3.3 Marine Habitats

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3.3 MARINE HABITATS

MARINE HABITATS SYNOPSIS

The United States Department of the Navy considered all potential stressors, and the following have been analyzed for marine habitats as a substrate for biological communities:

- Acoustic (underwater explosives)
- Physical disturbance and strike (vessels, in-water devices, military expended materials, and seafloor devices)

Preferred Alternative (Alternative 1)

- Acoustic: Most of the high-explosive military expended materials would detonate at or near the water surface. Only bottom-laid explosives could affect bottom substrate and, therefore, marine habitats. Habitat utilized for underwater detonations would primarily be soft-bottom sediment. The surface area of bottom substrate affected would be less than 1 percent of the total training and testing area available in the Study Area.
- Physical Disturbance and Strike: Ocean approaches would not be expected to affect marine habitats because of the nature of high-energy surf and shifting sands. Seafloor devices would be located in areas that would be primarily soft-bottom habitat. Most seafloor devices would be placed in areas that would result in minor bottom substrate impacts. Once on the seafloor, military expended material would be buried by sediment, corroded from exposure to the marine environment, or colonized by benthic organisms. The surface area of bottom substrate affected would be a fraction of the total training and testing area available in the Study Area.
- Pursuant to the Essential Fish Habitat requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of explosives on or near the bottom, military expended materials, and seafloor devices during training and testing activities may have an adverse effect on Essential Fish Habitat by reducing the quality and quantity of non-living substrates that constitute Essential Fish Habitat and Habitat Areas of Particular Concern. Essential Fish Habitat conclusions for associated marine vegetation and sedentary invertebrates are summarized in corresponding resource sections (e.g., marine vegetation, invertebrates). Impacts to the water column as Essential Fish Habitat are summarized in corresponding resource sections (e.g., invertebrates, fish) because they are impacts on the organisms themselves.

3.3.1 INTRODUCTION

This section analyzes potential impacts on marine nonliving (abiotic) substrates found in the Mariana Islands Training and Testing (MITT) Study Area (Study Area). The Study Area covers a range of marine habitats, each supporting communities of organisms that can vary by season and location. The intent of this chapter is to cover abiotic habitat features that were not addressed in the individual biological resource chapters (i.e., disturbance of bottom substrate). The water column and bottom substrate provide the necessary habitats for living resources that form biotic habitats (i.e., aquatic beds and attached invertebrates), which are discussed in other sections. The Essential Fish Habitat Assessment (EFHA) for the MITT Study Area is a supporting technical document (U.S. Department of the Navy 2014). The United States (U.S.) Department of the Navy (Navy) has consulted with the National Marine Fisheries Service (NMFS) on the EFHA.

Table 3.3-1 lists the types of habitats that will be discussed in this section in relation to the open-ocean areas, and bays and estuaries in which they occur. Habitat types are derived from the Classification of Wetlands and Deepwater Habitats of the United States (Cowardin et al. 1979). Habitat types and subtypes presented in Table 3.3-1 are grouped based on similar stressor responses to locations within the aquatic environment (e.g., depth, illumination, waves, and currents) as well as remote detection signatures for mapping. As such, these classifications may or may not overlap with the Coastal and Marine Ecological Classification Standard (Federal Geographic Data Committee 2012) catalog of terms that provides a means for classifying ecological units using a simple, standard format and common terminology. Therefore, Table 3.3-2 aligns the habitat groupings used in this analysis with the Coastal and Marine Ecological Classification Standard.

Description and distribution information for the water column itself are not provided here, because it is unaffected by the physical and acoustic impacts of military training and testing activities. The direct impacts of the Proposed Action are on living marine resources in the water column and on abiotic habitats forming the bottom. The distribution of water column features is described in Section 3.0.3 (Ecological Characterization of the Mariana Islands Training and Testing Study Area). Impacts on federally managed species via the water column (e.g., noise, contaminants), are summarized in corresponding resource sections (e.g., marine vegetation, invertebrates, fish).

The rationale for evaluating the impact of stressors on marine substrate differs from the rationale applied to other biological resources. Unlike organisms, habitats are valued mainly for their function, which is largely based on their structural components and ability to support a variety of marine organisms. Accordingly, the assessment focuses on the ability of substrates to function as habitats. An impact on abiotic marine habitat is anticipated where training, testing, or associated transit activities could convert one substrate type into another (i.e., bedrock or consolidate limestone to unconsolidated soft bottom, or soft bottom to parachute canvas). Whereas the impacts on the biotic growth (i.e., vegetation and algae) are covered in their respective resource sections, the impacts on bottom substrate itself are considered here.

Table 3.3-1: Habitat Types within the Open Ocean and Coastal Portions of the Mariana Islands Training and Testing Study Area

Habitat Type	Subtypes	Location in the Study Area		
		Open Ocean	Coastal Ocean	Estuaries
Soft Shores[1]	Beach		✓	
	Tidal Delta/mudflats and tidal riverine and estuarine streambeds		✓	✓
Rocky Shores[1]	Rocky Shores		✓	
Vegetated Shores[2]	Salt/Brackish Marsh			✓
	Mangrove		✓	✓
Aquatic Beds[2]	Seagrass		✓	
	Sargassum		✓	
Soft Bottoms[1]	Lagoons		✓	✓
	Abyssal Plain	✓		
	Trench	✓		
Hard Bottoms[1]	Biotic/Reef		✓	
	Seamount	✓		
	Hydrothermal vents	✓		
Artificial Structures[1]	Artificial Reefs		✓	
	Shipwrecks	✓	✓	
	FADs		✓	

[1] See Section 3.8 (Marine Invertebrates) for living habitat component assessment.
[2] See Section 3.7 (Marine Vegetation) for living habitat component assessment.
Notes: FAD = Fish Aggregating Device, Study Area = Mariana Islands Training and Testing Study Area

Table 3.3-2: Coastal and Marine Ecological Classification Standard Crosswalk

MITT EIS/OEIS Habitat Type and Subtypes	Relationship to CMECS	CMECS Class/ Subclass	Confidence[2]	Relationship Notes
Soft Shores[1]	<	Unconsolidated Substrate	Certain	CMECS Unconsolidated Substrate = Cowardin Unconsolidated Shore + Unconsolidated bottom. Shore is considered in the CMECS Geoform Component.
Beach	=	Beach	Somewhat Certain	
Tidal Delta/mudflats and tidal riverine and estuarine streambeds	<	Flat	Somewhat Certain	MITT habitat type = CMECS ebb tidal delta flat + flood tidal delta flat + tidal flat+ wind tidal flat
Rocky Shores[1]	<	Rock Substrate	Certain	CMECS Rock substrate = Cowardin Rocky Shore + Rock Bottom. Shore is considered in the CMECS Geoform Component.
Vegetated Shores[1]	=	Emergent Wetland	Certain	
Salt/Brackish Marsh	≈	Emergent Tidal Marsh	Somewhat Certain	

Table 3.3-2: Coastal and Marine Ecological Classification Standard Crosswalk (continued)

MITT EIS/OEIS Habitat Type and Subtypes	Relationship to CMECS	CMECS Class/ Subclass	Confidence[2]	Relationship Notes
Mangrove	>	Tidal Mangrove Forest, Tidal Mangrove Shrubland	Somewhat Certain	MITT Mangrove = CMECS Tidal Mangrove Shrubland + Tidal Mangrove Forest. MITT Mangrove has no height threshold.
Aquatic Beds[1]	=	Aquatic Vegetation Bed	Certain	
Seagrass	≈	Aquatic Vascular Vegetation	Somewhat Certain	MITT Seagrass = CMECS Freshwater and Brackish Tidal Aquatic Vegetation + Seagrass bed. MITT Seagrass has no salinity threshold.
Sargassum	<	Bethic Macroalgae	Somewhat Certain	
Soft Bottoms[1]	<	Unconsolidated Substrate	Certain	CMECS Unconsolidated Substrate = Cowardin Unconsolidated Shore + Unconsolidated Bottom.
Lagoons	≈	Lagoon	Somewhat Certain	
Abyssal Plain	≈	Abyssal Plain	Somewhat Certain	
Mariana Trench	≈	Tectonic Trench	Somewhat Certain	CMECS Tectonic Trench = General description of trenches. Mariana Trench is specific to Study Area.

Table 3.3-2: Coastal and Marine Ecological Classification Standard Crosswalk (continued)

MITT EIS/OEIS Habitat Type and Subtypes	Relationship to CMECS	CMECS Class/ Subclass	Confidence[2]	Relationship Notes
Hard Bottoms[1]	<	Rock Substrate	Certain	CMECS Rock Substrate = Cowardin Rocky Shore + Rock Bottom
Biotic/Reef	≈	Shallow/Mesophotic Coral Reef Biota	Somewhat Certain	
Seamount	>	Seamount (Level 1)	Somewhat Certain	MITT Seamount = CMECS Guyot + Knoll + Pinnacles. MITT Seamounts does not have shape delimiters.
Hydrothermal vents	>	Hydrothermal Vent (Level 2), Hydrothermal Vent Field (Level 1 and 2)	Somewhat Certain	MITT Hydrothermal Vent does not have a number of vents threshold.
Artificial Structures	<	Anthropogenic Substrate	Somewhat Certain	Anthropogenic Substrate = includes classes dependent on the anthropogenic material; however, materials in the Study Area vary.
Artificial Reefs	≈	Artificial Reef	Somewhat Certain	
Shipwrecks	≈	Wreck (Level 2)	Somewhat Certain	
FADs	≈	Buoy (Level 2)	Somewhat Certain	

[1] These habitat types were derived directly from Cowardin 1979.
[2] "Confidence" is a CMECS classification to describe the relative strength of the relationship between the CMECS unit and the unit being compared. There are three levels of confidence: Certain, Somewhat Certain, and Not Certain.
Notes: CMECS = Coastal and Marine Ecological Classification Standard, EIS = Environmental Impact Statement, FAD = Fish Aggregating Device, MITT = Mariana Islands Training and Testing, OEIS = Overseas Environmental Impact Statement, Study Area = Mariana Islands Training and Testing Study Area

3.3.2 AFFECTED ENVIRONMENT

The majority of the Study Area lies within open-ocean areas. Relatively little of the Study Area includes intertidal and shallow subtidal areas in U.S. territory waters, where numerous habitats are exclusively present (e.g., salt/brackish marsh, mangrove, coral reefs, and seagrass beds). Intertidal abiotic habitats (e.g., beaches, tidal deltas, mudflats, rocky shores) are addressed only where intersections with military training and testing activities are reasonably likely to occur. The distribution of abiotic marine habitats among the open oceans, estuaries, and coastal areas is described in their respective sections and is generalized to each area in Table 3.3-1.

Abiotic marine habitats vary according to geographic location, underlying geology, hydrodynamics, atmospheric conditions, and suspended particles. Flows and sediments from creeks and rivers create channels, tidal deltas, intertidal and subtidal flats, and shoals of unconsolidated material along the shorelines and estuaries. The influence of land-based nutrients and sediment increases with proximity to nearshore and inland waters. In the pelagic ocean, gyres, eddies, and oceanic currents create dynamic microhabitats that influence the distribution of organisms. A patchwork of diverse habitats exists on the open ocean floor, where there is no sunlight, low nutrient levels, and minimal sediment movement (Levinton 2009). Major bottom features in offshore areas include shelves, banks, guyots, breaks, slopes, trenches, plains, deep-water reefs, volcanoes, and seamounts. Geologic features such as these affect the hydrodynamics of the ocean water column (e.g., currents, gyres, and upwelling) as well as the biological resources present.

Estuarine and ocean environments worldwide are under increasing pressure from human development and expansion, accompanied by increased ship traffic, pervasive pollution, invasive species, destructive fishing practices, vertical shoreline stabilization, offshore energy infrastructure, and global climate change (Crain et al. 2009; Lotze et al. 2006; Pandolfi et al. 2003). The stressors associated with these activities are not distributed randomly across the patchwork of habitat types and ecosystems (Halpern et al. 2008). Areas where heavy concentrations of human activity co-occur with military training or testing activities have the greatest potential for cumulative stress on the marine ecosystem (Chapter 4, Cumulative Impacts). Refer to individual biological resource chapters for specific stressors and impacts.

3.3.2.1 Soft Shores

3.3.2.1.1 Description

Soft shores include all wetland habitats having three characteristics: (1) unconsolidated substrates with less than 75 percent areal coverage of stones, boulders, accreted limestone, or bedrock; (2) less than 30 percent areal coverage of vegetation other than pioneering plants and algae; and (3) any of the following water regimes: irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, intermittently flooded, saturated, or artificially flooded (Cowardin et al. 1979). Soft shores include stream beds of the tidal riverine and estuarine systems, tidal flats and deltas, and beaches.

Intermittent and intertidal channels of the riverine system and intertidal channels of the estuarine system are classified as streambed. Intertidal flats, also known as tidal flats or mudflats, consist of loose mud, silt, and fine sand with organic-mineral mixtures that are regularly exposed and flooded by the tides (Mitsch and Gosselink 2000). Muddy fine sediment is deposited in sheltered inlets and estuaries where wave energy is low (Holland and Elmore 2008). Mudflats are typically unvegetated, but may be covered with mats of green algae and benthic diatoms (single-celled algae), or sparsely vegetated with low-growing aquatic species. The muddy intertidal habitat occurs most often as part of a patchwork of intertidal habitats that may include rocky shores, tidal creeks, sandy beaches, salt marshes, and mangroves.

Beaches form through the interaction of waves and tides, as particles are sorted by size and deposited along the shoreline (Karleskint et al. 2006). Wide flat beaches with fine-grained sands occur where wave energy is limited. Narrow steep beaches of coarser sand form where energy and tidal ranges are high

(Speybroeck et al. 2008). Three zones characterize beach habitats: (1) dry areas above the mean high water, (2) the area where seaweed and debris is deposited at high tide, and (3) a high-energy intertidal zone (area between high and low tide). Refer to biological resources chapters for more information on species use of tidal deltas, intertidal flats, and beaches.

3.3.2.1.2 Distribution

On the island of Guam, the majority of the coastline is comprised of rocky intertidal regions. Interspersed among this rocky shoreline are 58 beaches composed of calcareous or volcanic sands (Eldredge 1983). The west coast of Saipan contains well developed fine-sand beaches protected by the Saigon and Tanapag Lagoons (Scott 1993). All other beaches of Saipan consist of coral-algal-mollusk rubble. The island of Tinian contains 13 beaches (10 located on the west coast and 3 on the east coast). These beaches are not well developed (except Tinian Harbor on the southwest coast, and Unai Dankulo along the east coast) and are comprised mainly of medium to coarse grain calcareous sands, gravel, and coral rubble (Eldredge 1983; Kolinski et al. 2001). On Rota, the rare beaches are found scattered among limestone patches and are composed of rubble and sand (Eldredge 1983). The coastal area of Farallon de Medinilla (FDM) contains two small intertidal beaches that are inundated by high tide on the northeastern and western coastlines.

