CHAPTER 4.
WATER RESOURCES

4.1 AFFECTED ENVIRONMENT

4.1.1 Definition of Resource

4.1.1.1 Water Resources Overview

Water resources as defined in this Environmental Impact Statement/ Overseas Environmental Impact Statement (EIS/OEIS) are sources of water available for use by humans, flora, or fauna, including surface water, groundwater, nearshore waters, and wetlands. Surface water resources, including but not limited to stormwater, lakes, streams and rivers, are important for economic, ecological, recreational, and human health reasons. Groundwater may be used for potable water, agricultural irrigation, and industrial applications. Groundwater is classified as any source of water beneath the ground surface, and is the primary source of potable water used to support human consumption.

Potable groundwater is discussed in detail in the Potable Water Section in the Utilities Volume 6, Chapter 15, of this EIS/OEIS. Consistent with the definition contained in 22 Guam Administrative Rule (GAR) 5105, nearshore waters are defined as all coastal waters lying within a defined reef area, all coastal waters of a depth of less than ten fathoms (60 feet [ft], 18.3 meters [m]), and all coastal waters greater than 10 fathoms up to 1000 ft (305 m) offshore where there is no defined reef area. Nearshore waters can be directly affected by human activity, and are important for human recreation and subsistence. Wetlands are habitats that are subject to permanent or periodic inundation or prolonged soil saturation, and include marshes, swamps, and similar areas. Areas described and mapped as wetland communities may also contain small streams or shallow ponds, or pond or lake edges. Surface water, groundwater, nearshore waters, and wetlands of Guam are discussed below.

4.1.1.2 Surface Water

<u>Surface Water Availability</u>

Rainfall on Guam averages between 85 and 115 inches (in) (215 and 292 centimeters [cm]) a year, most of which falls during the rainy season from July to December. Figure 4.1-1 shows the average annual distribution of rainfall on Guam. On average, southern Guam receives more rain than northern Guam, especially around the Naval Munitions Site (NMS). In the highly permeable limestone geology of northern Guam, surface runoff occurs only during heavy rainfall events due to the high rates of surface water infiltration into the underlying groundwater basins. Less infiltration occurs in the low-permeability volcanic rocks of southern Guam, resulting in more surface runoff.

Guam has 97 rivers and streams, ranging in length from 0.6 mile (mi) (1 kilometer [km]) to more than 3.1 mi (5 km). All of the rivers and streams are found in the central and southern half of the island. Northern Guam does not have perennial streams due to the karst geology of this area. Due to the high permeability of the limestone, water in this area does not flow at the surface, but instead infiltrates quickly into the subsurface, recharging the freshwater groundwater lens. Because of the lack of perennial streams, there are no estuaries in the north.

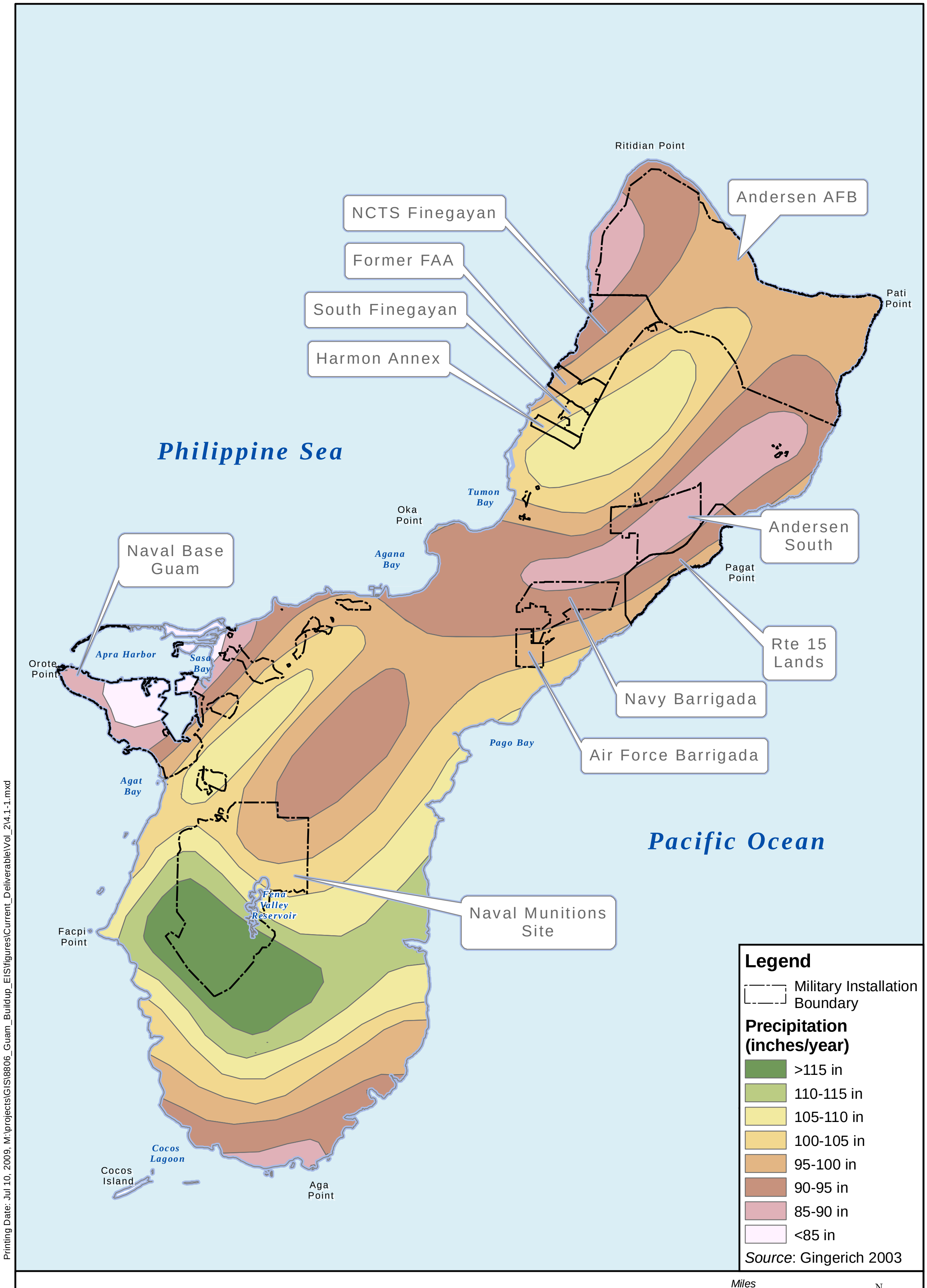

Figure 4.1-1
Guam Annual Rainfall

Figure 4.1-2 shows Guam's streams and graphically depicts the lack of surface water in the northern part of the island. In southern Guam, a mountain ridge runs along the western coast and creates small, steep drainage basins to the west. To the east, broader floodplains drain into longer, larger rivers. Forty-six of Guam's rivers and streams drain into the ocean, five drain into lakes, and the remainder feed into other rivers. Detailed information on surface waters is provided in the following site-specific discussions.

