours that are generally 1900-0600 on Guam. With the exception of the breacher and shooting house, training at the demolition or explosive ranges would occur during daylight hours only. See note (e) for additional estimates for firing of the 5.56mm rifle at the shooting house.

(i) The annual estimate is consistent with the AIP munitions allocation.

(j) In addition to the use of breacher charges, the 5.56mm rifle would be used by the 40 personnel conducting training at this location. An estimated 2,400 5.56mm rounds would be expended by these personnel at the breacher and shooting house in a busy training day, with 1,200 of those expended during night-time, but not past 2200 (2200-0700 is considered night-time for community noise analysis).

Live-Fire Training Range Complex

The training range complex would operate 7 days per week, 24 hours per day, with the highest use generally being between 6:00 a.m. and 10:00 p.m. An estimated 15% of the operations at the pistol, Nonstandard Small Arms, Modified Record of Fire, and machine gun ranges would occur at night. The proposed action Agreed Implementation Plan (AIP) would result in an estimated utilization of qualification ranges (KD, pistol, Nonstandard Small Arms, and Modified Record of Fire) for up to 8 hours a day, 5 days per week, for 45 weeks per year, while the remainder of available time would be used for transient and other service requirements. The number of personnel training on the range complex could vary between 70 and 250. It is anticipated that the qualification firing ranges would ultimately be used by military personnel (all services up to 24 hours a day, 7 days per week, for 45 weeks per year). Range management, including maintenance, accounts for up to 4 weeks per year that the range complex may not be available for use. The proposed training range complex is discussed in more detail in Volume 2, Chapter 2 of this EIS.

Range Control and Range Maintenance Buildings

The range and training area management and maintenance facilities would house several related functions necessary for managing and maintaining the ranges, including scheduling, safety, air/sea-space clearance, maintenance, environmental monitoring, security, and training. These functions are specified in detail in Marine Corps Order P3550.10, "Policies and Procedures for Range and Training Area Management." Numerous smaller structures associated with each range are covered with the range itself.

The range control function would be operating whenever there are training activities. During the day, 100-120 personnel could be working at the facility. If there are evening training operations, 2 to 8 persons would be at the facility. Traffic to the site would include personal vehicles, buses, and delivery trucks.

Conservative munitions strike probability, as described below for the spinner dolphin, would be significantly less than 2.3 x 10^{-8}, hence negligible. Other larger marine mammal species present outside the 655-ft (200-m) isobath are less common and include only a small representative portion of the SDZ and ocean surface area.

Munitions Strike Probability

Based on the minimal potential for adverse impacts, a comprehensive statistical analysis of the probability for expended projectiles to fall outside the range footprint, within the SDZ was not conducted for this EIS. For analytical purposes, it is estimated that 1 in 10,000 (or 0.01%) rounds fired at all proposed ranges would fall outside the range footprint, but within the SDZ. This is a conservative estimate. Actual modeled distribution would vary based on a number of factors including range type, weapons and type of munitions fired, firing positions, range design, impact media, and a number of other specifics not currently available. SDZs are developed for total confinement of expended munitions, and are not probability-based. Probability modeling for a particular .50 cal range (with sand impact media and a range footprint that extended 800 m from the firing point) found that between 1 in 100,000 (0.001%) to 1 in 10,000,000 (0.00001%) rounds would fall beyond the 800 m long range footprint and within the SDZ in this particular circumstance (Army 1995). Based on studies conducted at other small arms ranges (NAVFAC Southeast 2008, Fort A.P. Hill 2005), projectile deposition outside the range footprint but within the SDZ would be at highest concentration in the downrange area outside the range footprint, just beyond the range backstop.

An analysis was conducted using a combination of the Marine Corps (2007) and Army 1995 methodology to examine the probability of direct strikes to special-status species and the resultant total number of potential strikes based on the annual number of munitions that may land in the water and the density of dolphins within SDZ areas identified off the Route 15 Range Lands. The probability of a direct strike was determined by first calculating the dolphin surface area (SA) = 9.35 ft (2.85 m) x 1.6 ft (0.49 m) = 1.3965 m^2. The dolphin density = 80 dolphins in the 13,107,100 m^2 SDZ area (NOAA 2005a) = 6.10352 x $10^{-6}/m^2$ (This assumes that the density of 80 dolphins/13,107,100 m^2 area [SDZ]. For this analysis it is assumed a pod of 80 exists in the SDZ area 24/7 for 365 days/year, an extremely conservative estimate). The probability of a strike to the dolphin's body = Dolphin SA x Dolphin Density = 1.3965 m^2 x 6.10352 x $10^{-6}/m^2$ = 8.5236 x 10^{-6} . The number of animals that may be struck by munitions = Probability x number of rounds that may land in water (0.001% of 10,000,000 = 10,000) = 8.5236 x 10^{-6} x 1,000 = 0.08524 dolphins struck per year.

The total number of rounds that may land in the SDZ and Pacific Ocean used in the calculation above was very conservative considering the distance .to the ocean from the range (approximately 1,300 ft [400 m]) which makes it is highly unlikely that a round would fall within the marine environment. Also, the number of bullets leaving the impact area is based on ricochets, not direct fire. As a result, the speed of the bullet would be reduced after deflecting off any surface, reducing the distance it can travel.

Due to the low probability of projectiles strike and the implementation of preventative measures (observers, etc.), there would be a very low likelihood that projectiles would come in contact with a marine mammal or sea turtle. An even less likely scenario would be significant injury to an animal, given that the velocity of the projectile would have significantly decreased due to the distance from the range.

Indirect impacts to special-status species would be similar to those described in the *Construction* section. No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1. Additionally, there may be a beneficial impact to sea turtles due to limited and controlled access at the coastline during training operations.

Therefore, Alternative 1 would result in less than significant impacts on special-status species.

Non-Native Species

Impacts to this resource would be similar as described in the *Construction* section. Alternative 1 would result in no impacts regarding the introduction of non-native species.

Barrigada

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities that would impact the marine environment; therefore, no impacts to marine biological resources would occur as a result of construction and direct operations associated with the proposed action. Indirect effects from recreational activities are anticipated to be mitigated to less than significant with mitigation measures, including an update of the Guam Comprehensive Outdoor Recreation Plan, that would provide data facilitating an estimation of potential marine environment impacts due to marine recreational activities on Guam (see Volume 2, Chapter 9 and Volume 7 for further information).

Piti/Nimitz Hill

There are no in-water construction, dredging, or training activities proposed for this study area, and/or land-based construction activities that would impact the marine environment; therefore, no impacts to marine biological resources would occur as a result of construction and direct operations associated with the proposed action. Indirect effects from recreational activities are anticipated to be mitigated to less than significant, update to the Guam Comprehensive Outdoor Recreation Plan, that would provide data facilitating an estimation of potential marine environment impacts due to marine recreational activities on Guam (see Volume 2, Chapter 9 and Volume 7 for further information).

Apra Harbor

Outer Apra Harbor

Construction

Project activities associated with construction dredging of Inner Apra Harbor in support of the Wharf refurbishing and following operational activites (see Section 2.5) may impact marine or estuarine organisms or habitats.

Construction dredging, including tug and scow transport of dredged materials, and pier rehabilitation associated with Alternative 1 would be limited to areas of Inner Apra Harbor that have been previously dredged. These operations and construction-related projects were assessed to address potential disturbances to marine biological resources including flora and invertebrates, fish and EFH, special-status species and non-native species.

The activities addressed include: embarkation and support ship berthing (embarkation operations, high speed vessel [HSV] berthing, escort ship berthing); Amphibious Vehicle Laydown Area and ramps construction, new USCG ship berthing, construction-related projects; and the increased small boat, HSV, and escort ship traffic within Apra Harbor. Documents from a variety of sources including Navy, NOAA NMFS, and individual scientific investigators are referenced for analysis of potential impacts to marine biological resources.

Marine Flora, Invertebrates and Associated EFH

This resource would not be appreciably modified from existing conditions. Impacts to this resource would be short-term and minor from Alternative 1 actions. Impact assessment reasoning is similar to that described below for Fish and EFH. Therefore, Alternative 1 would result in less than significant impacts to marine flora and invertebrates; there would be no adverse effect on associated EFH.

Essential Fish Habitat

There may be minor impacts to this study area from Inner Apra Harbor dredging-related sedimentation during receding tidal actions carrying the sediment plume toward the Entrance Channel and Outer Apra Harbor. The turbidity levels are not expected to increase above existing conditions in Outer Apra Harbor with the implementation USACE permit BMP conditions (i.e., silt curtains). Short-term behavioral responses to noise are expected from finfish during dredging operations, which may temporarily inhibit entrance to Inner Apra Harbor. This temporary impact is considered minimal.

It is estimated that a tug and scow would make one round trip/day for 6 to 8 months for dredged material disposal. See Volume 2, Chapter 14, Marine Transportation for a detailed description. The vessels would adhere to the channel centerline, use the existing Outer Apra Harbor navigational channel to the ocean dredged disposal site, and return to Inner Apra Harbor. This increase of vessel movements would result in short-term and localized disturbances to the water column and organisms living in or on the shallow portions of the benthic substrate due to propeller wash and resuspension of sediments. Short-term behavioral and/or physiological responses by finfish (e.g., swimming away and increased heart rate) would result; however, such responses would not be expected to compromise the general health or condition of individual fish. The seasonal pupping of scalloped hammerhead sharks, although reported to be extremely rare (personal communication with Steve Smith, [Navy 2009b]), may also be temporarily disturbed by increased vessel traffic if in the area. EFH for this PHCRT species would not likely be adversely affected with appropriate NMFS BMPs being implemented (Volume 7). The probability of collisions between vessels and adult fish, which could result in injury, would be extremely low for individuals in this highly mobile life stage and slow moving vessels within the navigational channel and shipping lanes in the ROI (Navy 2010c).

There is no evidence that underwater noise negatively affects marine invertebrates (COMNAV Marianas 2007b).

The EFH of planktonic eggs and larvae of all species as identified in the Coral Reef Ecosystem, Bottomfish, Pelagic Fish, and Crustacean MUS in the Mariana Archipelago and Pelagic FEPs could be directly impacted by increased vessel movement. These life stages typically are weak swimming forms and are highly influenced by local currents. Based on wind and current measurements (SEI 2008) planktonic larvae of many species most likely never leave the confines of the harbor. Some recruitment to Apra Harbor may occur from eggs and larvae being carried into the harbor by local currents as well as by actively swimming late-stage larvae. The relative contributions from each of these sources of larvae are unknown, although recruits from outside Apra Harbor must pass through the relatively narrow entrance channel (relative to the volume of Apra Harbor), which would reduce the opportunity for eggs and larvae to passively enter the harbor. Thus, the probability of their presence in the vicinity of the Alternative 1 action area is small (COMNAV Marianas 2007b). Although the eggs and larvae of these FEP MUS in the upper portions of the water column associated with the Alternative 1 actions (including previously identified turbidity plume limits) could be displaced, injured, or killed by vessel and propeller movements, no measurable effects on fish or invertebrate recruitment would occur; the number of eggs and larvae exposed to vessel movements would be low relative to total biomass within the ROI (Navy 2010c). Based on the small coverage areas, these impacts would be negligible; therefore, would have no adverse effect on EFH.

Indirect effects from recreational activities are anticipated to be mitigated to less than significant, including an update to the Guam Comprehensive Outdoor Recreation Plan, that would provide data facilitating an estimation of potential marine environment impacts due to marine recreational activities on Guam (see Volume 2, Chapter 9 and Volume 7 for further information).

Figure 11.2-5 (used together with Table 11.2-7) identifies sensitive months (and areas) for certain species (including EFH species) in Apra Harbor.