3.3.2.2 Rocky Shores

3.3.2.2.1 Description

Rocky shores include aquatic environments characterized by bedrock, stones, or boulders which singly or in combination have an aerial cover of 75 percent or more and an aerial coverage by vegetation of less than 30 percent (Cowardin et al. 1979). Water regimes are restricted to irregularly exposed, regularly flooded, irregularly flooded, seasonally flooded, temporarily flooded, or intermittently flooded. Rocky intertidal shores are areas of bedrock that alternate between periods of submergence and exposure to air, depending on whether the tide is high or low. Extensive rocky shorelines can be interspersed with sandy areas, estuaries, or river mouths.

Environmental gradients between hard shorelines and subtidal habitats are determined by wave action, depth and frequency of tidal inundation, and stability of substrate. Where wave energy is extreme, only rock outcrops may persist. In lower energy areas, a mixture of rock sizes will form the intertidal zone. Boulders scattered in the intertidal and subtidal areas provide substrate for attached macroalgae and sessile invertebrates. Refer to biological resources chapters for more information on species inhabiting hard shorelines.

3.3.2.2.2 Distribution

Rocky shores are the dominant marine habitat on all islands within the Study Area. This is due to the volcanic origin of all of the islands (Eldredge 1983). Coastlines within the Study Area are generally lined with rocky intertidal areas, steep cliffs and headlands, and the occasional sandy beach or mudflat (Eldredge 1983). The water erosion of rocky coastlines in the Study Area has produced wave-cut cliffs (produced by undercutting and mass wasting), and sea-level benches (volcanic and limestone and wave cut notches at the base of the cliffs (Eldredge 1979, 1983). Large block and boulders often buttress the foot of these steep cliffs in the Study Area.

3.3.2.3 Vegetated Shores

Vegetated shorelines are characterized by erect, rooted, herbaceous aquatic plants, excluding mosses and lichens, which grow above the water line (Cowardin et al. 1979). This vegetation is present for most of the growing season in most years. These wetlands are usually dominated by perennial plants. All water regimes are included except subtidal and irregularly exposed (Cowardin et al. 1979). Vegetated shorelines in the Study Area are formed by salt marsh or mangrove plant species. Salt marsh and mangrove plants are living marine resources and biotic habitat where they dominate the intertidal zone, and are therefore not covered in this chapter. Refer to Section 3.7 (Marine Vegetation) for information on marsh and mangrove plant species.

3.3.2.4 Aquatic Beds

Aquatic beds include wetlands and permanently submerged habitats dominated by plants that grow principally on or below the surface of the water for most of the growing season in most years (Cowardin et al. 1979). Water regimes include subtidal, irregularly exposed, regularly flooded, permanently flooded, intermittently exposed, semi-permanently flooded, and seasonally flooded. Seagrasses and floating macroalgae (i.e., *Sargassum*) are living marine resources and biotic habitats where they dominate the intertidal or shallow subtidal zone, and are therefore not covered in this chapter. Refer to Section 3.7 (Marine Vegetation) for information on seagrasses and macroalgae.

3.3.2.5 Soft Bottoms

3.3.2.5.1 Description

Soft bottoms include all wetland and deepwater habitats with at least 25 percent cover of particles smaller than stones (10–24 inches [in.] [25.4–61.0 centimeters {cm}]), and a vegetative cover less than 30 percent (Cowardin et al. 1979). Water regimes are restricted to subtidal, permanently flooded, intermittently exposed, and semi-permanently flooded. Soft bottom forms the substrate of channels, shoals, subtidal flats, and other features of the bottom. Sandy channels emerge where strong currents connect estuarine and ocean waters. Shoals form where sand is deposited along converging, sediment-laden currents forming capes. Subtidal flats occur between the soft shores and the channels or shoals. The continental shelf extends seaward of the shoals and inlet channels, and includes an abundance of coarse-grained, soft-bottom habitats. Finer-grained sediments collect beyond the shelf break on the continental slope, along the continental rise at the base of the continental slope and on the abyssal plain. These areas are inhabited by soft-sediment communities of mobile invertebrates fueled by benthic algae production, chemosynthetic microorganisms, and detritus sinking through the water column. Refer to biological resources chapters for more information on species use of soft-bottom habitats.

One type of soft-bottom habitat that occurs in the Study Area is lagoons. A lagoon can be described as a semi-enclosed bay found between the shoreline and the landward edge of a fringing reef or barrier reef (National Centers for Coastal Ocean Science and National Oceanic and Atmospheric Administration 2005). Lagoons typically contain three distinct zones: freshwater zone, transitional zone, and saltwater zone (Thurman 1997). Most tropical reef-associated lagoons are not brackish and lack significant freshwater input. The bottoms of the lagoons are mostly sandy and can be flat, rippled, or filled with sand mounds created by burrowing organisms. Coral rubble, coral mounds, 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 (National Centers for Coastal Ocean Science and National Oceanic and Atmospheric Administration 2005; Pacific Basin Environmental Consultants 1985).

3.3.2.5.2 Distribution

Soft-bottom substrates in coastal regions of the Study Area are not common. This is due to the fact that the intertidal and subtidal regions are often characterized by limestone pavement interspersed with coral colonies and submerged boulders (Kolinski et al. 2001). Shorelines are often rocky with interspersed sand beaches or mud flats (Eldredge 1983; Pacific Basin Environmental Consultants 1985).

Lagoons of coastal Guam are associated with Apra Harbor (Inner Harbor, Outer Harbor, and Sasa Bay), Cocos Lagoon, and numerous embayments along the western coastline. Apra Harbor is the only deep lagoon on Guam and is the busiest port in the Mariana Islands. The Outer Harbor is enclosed by the Glass Breakwater. Sasa Bay, located on the edge of the Outer Harbor, is a shallow coastal lagoon populated with patchy corals (Scott 1993). The Inner Apra Harbor is a human-made lagoon created by dredging in the 1940s. Cocos Lagoon, a shallow lagoon (40 feet [ft.] [12.2 meters {m}]) deep, is located on the southern tip of Guam and is encompassed by a series of barrier and fringing reefs (Paulay et al. 2002). The majority of the substrate in Apra Harbor is sand, as depicted in Figure 3.3-2; however, there are intermittent patches of harder substrates (shoals and reefs) within the harbor.

The western coastline of Saipan is lined with sandy beaches protected by a barrier reef which forms Tanapag and Saipan Lagoons (Scott 1993). Tanapag Lagoon is a typical high-island barrier reef lagoon. Tanapag Lagoon is located on the northwestern coast of Saipan. Also, on the western coastline of Saipan, the barrier reefs form two additional lagoons, creating the largest lagoon system in the Mariana Islands, Garapan Lagoon and Chalan Kanoa Lagoon (Environmental Services Duenas & Associates 1997). The western side of Tinian has limited lagoon development near the harbor, whereas Rota does not have any well-developed lagoon formations (Pacific Basin Environmental Consultants 1985). Offshore of FDM, at a depth of approximately 65 ft. (19.8 m), the sandy soft-bottom seafloor slopes abruptly downward toward the abyssal plain (U.S. Department of the Navy 2005). Most of the other islands in the Marianas also have sandy slopes below the fore reef, typically starting at 100–130 ft. (30.48–39.62 m), with some variations (U.S. Department of the Navy 2005). See Figure 3.3-1, Figure 3.3-2, Figure 3.3-3, Figure 3.3-4, and Figure 3.3-5 for information on the distribution of soft-bottom habitats as derived by satellite imagery by the National Oceanic and Atmospheric Administration, near Guam, Apra Harbor, Saipan, Tinian, and FDM, respectively.

In the open ocean portion of the Study Area the soft-bottom habitat is located in the Mariana Trough. The Mariana Trough is comprised of a large relatively flat abyssal plain with water depths ranging from approximately 11,500 to 13,100 ft. (3,505.2 to 3,992.9 m) (Thurman 1997). Very little data regarding the Mariana Trough within the Study Area has been obtained. However, in general abyssal plains can be described as large and relatively flat regions covered in a thick layer of fine silty sediments with the topography interrupted by occasional mounds and seamounts (Kennett 1982; Thurman 1997). The abyssal plain and similar deepwater areas were originally thought to be devoid of life; however recent research has shown that these areas are host to thousands of species of invertebrates and fish ("The Mariana Trench - Biology - Part 1" 2003). Refer to biological resources chapters for more information on species inhabiting the abyssal plain.

3.3.2.6 Hard Bottoms

3.3.2.6.1 Description

Hard-bottom habitat in the coastal portion of the Study Area includes both biogenic reefs and rocky bottoms covered by a thin veneer of living and dead sedentary invertebrates. Biogenic reefs include ridge-like or mound-like structures formed by the colonization and growth of sedentary invertebrates (Cowardin et al. 1979). Water regimes are restricted to subtidal, irregularly exposed, regularly flooded, and irregularly flooded. Corals and associated calcareous organisms form reefs that are living marine resources and biotic habitats. Coral reefs tend to dominate intertidal shores or subtidal bottoms, and are not covered in this section. Refer to Section 3.8 (Marine Invertebrates) for more information on coral reefs. “Rock Bottom” includes all wetlands and deepwater habitats with substrates having a surface of stones, boulders, or bedrock (75 percent or greater coverage) with vegetative coverage of less than 30 percent (Cowardin et al. 1979). Water regimes are restricted to subtidal, permanently flooded, intermittently exposed, and semi-permanently flooded.

Subtidal rocky bottom occurs as extensions of intertidal rocky shores and as isolated offshore outcrops. The shapes and textures of the larger rock assemblages and the fine details of cracks and crevices are determined by the type of rock, the wave energy, and other local variables (Davis 2009). Maintenance of rocky reefs requires wave energy sufficient to sweep sediment away (Lalli and Parsons 1997) or offshore areas lacking a significant sediment supply; therefore, rocky reefs are rare on broad coastal plains near sediment-laden rivers and are more common on high-energy shores and beneath strong bottom currents, where sediments cannot accumulate. The shapes of the rocks determine, in part, the type of community that develops on a rocky bottom (Witman and Dayton 2001). Below a depth of about 650 ft. (200 m) on rocky reefs, light is insufficient to support much plant life (Dawes 1998). Rocky reefs in this zone are encrusted with invertebrates and algae such as sponges, soft and hard coral, worms, bryozoans, and coralline algae. Typically, a sea cucumber would not be thought of as an encrusting organism, and sea whips are a type of soft coral. Refer to living resource sections for more information on species inhabiting rock bottoms.

There are two types of hard-bottom habitats found in the open ocean portion of the Study Area, seamounts and hydrothermal vents. Seamounts are undersea mountains that rise steeply from the ocean floor to an altitude greater than 3,281 ft. (1,000 m) above the ocean basin (Thurman 1997). Hydrothermal vents are created from seawater permeating and entrained through the crust and upper mantle below the seafloor. The seawater is superheated by hot basalt and is chemically altered to form hydrothermal fluids as it rises through networks of fissures in newly-formed seafloor (Humphris 1995; McMullin 2000). The area immediately around hydrothermal vents, including the chimney structures that form from the tectonic activity, can be colonized by various organisms adapted to this deep sea environment (McMullin 2000).