Surface Water Quality

Surface water quality, in general, is good, but Guam's surface waters are vulnerable to contamination from sewage disposal overflows, animal wastes, and sediment erosion carried into streams during periods of heavy rainfall. Inland surface water bodies are of highest quality, whereas coastal regions contain surface water bodies of medium to low quality (NAVFAC Pacific 2008).

Federal Regulations

The Clean Water Act

The Clean Water Act (CWA) of 1972 is the primary federal law that protects the nation's waters, including lakes, rivers, wetlands and coastal areas. The primary objective of the CWA is to restore and maintain the integrity of the nation's waters. In Guam, CWA oversight responsibilities lie with the Guam Environmental Protection Agency (GEPA). Under GEPA, Guam's Water Pollution Control Program reviews and certifies National Pollutant Discharge Elimination System (NPDES) permit applications and the United States (U.S.) Environmental Protection Agency (USEPA) coordinates, drafts, and issues NPDES permits for storm water and point source pollution discharges. The United States Army Corps of Engineers (USACE) issues permits for the discharge of dredged or fill material under Section 404 of the CWA.

Governing procedures for the use of training areas, ranges, and airspace operated and controlled by the Commander U.S. Naval Forces, Marianas (COMNAV) including instruction and procedures is included in COMNAV Marianas Instruction 3500.4 (Marianas Training Handbook [COMNAV Marianas 2000]). This guidance identifies specific land use constraints to enable protection of environmental resources during military training.

Guam Regulations

Surface Water Designations

The GEPA classifies surface waters into three categories: S-1, S-2, and S-3, depending on the location within the watershed. Both S-1 and S-2 designations fully protect recreational uses, including swimming, and all stages of aquatic life. An S-1 designation is more stringent in that no pollutants are allowed to be discharged into S-1 waters. Waters designated as S-1 are to be kept free of substances or pollutants that may impact water quality.

The surface water designations encompass all fresh surface water bodies, including: (1) waters that flow continuously over land surfaces in a defined channel or bed, such as streams and rivers; (2) standing water in basins such as lakes, wetlands, marshes, swamps, ponds, sinkholes, impoundments, and reservoirs either natural or man-made; and (3) all waters flowing over the land as runoff, or as runoff confined to channels with intermittent flow (see Figure 4.1-2). Figure 4.1-3 depicts the surface water designations. Below are the category descriptions from the GEPA (GEPA 2001):

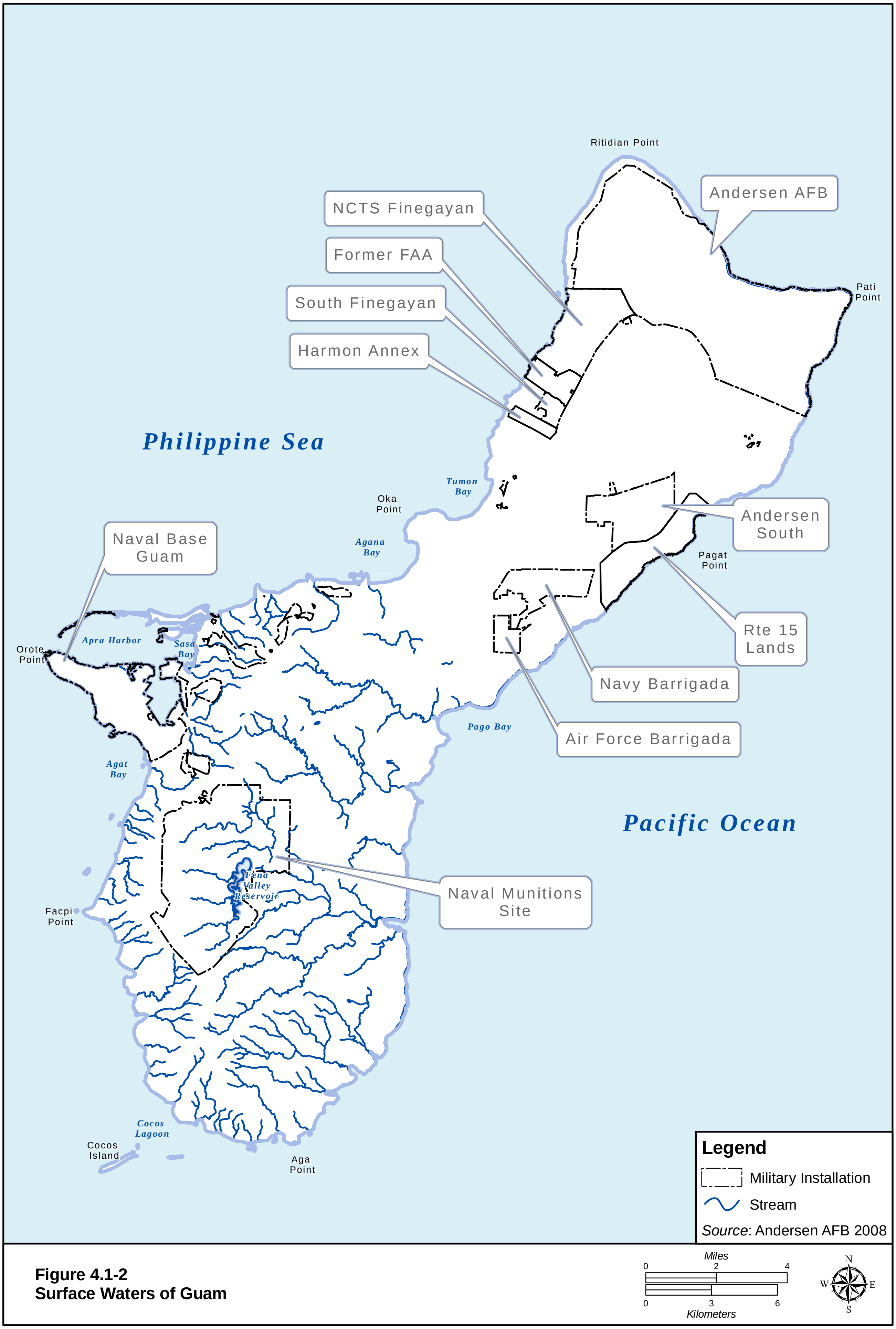

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Figure 4.1-2
Surface Waters of Guam