Table 11.2-7. Sensitive Months for Certain Species within Apra Harbor

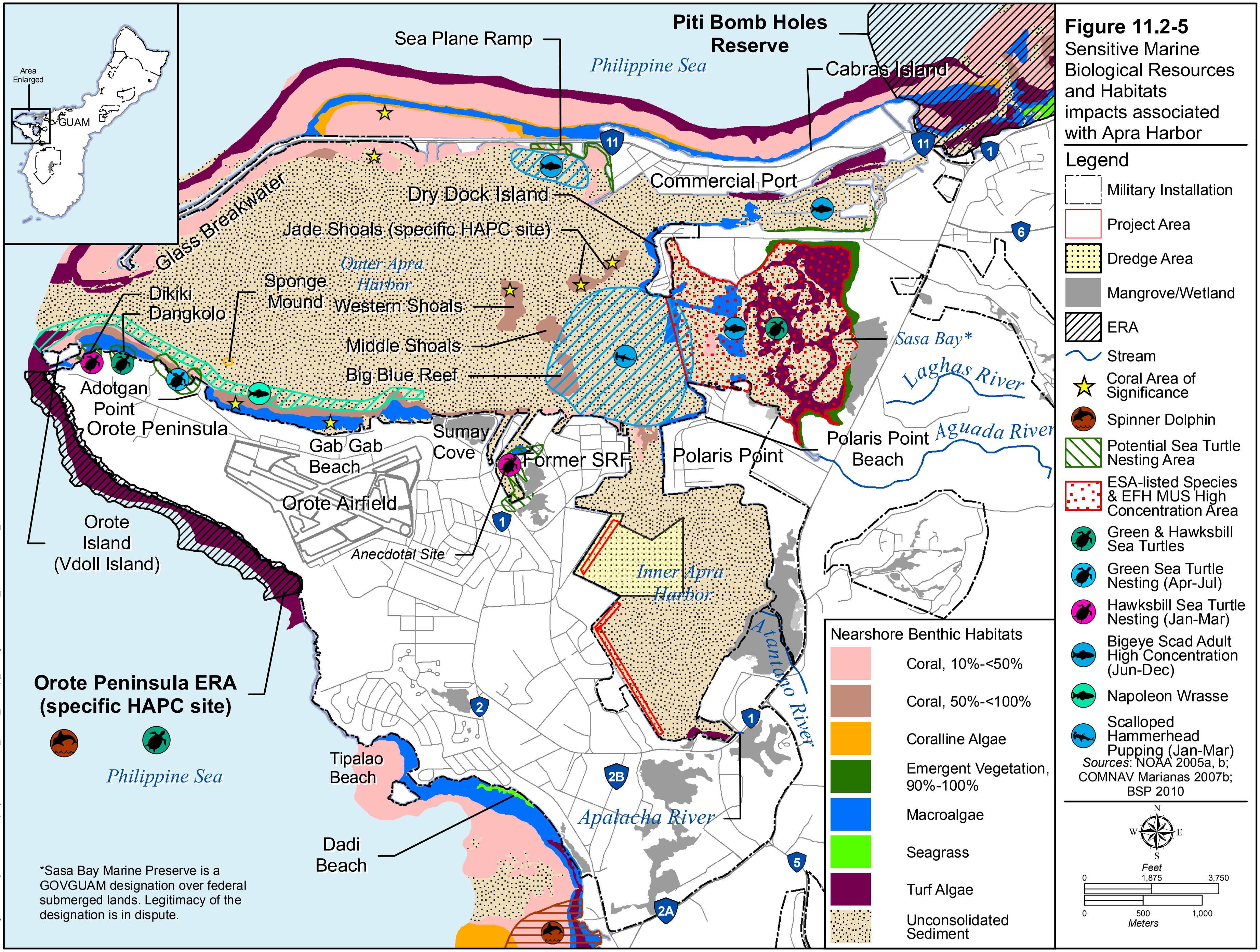
Species	*Status*	*Location*	*Months*
Green Sea Turtle	ESA-listed, Threatened	see Figure 11.2-5	Nesting: Jan – Mar
Hawksbill Sea Turtle	ESA-listed, Endangered	see Figure 11.2-5	Nesting: Apr – Jul
Green and Hawksbill Sea Turtles	ESA-listed	see Figure 11.2-5	Foraging: Jan – Dec
Adult Bigeye Scad	EFH species- CHCRT	see Figure 11.2-5	Jun – Dec
Scalloped Hammerhead	EFH species- PHCRT	CVN turning basin - see Figure 11.2-5	Pupping: Jan – Mar
Juvenile Fish[1]	EFH species- all EFH categories	Sasa Bay and other nearshore environments	Nursery: Jan – Dec
Hard Corals	EFH species- PHCRT	All of Outer Apra Harbor	Full Moon Spawning: (July-Aug)

Note: [1]includes barracudas, emperors, goatfishes, groupers, mullets, parrotfishes, puffers, snappers, surgeonfishes, wrasses, and small-toothed whiptails.

The EFHA for Outer Apra Harbor found that the increase of construction-related vessel movements could result in:

- Short-term, periodic, and localized disturbance and displacement of motile species (fish) during in-water transit activities
- Short-term, periodic, and localized increase of turbidity (decreased water quality) in the water column from propeller wash
- Short-term, periodic, and localized increase in benthic sedimentation
- Short-term, periodic, and localized potentially significant impacts to eggs and larvae in the upper water column from increased vessel traffic
- Seasonal disturbances to spawning coral reef and pupping scalloped hammerhead sharks respectively

Based on this assessment, the potential for long-term reduction of the quality and/or quantity of the EFH does not exist; therefore, there would be no adverse effects on EFH with the implementation of Alternative l, and less than significant impacts to fish in general.



Printing Date: May 11, 2010, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\11.2-5.mxd

Table 11.2-8 includes information on the EFH types present in the study area and potential effects.

Table 11.2-8. EFH Areas Associated with Outer Apra Harbor and Potential Effects

EFH Habitat Description	*Area of Occurrence*	*Associated Activity*	*Potential Effect*
Corals/Coral Reef Ecosystem	Shoal, Sasa Bay, and Entrance Channel Areas	Increased sediment resuspension and vessel traffic	No adverse effect. Temporary and episodic minor behavioral responses to fish MUS and impact to coral polyp spawning survival.
Marine Water Column	Apra Harbor and Turning Basin	Increased vessel traffic	No adverse effect. Temp. and episodic minor impacts for most species. Potential for limited injury or mortality to fish eggs and larva.
Embayment Water Column	Sasa Bay	Increased vessel traffic	No adverse effect. Temp. and episodic minor impacts for most species. Potential for limited injury or mortality to fish eggs and larva.
Embayment Benthic Habitat	Sasa Bay	Increased vessel traffic and sediment resuspension	No adverse effect. Temp. and episodic disturbances
Submerged Aquatic Vegetation	Sasa Bay	Increased vessel traffic	No adverse effect

Special-Status Species

There would be a less than significant impact on this resource. Indirect effects from sedimentation plumes would be similar as described under fish and EFH above. Turbidity levels are not anticipated to exceed existing conditions in Outer Apra Harbor.

Many of the ongoing and proposed actions within the ROI involve marine navigation of various types of surface ships and boats (vessels). The increased vessel movements through the Outer Apra Harbor navigational channel associated with the ocean disposal of dredged materials has the potential to affect sea turtles by disturbing or directly striking individual animals.

The implementation of NOAA-NMFS recommended BMPs and existing Navy maritime policies (see Volume 7 and Section 11.2.2.5 in association with Table 11.2-7 and Figure 11.2-5) is anticipated to continue to reduce potential vessel interactions and impacts to sea turtles.

Construction-related vessel movements would be short-term, localized and slow-moving (see Volume 2, Chapter 14, Marine Transportation). The ability of sea turtles to detect slow approaching vessels via auditory and/or visual cues would be expected based on knowledge of their sensory biology. If their response to oncoming vessels does not induce a sea turtle to flee the area of vessel movement, the behavioral response may induce confusion, thereby increasing the possibility of a collision. Boat strikes in general are from small fast moving boats (Navy 2010c). According to GDAWR (2010), there have been four reported sea turtle stranding incidences within Apra Harbor. One Navy reported sea turtle stranding occurred on November 19, 2002 at Gab Gab beach, where the sea turtle had washed ashore. The dead sea turtle had multiple gashes to the carapace and head resembling propeller strikes (GDAWR 2002).

The two MMPA-species and fish species of concern are not expected in the area. No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species or stocks is expected with the implementation of Alternative 1.

The short-term and periodic impacts associated with Alternative 1 actions may affect, but are not likely to adversely affect ESA-listed sea turtles. Therefore, Alternative 1 would result in less than significant impacts on special-status species.

Non-Native Species

Potential impacts to the marine habitat from non-native marine organisms, pathogens, or pollutants taken up with ship ballast water (or attached to vessel hulls) are a genuine threat as described in the Affected Environment, Section 11.1. Any potential introduction/transport of non-native species from one area to another may be lessened or even prevented through appropriate implementation and management of BMPs and existing USCG and Navy policies (see Volume 7).

As described in Section 11.1.4.4, the Navy would prepare a MBP with the overall goals of 1) identifying terrestrial and marine biosecurity risks associated with DoD build-up and training activities on Guam and the CNMI posed by transportation and commerce to and within the Micronesia and Hawaii and 2) documenting prevention, control and treatment measures that can be incorporated by civilian and military operations. The DoD will adopt appropriate BMPs recommended by MBP working groups during the MBP development to reduce the likelihood of the introduction and spread of invasive marine organisms. Some example BMPs may include clarifying biosecurity requirements for all Navy vessels (including chartered Military Sealift Command [MSC] ships), improving hull husbandry documentation, and incorporating specific criteria to ensure low levels of biofouling into contractual agreements with vessels chartered to support the military build-up and ballast water management. Actions to prevent transfers of invasive species are just one aspect of a complete biosecurity plan. Additional components may include monitoring and the ability to respond to a new invasion. These, along with a more detailed risk assessment and more refined recommendations for shipping and other potential transport modes will be part of the MBP to be completed in 2010; Volume 7 includes a more detailed description of the MBP. Therefore, with the implementation of the MBP goals and objectives in addition to the existing USCG adopted polices by the Navy, Alternative 1 would result in significant impacts, mitigated to less than significant impacts regarding the introduction of non-native species.

Operation

There are general purpose Navy wharves in Inner Apra Harbor that the amphibious task force currently uses. The proposed increase in the number of amphibious task force visits, the class of ships that would be homeported, and the utilities that would be needed would require a new embarkation area for loading and unloading of ships and a new amphibious vehicle laydown area.

The embarkation operations would support amphibious transportation of Guam-based Marines to and transiting amphibious forces for potential contingency, humanitarian efforts, and exercise operations in the Pacific Theater. The Navy's Amphibious Ready Groups and the Marine Expeditionary Units (MEU) are transient forces that have traditionally come to Guam for port visits and training. These and other amphibious task force visits would occur more frequently with the relocation. The MEU embarkation ships currently come into port four times per year. This frequency would increase under Alternative 1. The escort ships for the MEU are the same types of ships that would support the CVN (see Volume 4 of this EIS for an assessment of CVN impacts). Typically, there would be three ships carrying amphibious vessels and four combatant ships that escort the amphibious ships. Transport of Marines and supplies between Guam and the CNMI would likely occur via HSVs. The HSVs would be homeported in Guam and are a new type of vessel for Apra Harbor.The information on past and projected traffic of commercial cargo vessels encompasses container ships as well as break-bulk and roll-on/roll-off bulk vessels. The data from 1995 through 2008, the datum from 2009 (Chapter 14, Table 14.1-1), as well as the projections through 2018 were provided by Navy contractors based upon their analysis of the Port of Guam Master Plan (Navy 2010b). The general trend for commercial vessel traffic visits at the Port of Guam is a decrease of traffic from 1995 through 2009 (594 – 353), after which the number of visits is projected to rise to a peak during the period of 2011 through 2014, rising as high as 776 projected visits. Thereafter, traffic is expected to decrease back down to between 400 and 500 visits by 2018, a level similar to that of a few years before the beginning of the buildup (Navy 2010b).

Projections of military vessel traffic and port visits to Apra Harbor are discussed in Volume 4, Chapter 2.5. In addition to the CVN component noted in Volume 4, the relocation of Marine Corps forces to Guam would result in embarkation operations to support amphibious transportation of Guam-based Marines and transiting amphibious forces for potential contingency, humanitarian, and exercise operations in the Pacific Theater. Such embarkation operations would be consistent with transiting amphibious forces carrying MEU forces that have traditionally come to Guam for port visits and training. Frequency of visits occur approximately twice annually (Navy 2010b) (see Chapter 2 and 14 for more detail). Under the proposed action it is anticipated that amphibious task force visits would increase from two to four annually with the relocation. The composition of the amphibious task force would be dependent on the specific mission. Typically, there are three ships carrying amphibious vehicles, equipment and personnel designed to support amphibious operations and an additional four surface combatant ships that escort the amphibious ships. In addition, naval anti-submarine and strike force surface and subsurface assets may accompany the task force. MEU training would increase to occur regularly at a minimum of two additional times per year (for a total of four times per year) for three weeks duration each visit on Guam. For training on Guam, the amphibious ships would offload personnel and amphibious craft at Apra Harbor, and troops and equipment would travel administratively to and bivouac (camp) at proposed training/maneuver areas on Guam. This training was addressed in consultations on the Mariana Islands Range Complex EIS (Navy 2010c). The escort combatant ships may or may not accompany the amphibious task force. When in port, the amphibious ships and escort ships would be berthed in Inner Apra Harbor. In addition, 12 Amphibious Assault Vehicles (AAVs), two Rigid Hull Inflatable Boats , and eight Combat Rubber Raiding Craft would be permanently based at the proposed Landing Craft Air Cushion/ (LCAC/AAV) laydown area as part of the proposed action (Navy 2010b) (see Chapter 2 and 14 for more detail).