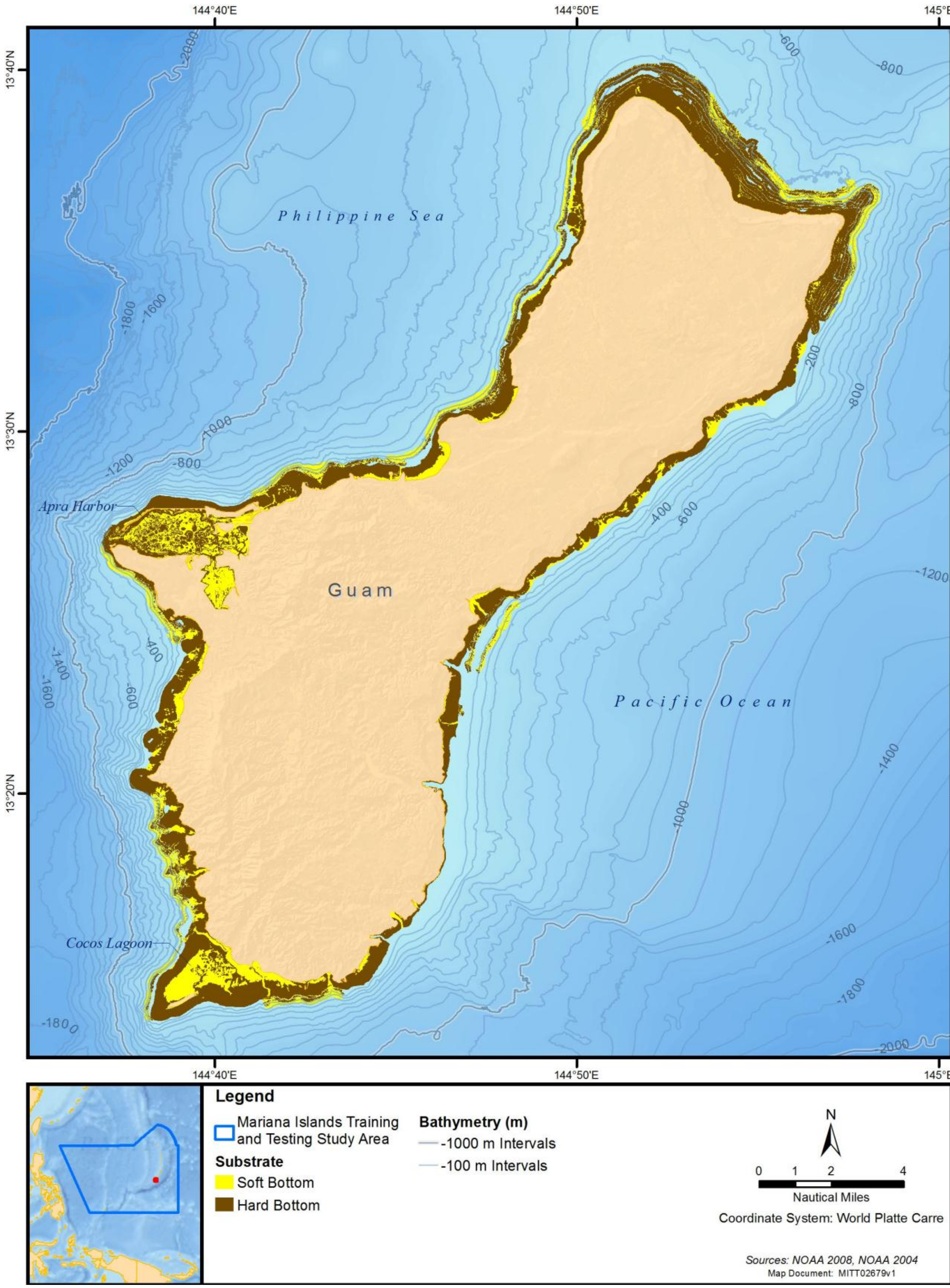

Figure 3.3-1: Nearshore Marine Habitats around Guam

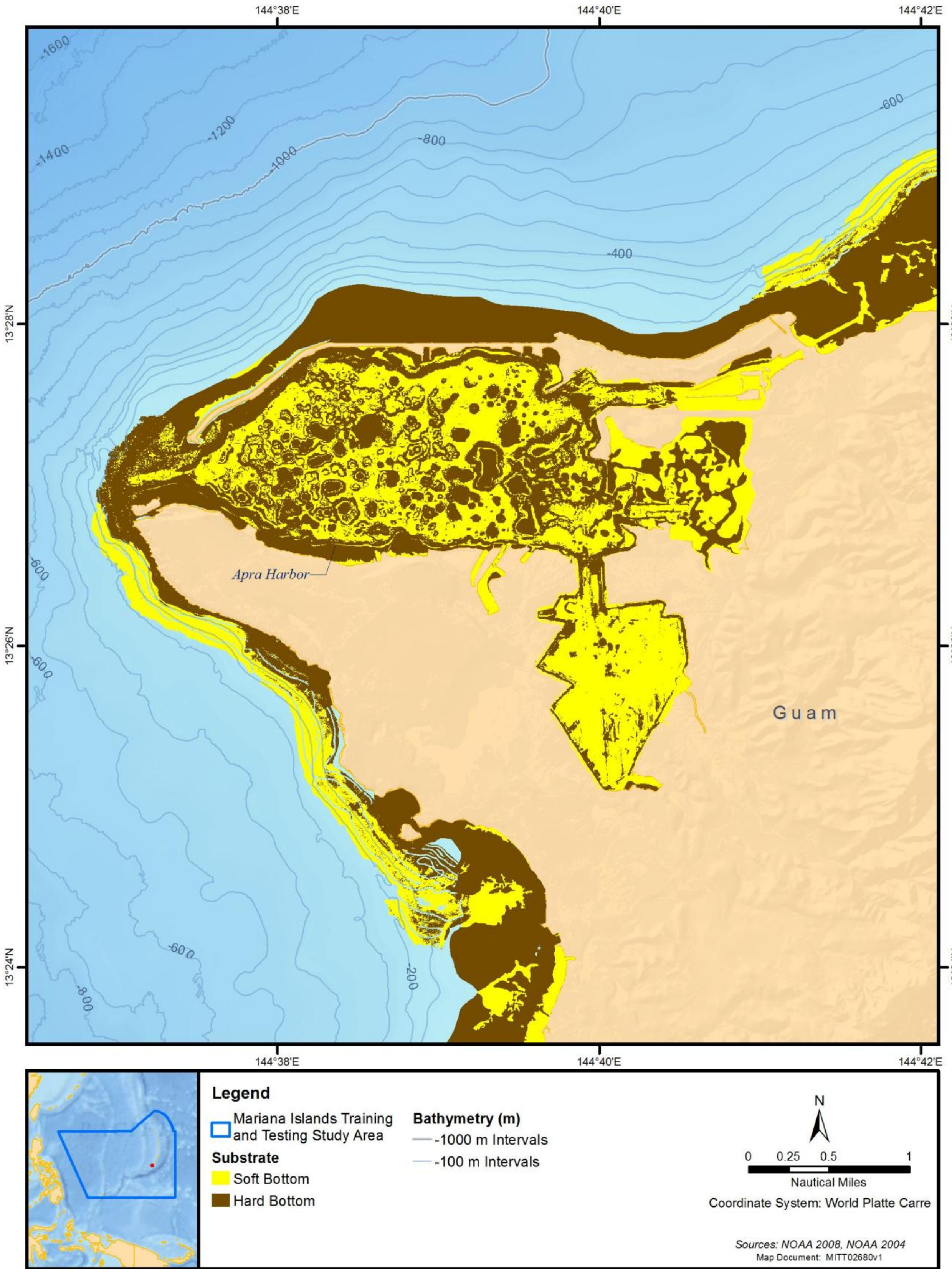

Figure 3.3-2: Marine Habitats of Apra Harbor, Guam

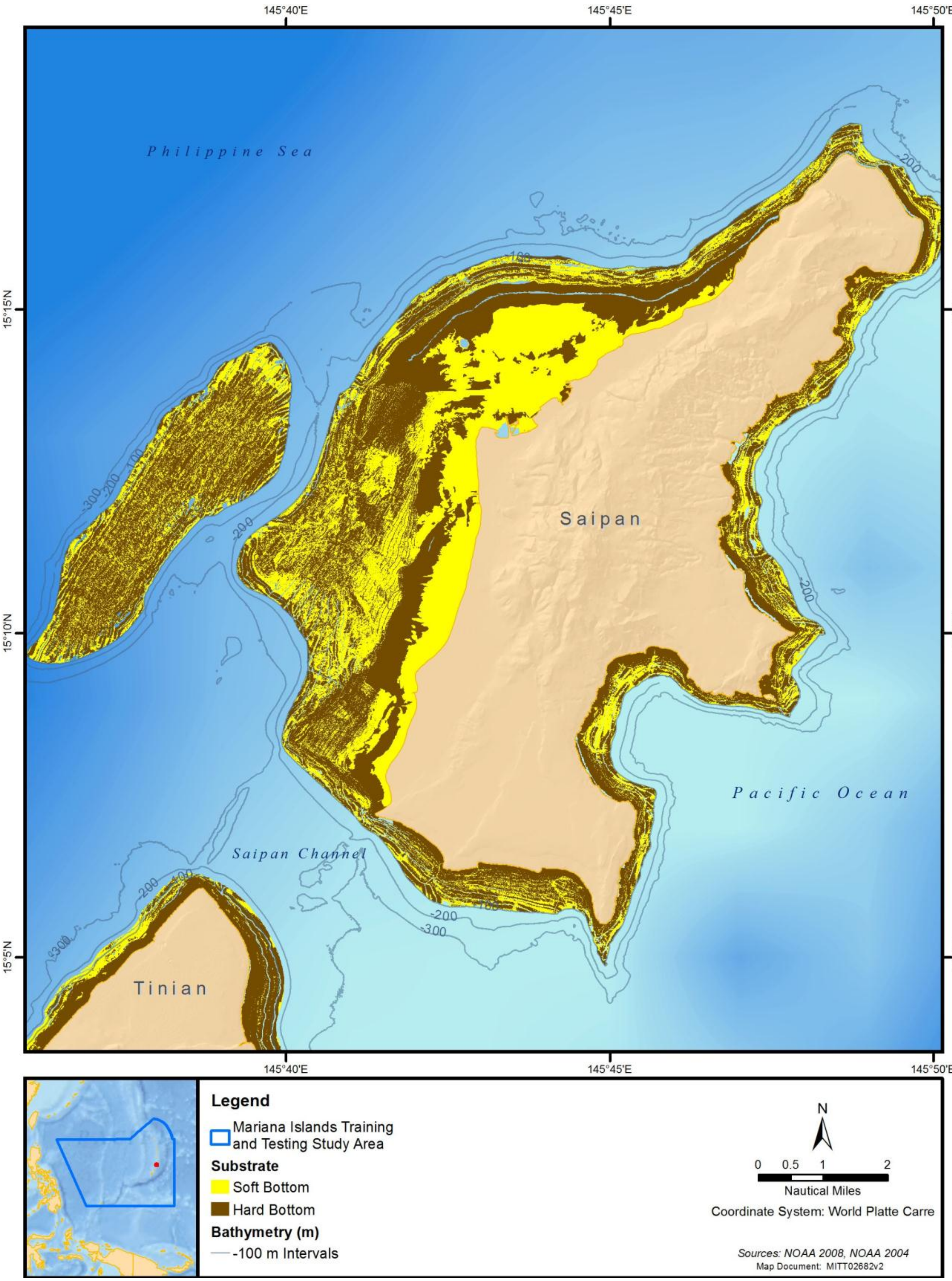

Figure 3.3-3: Nearshore Marine Habitats around Saipan

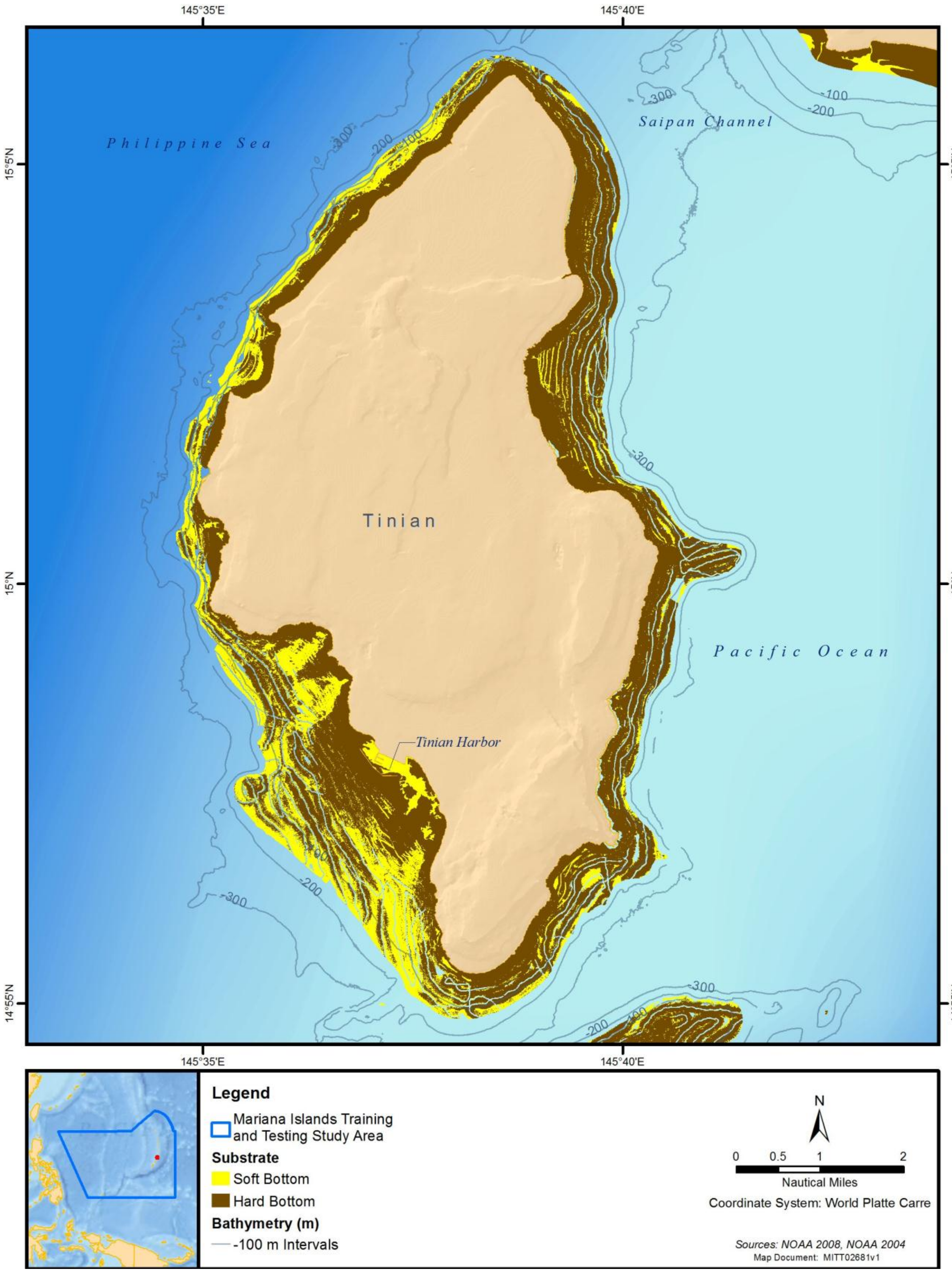

Figure 3.3-4: Nearshore Marine Habitats around Tinian

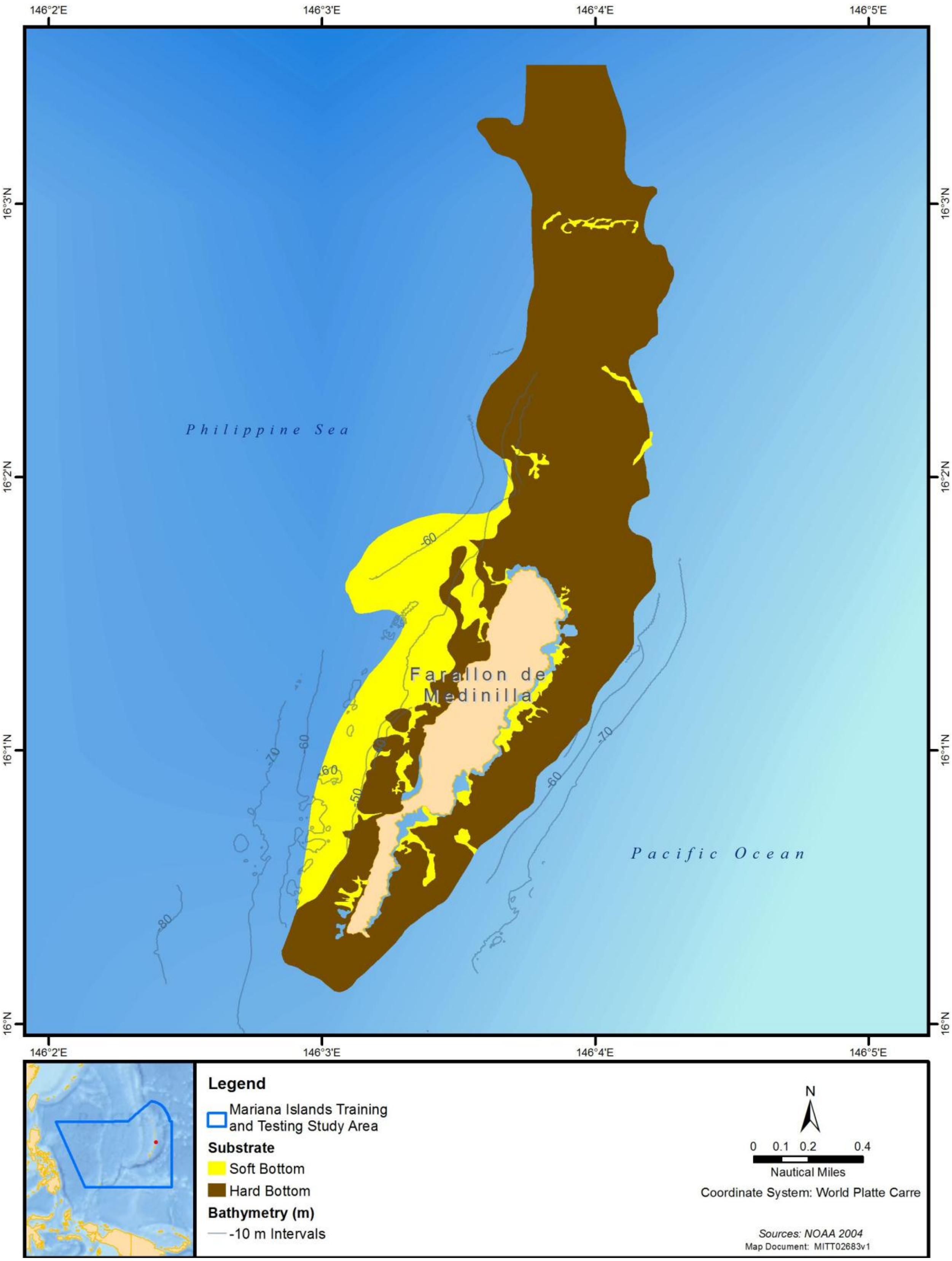

Figure 3.3-5: Nearshore Marine Habitats around Farallon de Medinilla

3.3.2.6.2 Distribution

Islands within the Study Area (Guam to FDM) support reefs as do islands north of FDM (Anatahan, Sarigan, Guguan, Alamagan, Maug, and Farallon de Pajaros). Reefs are also found on offshore banks including Galvez bank located 12 miles (mi.) (19.3 kilometers [km]) south of Guam, Santa Rosa Reef located 25 mi. (40.2 km) south-southwest of Guam, Arakane Bank located 200 mi. (321.9 km) west-northwest of Saipan, Tatsumi Reef located 1.2 mi. (1.93 km) southeast of Tinian, Pathfinder Bank located 170 mi. (273.6 km) west of Anahatan, and Supply Reef located 11.5 mi. (18.5 km) northwest of Maug Island (Starmer 2005). 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 (Eldredge 1983; Paulay 2003; Randall 1985, 1995; Randall et al. 1984; Starmer 2005). See Figure 3.3-1, Figure 3.3-2, Figure 3.3-3, Figure 3.3-4, and Figure 3.3-6, for information on the distribution of hard-bottom habitats near Guam, Apra Harbor, Saipan, Tinian, and the open ocean, respectively.