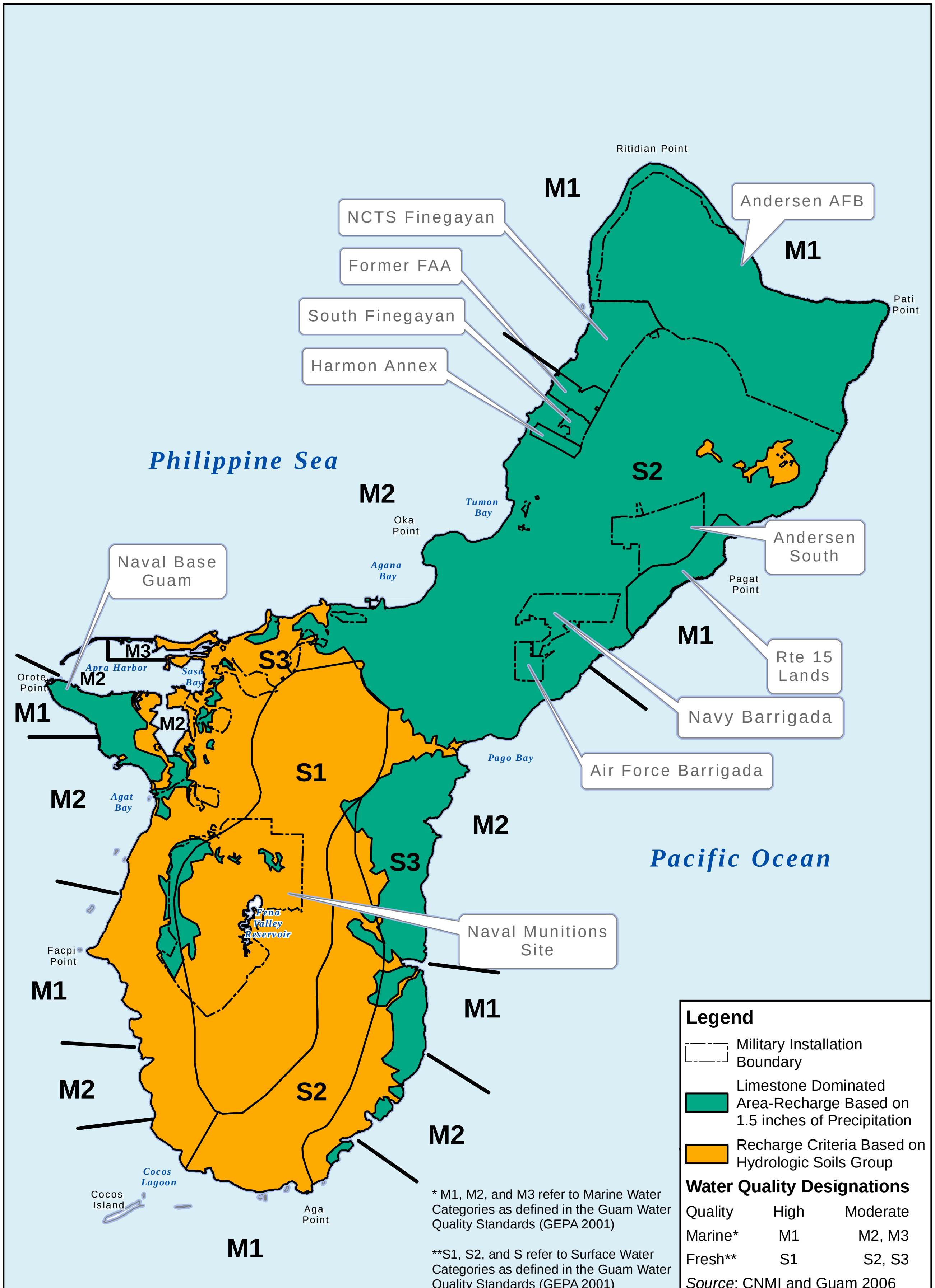

Figure 4.1-3
Water Quality Criteria Designations and Stormwater Recharge Zones

(1) Category S-1 HIGH. Surface waters in this category are used for drinking water resources, conservation of wilderness areas, and propagation and preservation of aquatic life and aesthetic enjoyment. It is the objective of these standards that these waters shall be kept free of substances or pollutants from domestic, commercial and industrial discharges, or agricultural activities, construction or other land-use practices that may impact water quality. No pollutant discharges would be permitted into S-1 waters via discharge or as a result of land uses adjacent to S-1 waters. Mixing zones would not be allowed within the boundaries of Category S-1.

(2) Category S-2 MEDIUM. Surface waters in this category are used for recreational purposes including water contact recreation, as potable water supply after adequate treatment is provided, and for propagation and preservation of aquatic wildlife and aesthetic enjoyment.

(3) Category S-3 LOW. Surface waters in this category are primarily used for commercial, agricultural and industrial activities. Aesthetic enjoyment and compatible recreation are acceptable in this zone, as well as maintenance of aquatic life. Compatible recreation may include limited body contact activities. All discharges within this zone that are not required to have construction and/or discharge permits under existing regulations may be required by the Agency to obtain such permits under these regulations.

The Guam Watershed Planning Committee (WPC) was established in 1998 and consists of representatives from 14 federal and local organizations and agencies, including GEPA, U.S. Department of Agriculture's Natural Resource Conservation Service, Guam Waterworks Authority, Guam Department of Commerce, Guam Department of Agriculture, Guam Bureau of Planning, College of Agriculture and Life Sciences at the University of Guam, Water and Environmental Research Institute, Guam Department of Land Management, Navy Public Works Center, COMNAV Marianas, Air Force, and Southern Soil and Water Conservation District. One of the WPC subcommittees focuses on restoration of the Northern Guam Lens Aquifer (NGLA).

Flood Zones

Floodplains are low-lying areas subject to flooding. Heavy rainfall in areas such as NMS may cause flooding in the stream drainage basins (Gingerich 2003). Figure 4.1-4 shows the 100-year and 500-year flood zones on Guam. As shown in the figure, areas of NMS are located within the 100-year flood zone. In addition, numerous areas at Apra Harbor and Cabras are also located within the 100-year flood zone.

4.1.1.3 Groundwater

The availability and quality of groundwater on Guam is greatly influenced by the island's geology; therefore, please refer to Volume 2, Chapter 3**,** Geological and Soils Resources, for information regarding geological conditions on Guam to increase the understanding of the following groundwater discussion.

Groundwater Availability

Water is held in pores in the soil by cohesive attraction between water molecules and the soil grains. Water transport in the soil, due its lower permeability, is slow compared to the rate of movement in the limestone found in northern Guam. Dissolution of the limestone by percolating rainwater has resulted in a complex underground drainage system, including caves and sinkholes. The large pore spaces and fractures in limestone rock allow water to percolate rapidly downward resulting in minimal surface runoff and groundwater recharge. The limestone in northern Guam overlies much less permeable volcanic rock. In the saturated zone of northern Guam this low permeability volcanic rock stratum underlies the

Figure 4.1-4
Guam Flood Zones

freshwater portion of the aquifer, except in the west-central portion of this region where the limestone/volcanic layer interface is above the freshwater/saltwater transition zone (Gingerich 2003).Percolation of precipitation through the rock formations to the underlying saltwater forms a lens of fresh groundwater that floats on top of the saltwater. Due to the density difference between freshwater and saltwater, the interface between the two is approximately 40 ft (12 m) below sea level for every foot the water table is above sea level. This 1:40 relationship is commonly referred to as the Ghyben-Herzberg relation after the two scientists that independently discovered it in the late 19th century (Freeze and Cherry 1979). The boundary between the two water bodies is not sharp but rather a gradual transition that begins at some depth that is determined by the rate of diffusion of salts into the freshwater and the mixing between the two bodies as the water flows laterally toward discharge points at the coast.