Recreational vessels are discussed in more detail in Chapters 9 and 14; some key points from those chapters include the following. The Marianas Yacht Club , which includes private boaters and sailors, hosts regattas and races at the entrance to the Outer Apra Harbor. The Marianas Yacht Club anticipates its membership will strengthen with the population increase. Besides yachts, sailboats, and commercial small boats, there is a popular jet ski area im East Agana Bay. There are rental facilities and the users are in harbor and in deeper water. Currently there is no official speed limit in the areas used.

The Navy has made a request to the Guam Police Department Administrative Division, which maintains local registrations for recreational vessels including personal watercraft (jet skis), for past and present numbers of registrations of such vessels in all of Guam in order to describe past trends and to estimate relative changes in recreational vessel traffic in Apra Harbor, but has not yet received a response. In the absence of these data, one alternative method of estimating future trends in recreational vessel traffic is to estimate a relative change based upon estimates of population changes.

Under the assumption that the degree of overall recreational boat use of all varieties (e.g., sailing, fishing, motoring, jet ski, etc.) relative to the population size remains approximately unchanged, recreational boat use may be expected to increase over 2010 levels by these amounts: 42.2% during the peak and 19.8% afterwards. In addition, Chapter 9 describes as a proposed mitigation measure the update to the Guam Comprehensive Outdoor Recreation Plan, which would also provide data facilitating an estimation of potential marine environment impacts due to marine recreational activities.

Another method of estimating future recreational vessel traffic is to estimate trends shown in the annual U.S. Coast Guard Boating Statistics reports. Table 3 shows these statistics for Guam, which are further annotated in these reports as estimated figures encompassing all watercraft. These figures estimate a total increase of 9.3% between 1997 and 2008 (the most recent year for which this report was available), a figure approximately half of the ~19% (see Chapter 16) population increase shown by U.S. Census data during this period. Therefore the previous estimates of increased recreational vessel use based upon population increase alone are likely to be significantly large over-estimates, even considering potential differences in boat-use between current and projected population demographics.

However, the subgroup of faster-moving vessels within the harbor is composed almost entirely of recreational vessels, in contrast to commercial and military vessels. Among the highest speed traffic are personal watercraft (jet skis), a type of vessel that has long been noted to be a threat to surfacing birds and marine mammals (e.g., Department of Lands and Natural Resouces 1995), and would be therefore expected to also be a threat to sea turtles at the surface. Also, other relatively high speed traffic encompasses vessels such as dive boats, parasailing boats, and various personal motorboats, which tend to transit at near full-throttle to their respective destinations during calm sea states. Dive boats in particular may selectively transit to areas of known biological abundance and sea turtle presence. The estimates indicate that the number of recreational vessels in Guam approximately outnumber military vessels by a factor of ten; these high numbers of vessels, combined with the fact that the majority of high speed vessels in Guam are recreational in nature suggest that recreational craft may be the primary source of any actual and near ship strikes on sea turtles.

Further, indirect effects from recreational activities are anticipated to be mitigated to less than significant, including the update to the Guam Comprehensive Outdoor Recreation Plan, that would provide data facilitating an estimation of potential marine environment impacts due to marine recreational activities on Guam (see Volume 2, Chapter 9 and Volume 7 for further information).

Marine Flora, Invertebrates and Associated EFH

Potential impacts to this resource would not appreciably modify existing conditions, although an increase in vessel traffic through the existing channel would be expected. Increased vessel traffic may disturb organisms living in the upper water column, or in/on the sediments due to propeller wash and resuspension of sediments. There is no evidence that underwater noise negatively affects marine invertebrates (COMNAV Marianas 2007b).

The impact reasoning would be similar to that described under construction activities for increased vessel movement, although includes a lower frequency of trips (approximately four times/year over existing conditions), but trips which are longer in duration. Impacts to this resource would be long-term, but episodic and minor compared to existing conditions. Therefore, Alternative 1 would result in less than significant impacts to marine flora and invertebrates; there would be no adverse effect on associated EFH.

Essential Fish Habitat

Impacts resulting from the increased MEU embarkation ship movement would be similar to those described in the Construction sections above. Fish in the Apra Harbor channel and associated nearby shoals and nurseries (Sasa Bay) may be disturbed by increased levels of vessel movements by underwater noise or physical disturbance (resuspension of sediment from propeller wash). While fish may exit the immediate area during vessel movement, it is not likely that there would be a permanent effect on the present populations. Impacts on reef fish populations would be short-term, periodic, localized, and would not appreciably change existing conditions.

Implementation of BMPs would reduce any potential impacts of vessel interactions with sensitive EFH MUS. Measures would be implemented by vessels while underway within Apra Harbor and especially while in the vicinity of Sasa Bay, and during sensitive months. Table 11.2-7 above (used in concert with Figure 11.2-5) identifies these sensitive months (and areas) for respective EFH (and ESA-listed) species in Apra Harbor.

The EFHA for Outer Apra Harbor found that the increase of MEU vessel movements could result in:

a. Long-term, periodic and localized disturbance and displacement of motile species (fish) during in-water transit activities
b. Long-term, periodic and localized minimal increase of turbidity (decreased water quality) in the water column from propeller wash
c. Long-term, periodic and localized minimal increase in benthic sedimentation
d. Long-term, periodic and localized potentially significant impacts to eggs and larvae in the upper water column from negligible increased vessel traffic
e. Seasonal disturbances to spawning coral reef and pupping scalloped hammerhead sharks

Based on this assessment, the potential for long-term reduction of the quality and/or quantity of EFH does not exist. Therefore, Alternative 1 would result in and less than significant impacts to fish and EFH, and no adverse effect on EFH.

Special-Status Species

There would be a less than significant impact on this resource based on the following assessment. Increased vessel movements (commercial, military, and recreational) associated with the proposed action have the potential for increased sea turtle strikes enroute to and from Sasa Bay (a high turtle concentration area) and other areas within the harbor. The likelihood of ship strikes to sea turtles by commercial traffic through 2018 is considered to be insignificant. Four factors that were considered include the potential increase in vessel traffic, the location of the traffic lanes with respect to the presence of sea turtles, vessel speed, and historic trends in ship strikes to sea turtles within Apra Harbor:

1. Increase in vessel traffic: Section 14.2.7 notes that considering the fact that the number of vessels visiting the harbor has declined steadily and substantially between the period of 1995 to 2008, the relocation of the Marines and the CVN project would result in an expected increase in vessel traffic that, even during the peak year of container shipments, would be less than the number of vessels visiting the harbor in 1995.
2. Location of traffic lanes: The majority of commercial is expected to traverse the navigational channel from the Outer Apra Harbor mouth to the commercial port, with some traffic expected to transit to Inner Apra Harbor. These waters have poor to moderate potential sea turtle foraging and resting habitat, with little to no record of sea turtle sightings and therefore

may be considered to be minimally affected by potential increases in any of the classes of commercial traffic.

However the waters comprising the expected transit paths of commercial traffic are adjacent to some areas with known good nesting and foraging sea turtle habitat where such turtles have been regularly sighted, such as Orote Peninsula, Jade Shoals, and Dry Dock Island. In particular, the navigational channel of the Outer Apra has not been adequately biologically surveyed, by either the Navy or other parties, to be able to quantitatively characterize the expected density of sea turtles. Therefore it is possible that sea turtles may temporarily transit these waters.

3. Vessel Speed: In the case that sea turtles transit waters where commercial traffic is operating (such as the outer harbor navigational channel), the typically slow velocity of such vessels navigating within the harbor (e.g., 10 knots or slower) suggest that the probability of a vessel strike is extremely low, especially in comparison to other classes of traffic such as recreational vessels, which typically have a higher velocity.
4. Historic trends in ship strikes on sea turtles: Although this information is limited, the implementation of NOAA-NMFS recommended BMPs (Navy 2010b), such as reducing vessel speeds to 10 knots or less in the proximity of sea turtles, and existing Navy maritime policies is anticipated to continue to reduce potential vessel interactions and impacts to sea turtles. Construction-related vessel movements would be short-term, localized and slow-moving (see Volume 2, Chapter 14, Marine Transportation). The ability of sea turtles to detect slow approaching vessels via auditory and/or visual cues would be expected based on knowledge of their sensory biology. If their response to oncoming vessels does not induce a sea turtle to flee the area of vessel movement, the behavioral response may induce confusion, thereby increasing the possibility of a collision. Boat strikes in general are from small fast moving boats. However, since baseline of known ship strikes on sea turtles in Apra Harbor since the Navy began operations there is zero (Navy 2010b), it is not possible to project an estimated trend of expected ship strikes by recreational vessels on sea turtles through 2018, or whether such ship strikes will occur. In light of the best currently available information and lack of turtle strike data, it is not feasible to determine the potential increase in the number of sea turtle strikes.

Additonally, with the implementation of NOAA/NMFS-recommended BMPs (Volume 7), it is anticipated to reduce any potential adverse impacts of vessel interactions with sea turtles to less than significant impacts. These BMPs would be implemented while vessels are underway within Apra Harbor and especially while in the vicinity of Sasa Bay and during nesting season. General maritime measures in place by the military are in use, including lookouts trained to sight marine mammals or sea turtles, and designed to avoid collisions with protected species. These protective measures are described in detail in Volume 7.

The two MMPA-species and fish species of concern are not expected in the area. No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1.

The long-term, periodic impacts associated with Alternative 1 actions may affect, but are not likely to adversely affect ESA-listed sea turtles. Therefore, Alternative 1 would result in less than significant impacts on special-status species.

Nesting sea turtles are addressed in more detail in Volume 2, Chapter 10, Terrestrial Biological Resources.

Non-Native Species

A less than significant impact would result from Alternative 1 actions regarding the introduction and transport of non-native marine organisms, pathogens, or pollutants taken up with ship ballast water (or attached to vessel hulls) as described in the Construction section and in Section 11.1.4.4, the Navy would prepare a MBP with the overall goals of 1) identifying terrestrial and marine biosecurity risks associated with DoD build-up and training activities on Guam and the CNMI posed by transportation and commerce to and within the Micronesia and Hawaii and 2) documenting prevention, control and treatment measures that can be incorporated by civilian and military operations. The DoD will adopt appropriate BMPs recommended by MBP working groups during the MBP development to reduce the likelihood of the introduction and spread of invasive marine organisms. Some example BMPs may include clarifying biosecurity requirements for all Navy vessels (including chartered Military Sealift Command [MSC] ships), improving hull husbandry documentation, and incorporating specific criteria to ensure low levels of biofouling into contractual agreements with vessels chartered to support the military build-up and ballast water management. Actions to prevent transfers of invasive species are just one aspect of a complete biosecurity plan. Additional components may include monitoring and the ability to respond to a new invasion. These, along with a more detailed risk assessment and more refined recommendations for shipping and other potential transport modes will be part of the MBP to be completed in 2010; Volume 7 includes a more detailed description of the MBP. Therefore, with the implementation of the MBP goals and objectives in addition to the existing USCG adopted polices by the Navy, Alternative 1 would result in significant impacts, mitigated to less than significant impacts regarding the introduction of non-native species.

<u>Inner Apra Harbor</u>

This EIS assumes five scenarios for the placement of dredged material: 100% disposal in a proposed ocean dredged material disposal site , 100% disposal upland, 100% beneficial reuse, 20-25% beneficial reuse/75-80% ocean disposal and 50% beneficial reuse/50% ocean disposal. These five scenarios are explained further below, and described in Volume 4, Chapter 2 of this EIS. The Navy would comply with all applicable requirements associated with dredged material disposal; therefore, associated biological resource impacts would not be significant.

Impacts associated with the fouling communities within Inner Apra Harbor (repair of waterfront facilities) were not included in the HEA Volume 9. Impacts related to these fouling communities would be short-term and localized and are discussed below.

Construction

Marine Flora, Invertebrates and Associated EFH

Dredging activities planned for Sierra and Tango Wharves would include all areas from -35 to -38 ft (-10 to -11 m) mean lower low water (MLLW). The effects on communities that have established themselves on Navy-installed artificial structures are of less concern than establishment on natural surfaces and will not be evaluated for compensatory mitigation. Marine flora communities are limited and occur mainly near Abo Cove. Benthic invertebrates, such as sponges, sea urchins, starfish, and mollusks are poorly represented within Inner Apra Harbor, except for on wharf vertical structures. Representatives of few families were sighted, and none of those groups observed were abundant (COMNAV Marianas 2007b.).