Within the open ocean portion of the Study Area, two types of hard-bottom habitat are seamounts and flat-topped seamounts known as guyots. Generally, seamounts tend to be conical in shape and volcanic in origin, although some seamounts are formed by vertical tectonic activity along converging plate margins (Rogers 1994). Both volcanic and tectonic seamounts are present in the open ocean portion of the Study Area. Seamount and guyot topography is a striking contrast to the surrounding flat, sediment-covered abyssal plain. Seamounts and guyots can affect local ocean circulation causing upwelling, which can supply nutrients to surface waters (Rogers 1994; Lalli and Parsons 1997). Seamount and guyot topography is a striking contrast to the surrounding flat, sediment-covered abyssal plain, and the effect seamounts can impart on local ocean circulation resulting in upwelling which can supply nutrients to surface waters (Rogers 1994; Lalli and Parsons 1997). Figure 3.3-5 shows the locations of both seamounts and guyots in the Study Area. Refer to biological resources chapters for more information on species inhabiting seamounts.

Deep-sea hydrothermal vents occur in areas of crustal formation near mid-ocean ridge systems (Humphris 1995). A number of hydrothermal vents have been located in the Study Area, and it is likely that more exist. Evidence of active hydrothermal venting has been identified in the vicinity of more than 12 submarine volcanoes and at two sites along the back-arc spreading center off to the west of the Mariana Islands (Embley et al. 2004; Kojima 2002). Hydrothermal vents located in the Mariana Trough experience high levels of site specific species due to their geographic isolation from other vent systems. At least 8 of the 30 identified genera known to occur only in the western Pacific hydrothermal vent systems are found in the Mariana Trough (Hessler and Lonsdale 1991; Paulay 2003). Hydrothermal vents at Esmeralda Bank, one of the active submarine volcanoes in the Study Area, span an area of 0.08 square miles (mi.^{2}) (0.207 square kilometers [km^2]) on the seafloor and expel water with temperatures exceeding 172 degrees (°) Fahrenheit (77.8° Celsius) (Stuben et al. 1992). West of Guam and on the Mariana Ridge, there are three known hydrothermal vent fields: Forecast Vent site (13°24'N, 143°55'E, depth 4,750 ft. [1,447.8 m]), TOTO Caldera (12°43'N, 143°32'E), and the 13°N Ridge (13°05'N, 143°41'E) (Kojima 2002). Refer to biological resources chapters for more information on species inhabiting hydrothermal vents.

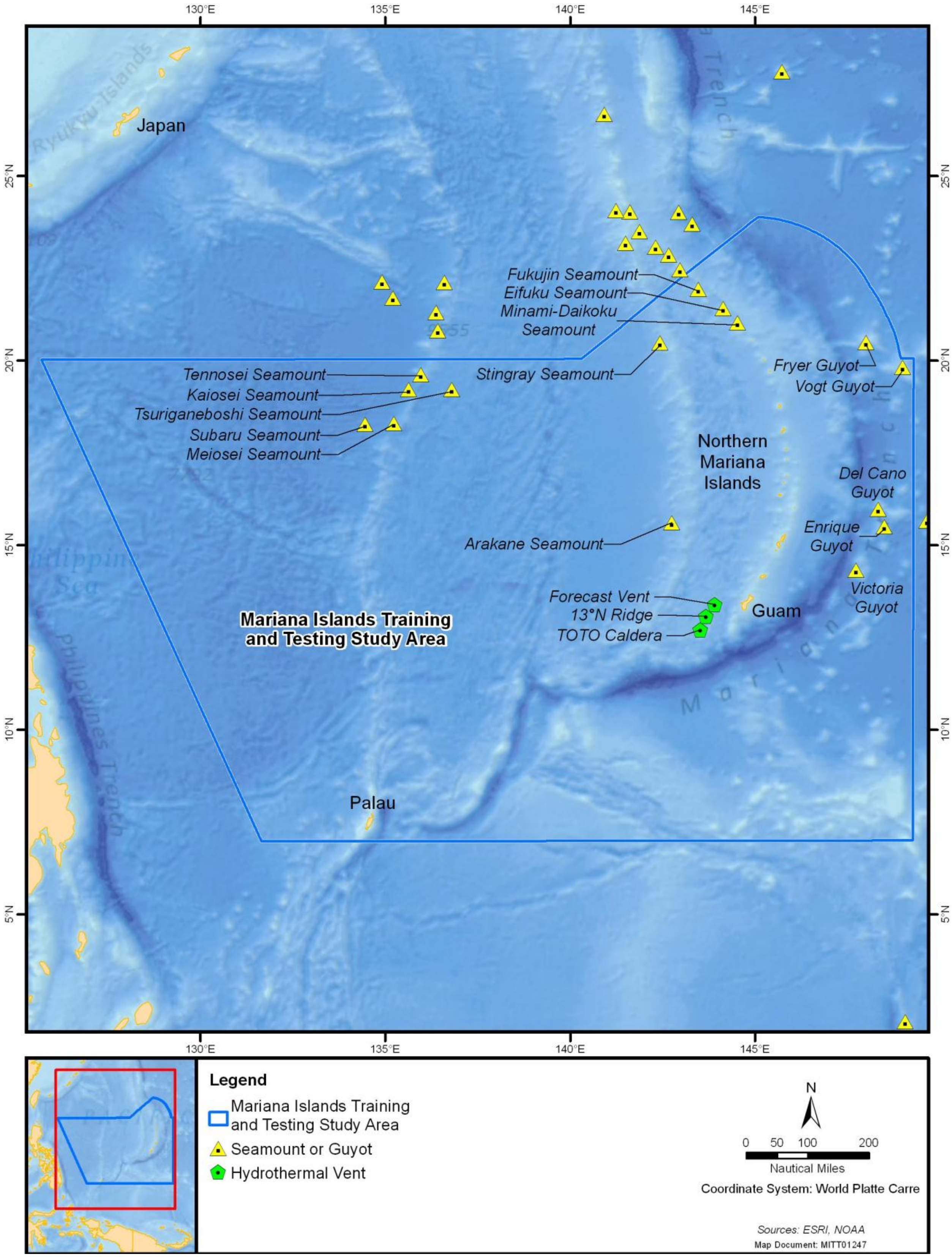

Figure 3.3-6: Deep Sea Habitat

3.3.2.7 Artificial Structures

3.3.2.7.1 Description

Artificial habitats are human-made structures that provide habitat for marine organisms. Artificial habitats occur in the marine environment either by design and are intended to be used as habitat (e.g., artificial reefs), by design but were intended for a function other than habitat (e.g., fish-aggregating devices, which are floating objects moored at specific locations in the ocean to attract fishes that live in the open ocean), or unintentionally (e.g., shipwrecks). Artificial structures function as hard bottom by providing structural attachment points for algae and sessile invertebrates, which in turn support a community of animals that feed, seek shelter, and reproduce there (National Oceanic and Atmospheric Administration 2007).

Artificial habitats in the Study Area include artificial reefs, shipwrecks (historic shipwrecks are analyzed in Section 3.11, Cultural Resources), human-made shoreline structures (i.e., piers, wharfs, docks, pilings), and fish-aggregating devices. Artificial reefs are designed and deployed to supplement the ecological services provided by coral or rocky reefs. Artificial reefs range from simple concrete blocks to highly engineered structures. Vessels that sink to the seafloor, including shipwrecks within the Study Area, are colonized by the common encrusting and attached marine organisms that attach to hard bases. Over time, the wrecks become functioning ecosystems. The submerged cultural resources within the Study Area are further discussed in Section 3.11 (Cultural Resources).

3.3.2.7.2 Distribution

Many shipwrecks are found within the Study Area, including grounded vessels and military wreckage. Vessels have probably wrecked upon the shores of the Mariana Islands since Spanish galleons sailed to these islands during the seventeenth century. There are abundant WWII-era remains (including sunken ships, airplanes, and tanks) along the shores of the Mariana Islands that resulted from the battles of Guam, Saipan, and Tinian (Commonwealth of the Northern Mariana Islands 2001). Most artificial reefs intended as habitat in marine waters have been placed and monitored by individual state programs; national and state databases indicating the locations of artificial reefs are not available (National Oceanic and Atmospheric Administration 2007). In the Study Area, there are dedicated artificial reefs found in two locations: Agat Bay, Guam and Apra Harbor, Guam. In 1969, 357 tires were tied together and scattered over a 5,000-square-foot (ft.^{2}) (4,645-square-meter [m^2]) area in Cocos Lagoon (Eldredge 1979). In the early 1970s, a second reef consisting of 2,500 tires was also placed in Cocos Lagoon (Eldredge 1979). These tire reefs have disintegrated and no longer serve as artificial reefs. In 1977, a 52.5 ft. (16.0 m) barge was modified to enhance fish habitat and was sunk in 60 ft. (18.3 m) of water in Agat Bay. In Apra Harbor, the "American Tanker" was sunk in 1944 at the entrance of the harbor to act as a breakwater. In 1944, the 76th Naval Construction Battalion (SEABEES) built the Glass Breakwater which forms the north and northwest sides of Apra Harbor (Thompson 2002). The enormous seawall is made of 1,200 acre-feet (148,000 cubic meters) of soil and coral extracted from Cabras Island (Thompson 2002). The Glass Breakwater is the largest artificial substrate in the Marianas.

Currently, Guam and the northern Mariana Islands maintain several fish aggregating devices within 20 nautical miles (nm) of the shoreline (Chapman 2004; Guam Department of Agriculture Division of Aquatic and Wildlife 2004). Figures 3.3-7 and 3.3-8 show the locations of the fish aggregating devices surrounding Guam, Tinian, and Saipan. Lost fish aggregating devices are replaced normally within 2 weeks (Chapman 2004). Fish aggregating device sites may change frequently; the U.S. Coast Guard is responsible for keeping track of these changes. Fish aggregating device buoys, with long chains, may be considered a safety hazard if the buoys become disconnected.