On Guam, the freshwater lens is divided into two zones based on chloride concentrations. The upper zone is the basal freshwater lens where the chloride concentration is less than the USEPA secondary Maximum Concentration Level (MCL) of 250 milligrams per liter (mg/L). The transition zone between freshwater and saltwater begins where the chloride concentration exceeds 250 mg/L down to a point where the chloride concentration is nearly equal to that of seawater. From a water resources perspective, that portion of the basal lens from the water table down the top of the transition, the basal freshwater lens, is most important. It represents the potable water portion of the aquifer that can be pumped for human use.

The thickness of the basal freshwater lens is dependent on the rate of recharge, the permeability of the aquifer formations, and the heterogeneity of the aquifer formations. Limestone formations are very porous providing a large of amount of freshwater storage volume. If the freshwater in the limestone extends downward far enough to intersect the low permeability volcanic rock, it is referred to as parabasal water. The low permeability of the volcanic rock acts as a barrier between the freshwater and underlying saltwater, mitigating the effects of saltwater intrusion. Figure 4.1-5 presents the groundwater zones on Guam.

In northern Guam, the basal freshwater lens is primarily recharged by rainwater falling across the island surface (area recharge). However, point recharge through sinkholes and dissolution caverns provides a direct path for surface water to reach the groundwater table. The continued development of northern Guam has resulted in once undeveloped areas being sealed with impervious materials (houses, roads, and parking areas), thus preventing or severely reducing groundwater area recharge rates. This change in land cover also generates large amounts of runoff during storm events. To manage this increase in surface water runoff, municipal rainwater collection and conduits have been installed to direct rainwater into sinkholes where the water rapidly percolates to the groundwater; however, data indicate that this stormwater often contains pollutants, which then negatively impacts groundwater quality (Navy 2009).

Unlike the highly permeable limestones that are found in northern Guam, low permeability volcanic rocks and their weathered products dominate the geology of southern Guam. Precipitation falling on southern Guam encounters soils derived from submarine volcanic rock formations. The small size of the clay particles in these soils readily retains any water deposited on the surface but has slow drainage due to the low permeability of these soils, thus resulting in comparatively more surface water runoff and less groundwater. The groundwater table elevations in the volcanic rock formations are much higher than in the limestone formations. In many areas in southern Guam, the water table intersects the ground surface, resulting in the discharge of groundwater into streams. Approximately 23% to 57% of the stream flow in gauged streams in Guam is from groundwater discharge to surface water (Gingerich 2003).

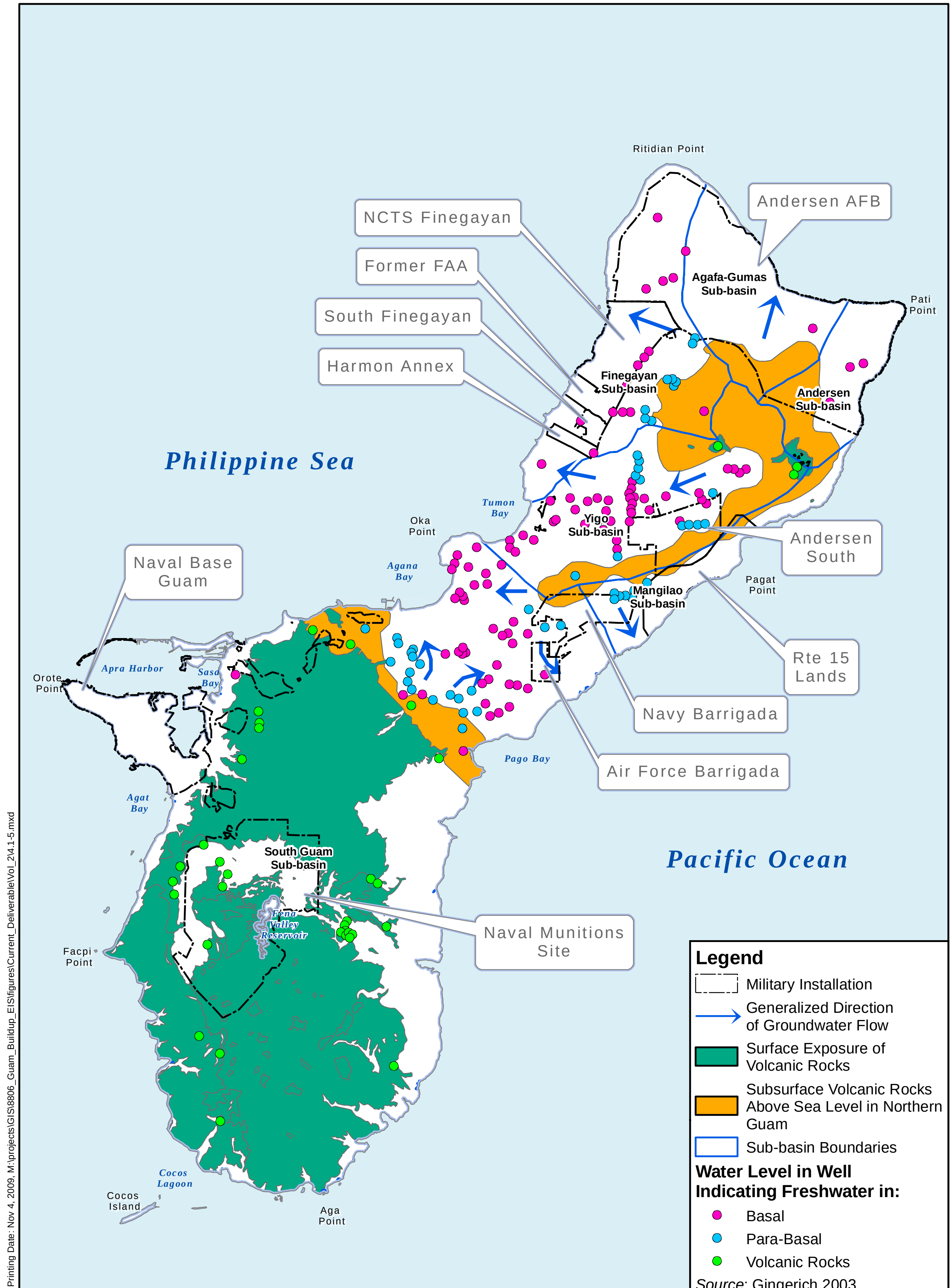

Figure 4.1-5
Guam Groundwater Resources

The freshwater aquifers on Guam are susceptible to contamination from surface activities and from saltwater intrusion. The high permeability of the limestone in northern Guam allows rapid infiltration of rainfall and the large pore size in the limestone formations allow contaminants (if present in the surface water) to reach the groundwater table. The thickness of the freshwater lens (the distance from the water table to the depth the salinity increases to 10% of seawater) is 150 to 200 ft (45 to 61 m) at the southern end of Guam. Further to the north the thickness decreases to approximately 100 ft (30 m). The thickness of the groundwater lens is directly related to the recharge rate and to water withdrawal rates (increased pumping generally results in a thinner lens).