Floral and invertebrate communities present on the wharves' vertical support columns or infaunal communities in the soft bottom may be directly impacted in the short-term through removal during wharf structural refurbishing and dredging operations, but are expected to reestablish themselves quickly on the new vertical structures from nearby soft bottom (Taylor Engineering, Inc. [TEI] 2009). TEI (2009) performed a literature review of effects of beach nourishment, dredging and disposal projects on benthic infaunal community-type habitats. The following paragraphs cite the reviewed articles and list the key findings related to impacts to marine benthic habitats:

1. NOAA Benthic Habitat Mapping. 2007. Applying Benthic Data: *Dredging and Disposal of Marine Sediment*.
   a. "Benthic organisms living in shallow water estuarine and nearshore environments are well adapted to frequent physical disturbance. Tides, currents, waves, and storms cause sediments to be lifted, deposited, or shifted. The resilience of benthic organisms to these environmental changes allows them to recolonize areas of the seafloor affected by dredging."
   b. "The resilience of benthic organisms to these environmental changes allows them to recolonize areas of the seafloor affected by dredging"
2. Dredging Operations and Environmental Research (DOER). 2005. *Sedimentation: Potential Biological Effects of Dredging Operations in Estuarine and Marine Environments.*
   a. "most shallow benthic habitats in estuarine and costal systems are subject to deposition and resuspension events on daily or even tidal time scales"
   b. "Many organisms have physiological or behavioral methods of dealing with sediments that settle on or around them, ranging from avoidance to tolerance of attenuated light and/or anaerobic conditions caused by partial or complete burial"
3. Section 404(b) Evaluation, *Pinellas county Florida Beach Erosion Control Project Alternative Sand Source Utilization."*
   a. "Fill material will bury some benthic organisms"
   b. "Most organisms in this turbid environment are adapted for existence in areas of considerable substrate movement"
   c. "Re-colonization will occur in most cases within one year following construction"
4. Atlantic States Marine Fisheries Commission. 2002. *Review of the Biological and Physical Impacts.*
   a. "Studies from 1985-1996 report short-term declines in infaunal abundance, biomass, and taxa richness following beach nourishment, with recovery occurring between 2 and 7 months"
   b. "Studies from 1994-2001 reported recolonization of infauna occurred within two weeks"
5. U.S. Army Corps of Engineers Coastal Engineering Research Center. 1982. *Biological Effects of Beach Restoration with Dredged material on Mid-Atlantic Coasts*.
   a. "animals that spend their entire life cycle in the substrate were not seriously impacted by burying from beach nourishment"
   b. "nourishment destroyed or drove away the inertial macrofauna; but, based in other regional studies, recovery should occur within one or two seasons (i.e. 3-6 months)"

Conclusions of the literature review identified short-term impacts to benthic habitat. Most references listed considered those impacts short-term because the majority of benthic infaunal organisms have the ability to adapt for existence in areas of considerable substrate movement (TEI 2009).

A beneficial long-term impact for the recruitment of marine flora, invertebrates and associated EFH and the ecology of the immediate area is expected with the increased settlement potential of the cleared hard surfaces after dredging and the added aircraft carrier wharf armor rip rap and vertical pilings provide. The development of the pier would provide suitable habitat for species such as benthic invertebrates including sponges, sea urchins, starfish, and mollusks, which are poorly represented within Inner Apra Harbor and the entrance channel areas (COMNAV Marianas 2006).

Those organisms that are not directly subjected to removal or fill or are motile, could sustain short-term and minimal impacts as a result of transport, suspension and or deposition of dredging-generated sediments. These organisms are accustomed to resuspension of sediment and would adapt to these short-term impacts. No coral reef communities have been identified on the harbor bottom in the areas fronting Sierra and Tango Wharves or within Inner Apra Harbor (MRC 2002). The impacts associated with marine flora, invertebrates and associated EFH (either on man-made structures or infaunal communities present in soft bottom habitat) would be short-term and localized based on rapid reestablishment rates (TEI 2009), and are less than significant.

Increased vessel movements during in-water construction and dredging activities would be similar to those described under Outer Apra Harbor Fish and EFH impact analysis. There would be a short-term and periodic increase in frequency of vessel movements. The impacts associated with marine flora, invertebrates and associated EFH would be short-term, periodic and localized, hence negligible, with no adverse effect to EFH. All the activities associated with Alternative 1 would result in less than significant impacts to marine flora and invertebrates, and would have no adverse effect on associated EFH.

Essential Fish Habitat

As described earlier, all of Apra Harbor is considered EFH; however, neither Inner Apra Harbor nor the entrance channel are cited as being significant from an EFH perspective. Fish and invertebrate MUS are poorly represented within the Inner Harbor as described above in the marine flora, invertebrates and associated EFH discussion. Based upon the available data and information provided in Section 11.1.7, there is no reason to suspect that Inner Apra Harbor is serving as a significant spawning or nursery area for either invertebrates or fishes and/or any other FEP MUS. The potential negative impacts on coral communities that have established themselves on Navy-installed artificial structures (e.g. wharf piers, etc.) will not be considered for compensatory mitigation.

The poor water quality in this area, due to extremely high levels of turbidity, reduces the likelihood that a large proportion of the larvae which might be present would survive. Therefore, spawning and reproductive activities that may occur within the Inner Harbor are unlikely to contribute significantly to the populations in Outer Apra Harbor or Guam overall (COMNAV Marianas 2007b).

The Navy would comply with appropriate federal and territorial (USACE and GEPA) conditions during in-water activities. Re-suspension of sediment would be short-term and localized. Long-term water quality would not be significantly altered as a result of these activities; however, removal of some of the very fine sediment in the Inner Harbor would likely have beneficial effects on the marine community and EFH. The beneficial effects would result from the following: improved water quality; the removal of fine particulates which are routinely re-suspended and swept into Outer Apra harbor; and the increase in the amount of hard substrate, which may enhance the successful recruitment of stony corals (COMNAV Marianas 2007b).

Table 11.2-9 includes information on the EFH types present in the study area and potential effects.

Table 11.2-9. EFH Areas Associated with Inner Apra Harbor and Potential Effects

EFH Habitat Description	*Area of Occurrence*	*Associated Activity*	*Effect*
Coral Reefs Ecosystem	Abo Cove	Dredging and wharf structural refurbishing, increased vessel movement	No adverse effect.Short-term and periodic behavioral responses from fish
Marine Water Column	Inner Apra Harbor	Dredging and wharf structural refurbishing, increased vessel movement	No adverse effect. Short-term and minimal w/ temporary beneficial
Wharf Vertical Substrate	All Wharves	Wharf structural refurbishing	No adverse effect. Direct removal, however short-term and minimal based on quick (2-6 months) reestablishment
Soft Bottom Benthic Habitat	Inner Apra Harbor Wharves and off Polaris Point	Dredging and wharf structural refurbishing, increased vessel movement	No adverse effect. Direct removal, however short-term and minimal based on quick (2-6 months) reestablishment
Submerged Aquatic Vegetation	Abo Cove	Dredging and wharf structural refurbishing, increased vessel movement	No adverse effect

Species included in FEPs may experience minimal, short-term and localized impacts; fish are highly mobile, so if disturbed are likely to leave the area and return once disturbing activities cease. Invertebrate communities that have established on Navy-installed wharves or man-made structures would be directly impacted during refurbishing; however, they are anticipated to recolonize quickly after the new wharf is constructed. Though infaunal soft bottom communities would be impacted through dredging removal, these communities are expected to reestablish themselves laterally from other areas in Inner Apra Harbor. Based on this assessment and information provided in other sections, there would be no adverse effect on EFH. Therefore, Alternative 1 would result in a less than significant impact to EFH.

Special-Status Species

The green sea turtle has been observed in Inner Apra Harbor, though with considerably less frequency and in smaller numbers than in Outer Apra Harbor. Nonetheless, the proposed construction action and associated noise has the potential to affect the ESA-listed green sea turtle if present within Inner Apra Harbor or swimming near the Entrance Channel. The Inner Apra Harbor area does not represent a preferred habitat for sea turtles in comparison to the entire Outer Apra Harbor reef complex, and does not contain an abundance of algal or seagrass species that represent a major food source for sea turtles that cannot be found elsewhere in Outer Apra Harbor. Aside from a recent observation during a survey in Inner Apra Harbor (Smith B.D. et al. 2008) no other observations have been reported. No density information is available for Inner Apra Harbor; As identified previously, the Navy and its contractors have logged thousands of hours over the last seven years in and around the proposed action area without observing a sea turtle.

In general, sea turtle nesting and hatching activities occur at night. They cue in on natural light to orient toward the ocean; however, the bright lights from the dredging platforms may confuse adult nesting turtles and hatchlings so that they orient away from the open ocean (COMNAV Marianas 2007b). Due to the distances of Adotgan Point, Kilo Wharf and Seaplane Ramp nesting areas from the proposed action under Alternative 1, it is unlikely that any nesting-related activities would be affected by the action alternatives, including night work and the associated lights and noise. The Sumay Cove historic nesting site is in close proximity and adult nesting or hatchlings entering the water have the potential to be disturbed or disoriented by lights used during night-time construction operations. As mentioned previously, this site has not been active since an anecdotal reporting of a hawksbill nesting event in 1997.

As identified in the affected environment section, the available data on sea turtle hearing suggest a hearing in the moderately low frequency range, and a relatively low sensitivity within the range they are capable of hearing (Bartol et al. 1999; Ketten and Bartol 1995). Green turtles are most sensitive to sounds between 200 and 700 Hz, with peak sensitivity at 300 to 400 Hz (Ridgway et al. 1969). Sensitivity even within the optimal hearing range is apparently low—threshold detection levels in water are relatively high at 160 to 200 dB with a reference pressure of one dB re 1 µPa-m (Lenhardt 1994).

As described earlier, the ability of sea turtles to detect noise and slow moving vessels via auditory and /or visual cues would be expected based on knowledge of their sensory biology (Navy 2010c). Noise from dredging activities (87.3 dB at 50 ft [15 m]) and pile driving (average 165 dB at 30 ft [9 m]) is well below the 180 dB re 1 µPa NMFS guideline to protect all marine species from high sound levels at any point on the frequency spectrum. Sound levels would decline to ambient levels (120 dB) within approximately 150 ft (45.8 m) from many in-water construction activities (NMFS 2008b). It is anticipated that NMFS-trained monitors would perform visual surveys prior to and during in-water construction work as part of the USACE permit conditions. If sea turtles are detected (within a designated auditory protective distance), in-water construction activities would be postponed until the animals voluntarily leave the area.

Tech Environmental, Inc. (2006) predicted underwater sound levels of pile driving perceived by sea turtles – all species (hearing threshold sound levels – dB_{ht} (general sea turtle) re 1 µPa) is 56 (at 500 m), 60 (at 320 m), and 80 (at 30 m). The units dB_{ht}(general sea turtle) re 1 µPa is an estimate of the threshold perceivable level of sound that causes disturbance calibrated across sea turtle species specifically. This metric can be created for any single species or related group of species. Research shows marine animals avoidance reactions occur for 50% of individuals at 90 dB_{ht} re 1 µPa, occur for 80% of the individuals at 98 dB_{ht}(general sea turtle) re 1 µPa, and occur for the single most sensitive individual at 70 dBht(general sea turtle) re 1 µPa. This threshold for significant behavioral response is consistent with NOAA/NMFS guidelines defining a zone of influence (i.e., annoyance, disturbance). For estimating the zone of injury for marine mammals, a sound pressure level of 130 dB_{ht} re 1 µPa (i.e. 130 dB above an animal's hearing threshold) is recommended (Nedwell and Howell 2004). Therefore the calculated zone of behavior response for significant avoidance reaction (i.e. distance where dB_{ht}(general sea turtle) = 90 dB re 1 µPa and avoidance reaction may occur) to pile driving for sea turtles-all species is <98 ft (<30 m) (Tech Environmental, Inc. 2006). In other words, no injury to any marine animals, including sea turtles, are predicted even if an individual were to approach as close as 30 m to pile driving because all dB_{ht}(general sea turtle) values at this minimum distance are well below.

Sea turtles are highly mobile and capable of leaving or avoiding an area during proposed dredging and in-water construction activities Dredging and pile driving activities would probably deter green sea turtles from closely approaching the work area, and as a result, the likelihood that a green sea turtle would get close enough to experience and effects is remote, especially with the silt curtain barriers and mitigation measures in place.