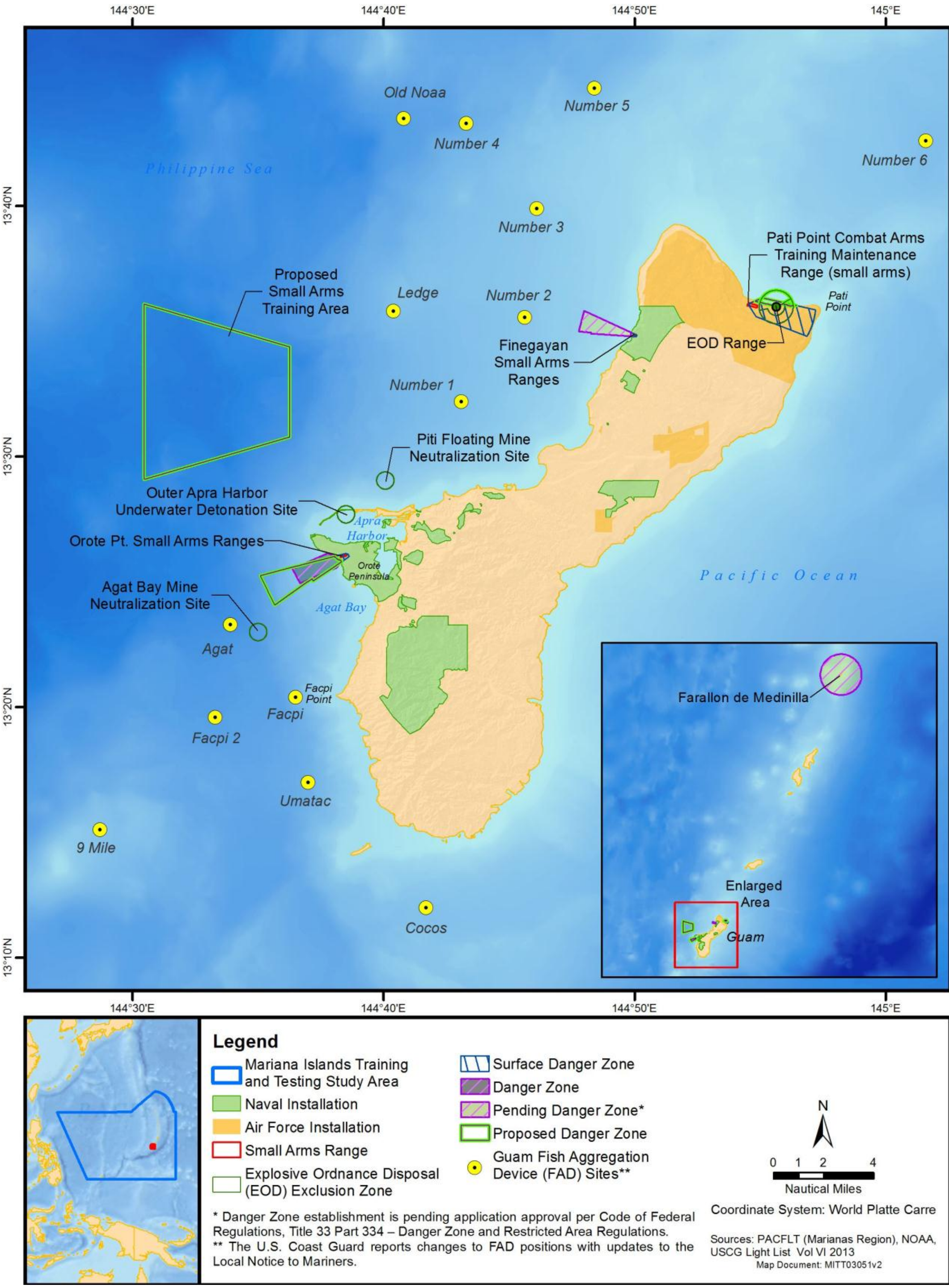

Figure 3.3-7: Fish Aggregating Devices near Guam

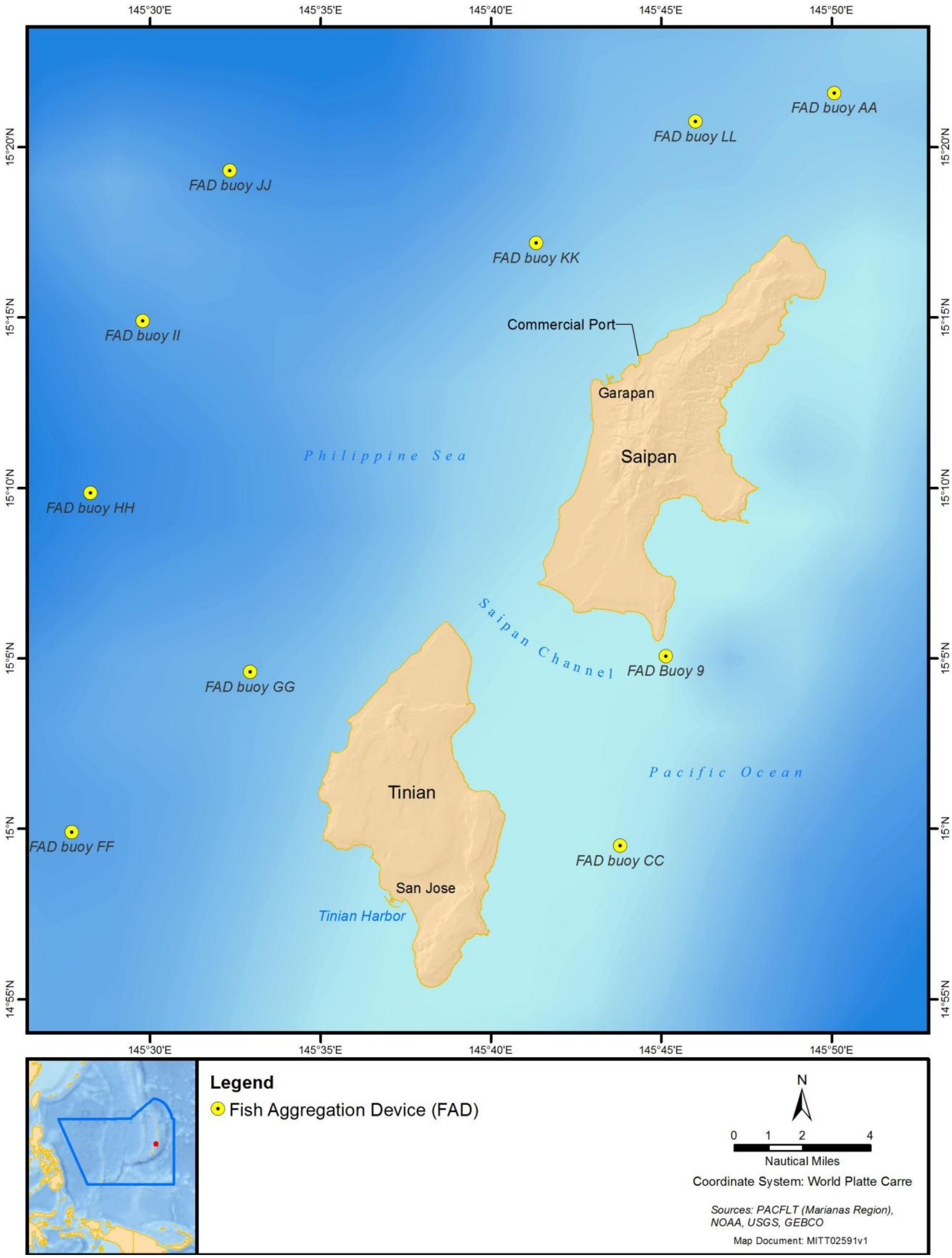

Figure 3.3-8: Fish Aggregating Devices near Tinian and Saipan

3.3.3 Environmental Consequences

This section evaluates how and to what degree training and testing activities described in Chapter 2 (Description of Proposed Action and Alternatives) could impact marine habitats in the Study Area. Tables 2.8-1 through 2.8-4 present the baseline and proposed training and testing activity locations for each alternative (including number of activities and ordnance expended). Each marine habitat stressor is introduced, analyzed by alternative, and analyzed for training activities and testing activities. Stressors vary in intensity, frequency, duration, and location within the Study Area. The following stressors are applicable to marine habitats in the Study Area and are analyzed because they have the potential to alter the quality or quantity of marine habitats for associated living resources:

- Acoustic (underwater explosives)
- Physical disturbance and strike (vessels, in-water devices, military expended materials, and seafloor devices)

Sonar sources do not change the substrate type of the bottom, and energy stressors do not change the substrate type by their surface orientation and nature. Entanglement and ingestion stressors are included as an aspect of military expended materials. In the remainder of this section, marine habitats will be referred to as marine substrates to reflect the subset of marine habitats being evaluated.

3.3.3.1 Acoustic Stressors

3.3.3.1.1 Impacts from Explosives

This section analyzes the potential impacts of underwater explosions on or near the bottom resulting from training and testing activities within the Study Area. Underwater detonations that occur on or near the bottom are primarily used during various mine warfare training activities. The impacts of underwater explosions vary with the bottom substrate type.

3.3.3.1.1.1 No Action Alternative

Training Activities

Mine neutralization training using divers and remotely operated vehicles, and airborne mine neutralization system AN/ASQ-235 training could involve explosions on or near the seafloor, which could affect marine habitats. Underwater demolitions qualification/certification would also be conducted in order to train and certify Navy divers in placing underwater demolition charges. Table 3.3-3 lists training and testing activities that include seafloor explosions, along with the location of the activity and the associated explosives charges. Soft bottoms are preferred for mine shape placement, and as such, most events would occur there, since this habitat type is likely to recover from these activities. Cobble, rocky reef, and other hard-bottom habitat may be scattered throughout the area, but those areas would be avoided during training to the maximum extent practicable.

Under the No Action Alternative, an estimated 50 underwater explosions would occur in the water column, and for purposes of this analysis, all are assumed to occur on or near the bottom within the Study Area, as identified in Table 3.3-3. Underwater explosions near the seafloor would primarily occur in the nearshore portions of the Study Area (see Figure 2.7-5) at appropriate mine countermeasure training sites. One site is located within Apra Harbor, where the main marine habitat is sand (see Figure 3.3-2).

Table 3.3-3: Annual Training and Testing Activities that Include Seafloor Explosions

Activity	Explosive Charge (NEW)[1]	Underwater Detonations			Location
		No Action[1]	Alternative 1	Alternative 2	
Training					
Mine Neutralization (Explosive Ordnance Disposal)	1–20 lb.	20	20	20	Agat Bay Mine Neutralization Site Piti Point Mine Neutralization Site Outer Apra Harbor Underwater Detonation Site
Underwater Demolition Qualification/ Certification	1–20 lb.	30	30	30	
Testing					
Mine Countermeasure Mission Package Testing	5 lb.	0	24	28	Study Area

[1] Under the No Action Alternative, the NEW would not exceed 10 lb. Under Alternatives 1 and 2 only the Agat Bay Mine Neutralization Site would increase the NEW to a maximum of 20 lb.
Notes: lb. = pound(s), MIRC = Mariana Islands Range Complex, NEW = net explosive weight

The determination of effect for training activities on the seafloor is based on the largest net-weight charge for the training activity, which is 20 pounds (lb.) (9.1 kilograms [kg]) net explosive weight (NEW) explosions. Explosions produce high energies that would be partially absorbed and partially reflected by the seafloor. Hard bottoms would mostly reflect the energy (Berglind et al. 2009), whereas a crater would be formed in soft bottom (Gorodilov and Sukhotin 1996). The area and depth of the crater would vary according to depth, bottom composition, and size of the explosive charge. The relationship between crater size and depth of water is non-linear, with relatively small crater sizes in the shallowest water, followed by a spike in size at some intermediate depth, and a decline to an average flat-line at greater depth (Gorodilov and Sukhotin 1996; O'Keeffe and Young 1984).

In general, training activities that include seafloor detonations occur in water depths ranging from 6 ft. (1.8 m) to about 100 ft. (30 m). Based on Gorodilov & Sukhotin (1996), the depth (h) and radius (R) of a crater from an underwater explosion over soft bottom is calculated using the charge radius (r_0)[1] multiplied by a number determined by solving for h or R along a non-linear relationship between [depth of water/r_0] and [h or R/r_0]. The area of impacted substrate for each 20 lb. (9.1 kg) underwater explosion on the seafloor would be approximately 366 $ft.^2$ (34 m^2). The radii of craters are expected to vary little among unconsolidated sediment types. On sediment types with non-adhesive particles (such as sand or mud), the impacts should be temporary; craters in clay may persist for years (O'Keeffe and Young 1984). The production of craters in soft bottom could uncover subsurface hard bottom, altering marine substrate types.

Hard substrates reflect more energy from bottom detonations than do soft bottoms (Keevin and Hempen 1997). The amount of consolidated substrate (i.e., bedrock) converted to unconsolidated sediment by surface explosions vary according to material types and degree of consolidation (i.e., rubble, bedrock). Because of a lack of accurate and specific information on hard bottom types, the impacted area is assumed to be equal to the area of soft bottom impacted. Potential exists for fracturing

[1] Pounds per cubic inch of trinitrotoluene (1.64 grams/cubic centimeter) x number of pounds, then solving for radius in the geometry of a spherical volume

and damage to hard-bottom habitat if underwater detonations occur over that type of habitat. Detonations on the seafloor would result in a maximum of approximately 11,500 $ft.^2$ (1,050 m^2) of disturbed substrate per year in the Study Area (Table 3.3-4).

Table 3.3-4: Bottom Detonations for Training Activities under the No Action Alternative, Alternative 1, and Alternative 2

Training Activity	Net Explosive Weight (lb.)[1]	Impact Footprint $ft.^2$ (m^2)	Number of Charges	Total Impact Area $ft.^2$ (m^2)
No Action Alternative				
Mine Neutralization (Explosive Ordnance Disposal)	10	230 (21)	20	4,600 (420)
Underwater Demolition Qualification/Certification	10	230 (21)	30	6,900 (630)
Total	-	-	50	11,500 (1,050)
Alternative 1 and Alternative 2				
Mine Neutralization (Explosive Ordnance Disposal)	20	366 (34)	20	7,320 (680)
Underwater Demolition Qualification/Certification	20	366 (34)	30	10,980 (1,020)
Total	-	-	50	18,300 (1,700)

[1] Analysis assumes the largest charge, in terms of net explosive weight, for the training activity. Table 3.3-3 lists the ranges of charges used for the training activity.
Notes: $ft.^2$ = square feet, lb. = pounds , m^2 = square meters

Training activities that include bottom-laid underwater explosions are infrequent (only about 50 explosions per year), and the percentage of training area affected is small (less than 1 percent of the total Study Area). Additionally, detonations are likely to occur in the same area, which would further decrease the total area impacted. Soft-bottom substrates of disturbed areas would be expected to recover their previous structure, with the fastest recovery occurring in areas with high waves and tidal energies. Recovery at the Outer Apra Harbor Underwater Detonation (UNDET) site would be expected to be prolonged due to lower tidal and wave energy in the area. The recovery for habitats in areas of repeated detonations would also be expected to be prolonged. Therefore, underwater explosions under the No Action Alternative would affect marine habitat structure in the Study Area, but these activities would occur in areas that have been previously disturbed, most impacts would be localized.

Testing Activities

No testing activities with seafloor detonations would occur under the No Action Alternative.

3.3.3.1.1.2 Alternative 1

Training Activities

Under Alternative 1, there would be the same number of underwater detonations as under the No Action Alternative (Table 3.3-4). However, the size of underwater detonations at the Agat Bay Mine Neutralization Site will change from 10 lb. to 20 lb. NEW. The size of underwater detonations at Piti Point Mine Neutralization Site and Outer Apra Harbor UNDET Site would remain at 10 lb. NEW. Underwater explosions associated with training activities under Alternative 1 would disturb approximately 18,300 $ft.^2$ (1,700 m^2) per year of substrate in the Study Area (see Table 3.3-4).

Training activities that include bottom-laid underwater explosions are infrequent (only about 50 explosions per year), and the percentage of training area affected is small (less than 1 percent of the total Study Area). Additionally, detonations are likely to occur in the same general area, which would further decrease the total area impacted. The recovery for habitats in areas of repeated detonations would be expected to be prolonged. Therefore, underwater explosions under Alternative 1 would affect marine habitat structure in the Study Area, but these activities would occur in areas that have been previously disturbed and most impacts would be localized.

Testing Activities

Under Alternative 1, there would be 24 underwater detonations (explosive neutralizers) used during mine countermeasure mission package testing activities. The maximum NEW of each detonation would be 5 lb., which could impact an area of 145 ft.^{2} (13.5 m^2). Underwater explosions associated with testing activities under Alternative 1 could disturb approximately 3,480 ft.^{2} (323.3 m^2) per year of substrate in the Study Area (Table 3.3-5).

Testing activities that include bottom-laid underwater explosions are infrequent (only about 24 explosions per year), and the percentage of area affected is small (less than 1 percent of the total Study Area). Additionally, detonations are likely to occur in the same area, which would further decrease the total area impacted. The recovery for habitats in areas of repeated detonations would be expected to be prolonged. Therefore, underwater explosions under Alternative 1 would affect marine habitat structure in the Study Area, but most impacts would be localized.

Table 3.3-5: Bottom Detonations for Testing Activities under Alternative 1 and Alternative 2

	Net Explosive Weight (lb.)[1]	Impact Footprint ft.^{2} (m^2)	Number of Underwater Detonations	Total Impact Area ft.^{2} (m^2)
Alternative 1	5	145 (13.5)	24	3,480 (323.3)
Alternative 2	5	145 (13.5)	28	4,060 (377.2)

[1] Analysis assumes the largest charge, in terms of net explosive weight, for the training activity.
Notes: ft.^{2} = square feet, lb. = pound(s), m^2 = square meter(s)

3.3.3.1.1.3 Alternative 2

Training Activities

Under Alternative 2, there would be the same number of underwater detonations as under the No Action Alternative (Table 3.3-4). However, the size of underwater detonations at the Agat Bay Mine Neutralization Site will change from 10 lb. to 20 lb. NEW. The size of underwater detonations at Piti Point Mine Neutralization Site and Outer Apra Harbor UNDET Site would remain at 10 lb. NEW. Underwater explosions associated with training activities under Alternative 2 would disturb approximately 18,300 ft.^{2} (1,700 m^2) per year of substrate in the Study Area (see Table 3.3-4).