The primary aquifer on Guam is the NGLA that extends from the northern most tip of the island to where the southern highlands start north of Apra Harbor. The NGLA is composed of six distinct subbasins (the Agana, Mangilao, Andersen, Agafa-Gumas, Finegayan, and Yigo-Tumon). Water levels in the NGLA vary daily and seasonally in response to ocean tides, recharge rates, and groundwater withdrawal. Daily fluctuation of water levels driven by tidal changes are about 0.5 ft (0.15 m) in wells near the coast, but these fluctuations decrease as distance from the coast increases and as the permeability of the aquifer material decreases. Well water levels in limestone formations can increase several feet in a matter of days when large storm events (and associated runoff) occur. Seasonal water level variations in the most permeable parts of the NGLA are less than 10 ft (3 m). In the southern part of the NGLA the seasonal water level variations can exceed 20 ft (6 m).

The NGLA is being considered by GEPA for designation as groundwater under direct influence of surface water (GEPA 2009). Drinking water extracted from groundwater designated as groundwater under direct influence of surface water would be subject to the same level of treatment as surface water. In addition, the aquifer has been designated by USEPA as a Sole Source Aquifer under the Safe Drinking Water Act.

On Guam, a significant portion of rainfall is lost to evapotranspiration and some is lost to surface runoff. Of the average annual rainfall of approximately 94 in (239 cm) in northern Guam, evapotranspiration has been estimated to account for 33% (Camp Dresser and McKee [CDM] 1982 in Guam Waterworks Authority [GWA] 2007) to 63% (Barrett 1991 in GWA 2007) of total rainfall. The portion that infiltrates to the subsurface recharges the underlying water table at an annual average rate of approximately 35 in (89 cm) per year (Navy 2009).

There are two published studies estimating the sustainable yield of the NGLA. In general terms, the sustainable yield is the amount of water that can be pumped from an aquifer without impairing the utility or quality of the water resource. To sustain a groundwater resource in an ocean island setting, the rate of groundwater withdrawal would be significantly less than the rate of recharge because seaward flow of groundwater is required to maintain the freshwater lens. An assessment done in 1982 (CDM 1982) determined the sustainable yield at 57.4 million gallons per day (MGd), and a study in 1991 determined a value of 80.5 MGd (Barrett 1991). Both studies are cited by various sources as the current estimate of sustainable yield. For example U.S. Geological Survey (USGS) (2007) lists the values from 1982, while the GWA in their Water Resources Master Plan (GWA 2007) uses the 1991 values. Part of the difference between the 1982 and 1991 sustainable yield values is due to a change in the subbasin boundaries. Since the 1991 study is most recent and was a more comprehensive study, these values are believed to more accurately reflect conditions on Guam and are used in this analysis. These studies of estimated sustainable yield of the aquifer subbasins have been reviewed by the University of Guam.. The findings of this September 2009 review confirm that the 1991 esimtates of sustainable yield are the more reliable of the two studies. Table 4.1-1 lists the subbasins, their sustainable yields, and recent average pumping rates (in MGd).

Table 4.1-1. Sustainable Yield Estimates and Recent Annual Average Pumping, NGLA

Subbasin	*1982 Sustainable Yield (MGd)*	*1991 Sustainable Yield (MGd)*[1]	*Current Well Production (MGd)*	*Current Available Yield (MGd)*[2]
Agana	11.7	20.5	10.9	9.6
Mangilao	3.9	6.6	2.5	4.07
Andersen	6.2	9.8	0.7	9.05
Agafa-Gumas	10.1	12.0	0.0	12.0
Finegayan	6.4	11.6	8.2	3.36
Yigo-Tumon	19.1	20.0	21.3	-1.33
Total	**57.4**	**80.5**	**43.7**	**36.75**

Note: [1]As part of the EIS/OEIS, a re-evaluation of the sustainable yield of the NGLA has been conducted and confirmed that the 1991 sustainable yield estimate is the more appropriate. .

[2] The current available yield is the difference between current well production and the 1991 sustainable yield.

Numbers may not add exactly due to rounding.

*Sources***:** CDM 1982, Barrett 1991, USGS 2007, NAVFAC Pacific 2008.

Based on these estimates, it is clear that groundwater resources are underdeveloped within the Andersen and Agafa-Gumas subbasins, compared to the southern subbasins. A parabasal zone exists in both the Andersen and Agafa-Gumas subbasins, meaning that these subbasins have the potential for increased production rates.

Groundwater Quality

GEPA manages several environmental programs that serve to protect groundwater resources. Most programs are fully established but undergo continuous revision based on changes in statutes or regulations or to maintain effective control measures. Two potential sources of negative impact to the groundwater resources in Guam are 1) over-pumping resulting in saltwater intrusion, and 2) contaminated leachate from the ground surface or shallow subsurface degrading the water quality. Due to potential increases in demand, saltwater intrusion poses the most significant threat to groundwater resources.

Wells closer to the coast have the potential to be most affected by saltwater intrusion brought on by pumping; some wells are already experiencing high chloride concentrations (concentrations >250 mg/L). For example, current chloride data indicate that some wells, particularly in the Finegayan and Agana Subbasins, are drawing water high in chloride concentrations from the transition zone into their intakes. This could indicate over-pumping of these subbasins or that the well intakes were installed too deep.

The groundwater quality within the NGLA is considered good but the aquifer is highly vulnerable to contamination from chlorides, and raw sewage leaking from the collection system. Bacteria, nutrients, chlorides, and toxic contaminants have been detected in groundwater from the NGLA. Many single-family dwellings on Guam, especially in the northern and central areas of the island, use septic systems with leach fields. Leach fields are perforated pipes typically buried in fully excavated fields that allow effluent to leach out into the surrounding soil or limestone formation. Where organic soil is present in fields, the soil acts as a filter and biologic purifier, removing pathogens and degrading contaminants to benign substances; however, since organic soils are absent in most systems constructed in northern Guam due to very shallow soil profiles, minimal nutrient and pathogen removal may occur. Thus, there is a potential for modified effluent to reach the NGLA. Since there are frequent discharges to a septic system and leach field, the treated effluent would eventually percolate down to the water table. This leachate may still contain problematic concentrations of contaminates such as nitrate or pharmaceuticals. This problem is exacerbated where there is a high density of septic systems or where they are not operating properly. These individual wastewater systems are considered a potential threat to the quality of the NGLA.

Federal Regulations

Safe Drinking Water Act

The Safe Drinking Water Act regulates the nation's drinking water supplies by establishing standards for drinking water to protect against both naturally occurring and man-made contaminants. This act also seeks to prevent contamination of drinking water resources by establishing requirements under programs such as the underground injection control program.

The Safe Water Drinking Act relates directly to groundwater resources on Guam as groundwater provides a majority of the drinking water. The Guam Safe Drinking Water Act was enacted in 1977 by Public Law 14-90. It establishes a policy for the protection and provision of safe drinking water via the establishment of primary and secondary standards.

Groundwater Rule

The Groundwater Rule (40 CFR Parts 9, 141 and 142) provides for increased protection against microbial contamination. This is a risk-based rule that mandates treatment of groundwater used by public drinking water system be disinfected if indicator bacteria are detected in this water. Since the NGLA is overlain by permeable limestone and there is a high density of individual wastewater systems, the rule may be applicable to groundwater in Guam that is used for drinking water.