The Navy recognizes that there are many on-going and recent past studies on the subject of potential exposures to sea turtles and other marine species from pile driving actions. Further research and validation of these studies are necessary prior to being able to determine the applicability of the methodologies and results to the proposed action within this EIS. The Navy will continue to research these studies and where appropriate, incorporate and apply methodologies, analysis, and results to the ongoing impact analysis to sea turtles from the proposed action. Applicability of these studies will also be coordinated through consultations with NMFS. Further information on in-water sound, as it relates to impacts on sea turtles, can be found in the Biological Assessment prepared for Section 7 consulation with NMFS regarding impacts of the preferred alternative.

The Navy would comply with USACE permit conditions, which include resource agency recommended BMPs for sea turtle avoidance and impact minimization measures and protocols during in-water construction activities (dredging and pile driving) and vessel operations. These measures are expected to considerably lessen any potential impacts to sea turtles in the area.

Table 11.2-7 and Figure 11.2-5 above identify sensitive months (and areas) for respective ESA-listed and FMP MUS in the EFH due to nesting, spawning and/or high concentration.

In summary, it is anticipated that implementation of Alternative 1 may affect, but is not likely to adversely affect the ESA-listed green sea turtle with respect to vessel traffic and dredging activities associated with forage habitat loss, nesting and physical injury. The increases of training described above are not expected to result in an increased likelihood of ship strike to sea turtles. Transit of large vessels, especially those utilizing tugs, are performed at low vessel speed, sufficient to minimize the likelihood of ship strikes. The implementation of NOAA-NMFS recommended BMPs and existing Navy maritime policies is anticipated to continue to reduce potential vessel interactions and impacts to sea turtles. The biological environment of the navigational channels and Inner Apra Harbor, as described in the discussion of commercial traffic above, as well as the lack of known ship strikes on sea turtles anywhere in Apra Harbor since the Navy began operating there, and the observed low densities of sea turtles in Polaris Bay and Inner Apra Harbor, provide additional rationale for the conclusion that the expected increase in military vessel traffic is unlikely to impact sea turtles.

Given the proposed action as currently defined, the pile driving components of Alternative 1, although not likely to take sea turtles, due to limited visibility from elevated turbidity of waters in the action area, may potentially expose sea turtles to noise levels that exceed NOAA's criterion for Level B Take. Therefore, activities associated with pile driving may affect, and are likely to adversely affect the green sea turtle and the hawksbill sea turtle. Alternative 1 would result in significant impacts on special-status species.

Non-native Species

A less than significant impact would result from Alternative 1 actions regarding the introduction and transport of non-native marine organisms, pathogens, or pollutants taken up with ship ballast water (or attached to vessel hulls). The Navy would implement USCG and Navy ballast water management policies and MBP as described in the Affected Environment, Section 11.1. Therefore, with the implementation of the MBP goals and objectives in addition to the existing USCG adopted polices by the Navy, Alternative 1 would result in significant impacts, mitigated to less than significant impacts regarding the introduction of non-native species.

Operation

Marine Flora, Invertebrates and Associated EFH

Potential impacts on this resource would not differ much from existing conditions, although an increase in ship traffic through the existing channel would be expected. Increased vessel traffic may disturb organisms living in the upper water column or in or on the sediments due to propeller wash and resuspension of sediments. However, with the new depths from dredging (approximately 3 feet [1 m]), a reduction in resuspension of fine sediment would be expected. This would decrease turbidity during vessel operations in Inner Apra Harbor providing a localized beneficial impact. There is no evidence that underwater noise negatively affects marine invertebrates (COMNAV Marianas 2007b).

The impact analysis would be similar to that described under Outer Apra Harbor operations activities and Inner Apra Harbor construction activities for vessel movements. Although this resource is poorly represented at this study area, impacts would be long-term but episodic and minor compared to existing conditions.

Therefore, Alternative 1 would result in less than significant impacts to marine flora and invertebrates, and would have no adverse effect on associated EFH.

Essential Fish Habitat

As described earlier in the construction section above, all of Apra Harbor is considered EFH, however neither Inner Apra Harbor, nor the entrance channel are cited as being significant from an EFH perspective. Fish and invertebrate species included in FEPs are poorly represented within the Inner Harbor.

Table 11.2-9 includes information on the EFH types present in the study area and potential effects.

Species with FMPs may experience short-term and temporary impacts during vessel movements; however, fish are highly mobile, so if disturbed are likely to leave the area and return once disturbing activities cease. Based on this assessment and information provided in other sections, there are no adverse impacts to EFH. Therefore, Alternative 1 would result in a less than significant impact to fish and would have no adverse effect on EFH.

Special-Status Species

There would be a less than significant impact on this resource. The green sea turtle may be expected in Inner Apra Harbor; however, it would occur less frequently and in considerably smaller numbers than in Outer Apra Harbor. As described earlier, sea turtles are expected to be able to detect noise and slow moving vessels via auditory and /or visual cues. Additionally, the Navy would comply with their general maritime measures reducing potential interactions with sea turtles and special-status species in general. Table 11.2-7 (used in concert with Figure 11.2-5) identifies sensitive months (and areas) for respective ESA-listed and EFH species in Apra Harbor.

The long-term but episodic impacts associated with Alternative 1 actions may affect, but are not likely to adversely affect ESA-listed sea turtles. Therefore, Alternative 1 would result in less than significant impacts on special-status species.

Non-Native Species

A less than significant impact would result from Alternative 1 actions regarding the introduction and transport of non-native marine organisms, pathogens, or pollutants taken up with ship ballast water (or attached to vessel hulls). The Navy would implement USCG and Navy ballast water management policies and MBP as described in the Affected Environment, Section 11.1. Therefore, with the implementation of the MBP goals and objectives in addition to the existing USCG adopted polices by the Navy, Alternative 1 would result in significant impacts, mitigated to less than significant impacts regarding the introduction of non-native species.

Naval Base Guam

Construction

Land-based activities associated with the LCAC Laydown Area may impact coastal water quality in the vicinity of Polaris Point within Inner Apra Harbor via sheet flow runoff, noise, and vibrations. Appropriate construction BMPs would be in place to minimize this short-term localized impact to marine biological resources that are well adapted to turbid waters.

The construction of the AAV Marine Ramp would affect soft bottom communities within the footprint from dredge and fill operations. The benthic community associated with the AAV's Marine Ramp would be the same as described under the Inner Apra Harbor section above (i.e., the inner harbor floor is composed predominantly of fine sand and silty sediment that is easily re-suspended. Marine biota are not abundant. Most common are burrowing benthic invertebrates, which are visible only by the mounds they build. No algae, sponges, soft corals, hard corals or gorgonian corals have been observed on the floor of the inner harbor or inner portions of the entrance channel (Smith et al. 2008).

There would be small, permanent, localized direct impacts to soft bottom infaunal communities at the area of impact. . Organisms that are not directly subjected to the construction activity would not be impacted. Considering the small area, the loss of soft bottom infaunal community is considered insignificant therefore, no effect on EFH. Alternative 1 impacts would be less than significant for marine biological resources.

Operation

The less than significant impacts to marine biological resources associated with the LCAC and AAV operation under Alternative 1 are expected to be similar to those described under Inner Apra Harbor above.

11.2.2.3 South

Baseline marine biology information for this South Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment. There would be no construction or operations impacts resulting from implementation of Alternative 1 in this area.

11.2.2.4 Summary of Alternative 1 Impacts

No adverse effects on EFH, specifically coral and coral reef ecosystem, at Andersen AFB and Haputo ERA and with the implementation of DoN avoidance and minimization measures for indirect recreational impacts; threrfore a less than significant impact. See description below in EFHA. A less than significant impact from non-native species introductions to Apra Harbor and island-wide with implementation of mitigation measures (i.e. MBP). All other impacts on marine biological resources are anticipated to be less than significant. Section 11.2.8, Table 11.2-1 and Table 11.2-2 describes associated impacts from all alternatives.

11.2.2.5 Summary of Alternative 1 EFH Assessment

Conclusions from the EFHA indicate that proposed activities associated with Alternative 1 would be long-term however minimal in nature. CREMUS at Haputo ERA would experience disturbances from an increase in recreational activities taking place in the area as a result of increased number of personnel at Finegayan.

All of these potential impacts are directly related to increased population size. DoN plans to educate its service members, dependants and construction workers on the importance of coastal ecosystems and the proper way to interact with those resources to avoid and minimize damage to reefs typically caused by anchors, reef-walkers, or reckless diving, snorkeling, and fishing activities. The DoN anticipates increased coastal resource management from local and federal agencies with the pending induced population growth. With the proper management of EFH by Guam and federal resource agencies and the implementation of appropriate mitigation measures, these impacts would be minimal. As discussed below, these mititgation measures may include the implementation of the existing Navy Interim Final INRMP (COMNAV Marianas 2008b) and any potential impact would be mitigated to less than signficant through implementation of the existing Navy Interim Final INRMP (COMNAV Marianas 2008b) and including retrictions on the use of Haputo Beach within the joint region INRMP. Additional preventative measures include marine biological resource education and training on ESA, MMPA, and EFH to military personnel and public outreach; controlled access (a short video and access pass required before entry); informational documents (i.e., preparation of a *Military Environmental Handbook);* distribution of natural resource educational materials to dive boat operators; multiple designated mooring areas offshore and and increased efforts toward ERA enforcement (starting with Haputo).

All other Alternative 1 actions would result in short-term and minimal disturbances, if any; therefore, would have no adverse effect on EFH. Potential impacts are summarized in Section 11.2.8, Table 11.2-7.

11.2.2.6 Alternative 1 Proposed Mitigation Measures

In addition to Volume 2, Recreational Resources, Chapter 9 and Terrestrial Biological Resources, Chapter 10, the following mitigation measures would help reduce impacts to marine biological resources. Proposed mitigation measures for all Volumes are summarized in Volume 7.

As discussed above, marine biological resources education and training on EFH to military personnel along with ESA and MMPA: may include Base Orders, educational training (i.e., require watching a short Haputo ERA video before entering reserve areas [e.g., Hanauma Bay]) and documentation (i.e., preparation of *Military Environmental/Natural Resource Handbook* and natural resource educational handouts [i.e., to dive boat tours)), or a combination of all. Additionally, implementation of existing Air Force and Navy INRMPs would help reduce the impacts from increased ocean-related recreational activities on-base at the areas identified above.

<u>In-Water Construction Activities</u>

- No in-water blasting would be allowed.
- Water quality would be monitored for in-water construction projects during the construction phase.
- Preliminary shutdown safety zones corresponding to where sea turtles could be injured or harassed would be established based upon empirical field measurements of pile driving sound levels at the construction site.
- The sound pressure levels (SPLs) would be monitored on the first day of pile driving to ensure accuracy of contours. Until validation of the harm threshold, no pile driving may occur within 100 m of sea turtles and no dredging operations shall occur within 50 m of sea turtles. Safety zones would be re-established to accommodate validated harm threshold and reported to NMFS with acoustic monitoring data.
- Monitoring of sea turtle harassment safety zones would be conducted by qualified observers, including two observers for safety zones around each pile driving and dredging site.

Monitoring shall commence 30 minutes prior to the start of pile driving. If a sea turtle is found within the safety zone, pile driving or dredging of the segment shall be postponed or halted until the animal(s) has been visually observed beyond the impact zone or 30 minutes have passed without re-detection. Pile driving of dredging may continue into the night, but where there has been an interruption of the activity the activity would not be initiated or re-initiated during nighttime hours when visual clearance cannot be conducted.