Training activities that include bottom-laid underwater explosions are infrequent (only about 50 explosions per year) and the percentage of training area affected is small (less than 1 percent of the total Study Area). Additionally, detonations are likely to occur in the same area, which would further decrease the total area impacted. Soft-bottom substrates of disturbed areas would be expected to recover their previous structure, with the fastest recovery occurring in areas with high waves and tidal energies. The recovery for habitats in areas of repeated detonations would be expected to be prolonged. Therefore, underwater explosions under Alternative 2 would affect marine habitat structure in the Study Area, but these activities would occur in areas that have been previously disturbed and most impacts would be localized.

Testing Activities

Under Alternative 2, there would be 28 underwater detonations (explosive neutralizers) used during mine countermeasure mission package testing activities. The maximum NEW of each detonation would be 5 lb., which could impact an area of 145 $ft.^2$ (13.5 m^2). Underwater explosions associated with testing activities under Alternative 2 could disturb approximately 4,060 $ft.^2$ (377.2 m^2) per year of substrate in the Study Area (see Table 3.3-5).

Testing activities that include bottom-laid underwater explosions are infrequent (only about 28 explosions per year), and the percentage of area affected is small (less than 1 percent of the total Study Area). Additionally, detonations are likely to occur in the same area, which would further decrease the total area impacted. The recovery for habitats in areas of repeated detonations would be expected to be prolonged. Therefore, underwater explosions under Alternative 2 would affect marine habitat structure in the Study Area, but most impacts would be localized.

3.3.3.1.2 Substressor Impact on Marine Vegetation as Essential Fish Habitat from Explosives (Preferred Alternative)

Pursuant to the Essential Fish Habitat (EFH) requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of explosives on or near the bottom during training and testing activities may have an adverse effect on EFH by reducing the quality and quantity of non-living substrates that constitute EFH and Habitat Areas of Particular Concern. The MITT EFHA report states that explosive impacts to hard-bottom substrate are determined to be permanent and minimal throughout the Study Area. The impacts on soft bottom are determined to be short term and minimal. Mitigation measures should avoid impacts to surveyed hard bottom, as defined in Chapter 5 (Standard Operating Procedures, Mitigation, and Monitoring). Impacts on water column as EFH are summarized in corresponding resource sections (e.g., Section 3.8, Marine Invertebrates, and Section 3.9, Fish) because they are impacts on the organisms themselves.

3.3.3.2 Physical Disturbance and Strike Stressors

This section analyzes the potential impacts of various types of physical disturbance and strike stressors resulting from military training and testing activities within the Study Area. Bottom substrates could be disturbed by military expended materials and seafloor devices used for military training and testing.

Impacts of physical disturbances or strikes resulting from military training and testing activities on biogenic soft bottom (e.g., seagrass, macroalgae, etc.) and hard bottom (e.g., corals, sponges, tunicates, oysters, mussels, macroalgae, etc.) substrates are discussed in Sections 3.7 (Marine Vegetation) and 3.8 (Marine Invertebrates), respectively. Potential impacts on the underlying substrates (soft, hard, or artificial) are analyzed in this section.

3.3.3.2.1 Impacts from Vessels and In-Water Devices

Vessels performing training and testing exercises in the Study Area are primarily large ocean-going ships and submarines operating in waters deeper than 328 ft. (100 m), transiting through the operating areas. Vessels used for training and testing activities range in size from small boats (35 ft. [10.7 m]) to large nuclear aircraft carriers (1,092 ft. [332.8 m]).

Some operations involve vessels towing in-water devices used in mine warfare activities but these are operated in a manner to ensure they avoid contacting the sea floor. Some vessels, such as amphibious vehicles, might contact portions of the reef crest or reef flat (although these areas are intentionally avoided to preserve equipment), but would contact the substrate in shallow water when transitioning onto land.

Prior to any amphibious over-the-beach training activity conducted with larger amphibious vehicles such as Air Cushioned Landing Crafts (LCACs) or Amphibious Assault Vehicles (AAVs) (e.g., Amphibious Assaults), a hydrographic survey and a beach survey would be required. The surveys would be conducted to identify and designate boat lanes and beach landing areas that are clear of coral, hard-bottom substrate, and obstructions. LCAC landing and departure activities would be scheduled at high tide. In addition, LCACs would stay fully on cushion or hover when over shallow reef to avoid corals and hard-bottom substrate. This is a standard operating procedure for safe operation of LCACs. Over-the-beach amphibious activity would only occur within designated areas based on the hydrographic and beach surveys. Similarly, AAV activities would only be scheduled within designated boat lanes and beach landing areas, and would conduct their beach landings and departures at high tide one vehicle at a time within their designated boat lane (Commander, U.S. Naval Forces Marianas Instruction 3500.4A). Based on the surveys, if the beach landing area and boat lane is clear, the activity could be conducted, and crews would follow procedures to avoid obstructions to navigation, including coral reefs; however, if there is any potential for impacts on corals or hard-bottom substrate, the Navy will coordinate with applicable resource agencies before conducting the activity. Hydrographic and beach surveys would not be necessary for beach landings with small boats, such as rigid hull inflatable boats.

Some anchored or expended in-water devices could impact any of the habitat types discussed in this section, including soft and hard shores, soft and hard bottoms, and artificial substrates. This could disturb the water column enough to stir up bottom sediments, temporarily and locally increasing the turbidity. The shore environment is typically highly dynamic because of its constant exposure to wave action and cycles of erosion and deposition. As a result, disturbed areas of soft-bottom habitat would be reworked by waves and tides shortly after the disturbance. In deeper waters where the tide or wave action has little influence, sediments suspended into the water column would quickly settle to the seafloor or would be carried along the bottom by currents before settling again. In either case, these disturbances would not alter the overall nature of the sediments to a degree that would impair their function as habitat or change the character of the substrate.

3.3.3.2.1.1 No Action Alternative

Training Activities

Amphibious landings would be associated with amphibious warfare training activities, which would include amphibious assault, amphibious assault-battalion landing, and amphibious raid training activities and could occur 10 times under the No Action Alternative. Boats and vessels (including Mechanized and Utility Landing Craft and LCAC) may transport personnel or equipment to the shore or beach in the Study Area. This beaching activity could affect marine habitats as the boat contacts and disturbs the sediment where it lands.

Amphibious vessels would approach the shore and could beach, which would disturb sediments and increase turbidity. The impact of vessels on the substrate in the surf zone would be minor because of the dispersed nature of the amphibious landings and the dynamic nature of sediments in these areas of high-energy surf. Amphibious Assault and Amphibious Raid training could be conducted in the nearshore area, including the surf zone up to the high tide line at Unai Chulu, Unai Babui, and Unai Dankulo, Tinian, as well as Dry Dock Island in Apra Harbor and Dadi Beach on Guam. Amphibious Raid activities could also be conducted on Rota, but they are restricted to approaches via boat docks (no beach landings). As is current practice, exposure of hard-bottom habitats would continue to be avoided in the No Action Alternative. Additionally, amphibious landing activities would be scheduled at high tide, pre-landing surveillance would be used to identify the best landing route, and crews would follow procedures to avoid obstructions to navigation, all of which would reduce the potential for the vessels to disturb sediments or marine habitats.

Under the No Action Alternative, vessels movements could affect bottom sediments during amphibious landings. Ocean approaches would not be expected to affect marine habitats because of the nature of surf and tidal energy in the area. The movement of sediment by wave and tidal energy would fill in disturbed soft-bottom habitat similar to sediment recovery from a severe storm. Impacts on substrate would be limited to suspended sediments that are carried away by ocean currents. Ocean currents, however, would carry sediments from other locations into the Study Area. Therefore, vessel movements in the Study Area would not be expected to affect marine habitats.

Testing Activities

Under the No Action Alternative, testing activities in the Study Area would not include activities, such as amphibious landings, where vessels would contact bottom substrates. Therefore, vessels and in-water devices for testing activities would have no effect on marine habitats under the No Action Alternative.

3.3.3.2.1.2 Alternative 1

Training Activities

Alternative 1 proposes to introduce new vessels (not replacement class vessel for existing vessels). The Littoral Combat Ship and the Joint High Speed Vessel are fast vessels that may operate in nearshore waters, but would not be expected to contact bottom substrates. The Navy would introduce unmanned undersea and surface systems under Alternative 1, which may contact bottom substrates. The number of amphibious warfare training activities with amphibious landings would increase by approximately 30 percent compared to the No Action Alternative.

Amphibious vessels would approach the shore and could beach, which would disturb sediments and increase turbidity. The impact of vessels on the substrate in the surf zone would be minor because of the dispersed nature of the amphibious landings and the dynamic nature of sediments in areas of these high-energy surf zones. Amphibious Assault and Amphibious Raids could occur up to six times each annually. These could occur at beaches at Una Babui, Una Chulu, and Unai Dankulo on Tinian and can also occur at Dry Dock Island in Apra Harbor, Dadi Beach on Guam. Amphibious Raid activities could also be conducted on Rota, but they are restricted to approaches via boat docks (no beach landings). As is current practice, exposure of hard-bottom habitats would continue to be avoided in the Proposed Action. Additionally, amphibious landing activities would be scheduled at high tide, pre-landing surveillance would be used to identify the best landing route, and crews would follow procedures to avoid obstructions to navigation, all of which would reduce the potential for the vessels to disturb sediments or marine habitats.

Under Alternative 1, vessels movements could affect bottom sediments during amphibious landings. Ocean approaches would not be expected to affect marine habitats because of the nature of surf and tidal energy in the area. The movement of sediment by wave and tidal energy would fill in disturbed soft-bottom habitat similar to sediment recovery from a severe storm. Impacts on substrate would be limited to suspended sediments that are carried away by ocean currents. Ocean currents, however, would carry sediments from other locations into the Study Area. Therefore, vessel movements in the Study Area would not be expected to affect marine habitats.

Testing Activities

Under Alternative 1, testing activities in the Study Area would not include activities, such as amphibious landings, where vessels would contact bottom substrates. Therefore, vessels and in-water devices for testing activities would have no effect on marine habitats under Alternative 1.

3.3.3.2.1.3 Alternative 2

Training Activities

The number of training activities under Alternative 2 would be slightly greater than under Alternative 1 (see Table 3.3-3). Vessels used under Alternative 2 would consist of the same proposed vessels and unmanned systems as described under Alternative 1. Therefore, the impacts of vessel movements under Alternative 2 would be as described for Alternative 1; they would not affect marine habitats.

Testing Activities

Under Alternative 2, testing activities in the Study Area would not include activities, such as amphibious landings, where vessels would contact bottom substrates. Therefore, vessels and in-water devices for testing activities would have no effect on marine habitats under Alternative 2.

3.3.3.2.1.4 Substressor Impact on Marine Habitat as Essential Fish Habitat from Vessels and In-Water Devices (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of vessels and in-water devices during training and testing activities may have an impact on EFH by reducing the quality and quantity of non-living substrates that constitute EFH and Habitat Areas of Particular Concern. The MITT EFHA report states that any impacts on marine habitats incurred by vessel movements and in-water devices would be minimal and short term.

3.3.3.2.2 Impacts from Military Expended Materials

The potential for physical disturbance of marine substrates by military expended materials from military training and testing activities exists throughout the Study Area, although the types of military expended materials vary by activity and region (see Tables 2.8-1 through 2.8-4 of Chapter 2, Description of Proposed Action and Alternatives) with some areas of greater concentration, such as the shoreline around FDM. Section 2.3.6 (Military Expended Materials) describes military expended materials, which include non-explosive practice munitions (projectiles, bombs, and missiles) that are used in military training and testing activities. Military expended materials could disturb marine substrates to the extent that they impair the substrate's ability to function as a habitat. These disturbances could result from several sources, including the impact of the expended material contacting the seafloor, the covering of the substrate by the expended material, or the alteration of the substrate from one type to another.

The potential of military expended materials to impact marine substrates as they contact the seafloor depends on several factors, including the size, type, mass, and speed of the material; water depth; the amount of material expended; the frequency of training or testing; and the type of substrate. Most of the kinetic energy of an expended item is dissipated within the first few yards of the object entering the water, causing it to slow considerably by the time it reaches the substrate. Because the damage caused by a strike is proportional to the force of the strike, slower speeds may result in lesser impacts. Because of the depth of the water in which most training and testing activities take place, a direct strike on either hard bottom or artificial structures (e.g., artificial reefs and shipwrecks) with sufficient force to damage the substrate is unlikely. Any damage would be limited to a small portion of the structural habitat. The value of these substrates as habitat, however, does not depend on the shape of the structure. An alteration in shape or structure caused by military expended materials is not expected to reduce the habitat value of either hard bottom or artificial structures. In softer substrates (e.g., sand, mud, silt, clay, and composites), the impact of the expended material on the seafloor, if large enough and striking with sufficient momentum, may create a depression and redistribute local sediments as they are temporarily re-suspended in the water column. During military training and testing, countermeasures such as flares and chaff are introduced into marine habitats. These types of military expended materials are not expected to impact marine habitats as strike stressors because of their size and low velocity when impacting water surface, compared to projectiles, bombs, and missiles.

Other potential impacts that military expended materials could have on marine substrates would be to cover them or to alter the type of substrate and, therefore, its function as habitat. The majority of military expended materials that settle on hard bottoms or artificial substrates, while covering the seafloor, would still provide the same habitat as the substrate it covers by providing a hard surface on which organisms can attach. An exception would be expended materials, such as decelerators/parachutes used to deploy sonobuoys, lightweight torpedoes, expendable mobile anti-submarine warfare training targets, and other devices from aircraft, that would not provide a hard or permanent surface for colonization. In these cases, the hard bottom or artificial substrate covered by the expended material would not be damaged, but its function as a habitat for colonizing or encrusting organisms would be impaired.

Most military expended materials that settle on soft-bottom habitats, while not damaging the substrate, would modify the habitat by covering the substrate with a hard surface. This event would alter the substrate from a soft surface to a hard structure and, therefore, would prevent the substrate from supporting a soft-bottom community. Expended materials that settle in the shallower, more dynamic environments of the nearshore coastal waters would likely be eventually covered over by sediments because of currents and other coastal processes or encrusted by organisms. In the deeper waters of the continental slope and beyond, where currents do not play as large of a role, larger expended materials (i.e., bombs, missiles) may remain exposed on the surface of the substrate with minimal change for extended periods. Softer expended materials, such as decelerators/parachutes, would not damage sediments. Decelerators/parachutes, however, could impair the function of the substrate as habitat because they could be a temporary barrier to interactions between the water column and the sediment.