Technical Standards and Corrective Action Requirements for Owners and Operator of Underground Storage Tanks

This regulation (40 CFR Chapter 1, Part 280) protects groundwater by establishing regulations and procedures for underground storage tanks that contain regulated substances such as petroleum products. Owners and operators are required to take specific action when investigating releases for their tanks.

Guam Regulations

Guam's groundwater falls into one of three classifications: G-1 (Resource Zone), G-2 (Recharge Zone), and G-3 (Buffer Zone). The G-1 category includes all groundwater and the water in the unsaturated zone extending 100 ft (30 m) above the water table or 20 ft (6 m) below the ground surface, whichever is lower. The G-1 water must meet drinking water quality standards (GEPA 2001). The G-2 water is tributary to and replenishes G-1 water. A description of the classifications (GEPA 2001) follows:

> §5102(b). Groundwater. This major type of water encompasses all subsurface waters and includes basal and parabasal water, perched water, all water below the groundwater table, water percolating through the unsaturated zone (vadose water), all saline waters below and along the perimeter of the basal freshwater body (freshwater lens), and water on the surface that has been collected with the specific intent of recharging or disposing of that water to the subsurface by means of injection, infiltration, percolation or other means. The northern Guam water lens (the Principal Source Aquifer) and any other groundwater resource as they are identified shall continue to receive protection under Guam's groundwater regulations.
>
> Category G-1. RESOURCE ZONE
>
> The primary use of groundwater within this zone is for drinking (human consumption) and this use must be protected. Virtually all water of the saturated zone of Guam is included. Specifically it includes all water occurring in the saturated zone below the groundwater table, all vadose water

occurring in an unsaturated zone interval extending 100 ft (30 m) above any water table, or to within 20 ft (6 m) of the ground surface above all fresh groundwater bodies, all water and the basal and parabasal freshwater bodies, and all water of and below the freshwater/salt-water transition zone beneath the basal water body.

Because any water discharges within this zone would (by definition) be tributary to groundwater bodies that are actual or potential sources of fresh, potable groundwater, no discharges within this zone would be allowed.

Category G-2. RECHARGE ZONE

Water within this zone is tributary to, replenishes and recharges the Category G-1 groundwater and must be of drinking water quality before it enters the Resource Zone. All water discharges within the Recharge Zone must receive treatment to the degree necessary to protect the underlying Category G-1 groundwater from any contamination.

Category G-2 is divided into two distinct subcategories based upon the boundaries of the protected groundwater area. The protected groundwater area includes all land over the entire NGLA, from coastline to coastline. Category G-2a exists within the protected groundwater area and extends from the ground surface to the top of the G-1 Zone. Category G-2b exists only outside the protected groundwater area and includes all waters that are collected and recharged or disposed of within a zone is bounded above by G-3 and below by G-1. Vertically, this zone extends 20 ft (6 m) below the ground surface to the upper surface of the Category G-1 waters. Input to groundwater within this zone occurs primarily through storm water injection wells.

It is recognized that surface water would percolate through soil/rock media before reaching the Resource Zone. In this way it may undergo some degree of natural treatment consisting of filtration and subsequent purification. However, the degree of treatment is not easily demonstrated. Thus, due to the need to protect G-1 waters and considering the difficulty in tracing pollutants reaching the G-1 zone to a particular source, discharge limitations have been established to regulate discharges to the G-2 zone.

Category G-3. BUFFER ZONE

Category G-3 exists only outside the protected groundwater area and includes all waters that are collected and disposed of or recharged at or near the existing groundwater supply. Vertically, the zone for this category extends from the surface to 20 ft (6 m) below the surface. Disposal methods that may result in discharges to groundwater within this zone include, but are not limited to, ponding basins, rapid infiltration, slow rate land treatment, surface or spray irrigation and all subsurface discharges (seepage, leaching).

Discharges equal to or less than 3,000 gallons per day (gpd) (11,356 liters per day [lpd]) within the G-3 zone are designated by G-3a. Water quality criteria for all discharges within zone G-3 that are >3,000 gpd (11,356 lpd) are designated G-3b. This differentiation in criteria addresses the fact that minor discharges typified by small scattered individual dwelling units probably have less adverse impact on underlying groundwater than major point source discharges and thus are allowed less restrictive water quality limits (i.e., equivalent to primary treatment). All discharges within this zone may require discharge permits under these regulations.

4.1.1.4 Nearshore Waters

Definition

For the purposes of this analysis, nearshore waters include all coastal waters having a salinity >0.5 parts per thousand (ppt) from the mean low water mark to a depth of 60 ft (18 m) and monitored under the Guam Coastal Assessment program. While not entirely satisfying this definition (it is >60 ft [18 m] deep), Apra Harbor is included in the nearshore discussion.

Oceanography

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

Nearshore Water Quality

Water quality in the marine environment is determined by a complex set of interactions between chemical and physical processes operating continuously in the ocean system. This dynamic equilibrium is expressed by a variety of indicators, including temperature, salinity, dissolved oxygen, and nutrient levels. Nutrients are chemicals necessary to produce organic matter. Basic nutrients include dissolved nitrogen, phosphates, and silicates. Dissolved inorganic nitrogen occurs in ocean water as nitrates, nitrites, and ammonia, with nitrates as the dominant form. Water pollutants alter the basic chemistry of seawater in various ways (Navy 2009).

The vast expanse of offshore waters, their distance from the shore, and mixing and transport effects of currents work together to maintain a generally high quality of water. The major chemical parameters of marine water quality include pH, amount of dissolved oxygen, and nutrient concentrations.

The quality of coastal ocean waters, or nearshore waters, is strongly affected by nonpoint source pollution. Domestic wastewater associated with population increase is the largest potential source of pollution to all waters of Guam. Soil erosion is one of the most serious nonpoint source pollution problems, particularly in the southern areas. Grading or clearing of land by burning results in significant topsoil loss during heavy rain storms leaving the more compact soil behind that makes re-vegetation difficult. Runoff of feedlot waste has also been identified as a nonpoint source of pollution needing mitigation. Urban runoff is one of Guam's most voluminous nonpoint source problems which impacts both groundwater and coastal waters. Runoff may contain bacterial contamination, inorganic nutrients, various organic compounds, and metals (GEPA 2006).

The Water Monitoring Strategy for the Territory of Guam began in 1978. It includes the Surface Water Monitoring Network and the Recreational Beach Monitoring Strategy. The goals of the Water Monitoring Strategy for the Territory of Guam are to:

- Conduct a comprehensive assessment of water quality throughout the island using a rotating basin approach
- Complete a thorough evaluation of monitoring data
- Evaluate if the quality of the island's waters is suitable for their designated uses
- Evaluate if the Guam Water Quality Standards (GWQS) are appropriate and relevant to present conditions in the waters of the island
- Coordinate new approaches to improving and protecting the island's water resources (GEPA 2008b)

The Recreational Beach Monitoring Program takes water samples of 44 recreational beaches every Wednesday and analyzes the samples for concentrations of the *enterococcus* bacteria indicator. Advisories are based on an instantaneous standard of not >104 *enterococci*/100 ml and a geometric mean standard of not >35 *enterococci*/100 ml (GEPA 2008b).