- Pile driving and dredging would commence using soft-start or ramp-up techniques, at the start of each work day or following a break of more than 30 minutes. Pile driving would employ a slow increase in hammering, whereas dredging would commence with slow and deliberate deployment of the bucket or chisel to the bottom for the first several cycles to alert protected species and allow them an opportunity to vacate the area prior to full-intensity operations.
- No pile driving or dredging would be conducted after dark unless that work has proceeded uninterrupted since at least 1 hour prior to sunset, and no protected species have been observed near the respective safety range for that work.
- If a sea turtle or other listed species is found injured within the vicinity of the action area, all in-water piling driving or dredging activities shall cease immediately, regardless of their effect to the noted turtle, and the Navy would contact the regional NMFS stranding coordinator.
- Pile driving and dredging observers shall remain continuously alert for protected species starting 60 minutes prior to commencement of work through 30 minutes after shut-down. This includes any break in operations expected to last an hour or less. Resumption of work following a break of an hour or more requires a 60 minute pre-work area search.
- Construction related vessels within Apra Harbor shall remain at least 50 yards from sea turtles, reduce speed to 10 knots or less in the proximity of sea turtles (if practicable, 5 knots or less in areas of suspected turtle activity), and, when consistent with safety practices, put engine in neutral and allow the turtle to pass if approached by a turtle. Additionally, sea turtles shall not be encircled or trapped between multiple construction-related vessels or between construction-related vessels and the shore. If approached by a sea turtle within Apra Harbor, construction related vessel operators would put the engine in neutral and allow the animal to pass.
- All construction-related equipment would be operated and anchored to avoid contacting coral reef resources during construction activities or extreme weather conditions. Anchor lines from construction vessels would be deployed with appropriate tension to avoid entanglement with sea turtles. Construction-related materials that may pose an entanglement hazard would be removed from the project site if not actively being used.
- Anchors, anchor chain, wire rope and associated anchor rigging from construction-related vessels would be restricted to designated anchoring areas within the construction footprint (i.e., soft) bottom or within the area that would be permanently impacted.
- As prescribed in permits for previous construction activities (i.e, Kilo Wharf) during pile driving or dredging activities, if a visible plume is observed outside the silt curtains, the construction activity would be suspended,, evaluated, and corrective measures would be taken. This mitigation measure also applies to Water Resources (Chapter 4).
- Incorporate seasonal dredging prohibitions which may include:

  - o Cessation of dredging operations during the period of peak coral spawning (7-10 days after the full moon in July) in consultation with the UoG Marine Lab.
  - o Dredging or filling of tidal waters would not occur during hard coral spawning periods, usually around the full moons of June, July, and August.

- Construction-related vessels would be restricted from Sasa Bay so as to reduce potential impacts to sea turtles and other protected marine and/or wildlife species.
- Provide marine biological resources education and training on Endangered Species Act (ESA), Marine Mammal Protection Act (MMPA) and Essential Fish Habitat (EFH) to military personnel. This may include Base Orders, natural resource educational training (i.e., watching of short ERA/MPA video) and documentation (i.e., preparation of *Military Environmental/ Natural Resource Handbook,* distribution of natural resource educational materials to dive boat operators), or a combination of all.
- Where practicable, installation of silt curtains during channel and/or harbor dredging operations to maintain water quality and provide coral protection. This mitigation measure also applies to Water Resources (Chapter 4).
- No barge overflow during dredging operations. This mitigation measure also applies to Water Resources (Chapter 4).
- Compensatory Mitigation for coral (see Volume 4 Section 11.2.2.5 for a detailed discussion).
- See Section 4.2.2.4, Chapter 4 of this Volume for mitigation measures associated with water resources.

<u>Sea Turtles and Lighting – the following three measures also apply to Terrestrial Biological Resources (Chapter 10)</u>

- Avoid the use of artificial lighting near beaches, where possible, during nesting and hatching seasons. Shield or redirect lights if avoidance is not possible, to reduce as much as possible the amount of light that can be seen from a potential nesting beach.
- Where possible, use low-intensity light sources that emit long wavelength light (yellow, red) and avoid sources that emit short wavelengths (ultraviolet, blue, green, white).
- Aboard dredge-related tug, barge or scow vessels at sea, use the minimum lighting necessary to comply with navigation rules and best safety practices and help reduce potential impacts on protected species such as sea turtles.

<u>Marine Invasive Species Avoidance, Minimization, and Control – Micronesia Biosecurity Plan</u>

As discussed within this chapter, the major pathways of introduction to Guam and other islands of potentially invasive aquatic species are ballast water loading and discharge and hull fouling of marine organisms. A MBP is being developed to address potential invasive species impacts associated with the proposed action as well as to provide a plan for a comprehensive regional approach. The MBP will include risk assessments for invasive species throughout Micronesia and procedures to avoid, minimize, and mitigate these risks. It is being developed in conjunction with experts within other federal agencies including the National Invasive Species Council , USDA-Agriculture Animal Plant and Health Inspection Service, the US. Geological Survey (USGS) Biological Resources Discipline , and the Smithsonian Environmental Research Center . The Smithsonian Environmental Research Center working group scientists are conducting risk assessments associated with marine invasive species, while the USGS Biological Resources Discipline working group scientists are addressing invasion pathways into freshwater aquatic environments. The MBP is intended to be a comprehensive evaluation of risks in the region, including all Marine Corps and Navy actions on Guam and Tinian and specifically those being proposed in this EIS. DoD would adopt appropriate BMPs recommended by MBP working groups during the MBP development to reduce the likelihood of the introduction and spread of invasive marine organisms. Some example BMPs may include clarifying biosecurity requirements for all Navy vessels (including chartered MSC ships), improving hull husbandry documentation, and incorporating into contractual agreements with vessels chartered to support the military re-location specific criteria to ensure low levels of biofouling and ballast water management. More information on the MBP and invasive species issues is provided in Volume 2, Chapter 10, Terrestrial Biological Resources of this EIS.

11.2.3 Alternative 2

11.2.3.1 North

Andersen AFB

Effects to marine biological resources from the implementation of Alternative 2 actions would be similar to those described in Section 11.2.2.1 Alternative 1.

Finegayan

Effects to marine biological resources from the implementation of Alternative 2 actions would be similar to those described in Section 11.2.2.1 Alternative 1.

Non-DoD Land

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.2.3.2 Central

Andersen South

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Barrigada

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Piti/Nimitz Hill

Effects to marine biological resources from the implementation of Alternative 2 actions would be similar to those described as described under Section 11.2.2.2 Alternative 1.

Non-DoD Land

Effects to marine biological resources from the implementation of Alternative 2 actions would be similar to those described in Section 11.2.2.2 Alternative 1 Route 15 Range Lands for either Alternative A or B.

11.2.3.3 Apra Harbor

Harbor

Alternative 1 is the only proposed wharf improvement alternative.

Naval Base Guam

Effects to marine biological resources from the implementation of Alternative 2 actions would be less than significant, similar to those described as described under Section 11.2.2.3 Alternative 1.

11.2.3.4 South

The impacts from this Overland Route to Training and Amphibious Training Beaches would be addressed within the programmatic NEPA documents**.**

11.2.3.5 Summary of Alternative 2 Impacts

The Alternative 2 impact assessment would be the same as prepared for Alternative 1.

11.2.3.6 Summary of Alternative 2 EFH Assessment

The Alternative 2 EFHA would be the same as prepared for Alternative 1, which are summarized in Section 11.2.8, Table 11.2-7.

11.2.3.7 Proposed Mitigation Measures

Mitigation measures for Alternative 2 would be similar to those described under Alternative 1, Section 11.2.2.5.

11.2.4 Alternative 3

11.2.4.1 North

Andersen AFB

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described in Section 11.2.2.1 Alternative 1.

Finegayan

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described in Section 11.2.2.1 Alternative 1.

Non-DoD Land

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.2.4.2 Central

Andersen South

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Barrigada

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Piti/Nimitz Hill

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described as described under Section 11.2.2.2 Alternative 1.

Non-DoD Land

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described in Section 11.2.2.2 Alternative 1 Route 15 Range Lands for either Alternative A or B.

11.2.4.3 Apra Harbor

Harbor

Alternative 1 is the only alternative where the proposed wharf improvement and LCAC/AAV Laydown and Ramp projects are planned.

Naval Base Guam

Effects to marine biological resources from the implementation of Alternative 3 actions would be similar to those described as described under Section 11.2.2.3 Alternative 1.

11.2.4.4 South

The impacts from the Overland Route to Training and Amphibious Training Beaches would be addressed within the programmatic NEPA documents.

11.2.4.5 Summary of Alternative 3 Impacts

The Alternative 3 impact assessment would be the same as prepared for Alternative 1.

11.2.4.6 Summary of Alternative 3 EFH Assessment

The Alternative 3 EFHA would be the same as prepared for Alternative 1, which are summarized in Section 11.2.8, Table 11.2-7.

11.2.4.7 Proposed Mitigation Measures

Mitigation measures for Alternative 3 would be similar to those described under Alternative 1, Section 11.2.2.5.

11.2.5 Alternative 8

11.2.5.1 North

Andersen AFB

Effects to marine biological resources from the implementation of Alternative 8 actions would be similar to those described in Section 11.2.2.1 Alternative 1.

Finegayan

Effects to marine biological resources from the implementation of Alternative 8 actions would be similar to those described in Section 11.2.2.1 Alternative 1.

Non-DoD Land

Baseline marine biology information for the North Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

11.2.5.2 Central

Andersen South

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Barrigada

Baseline marine biology information for the Central Guam study area was not analyzed as there are no in-water construction, dredging, or training activities proposed and/or land-based construction activities that would affect the marine environment.

Piti/Nimitz Hill

Effects to marine biological resources from the implementation of Alternative 8 actions would be similar to those described as described under Section 11.2.2.2 Alternative 1.

Non-DoD Land

Effects to marine biological resources from the implementation of Alternative 8 actions would be similar to those described in Section 11.2.2.2 Alternative 1 Route 15 Range Lands for Alternative A or B.

11.2.5.3 Apra Harbor

Harbor

Alternative 1 is the only alternative where the proposed wharf improvement and LCAC/AAV Laydown and Ramp projects are planned.

Naval Base Guam

Effects to marine biological resources from the implementation of Alternative 8 actions would be similar to those described as described under Section 11.2.2.3 Alternative 1.

11.2.5.4 South

The impacts from the Overland Route to Training and Amphibious Training Beaches would be addressed within the programmatic NEPA documents.

11.2.5.5 Summary of Alternative 8 Impacts

The Alternative 8 impact assessment would be the same as prepared for Alternative 1.

11.2.5.6 Summary of Alternative 8 EFH Assessment

The Alternative 8 EFHA would be the same as prepared for Alternative 1, which are summarized in Section 11.2.8, Table 11.2-7

11.2.5.7 Proposed Mitigation Measures

Mitigation measures for Alternative 8 would be similar to those described under Alternative 1.

11.2.6 No-Action Alternative

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction, dredging, training, or operations associated with the military relocation would occur. Existing operations on Guam would continue. Therefore, implementation of the no-action alternative would maintain existing conditions and there would be no impacts associated with the proposed action and alternatives. Implementation of the no-action alternative would not meet the mission, readiness, national security and international treaty obligations of the U.S.

The embarkation areas and the LCAC/AAV laydown area, discussed in Section 2.7.5.2, would not be constructed. The USCG would not relocate facilities from Victor Wharf to Oscar and Papa Wharves, and the Military Working Dog Kennel would not be relocated. There eventually would be structural improvements at Victor, Sierra, and Uniform Wharves, including dredging at Sierra and Tango Wharves to maintain existing operations at these wharves.

The no-action alternative does not meet the purpose and need of the proposed action. It serves as a baseline, representative of the "status quo" condition, against which to compare the action alternatives when assessing potential environmental impacts. See Section 2.7.5.2 for the Description of Proposed Action and Alternatives for this project for more details.

11.2.7 Summary of Impacts

Table 11.2-10 summarizes the potential impacts of each Main Cantonment alternative evaluated. Table 11.2-11 summarizes the potential impacts of each Firing Range alternative evaluated. Tables 11.2-12 and 11.2-13 summarize the impacts at NMS for the Ammunition Storage Alternatives and the Access Roads Alternatives respectively. A summary of potential noise impacts due to Other Training, Airfield, and Waterfront is provided in Table11.2-14. A text summary follows the summary tables.