One unique type of military expended material, because of its size, is a ship hulk. Sinking exercises use a target (ship hull or stationary artificial target) against which explosive and non-explosive ordnance are fired. These exercises eventually sink the target. The exercise lasts 4–8 hours over 1–2 days, and may use multiple targets. Sinking exercises would only occur in waters more than 6,000 ft. (1,828.8 m) deep. The potential impacts of sinking exercises depend on the amounts of ordnance and types of weapons used, which are situational and training-need dependent (U.S. Department of the Navy 2006). The potential military expended materials from sinking exercises include the ship hull and shell fragments. The expended materials that settle to the seafloor would not affect the stability of the seafloor or disturb natural ocean processes (U.S. Department of the Navy 2006). On sloping bottoms, some expended materials may disrupt the periodic turbidity currents or sand flows of the immediate area. The impact of a ship hull settling on marine substrates would depend on the size of the ship hull and the type of substrate it settles upon. Areas of hard bottom may fragment or break as the ship settles to the seafloor. While the ship would cover a portion of the seafloor, it may support communities similar to those found on the hard substrate it covered, and likely would provide more complexity and relief, which are important habitat features for hard-bottom communities. Areas of unconsolidated sediments would experience a temporarily large increase in turbidity as sediment is suspended in the water column. The settling of the ship to the seafloor would also likely displace sediment and create a large depression in the substrate. The soft substrates covered by the ship would no longer serve their function in supporting a soft-bottom community, having been replaced by a hard structure more suitable for attaching and encrusting organisms.

The analysis to determine the potential level of disturbance of military expended materials on marine substrates assumes that the impact of the expended material on the seafloor is twice the size of its footprint (Gorodilov and Sukhotin 1996). This assumption would more accurately reflect the potential disturbance to soft-bottom habitats, but could overestimate disturbance of hard-bottom habitats. For this analysis, explosive munitions were treated in the same manner as non-explosive practice munitions in terms of impacts on the seafloor, to be conservative, even though explosive ordnance would normally explode in the upper water column, and only fragments of the ordnance would settle on the seafloor.

Strike warfare activities such as Bombing Exercises (Land) and Missile Exercises involve the use of live munitions by aircrews that practice on ground targets on FDM. These warfare training activities occur on the FDM land mass and are limited to the designated impact zones along the central corridor of the island. Explosives that detonate on land could loosen soils and subsequently get transported into surface drainage areas or nearshore waters. It should be noted that FDM is highly susceptible to natural causes of erosion because it is comprised of highly weathered limestone overlain by a thin layer of clay soil. Sediments entering the nearshore environment could cause temporary water quality impacts, some of which may be in foraging areas used by marine organisms. By limiting the location and extent of target areas, along with the types of ordnance allowed within specific impact areas, the Navy minimizes the potential for soil transport and, thus, water quality impacts. Additionally, as described in Section 3.1.3.1.5.3 (Farallon de Medinilla Specific Impacts), the Navy has conducted annual marine dive surveys in waters surrounding FDM from 1999 to 2010. Throughout all dive surveys, the coral fauna at FDM was observed to be healthy and robust. The nearshore physical environment and basic habitat types at FDM have remained unchanged over the 13 years of survey activity. These conclusions are based on (1) a limited amount of physical damage, (2) very low levels of partial mortality and disease (less than 1 percent of all species observed), (3) absence of excessive mucus production, (4) good coral recruitment, (5) complete recovery by 2012 of the 2007 bleaching event, and (6) a limited number of macrobioeroders and an absence of invasive crown of thorns starfish (*Acanthaster planci*). These factors suggest that sedimentation that may result from military use of FDM is not sufficient as to adversely impact water quality, and as such, marine habitats.

3.3.3.2.2.1 No Action Alternative

The numbers of military expended materials used for training and testing activities under the No Action Alternative are listed in Table 3.3-6. The physical impact area is estimated as twice the footprint of each type of military expended material.

<u>Training Activities</u>

Training activities involving military expended materials could impact the marine substrates within the areas where training would occur. A total of 116,241 military items, including several gun rounds and two ship hulks (Table 3.3-6), would be expended annually in the Study Area during training activities, which would result in a total impact area of approximately 1,505,166 ft.^{2} (139,738 m^2), which is less than 1 percent of the total Study Area. The majority of the impact area would be ship hulks expended during sinking exercises. With an impact area of 632,272 ft.^{2} (58,740 m^2) for each vessel and up to two sinking exercises per year, ship hulks would account for about 84 percent (1,265,000 ft.^{2} [117,480 m^2]) of the annual impact area for training activities under the No Action Alternative.

Table 3.3-6: Number and Impact Footprint of Military Expended Materials – No Action Alternative

Military Expended Material	Size ft.^{2} (m^2)	Impact Footprint ft.^{2} (m^2)	Study Area			
			Training Activities		Testing Activities	
			Number	Impact ft.^{2} (m^2)	Number	Impact ft.^{2} (m^2)
Bombs (Explosives)	16.17 (1.5022)	32.34 (3.0044)	32	1034.88 (96.1408)	0	0
Bombs (NEPM)	16.17 (1.5022)	32.34 (3.0044)	522	16,881.48 (1,568.29)	0	0
Small caliber	0.0301 (0.0028)	0.0603 (0.0056)	60,000	3,618 (336)	0	0
Medium caliber (Explosives)	0.056 (0.0052)	0.1119 (0.0104)	0	0	0	0
Medium caliber (NEPM)	0.056 (0.0052)	0.1119 (0.0104)	26,500	2,965.35 (275.6)	0	0
Large caliber (Explosives)	1.01 (0.0938)	2.0193 (0.1876)	1,240	1,242.02 (232.62)	0	0
Large caliber (NEPM)	1.01 (0.0938)	2.0193 (0.1876)	0	0	0	0
Missiles (Explosives)	37.37 (3.4715)	74.73 (6.9430)	58	4,334.34 (402.69)	0	0
Rockets (Explosives)	0.7987 (0.0742)	1.5974 (0.1484)	0	0	0	0
Rockets (NEPM)	0.7987 (0.0742)	1.5974 (0.1484)	0	0	0	0
Chaff (cartridges)	0.00108 (0.0001)	0.00215 (0.0002)	5,830	12.53 (1.16)	0	0
Flares	1.2196 (0.1133)	2.4391 (0.2266)	5,740	14,000.43 (1,300.68)	0	0
Acoustic countermeasures	0.3111 (0.0289)	0.6222 (0.0578)	0	0	0	0
Expendable Targets	96.88 (9)	193.8 (18)	159	30,814.2 (2,646)	0	0
Ship hulk (SINKEX)	316,136 (29,370)	632,272 (58,740)	2	1,264,540 (117,480)	0	0
Torpedo/accessories (Explosives)	7.53 (0.7)	15.1 (1.4)	53	800.3 (74.2)	0	0
Sonobuoys	1.2206 (0.1134)	2.4413 (0.2268)	8065	19,689.08 (1829.14)	0	0
Sonobuoys (explosives)	0.9752 (0.0906)	1.9504 (0.1812)	8	15.603 (1.45)	0	0
Decelerators/parachutes	9.04 (0.84)	18.08 (1.68)	8032	145,218.56 (13,493.76)	0	0
Total			**116,241**	**1,505,166 (139,738)**	0	0

Notes: ft.^{2} = square foot, m^2 = square meters, NEPM = Non-explosive Practice Munitions, SINKEX = Sinking Exercise

Under the No Action Alternative, the majority of military expended material would be used in open ocean areas, where the substrate is clays and silts. Explosive military expended material would typically fragment into small pieces. Ordnance that fails to function as designed and inert munitions would result in larger pieces of military expended material settling to the seafloor. Once on the seafloor, military expended material would be buried by sediments, corroded from exposure to the marine environment, or colonized by benthic organisms.

During sinking exercises, large amounts of military expended material and a vessel hulk would be expended. Sinking exercises in the Study Area, however, would occur over 50 nm from shore to the southwest of Guam, where the substrate would be primarily clays and silts. Clay and silt deep-water habitats would primarily consist of abyssal plains. Impacts of military materials expended over deep-water would be negligible because the military would typically avoid hard-bottom sub-surface features (e.g., sea mounts). Vessel hulks used during sinking exercises would alter the bottom substrate, converting soft-bottom habitat into an artificial, hard-bottom structure. The amount of area affected by vessel hulks would be a fraction of the available training area, and the vessel hulk would create a hard substrate which could act as an anchoring point for marine life in the open ocean where the predominant habitat is soft bottom.

Military expended material in the coastal portions of the Study Area would be limited to small-caliber projectiles, flares, and target fragments. These materials would be small, and would typically be covered by sediment or colonized by benthic organisms. The small size of military expended materials would not change the habitat structure. In heavily used coastal areas around FDM, annual monitoring since 1999 has determined that impacts to the marine habitats from military expended materials have been insignificant. Therefore, impacts to marine habitats from military expended material from training activities in the Study Area would be insignificant.

Testing Activities

Under the No Action Alternative, testing activities would not include military expended materials that may impact marine habitats.

3.3.3.2.2.2 Alternative 1

The numbers of military items expended for training and testing activities under Alternative 1 that may impact marine habitats are listed in Table 3.3-7.

Training Activities

A total of 261,482 military items that could impact marine habitats would be expended annually in the Study Area during training activities, which would result in a total impact area of approximately 1,705,266 $ft.^2$ (158,424 m^2) which is less than 1 percent of the total Study Area. Although there would be an approximate 120 percent increase in the number of military expended materials compared to the No Action Alternative, there would only be an increase of approximately 10 percent in the total area of bottom substrate affected.

Table 3.3-7: Number and Impact Footprint of Military Expended Materials – Alternative 1

Military Expended Material	Size ft.^{2} (m^2)	Impact Footprint ft.^{2} (m^2)	Study Area			
			Training Activities		Testing Activities	
			Number	Impact ft.^{2}(m^2)	Number	Impact ft.^{2} (m^2)
Bombs (Explosive)	16.17 (1.5022)	32.34 (3.0044)	212	6,856.08 (636.93)	0	0
Bombs (NEPM)	16.17 (1.5022)	32.34 (3.0044)	848	27,424.32 (2,547.73)	0	0
Small caliber	0.0301 (0.0028)	0.0603 (0.0056)	86,140	5,210.52 (482.34)	2,000	120.6 (11.2)
Medium caliber (Explosive)	0.056 (0.0052)	0.1119 (0.0104)	8,250	923.175 (85.8)	2,040	228.28 (21.21)
Medium caliber (NEPM)	0.056 (0.0052)	0.1119 (0.0104)	85,500	9,567.45 (889.2)	2,040	228.28 (21.21)
Large caliber (Explosive)	1.01 (0.0938)	2.0193 (0.1876)	1,300	2,625.9 (243.88)	3,920	7,915.66 (735.4)
Large caliber (NEPM)	1.01 (0.0938)	2.0193 (0.1876)	5,238	10,577.09 (982.65)	1,680	3,392.42 (315.168)
Missiles (Explosive)	37.37 (3.4715)	74.73 (6.9430)	113	8,444.5 (784.5)	20	1,494.6 (138.86)
Missiles (NEPM)	37.37 (3.4715)	74.73 (6.9430)	0	0	20	1,494.6 (138.86)
Rockets (Explosive)	0.7987 (0.0742)	1.5974 (0.1484)	114	182.10 (16.92)	0	0
Rockets (NEPM)	0.7987 (0.0742)	1.5974 (0.1484)	0	0 (0)	0	0
Chaff (cartridges)	0.00108 (0.0001)	0.00215 (0.0002)	25,840	55.56 (5.17)	600	1.29 (0.12)
Flares	1.2196 (0.1133)	2.4391 (0.2266)	25,600	62,440.96 (5,800.96)	300	731.73 (67.98)
Acoustic counter-measures	0.3111 (0.0289)	0.6222 (0.0578)	0	0	0	0
Expendable targets	96.88 (9)	193.8 (18)	426	82,558.8 (7,668)	360	69,768 (6,481.66)
Ship hulk (SINKEX)	316,136 (29,370)	632,272 (58,740)	2	1,264,544 (117,480)	0	0
Torpedo/ accessories (Explosive)	7.53 (0.7)	15.1 (1.4)	63	951.3 (88.2)	116	1,751.60 (162.40)
Sonobuoys	1.2206 (0.1134)	2.4413 (0.2268)	10,980	26,805.47 (2,490.26)	932	2,275.29 (211.37)
Sonobuoys (Explosive)	0.9752 (0.0906)	1.9504 (0.1812)	11	21.45 (1.99)	793	1,546.67 (143.69)
Decelerators/ parachutes	9.04 (0.84)	18.08 (1.68)	10,845	196,077.6 (18,219.6)	1,727	31,224.16 (2,901.36)
Total			**261,482**	**1,705,266 (158,424.2)**	**16,829**	**122,172 (11,348.83)**

Notes: ft.^{2} = square foot, m^2 = square meters, NEPM = Non-explosive Practice Munitions, SINKEX = Sinking Exercise, The majority of military expended material would be used in the open ocean, where substrates would primarily be clays and silts with few benthic invertebrates. Military expended material in the coastal portions of the Study Area would be limited to small-caliber projectiles, flares, and target fragments. In heavily used coastal areas around FDM, annual monitoring since 1999 has determined that impacts to the marine habitats from military expended materials have been insignificant. While the number of activities would increase, the types of military expended materials under Alternative 1 would be the same as under the No Action Alternative. Therefore, military material expended from training activities in the Study Area would have a slightly greater impact on marine habitats compared to the No Action Alternative.

Testing Activities

A total of 16,829 military expended materials that may impact marine habitats would be expended annually in the Study Area during testing activities, which would result in a total impact area approximately 122,172 $ft.^2$ (11,348.83 m^2), which is less than 1 percent of the total Study Area.

The majority of military expended materials would be used in the open ocean, where substrates would primarily be clays and silts with few benthic invertebrates. Military expended material in the coastal portions of the Study Area would be limited to small-caliber projectiles, flares, and target fragments. In heavily used coastal areas around FDM, annual monitoring since 1999 has determined that impacts to the marine habitats from military expended materials have been insignificant. The types of military expended materials under Alternative 1 would be the same as those used for training under the No Action Alternative. Therefore, military material expended from testing activities in the Study Area would have a similar impact on marine habitats compared to those used under training activities in the No Action Alternative.

3.3.3.2.2.3 Alternative 2

The numbers of military items that would be expended for training and testing activities that may impact marine habitats under Alternative 2 are listed in Table 3.3-8.

Training Activities

A total of 269,352 military items that may impact marine habitats would be expended annually in the Study Area during training activities, which would result in a total impact area of approximately 1,717,415 $ft.^2$ (159,544.4 m^2), which is less than 1 percent of the total Study Area. Although there would be an approximate 130 percent increase in the number of military expended materials compared to the No Action Alternative, there would only be an increase of 12 percent in the total area of bottom substrate affected.

The majority of military expended material would be used in the open ocean, where substrates would primarily be clays and silts with few benthic invertebrates. Military expended material in the coastal portions of the Study Area would be limited to small-caliber projectiles, flares, and target fragments. In heavily used coastal areas around FDM, annual monitoring since 1999 has determined that impacts to the marine habitats from military expended materials have been insignificant. While the number of activities would increase, the types of military expended materials under Alternative 2 would be the same as under the No Action Alternative. Therefore, military material expended from training activities in the Study Area would have a slightly greater impact on marine habitats compared to the No Action Alternative.