Swimming advisories are issued based upon either an instantaneous concentration of 104 most probable number/ 100 ml or a geometric mean concentration of 35 most probable number/100 ml, over a 5-week period. For calendar year 2004, 39 beaches were monitored for the USEPA-approved *enterococci* indicator (weekly, year round). This resulted in approximately 1,881 samples analyzed and 864 swimming advisories issued. In calendar year 2005, 42 beaches were monitored for the USEPA-approved *enterococci* indicator (weekly, year round). This resulted in approximately 2,236 samples analyzed and 535 swimming advisories issued (GEPA 2006).

<u>Federal Regulations</u>

CWA or Federal Water Pollution Control Act

The purpose of the CWA is to "restore and maintain the chemical, physical, and biological integrity of the Nation's waters." Under Section 404 of the CWA the USACE has regulatory jurisdictions over the discharge of dredged or fill material into waters of the U. S. including wetlands.

Coastal Zone Management Act (CZMA)

The CZMA establishes a federal-state partnership to provide for the comprehensive management of coastal resources. Coastal states and territories develop management programs based on enforceable policies and mechanisms to balance resource protection and coastal development needs.

Fish and Wildlife Coordination Act

The Fish and Wildlife Coordination Act provides that water resources development programs must consider wildlife conservation. Under this act, federal agencies proposing actions, including issuance of permits, that would affect any body of water, must consult with U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), and the affected state or territory's fish and wildlife management agency.

Merchant Marine Act

This law empowers the Maritime Administration to investigate causes of congestion at ports; to investigate the practicability and advantage of harbor, river, and port improvements in connection with foreign and coastwise trade; and to investigate any other matter that may tend to promote use by vessels of ports.

Rivers and Harbors Act

The original purpose of the Rivers and Harbors Act was to establish the federal interest in interstate navigation. Section 10 of the Act requires approval from the USACE prior to undertaking any work with the potential to affect the course, capacity, use, or quality of navigable waters.

Water Resources Development Acts

Dredging projects are authorized by Congress through the Water Resources Development Acts that are reauthorized biennially. Water Resources Development Act 86 introduced cost sharing for construction projects whereby the local sponsor pays between 20% and 60% of the construction cost based on the depth of the navigation channel. The Water Resources Development Act cost sharing provisions apply to

Federal dredging projects implemented by the USACE Civil Works Program, and are not applicable to dredging undertaken by other agencies.

Guam Regulations

Guam Water Pollution Control Act

As defined in 10 Guam Code Annotated, Chapter 47 (Water Pollution Control Act), this Act's primary statutory provisions include the: Water Resources Conservation Act (ground and surface water management/development); well head regulations; water development (wells) regulations; ground and surface water protection/management; pollution discharge permiting; erosion control and control of other point/nonpoint pollution sources; and the Safe Drinking Water Act, which authorizes primary and secondary drinking water standards.

Guam Water Quality Standards (GWQS)

The GWQS identify three classes of marine water that apply to all coastal waters from the mean high water mark, including estuarine waters; lagoons and bays; brackish areas; wetlands and other special aquatic sites; and other inland waters that are subject to ebb and flow of the tides, as follows:

- *Category M-1 EXCELLENT.* Water in this category must be of high enough quality to protect for whole body contact recreation, and to ensure the preservation and protection of marine life, including corals and reef dwelling organisms; fish and related fisheries resources; and enable the pursuit of marine research as well as aesthetic enjoyment. This category shall remain substantially free from pollution attributed to domestic, commercial and industrial discharges; shipping and boating; or mariculture, construction and other activities that can reduce the waters' quality.
- *Category M-2 GOOD.* Water in this category must be of sufficient quality to allow for the propagation and survival or marine organisms, particularly shellfish and other similarly harvested aquatic organisms; corals and other reef related resources; and whole body contact recreation. Other important and intended uses include mariculture activities, aesthetic enjoyment and related activities.
- *Category M-3 FAIR.* Water in this category is intended for general, commercial and industrial use, while allowing for the protection of aquatic life, aesthetic enjoyment and compatible recreation with limited body contact. Specific intended uses include the following: shipping, boating and berthing, industrial cooling water and marinas (GEPA 2001).

Guam's marine waters, including nearshore waters, are designated primarily as M-1 and M-2 waters. Outer Apra Harbor and Inner Apra Harbor are designated as M-2 waters. M-3 waters can be found in the northeast portion of Apra Harbor (GEPA 2001). The designation of marine waters as M-2 in the vicinity of Tanguisson Beach Park located on the western coast of central Guam is of particular interest. In 1991, three people died after consuming seaweed, Gracilaria tsudae, collected from the beach. Therefore, since 1991, there has been a standing fish/seaweed consumption advisory for that particular beach. The exact source of the contamination has not been identified and a no-harvesting advisory remains in effect (Clean Water Action Plan 1998).

Guam Laws, Permits and Regulations Governing Dredging and Contamination of Nearshore Waters

U.S. CWA Section 401 Water Quality Certification

A number of federal permits, most of which are identified in the federal CWA, for construction, fill, dredging, and discharges to waters of the U.S. and Territorial Waters require Territorial (GEPA) Section 401 Water Quality Certification (WQC). Section 401 WQC issuance identifies that construction or operation of a proposed project or facility would be conducted in a manner consistent with GWQS.

Guam Water Quality Standards

The GWQS were revised in 1999-2000, partly in response to the needs of the Memorandum of Understanding (MOU) for the Section 309 Guam Harbors Sediment Project, Phase III. These final revised regulations include a revised and streamlined approach to the Section 401 WQC process administered by GEPA.

Guam Environmental Protection Act

Public Law 11-191 created GEPA in 1973, with responsibilities for comprehensive protection of Guam's land, water and air.

Guam Seashore Protection Act and Permit System

The Guam Seashore Protection Act (GCA Title 21, Chapter 63) establishes the Guam Seashore Reserve and the Guam Seashore Protection Commission, that must review and act on any applications for development, including any dredging, within the reserve. The reserve includes all subtidal areas down to ten fathoms and extends inland to within 328 ft (100 m) (amended to 33 ft [10 m] of the mean high high-water mark).

Guam Soil Erosion and Sedimentation Control Regulations/Permits

Erosion Control Permits are issued by GEPA while the Department of Public Works issues Clearing and Grading Permits. Since Clearing and Grading Permits require GEPA review for compliance with the Guam Soil Erosion and Sedimentation Control Regulations, GEPA actually assumes the lead in review and approval responsibility. For most clearing and/or grading permits there must be an accompanying Erosion Control Plan to protect water quality of the affected water resources, fresh or marine.