Table 11.2-10. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternative 1(North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
Construction			
LSI • Less than significant direct impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and LID IMPs. • Increased recreational use of Haputo ERA may occur through dive boat tours and beach accessible trails. This indirect and cumulative impact to the ERA would result in no adverse affect on EFH, and may affect, not likely to adversely affect ESA-listed sea turtles in water. • Implementation of BMPs and mitigation measures would help to avoid and minimize effects. Therefore, the implementation of Alternative 1 would result in less than significant impacts.	LSI • Less than significant direct impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and LID IMPs. • Increased recreational use of Haputo ERA may occur through dive boat tours and beach accessible trails. This indirect and cumulative impact to the ERA would result in no adverse affect on EFH, and may affect, not likely to adversely affect ESA-listed sea turtles in water. • Implementation of BMPs and mitigation measures would help to avoid and minimize effects. Therefore, the implementation of Alternative 2 would result in less than significant impacts.	LSI • Less than significant direct impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and LID IMPs. • Increased recreational use of Haputo ERA may occur through dive boat tours and beach accessible trails. This indirect and cumulative impact to the ERA would result in no adverse affect on EFH, and may affect, not likely to adversely affect ESA-listed sea turtles in water. • Implementation of BMPs and mitigation measures would help to avoid and minimize effects. Therefore, the implementation of Alternative 3 would result in less than significant impacts.	LSI • Less than significant direct impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and LID IMPs. • Increased recreational use of Haputo ERA may occur through dive boat tours and beach accessible trails. This indirect and cumulative impact to the ERA would result in no adverse affect on EFH, and may affect, not likely to adversely affect ESA-listed sea turtles in water. • Implementation of BMPs and mitigation measures would help to avoid and minimize effects. Therefore, the implementation of Alternative 8 would result in less than significant impacts.
Operation			
LSI • No direct impacts. Long-term, indirect minimal effects to EFH (coral and coral reef ecosystems). SI-M • Significant impacts, mitigated to less than significant, on special-status species from increased recreational activities at Haputo ERA. See Table 11.2-15 for EFHA summary.	LSI • No direct impacts. Long-term, indirect minimal effects to EFH (coral and coral reef ecosystems). SI-M • Significant impacts, mitigated to less than significant, on special-status species from increased recreational activities at Haputo ERA. See Table 11.2-15 for EFHA summary.	LSI • No direct impacts. Long-term, indirect minimal effects to EFH (coral and coral reef ecosystems). SI-M • Significant impacts, mitigated to less than significant, on special-status species from increased recreational activities at Haputo ERA. See Table 11.2-15 for EFHA summary.	LSI • No direct impacts. Long-term, indirect minimal effects to EFH (coral and coral reef ecosystems). SI-M • Significant impacts, mitigated to less than significant, on special-status species from increased recreational activities at Haputo ERA. See Table 11.2-15 for EFHA summary.

Legend: SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact.

Table 11.2-11. Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternative A (Central)	*Firing Range Alternative B (Central)*
Construction	
LSI • Less than significant impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and IMPs.	LSI • Less than significant impact to marine biological resources. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal runoff from the limestone landscape, and the implementation and management of appropriate construction permits BMPs and IMPs.
Operation	
LSI • Less than significant impact from range training activities associated with SDZs over water (munitions strike and accumulation in the marine environment) to special-status species. BI • Beneficial impacts to marine biological resources, including special-status species, may be seen from restricted access to the coastal areas during training activities.	LSI • Less than significant impact from range training activities associated with SDZs over water (munitions strike and accumulation in the marine environment) to special-status species. BI • Beneficial impacts to marine biological resources, including special-status species, may be seen from restricted access to the coastal areas during training activities.

Legend: LSI = Less than significant impact; BI = Beneficial Impact.

Table 11.2-12. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternative A (South)	*Ammunition Storage Alternative B (South)*
Construction	
NI • Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment.	NI • Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment.
Operation	
NI • Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment.	NI • Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment.

Legend: NI = No impact.

Table 11.2-13. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternative A (South)	*Access Road Alternative B (South)*
Construction	
NI • Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment.	NI • Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment.
Operation	
NI • Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment.	NI • Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment.

Legend: NI = No impact.

Table 11.2-14. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
NI • Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment. • Environmental effects from roadway construction activites are addressed in Volume 6.	NI • Baseline marine biological resource information for this study area was not analyzed as there are no in-water construction, dredging activities proposed for this study area, and/or land-based construction activities that would affect the marine environment.	SI • Significant noise-related impacts to ESA-listed sea turtles from the pile driving component of the Inner Apra Harbor wharf improvement projects. Although a take is not anticipated, due to the turbidity of the water in the project area, observers may not see sea turtles approaching the area and consequently be exposed to noise levels that exceed NOAA's criterion for Level B Take, and therefore may affect, and is likely to adversely affect ESA-listed sea turtles. SI-M • Significant impacts from non-native species introductions, mitigated to less than significant through existing Navy hull and ballast water management and the forthcoming Marianas Biosecurity Plan. LSI • Less than significant, short-term and localized direct, indirect and cumulative impacts from turbidity, decreased water quality, and other disturbances from dredging activites to ESA-listed sea turtles associated with foraging , resting, nesting or swimming , EFH FEP MUS, and soft bottom community during vessel movements (Outer and Inner Apra Harbor), dredging and in-water construction activities of wharves (pile driving) and LCAC and AAV operations area within Inner Apra Harbor. See Table 11.2-11 for EFHA summary. BI • A beneficial impact (BI) may be seen to water quality (and associated marine biological resources identified above) from the removal of fine benthic sediment (3 ft.[1 m] within Inner Apra Harbor. LSI • Less than significant direct and indirect impacts (no adverse effects) from increased vessel movements in Apra Harbor. • Less than significant impacts from runoff or spills associated with construction- related activities in Apra Harbor • Environmental effects from roadway construction activities are addressed in Volume 6.

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Operation		
LSI • No direct impacts. Long-term, indirect minimal effects to EFH (coral and coral reef ecosystems). See Table 11.2-15 for EFHA summary. SI-M • Less than significant impacts to special-status species from increased recreational activities at Andersen AFB Environmental effects from roadway construction activities are addressed in Volume 6.	NI • Baseline marine biological resource information for this study area was not analyzed as there are no operation activities proposed for this study area that would affect the marine environment.	SI-M • Significant impacts from non-native species introductions, mitigated to less than significant through existing Navy hull and ballast water management and the future MBP. LSI • Less than significant direct and indirect impacts from noise, resuspension of sediment, decreased water quality, and other disturbances to ESA-listed sea turtles, EFH FEP MUS, and soft bottom community during increased vessel movements (Outer and Inner Apra Harbor). See Table 11.2-11 for EFHA summary). • Less than significant direct and indirect impacts from noise, resuspension of sediment, decreased water quality and other disturbances to ESA-listed sea turtles, EFH FEP MUS, and soft bottom community during increased vessel movements (Outer and Inner Apra Harbor). See Table 11.2-11 for EFHA summary). • Less than significant direct and indirect impacts from increased vessel movements in Apra Harbor. • Less than significant impacts from runoff or spills associated with operation-related activities in Apra Harbor

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

11.2.8 Summary of Essential Fish Habitat Assessment

The Alternative 1 EFHA would be essentially the same for all alternatives. Table 11.2-15 below summarizes this Assessment.

Table 11.2-15. EFHA Summary

<table>
<tr><th>Area</th><th>Project Activities</th><th>Project Specific Impacts</th></tr>
<tr><td colspan="3">NORTH</td></tr>
<tr><td>Andersen AFB</td><td>Construction</td><td>Increased construction-related personnel on-island may effect EFH through increased ocean-related recreational activities, however the effect would be temporary and minimal as described below. Therefore, no adverse effect to EFH, specifically CREMUS at the Piti Point MRP and adjacent beaches and coral reef ecosystems.

There would be no direct adverse effects on EFH, as this resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal storm runoff from the limestone landscape, and the implementation and management of appropriate construction permits, BMPs and IMPs.

The EFHA identified the following indirect and cumulative effects:
• Minor, short-term and localized disturbance and displacement of motile species.
• Minor short-term and localized increase of potential intertidal collection (illegal inside Piti Point MPA)
• Minor, shor-term and localized potential increase in hook and line fishing.
• Potential long-term and localized damage to coral structures and the coral reef ecosystem within and adjacent to Piti Point MRP.

Within the Pati Point Marine Preserve there are prohibitions on spearfishing and the use of gill nets or throw nets to protect fish and enhance marine fisheries production in Additionally, the collection of any marine organisms (dead or alive) is prohibited except by fishing with a hook and line from designated areas of the shoreline. The MPA boundary extends seaward to any distance where spear or net fishing is observed.

Considering the current infrastructure present at the beach area, including a designated swimming and snorkeling zone, and apparent enforcement of the AAFB INRMPs goals and objectives, this potential increased indirect impact is anticipated to be negligible, and therefore no adverse effect on EFH.

Based on this assessment, Alternative 1 construction activies would result in no adverse effects on EFH at Andersen AFB. Any effects would be further reduced with the implementation of BMPs and mitigation measures as described in Volume 7.</td></tr>
<tr><td>Andersen AFB</td><td>Operation</td><td>Increased operation-related personnel on-island may effect EFH through increased ocean-related recreational activities, however the effect would be temporary and minimal as described below. Therefore, no adverse effect to EFH, specifically CREMUS at the Piti Point MRP and adjacent beaches and coral reef ecosystems.

There would be no adverse direct effects on EFH. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal storm runoff from the limestone landscape, and the implementation and management of appropriate construction permits, BMPs and IMPs.

The EFHA identified the following indirect and cumulative effects:
• Minor, long-term and localized disturbance and displacement of motile species.
• Minor long-term and localized increase of potential intertidal collection outside Piti Point MPA (illegal inside Piti Point MPA)
• Minor, long-term and localized potential increase in hook and line fishing.
• Potential long-term and localized damage to coral structures and the coral reef ecosystem within and adjacent to Piti Point MRP
• Potential long-term reduction in the quality and/or quantity of the and EFH through long-term, periodic and localized degradation</td></tr>
</table>

Area	*Project Activities*	*Project Specific Impacts*
		Within the Pati Point Marine Preserve there are prohibitions on spearfishing and the use of gill nets or throw nets to protect fish and enhance marine fisheries production in Additionally, the collection of any marine organisms (dead or alive) is prohibited except by fishing with a hook and line from designated areas of the shoreline. The MPA boundary extends seaward to any distance where spear or net fishing is observed. Considering the current infrastructure present at the beach area, including a designated swimming and snorkeling zone, and apparent enforcement of the AAFB INRMPs goals and objectives, this potential increased indirect impact is anticipated to be negligible and therefore no adverse effect on EFH. Based on this assessment, Alternative 1 would result in no adverse effects on EFH. Any effects would be further reduced with the implementation of BMPs and mitigation measures as described in Volume 7.
Finegayan	Construction	Increased construction-related personnel on-island may effect EFH through increased ocean-related recreational activities, however the effect would be temporary and minimal as described below. Therefore, no adverse effect to EFH, specifically CREMUS at the Piti Point MRP and adjacent beaches and coral reef ecosystems. There would be no adverse **direct** effects on EFH, as this resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal storm runoff from the limestone landscape, and the implementation and management of appropriate construction permits, BMPs and IMPs. The EFHA identified the following **indirect** and **cumulative** effects: • Minor, short-term and localized disturbance and displacement of motile species. • Minor short-term and localized increase of potential intertidal collection (illegal inside Piti Point MPA) • Minor, shor-term and localized potential increase in hook and line fishing. • Potential long-term and localized damage to coral structures and the coral reef ecosystem within and adjacent to Piti Point MRP. Th primary purpose of an ERA is to preserve an identified physical or biological unit. The entire focus of the Haputo Management Plan is to protect the Haputo ERA ecological communities from change. No actions will be taken or allowed, which have a detrimental effect on either the terrestrial or marine habitat. Scientific collecting of plant, fish and wildlife may be permitted within the ERA providing that it is determined that such proposed collection will not adversely affect the continued existence or maintenance of that species in the ERA (NAVFAC Pacific 1986.). Considering the distance, and difficutly to access Haputo Beach area by steps it is unlikely that a majority of construction workers would have time and/or the ability to access the beach by land or water. Additionally, with proper enforcement of the ERA in place, the potential increased indirect impact is anticipated to be negligible and therefore no adverse effect on EFH. Based on this assessment, Alternative 1 construction activites would result in no adverse effects on EFH at Haputo ERA.
	Operation	Increased construction-related personnel on-island may effect EFH through increased ocean-related recreational activities, however the effect would be temporary and minimal as described below. Therefore, no adverse effect to EFH, specifically CREMUS at the Piti Point MRP and adjacent beaches and coral reef ecosystems. There would be no adverse **direct** effects on EFH. This resource would not be

Area	*Project Activities*	*Project Specific Impacts*
		appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal storm runoff from the limestone landscape, and the implementation and management of appropriate construction permits, BMPs and IMPs. The EFHA identified the following **indirect** and **cumulative** effects: • Minor, long-term and localized disturbance and displacement of motile species. • Minor long-term and localized increase of potential intertidal collection outside Piti Point MPA (illegal inside Piti Point MPA) • Minor, long-term and localized potential increase in hook and line fishing. • Minimal long-term and localized potential damage to coral structures and the coral reef ecosystem within and adjacent to Haputo ERA • Long-term reduction in the quality and/or quantity of the and EFH through minimal, periodic and localized degradation The primary purpose of an ERA is to preserve an identified physical or biological unit. The entire focus of the Haputo Management Plan is to protect the Haputo ERA ecological communities from change. No actions will be taken or allowed, which have a detrimental effect on either the terrestrial or marine habitat. Scientific collecting of plant, fish and wildlife may be permitted within the ERA providing that it is determined that such proposed collection will not adversely affect the continued existence or maintenance of that species in the ERA (NAVFAC Pacific 1986.). Considering the current lack of infrastructure present at the beach area, popularity and uniqueness of the double reef and adjacent coral reef ecosystem, and apparent over fishing issues, this potential increased indirect impact is anticipated to be significant. Based on this assessment, Alternative 1 operations would result in no adverse effects to EFH.
CENTRAL		
Non-DoD Land	Construction	There would be no adverse effects on EFH. This resource would not be appreciably modified from existing conditions considering the distance and elevation from the shoreline, the minimal storm runoff from the limestone landscape, and the implementation and management of appropriate construction permits, BMPs and IMPs. Increased construction-related personnel and associated recreational activities would not affect EFH as access to this shoreline is limited and there are no dive boat tour spots identified. Based on this assessment, Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs as described in Volume 7.
	Operation	There would be minimal indirect impacts to EFH from recreational activities of operation-based personnel and their dependants. Effects determination would be similar as that described above under construction. Additionally, beneficial impact to nearshore communities due to limited and controlled access at the coastline during training operations. There would be long-term, localized accumulation of small arms (.50 cal and MK19 TP) expended materials in the benthic habitat from the range operations, however the amount of bullets that actually make it to the marine environment from ricochetes would be negligible, therefore minimal potential for ingestion or benthic contamination. Avoidance and minimization measures, including the use of “green bullets” (non-toxic alloys) and periodic benthic clean up, were considered to decrease potential impacts, however deemed unnecessary as described in Section 11.2.2.2, Munitions Strike Probability. Based on this assessment, Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs as described in Volume 7.