Table 3.3-8: Number and Impact Footprint of Military Expended Materials – Alternative 2

Military Expended Material	Size ft.^{2} (m^2)	Impact Footprint ft.^{2} (m^2)	Study Area			
			Training Activities		Testing Activities	
			Number	Impact ft.^{2} (m^2)	Number	Impact ft.^{2} (m^2)
Bombs (Explosive)	16.17 (1.5022)	32.34 (3.0044)	212	6,856.08 (636.93)	0	0
Bombs (NEPM)	16.17 (1.5022)	32.34 (3.0044)	848	27,424.32 (2,547.73)	0	0
Small caliber	0.0301 (0.0028)	0.0603 (0.0056)	86,140	5,194.24 (482.38)	2,500	150.75 (14)
Medium caliber (Explosive)	0.056 (0.0052)	0.1119 (0.0104)	8,250	923.175 (85.8)	2,490	278.63 (25.9)
Medium caliber (NEPM)	0.056 (0.0052)	0.1119 (0.0104)	87,750	9,819.22 (912.6)	2,490	278.63 (25.9)
Large caliber (Explosive)	1.01 (0.0938)	2.0193 (0.1876)	1,300	2,625.09 (243.88)	4,900	9,894.57 (919.24)
Large caliber (NEPM)	1.01 (0.0938)	2.0193 (0.1876)	5,238	10,577.09 (982.64)	9,300	18,779.49 (1,744.68)
Missiles (Explosive)	37.37 (3.4715)	74.73 (6.9430)	125	9,341.25 (867.87)	25	1868.25 (173.58)
Missiles (NEPM)	37.37 (3.4715)	74.73 (6.9430)	0	0	25	1868.25 (173.58)
Rockets (Explosive)	0.7987 (0.0742)	1.5974 (0.1484)	380	607.01 (56.39)	0	0
Rockets (NEPM)	0.7987 (0.0742)	1.5974 (0.1484)	0	0	0	0
Chaff (cartridges) – aircraft	0.00108 (0.0001)	0.00215 (0.0002)	28,512	61.3 (5.7)	660	1.42 (0.13)
Flares	1.2196 (0.1133)	2.4391 (0.2266)	28,272	68,958.24 (6,406.44)	330	804.90 (74.77)
Acoustic counter-measures	0.3111 (0.0289)	0.6222 (0.0578)	0	0	0	0
Expendable targets	96.88 (9)	193.8 (18)	447	86,628.6 (8,046)	401	77,713.8 (7,218)
Ship hulk (SINKEX)	316,136 (29,370)	632,272 (58,740)	2	1,264,544 (117,480)	0	0
Torpedo/ accessories (Explosive)	7.53 (0.7)	15.1 (1.4)	63	951.3 (88.2)	154	2,325.4 (215.6)
Sonobuoys	1.2206 (0.1134)	2.4413 (0.2268)	10,980	26,805.47 (2,490.26)	1,025	2502.33 (242.47)
Sonobuoys (Explosive)	0.9752 (0.0906)	1.9504 (0.1812)	11	21.45 (1.99)	884	1,724.15 (160.18)
Decelerators /parachutes	9.04 (0.84)	18.08 (1.68)	10,845	196,077.6 (18,219.6)	1,912	34,568.96 (3,212.16)
Total			**269,375**	**1,717,415 (159,554.4)**	**27,096**	**152,759 (14,200.4)**

Notes: ft.^{2} = square feet, m^2 = square meters, NEPM = Non-explosive Practice Munitions, SINKEX = Sinking Exercise

Testing Activities

A total of 27,096 military expended materials that may impact marine habitats would be expended annually in the Study Area during testing activities, which would result in a total impact area of 152,759 $ft.^2$ (14,200.4 m^2), which is less than 1 percent of the total Study Area.

The majority of military expended material would be used in the open ocean, where substrates would primarily be clays and silts with few benthic invertebrates. Military expended material in the coastal portions of the Study Area would be limited to small-caliber projectiles, flares, and target fragments. In heavily used coastal areas around FDM, annual monitoring since 1999 has determined that impacts to the marine habitats from military expended materials have been insignificant. While the number of activities would increase, the types of military expended materials under Alternative 2 would be the same as under Alternative 1. Therefore, military material expended from testing activities in the Study Area would have a slightly greater impact on marine habitats compared to Alternative 1.

3.3.3.2.2.4 Substressor Impact on Marine Vegetation as Essential Fish Habitat from Military Expended Materials (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of military expended materials during training and testing activities may have an adverse effect on EFH by reducing the quality and quantity of non-living substrates that constitute EFH and Habitat Areas of Particular Concern. The MITT EFHA report states that military expended material impacts to both soft- and hard-bottom substrates would be minimal with a duration period of long term to permanent within the MITT Study Area.

3.3.3.2.3 Impacts from Seafloor Devices

Seafloor devices are items used during training or testing activities that intentionally contact the seafloor. Seafloor devices include moored mine shapes, bottom placed instruments, and anchors.

Moored mines deployed by fixed-wing aircraft enter the water and impact the bottom, becoming partially buried in sediments. Upon impact, the mine casing separates and the semi-buoyant mine floats up through the water column until it reaches the end of the mooring line. Bottom mines are typically positioned manually and are allowed to free sink to the bottom to rest. Mine shapes are normally deployed over soft sediments and are recovered within 7–30 days following the completion of the training or testing activities.

Precision anchoring training exercises involve releasing anchors in precise locations throughout the Study Area. The intent of these training exercises is to practice anchoring the vessel within 100 yards (91.4 m) of the planned anchorage location. These training activities typically occur within predetermined shallow water anchorage locations near ports. In these locations the seafloors consist of hard and soft sediments. The level of impact on the sediments would depend on the size of the anchor used, which would vary according to vessel type.

3.3.3.2.3.1 No Action Alternative

Training Activities

Under the No Action Alternative, 480 mine shapes would be used during mine laying training activities. Mine shapes would be used primarily in Warning Area 517, which is located over predominately soft-bottom habitat in the open ocean offshore area (Figure 2.1-2). Based on the small area affected by mine shapes (approximately 8–15 $ft.^2$ [0.7–1.4 m^2]), and the substrate on which mine shapes are used, the use of mine shapes during training activities would not be expected to affect marine habitats. Additionally, the Portable Underwater Tracking Range (PUTR) would be deployed under the No Action Alternative. This would involve anchoring of approximately seven transponders normally in waters of depths greater than approximately 5,900 ft. (1,800 m). These locations would include seafloors consisting with soft-bottom habitat of unconsolidated sediments. Based on the use of areas of soft-bottom habitat the PUTR anchoring activities would not be expected to affect marine habitats.

Testing Activities

Under the No Action Alternative, seafloor devices are only utilized during testing activities at the North Pacific Acoustic Lab's Deep Water site. The deep water experimental site consists of an acoustic tomography array, a distributed vertical line array, and moorings in the deep-water environment (depths greater than 3,280 ft. [1,000 m]) of the northwestern Philippine Sea. The impact of seafloor devices on marine habitats is unlikely since these activities would occur over soft-bottom sediment in the deep sea.

3.3.3.2.3.2 Alternative 1

Training Activities

Under Alternative 1, 480 mine shapes would be used during mine laying training activities. Mine shapes would be used primarily in Warning Area 517, which is located over predominately soft-bottom habitat in the open ocean offshore area (see Figure 2.1-2). Based on the small area affected by mine shapes (approximately 8–15 $ft.^2$ [0.7–1.4 m^2]), and the substrate on which mine shapes are used, the use of mine shapes during training activities would not be expected to affect marine habitats. Additionally there would be 18 precision anchoring activities which would occur within predetermined shallow water anchorage locations near ports. These locations would include seafloors consisting of hard- and soft-bottom habitat. The level of impact on the sediments would depend on the size of the anchor used, which would vary according to vessel type. However, based on the use of areas that have been previously disturbed, precision anchoring activities would not be expected to affect marine habitats.

Testing Activities

Under Alternative 1, seafloor devices are utilized during pierside integrated swimmer defense activities, testing activities at the North Pacific Acoustic Lab's Deep Water site, and during the mine countermeasure mission package testing. The deep water experimental site consists of an acoustic tomography array, a distributed vertical line array, and moorings in the deep-water environment (depths greater than 3,280 ft. [1,000 m]) of the northwestern Philippine Sea. All equipment except for expendable transponders and anchors will be retrieved from the experiment area following the final phase of the PhilSea 10-11 Experiment. The locations for mine countermeasure mission testing would typically include seafloors consisting of soft-bottom habitat of unconsolidated sediments, such as Apra Harbor for the pierside integrated swimmer defense activities, which involve the retrieval of diver-placed items. Mine shapes could be used during the mine countermeasure mission package testing throughout the Study Area, though located over predominately soft-bottom habitat in the open ocean offshore area. Based on the small area affected by mine shapes (approximately 8–15 $ft.^2$ [0.7–1.4 m^2]), and the substrate on which mine shapes are used, the use of mine shapes during training activities would not be expected to affect marine habitats. Therefore, the impact of seafloor devices on marine habitats is unlikely because these activities would occur over soft-bottom sediment, the items used in nearshore areas have a small footprint, and the items are retrieved.

3.3.3.2.3.3 Alternative 2

Training Activities

Under Alternative 2, no additional seafloor devices would be used or implemented. Therefore, seafloor devices under Alternative 2 would have the same impacts on marine habitats as under Alternative 1.

Testing Activities

Under Alternative 2, seafloor devices are utilized during pierside integrated swimmer defense activities, testing activities at the North Pacific Acoustic Lab's Deep Water site, and during the mine countermeasure mission package testing. The deep water experimental site consists of an acoustic tomography array, a distributed vertical line array, and moorings in the deep-water environment (depths greater than 3,280 ft. [1,000 m]) of the northwestern Philippine Sea. The location of pierside integrated swimmer defense activities, such as Apra Harbor, include seafloors consisting of soft-bottom habitat of unconsolidated sediments, which involve the retrieval of diver-placed items. Mine shapes could be used during the mine countermeasure mission package testing throughout the Study Area, though located over predominately soft-bottom habitat in the open ocean offshore area. Similar to Alternative 1, based on the small area affected by mine shapes and the substrate on which mine shapes are used, the use of mine shapes during training activities would not be expected to affect marine habitats Therefore, the impact of seafloor devices on marine habitats is unlikely because these activities would occur over soft-bottom sediment, the items used in nearshore areas have a small footprint area, and the items are retrieved.

3.3.3.2.3.4 Substressor Impact on Marine Vegetation as Essential Fish Habitat from Seafloor Devices (Preferred Alternative)

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of seafloor devices during training and testing activities may have an adverse effect on bottom substrates that constitute EFH. These potential impacts to bottom substrates would be minimal in size and temporary (recovery in days to weeks) to short term (recovery in weeks up to 3 years) in duration. Artificial structures should not be adversely affected by the use of seafloor devices.

3.3.3.2.4 Summary of Physical Disturbance and Strike Stressors

Physical disturbance and strike stressors that could affect bottom substrates include vessel and in-water strikes, seafloor devices, and military expended materials. Amphibious landings in marine habitats of concern would be located to limit the potentially affected area. Ocean approaches would not be expected to affect marine habitats because of the nature of surf and tidal energy, and shifting sands. Seafloor devices would be located in areas that would be primarily soft-bottom habitat. Most seafloor devices would be placed in areas that would result in minor bottom substrate impacts. Once on the seafloor, military expended material would be colonized by benthic organisms because military expended materials would be anchor points in the shifting bottom substrates. The total area impacted by both training and testing activities for each alternative is summarized in Table 3.3-9.

3.3.4 SUMMARY OF POTENTIAL IMPACTS (COMBINED IMPACTS OF ALL STRESSORS) ON MARINE HABITATS

Most of the explosive military expended materials would detonate at or near the water surface. Underwater explosions that could affect bottom substrate, and therefore marine habitats, would be underwater detonations on the seafloor. Habitat utilized for underwater detonations would primarily be soft-bottom sediment.

Physical stressors that could affect bottom substrates include vessel and in-water strikes, seafloor devices, and military expended materials. Seafloor devices are intended to be deployed in soft-bottom habitat. Once on the seafloor, most military expended material would be colonized by benthic organisms because these military expended materials would provide anchor points in the shifting, soft-bottom substrate.

3.3.4.1 No Action Alternative

Based on the analysis presented above for acoustic stressors, physical disturbances, and strike stressors proposed from the training and testing activities under the No Action Alternative, the combined impact area would not diminish the ability of soft shores, soft bottoms, hard shores, hard bottoms, or artificial substrates to function as habitat. The total area impacted by underwater explosions and military expended materials is less than 1 percent of the Study Area and is summarized in Table 3.3-9.

Table 3.3-9: Combined Impact of Acoustic Stressor (Underwater Explosions) and Physical Disturbances (Military Expended Materials) on Marine Substrates for All Alternatives

Alternative	Impact Footprint (ft.^{2})		
	Underwater Explosions[1]	Military Expended Materials[2]	Total
No Action Alternative	11,500	1,506,136	1,517,636
Alternative 1	21,780	1,842,260	1,864,040
Alternative 2	22,360	1,852,953	1,875,313

[1] Totals are derived from Tables 3.3-4 and 3.3-5
[2] Totals are derived from Tables 3.3-6, 3.3-7, and 3.3-8
Note: ft.^{2} = square feet

3.3.4.2 Alternative 1

Based on the analysis presented above for acoustic stressors, physical disturbances, and strike stressors proposed from the training and testing activities under Alternative 1, the combined impact area would not diminish the ability of soft shores, soft bottoms, hard shores, hard bottoms, or artificial substrates to function as habitat. The total area impacted by underwater explosions and military expended materials is less than 1 percent of the Study Area and is summarized in Table 3.3-9.

3.3.4.3 Alternative 2

Based on the analysis presented above for acoustic stressors, physical disturbances, and strike stressors proposed from the training and testing activities under Alternative 2, the combined impact area would not diminish the ability of soft shores, soft bottoms, hard shores, hard bottoms, or artificial substrates to function as habitat. The total area impacted by underwater explosions and military expended materials is less than 1 percent of the Study Area and is summarized in Table 3.3-9.

3.3.4.3.1 Essential Fish Habitat Determinations

Pursuant to the EFH requirements of the Magnuson-Stevens Fishery Conservation and Management Act and implementing regulations, the use of explosives on or near the bottom, vessel movement, military expended materials, and seafloor devices may have an adverse effect on EFH by reducing the quality and quantity of non-living substrates that constitute EFH and Habitat Areas of Particular Concern. The MITT EFHA report states that individual stressor impacts to non-living substrates were all either no effect or minimal and ranged in duration from temporary to permanent, depending on the habitat impacted. As a result of consultation with NMFS for EFH, the Navy will not increase the amount of explosive used at the Outer Apra Harbor UNDET site from 10 lb. NEW to 20 lb. NEW. If the proposed increase becomes necessary at a later date, the Navy will conduct the appropriate analysis to assess potential effects on nearby EFH. The MITT EFHA report is available on the MITT project website (www.mitt-eis.com), and Appendix C (Agency Correspondence) provides agency correspondence and supporting documentation.

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