<table>
<tr><th>Area</th><th>Project Activities</th><th>Project Specific Impacts</th></tr>
<tr><td colspan="3">APRA HARBOR</td></tr>
<tr><td>Harbor</td><td>Construction</td><td>The proposed action (Inner Apra Harbor Wharf refurbishing and associated dredging, pile driving, and vessel movement activities) would have direct, indirect and cumulative impacts from noise, turbidity - decreased water quality, and other disturbances on EFH FEP MUS. These impacts would occur during dredging and in-water construction activities of the wharves (i.e. pile driving) and LCAC and AAV operations area associated with Inner Apra Harbor, including dredged spoils tug and scow movements through Outer Apra Harbor to the ocean disposal site.

The EFHA for Apra Harbor found that the in-water construction and increase of construction-related vessel movements could result in:
• Direct, short-term and localized removal of soft bottom habitat and infaunal community during dredging activities, which is anticipated to recovery quickly (2-6 months) due to horizontal reestablishment
• Direct, short-term and localized impacts to invertebrates colonized on wharf vertical structures. Invertebrates are anticipated to quickly recolonize post construction.
• Short-term, and localized disturbance and displacement of motile species of fish during in-water transit, dredging and pile driving activities. Ramping up methods of pile driving will allow marine species to exit the immediate area
• Short-term, periodic, and localized increase of turbidity (decreased water quality) in the water column from dredging, pile driving, and vessel propeller wash
• Short-term, periodic, and localized increase in benthic sedimentation
• Potential Seasonal disturbances to pupping scalloped hammerhead sharks

As describe earlier, all of Apra Harbor is considered EFH, however neither Inner Apra Harbor, nor the entrance channel are cited as being significant from an EFH perspective. Fish and invertebrates species with FMPs are poorly represented within the inner harbor. Based upon the available data and information provided in Section 11.1.7, there is no reason to suspect that Inner Apra Harbor is serving as an important spawning or nursery area for either invertebrates or fishes.

Based on this assessment, the Navy has determined that these minimal, short-term and localized impacts associated with Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs along with USACE permit conditions as described in Volume 7.</td></tr>
<tr><td></td><td>Operation</td><td>The proposed action would have direct, indirect and cumulative impacts from noise, re-suspension of sediment, decreased water quality, and other disturbances on EFH FEP MUS from increased vessel movements in Outer and Inner Apra Harbor.

The EFHA for Outer Apra Harbor found that the increase of MEU vessel movements would be a negligible increase, however would result in:
a. Long-term, however, periodic and localized disturbance and displacement of motile species (fish) during in-water transit activities
b. Long-term, however, periodic and localized increase of turbidity (decreased water quality) in the water column from propeller wash
c. Long-term, however periodic and localized increase in benthic sedimentation
d. Long-term, however periodic and localized potentially significant impacts to eggs and larvae in the upper water column from increased vessel traffic
e. Potential seasonal disturbances to pupping scalloped hammerhead sharks.

Based on this assessment, the Navy has determined that these temporary and/or minimal impacts associated with Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs as described in Section 11.2.2.1 and associated Figures (11.1-3 – 11.1-7, 11.1-11 and 11.1-12) and Tables 11.2-6, 11.2-7, and 11.2-9).</td></tr>
</table>

Area	*Project Activities*	*Project Specific Impacts*
Naval Base Guam	Construction	The proposed action would have minimal direct, indirect and cumulative impacts from noise, turbidity, decreased water quality, and other disturbances on EFH FEP MUS present during land-based and in-water construction activities of the LCAC and AAV operations area associated with Inner Apra Harbor. The poor water quality in this area, due to extremely high levels of turbidity, reduces the likelihood that larvae present would survive. Therefore, spawning and reproductive activities that may occur within the inner harbor are unlikely to contribute significantly to the populations in Outer Apra Harbor or Guam overall (COMNAV Marianas 2007b). Based on this assessment, the Navy has determined that these minimal impacts associated with Alternative 1 would result in no adverse effects on EFH with the implementation of BMPs as described in Volume 7.
	Operation	There would be minimal, short-term and localized impacts to EFH. Effects determination would be similar as that described above under construction.

11.2.9 Summary of Proposed Mitigation Measures

In addition to Volume 2, Recreational Resources, Section 9.2.2.5 and the Terrestrial Biological Resources, Section 10.2.2.5, the following mitigation measures (Table 11.2-16) would further reduce impacts to marine biological resources. Proposed mitigation measures for all Volumes are summarized in Volume 7.

Table 11.2-16. Summary of Proposed Mitigation Measures

Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*
Construction Activities			
• Provide marine biological resources education and training on EFH to military personnel along with ESA and MMPA: may include Naval Base orders, natural resource educational training (i.e., required viewing of a short Haputo ERA video 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 of all. • To prevent disturbance of sensitive species in recreational areas, restrictions on the use of Haputo Beach and ERA, would be included within the Joint Region INRMP. This mitigation measure also applies to Terrestrial Biological Resources (Chapter 10). In-Water Construction Activities: • No in-water blasting would be allowed. • Water quality would be monitored for in-water construction projects during the construction phase. • Preliminary shutdown safety zones corresponding to where sea turtles could be injured or harassed would be established based upon empirical field measurements of pile driving sound levels at the construction site.	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1

Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*
• The sound pressure levels (SPLs) would be monitored on the first day of pile driving to ensure accuracy of contours. Until validation of the harm threshold, no pile driving may occur within 100 m of sea turtles and no dredging operations shall occur within 50 m of sea turtles. Safety zones would be re-established to accommodate validated harm threshold and reported to NMFS with acoustic monitoring data. • Monitoring of sea turtle harassment safety zones would be conducted by qualified observers, including two observers for safety zones around each pile driving and dredging site. Monitoring shall commence 30 minutes prior to the start of pile driving. If a sea turtle is found within the safety zone, pile driving or dredging of the segment shall be postponed or halted until the animal(s) has been visually observed beyond the impact zone or 30 minutes have passed without re-detection. Pile driving of dredging may continue into the night, but where there has been an interruption of the activity the activity would not be initiated or re-initiated during nighttime hours when visual clearance cannot be conducted. • Pile driving and dredging would commence work using soft-start or ramp-up techniques, at the start of each work day following a break of more than 30 minutes. Pile driving would employ a slow increase in hammering, whereas dredging would commence with slow and deliberate deployment of the bucket or chisel to the bottom for the first several cycles to alert protected species and allow them an opportunity to vacate the area prior to full-intensity operations. • No pile driving or dredging would be conducted after dark unless that work has proceeded uninterrupted since at least 1 hour prior to sunset, and no protected species have been observed near the respective safety range for that work. • If a sea turtle or other listed species is found injured within the vicinity of the action area, all in-water pile driving or dredging activities shall cease immediately, regardless of their effect to the noted turtle and the Navy would contact the regional NMFS stranding coordinator. • Construction related vessels within Apra Harbor shall remain at least 50 yards from sea turtles, reduce speed to 10 knots or less in the proximity of sea turtles (if practicable, 5 knots or less in areas of suspected turtle activity), and, when consistent with safety practices, put engine in neutral and allow the turtle to pass if approached by a turtle. • Additionally, sea turtles shall not be encircled or trapped between multiple construction-related vessels or between construction-related vessels and the shore. • All construction-relatated equipment would be operated and anchored to avoid contacting coral reef resources during construction activities or extreme weather conditions.			

Alternative 1	Alternative 2	Alternative 3	Alternative 8
• Anchor lines from construction vessels would be deployed with appropriate tension to avoid entanglement with sea turtles. Construction-related materials that may pose an entanglement hazard would be removed from the project site if not actively being used. • Anchors, anchor chain, wire rope and associated anchor rigging from construction-related vessels would be restricted to designated anchoring areas within the construction footprint (i.e. soft bottom) or within the area that would be permanently impacted. • As prescribed in permits for previous construction activities (i.e, Kilo Wharf), during pile driving or dredging activities, if a visible plume is observed outside the silt curtains, the construction activity would be suspended, evaluated, and corrective measures would be taken. This mitigation measure also applies to water resources (Chapter 4). Incorporate seasonal dredging prohibitions which may include: o Cessation of dredging operations during the period of peak coral spawning (7-10 days after the full moon in July) in consultation with the UoG Marine Lab. o Dredging or filling of tidal waters would not occur during hard coral spawning periods, usually around the full moons of June, July, and August. • Construction-related vessels would be restricted from Sasa Bay so as to reduce potential impacts to sea turtles and other protected marine and/or wildlife species. This mitigation measure to terrestrial biological tesources (Chapter 10). • Provide marine biological resources education and training on ESA, MMPA, and EFH to military personnel This may include Base Orders, natural resource educational training (i.e., watching of short ERA/MPA video) and documentation (i.e., preparation of Military Environmental/ Natural Resource Handbook, distribution of natural resource educational materials to dive boat operators), or a combination of all. • Where practicable, installation of silt curtains during channel and/or harbor dredging operations to maintain water quality and providecoral protection. This mitigation measure also applies to water resources (Chapter 4). • No barge overflow during dredging operations. This mitigation measure also applies to water resources (Chapter 4). • Compensatory Mitigation for coral (see Volume 4 Section 11.2.2.5) for a detailed discussion. • See Section 4.2.2.4, Chapter 4 of this Volume for mitigation measures associated with water resources. • See Section Table 10.2-22, Chapter 10 of this Volume for mitigation measures associated with Terrestrial Biological Resources.			

Alternative 1	Alternative 2	Alternative 3	Alternative 8
• Develop the Micronesia Biosecurity Plan to address potential invasive species impacts associated with the proposed action as well as to provide a plan for a comprehensive regional approach. Develop an associated biosecurity program with terrestrial and aquatic response cababilities. Implement biosecurity measures and appropriate Best Management Practices recommended by the Micronesia Biosecurity Plan reduce the likelihood of the introduction and spread of invasive marine organisms. Sea Turtles and Lighting – These three mitigation measure also apply to Terrestrial Biological Resources (Chapter 10). • Avoid the use of artificial lighting near beaches, where possible, during nesting and hatching seasons. Shield or redirect lights if avoidance is not possible, to reduce as much as possible the amount of light that can be seen from a potential nesting beach. • Where possible, use low-intensity light sources that emit long wavelength light (yellow, red) and avoid sources that emit short wavelengths (ultraviolet, blue, green, white). • Aboard dredge-related tug, barge or scow vessels at sea, use the minimum lighting necessary to comply with navigation rules and best safety practices to help reduce potential impacts on protected species such as sea turtles.			
Operation Activities			
• Provide marine biological resources education and training on EFH to military personnel along with ESA and MMPA: may include Naval Base orders, educational training (i.e., required viewing of a short Haputo ERA video 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 of all. • Implement biosecurity measures and appropriate Best Management Practices recommended by the Micronesia Biosecurity Plan to reduce the likelihood of the introduction and spread of invasive marine organisms. • To prevent disturbance of sensitive species in recreational areas, restrictions on the use of Haputo Beach and ERA would be included within the Joint Region INRMP. This mitigation measure also applies to marine biological resources.	• Same as Alternative 1	• Same as Alternative 1	• Same as Alternative 1

This Page Intentionally Left Blank.