Water Quality Monitoring Plan

Water Quality Monitoring Plans may be required to evaluate the effectiveness of any number of different environmental permits and/or performance standards. Monitoring plans are formulated to identify ambient or control conditions at a particular site and to capture deviations from those conditions resulting from a project or operations of a facility. Water Quality Monitoring Plans may range in complexity from visual inspections for sedimentation and protection measure failure to laboratory or field analysis of chemical and biological effects on water quality or organisms (acute/chronic bioassay), dependent on a given water resource. Water Quality Monitoring Plans always include procedures for reporting results and observations to GEPA and provisions for corrective actions. Water quality monitoring is a standard requirement for all dredging, industrial point source discharges, municipal wastewater treatment plant discharges, thermal discharges, marine and underwater construction activities, aquaculture effluent discharges, and mass clearing and grading projects such as golf course construction.

Environmental Protection Plan

Environmental Protection Plans are required for most clearing, grading, dredging, and marine related construction work. The Environmental Protection Plan should be developed by a project contractor who would be responsible for its implementation.

National Pollution Discharge Elimination System

The NPDES is a federal permit for all stormwater and other point source pollution discharges. GEPA assists in the administration of these permits and reviews and certifies (Section 401 WQC) the permit for compliance with all local regulations and policies and in accordance with the GWQS (Title 10 GCA Chapter 47 Water Pollution Control). USEPA coordinates, drafts, and issues the permit for facilities that require wastewater discharges such as sewage treatment plants, electrical power generation plants, industrial processing facilities, stormwater outfalls, aquaculture facilities, aquariums, and similar operations must be permitted under this permit system.

Pollution Discharge Permit

For discharges similar to those covered by the NPDES permit, as authorized under the Guam Water Pollution Control Act, GEPA may require a Government of Guam (GovGuam) Pollution Discharge Permit. This permit may be issued for any number of liquid, gaseous, solid or thermal discharges to territorial waters that fall below the minimum criteria defined in the federal CWA. Applicability is determined by the Administrator on a case-by-case basis.

Test Boring and Dewatering Permits

Individuals conducting soil test boring and measurement activities are required to obtain a GEPA Test Boring Permit. Authorized under 10 Guam Code Annotated, Chapter 46 (Water Resources Conservation Act), permitted test boring activities include drilling and excavations deeper than 6 ft (1.8 m) deep for a number of soil and structural engineering analysis work. In addition, if the water table is encountered during excavation work for building foundations and similar construction activities, a Dewatering Permit is required to control and treat water pumped from an excavation prior to final discharge. Dewatering Permits may apply to dredging operations as well.

4.1.1.5 Wetlands

Definition

Wetlands are habitats that are subject to permanent or periodic inundation or prolonged soil saturation including marshes, swamps, and similar areas. The recurrent excess of water in wetlands imposes controlling influences on all biota (plants, animals, and microbes). Areas described and mapped as wetland communities may also contain small streams or shallow ponds or pond or lake edges.

Marshes are generally located in low places along the coast, along streams, in depressions and sinkholes with argillaceous limestone, or in poorly drained areas with volcanic soils. Marshes may be inundated with freshwater or brackish water if near the ocean. Swamps are generally located along rivers, especially near the coast or near sea level along river valleys if inland, and are usually designated as ravine communities rather than as wetland communities.

Wetland Areas and Quality

USFWS National Wetland Inventory (NWI) data indicate there are approximately 4,056 acres (ac) (1,642 hectares [ha]) of potential wetland areas on Guam. These NWI-indicated wetland areas do not equate to the amount of USACE-certified jurisdictional wetlands; however, they indicate the potential for wetland areas on Guam. The USFWS neither designed nor intended the NWI program to produce legal or regulatory products. Federal, state, and local regulatory agencies with jurisdiction over wetlands may define and describe wetlands in a different manner than that presented in the NWI maps.

For regulatory purposes, potentially affected wetlands must be formally delineated and a jurisdictional determination obtained from the USACE as part of the Section 404 CWA permitting process. In the absence of other data, NWI data can indicate the potential for wetland areas and be used for macro-level impact analysis, with the qualification that the analysis is not based on a jurisdictional determination (USFWS 2009). In this EIS/OEIS/OEIS, the best available wetland data are used including NWI maps, previous wetland delineations and site visits by certified wetlands scientists in September 2009.

Guam's wetlands generally fall into four of the major wetland subclasses used by the USFWS (USFWS 2009) which follow the classification system developed by Cowardian et al in 1979 for the USFWS (USFWS 1979) to describe wetlands and are as follows:

1. Palustrine, forested (freshwater swamps of woody vegetation). Found along edges of emergent wetland areas and in areas with less water than emergent wetlands, most notably in southern Guam.
2. Palustrine, emergent (freshwater marshes dominated by reeds and sedges). Typified by Agana Marsh.
3. Lacustrine (man-made open water impoundments). Examples include areas around the margins of Fena Reservoir and small man-made ponds.
4. Estuarine (mangrove and lower channels of rivers). An example would be the mangroves located within the Inner Apra Harbor.

The northern limestone plateau lacks substantial wetlands because of the high permeability of the karst limestone in the area. The majority of wetlands are found in southern Guam due to the lower permeability volcanic soils in the area. Primary threats to wetlands on Guam include feral ungulates, human disturbance, invasive plants species, and sedimentation and erosion.

<u>Federal Regulations</u>

Federal Water Pollution Control Act (CWA 33 U.S. Code [USC] §1251 et seq.)

The Water Pollution Control Act gives the USACE regulatory jurisdiction over the discharge of dredged or fill material into jurisdictional waters of the U.S., including wetlands. Actions require federal consistency with State Nonpoint Source Pollution Control Plans.

Statement of Procedures on Floodplain Management and Wetlands Protection; 40 CFR Part 6, Appendix A

These procedures set forth USEPA policy and guidance for carrying out Executive Orders 11990 and 11988.

Endangered Species Act, 16 USC §1531 et seq.; 50 CFR Parts 17, Subpart I, and 50 CFR Part 40

The Endangered Species Act of 1973 and subsequent amendments provide for the conservation of threatened and endangered species of animals and plants, and the habitats in which they are found. The act requires federal agencies, in consultation with the Secretary of the Interior, to verify that any agency supported action is not likely to jeopardize the continued existence of any endangered or threatened species or its critical habitat, or result in the destruction or adverse modification of a critical habitat of such species. Exemptions may be granted by the Endangered Species Committee.

Fish and Wildlife Coordination Act (16 USC § 662)

The Fish and Wildlife Coordination Act requires consideration of the effects of a proposed action on wetlands and areas affecting streams (including floodplains), as well as other protected habitats. Federal agencies must consult with the USFWS and the appropriate state agency with jurisdiction over wildlife resources prior to issuing permits or undertaking actions involving the modification of any body of water (including impoundment, diversion, deepening, or otherwise controlled or modified for any purpose). The requirements of this act are applicable for alternatives involving remediation activities in wetlands or floodplains.

National Wildlife Refuge System Administration Act of 1966 (16 USC §§ 668dd-668ee)

The Act provides for the administration and management of the national wildlife refuge system, including wildlife refuges, areas for the protection and conservation of fish and wildlife threatened with extinction, wildlife ranges, game ranges, wildlife management areas and waterfowl production areas.

<u>Guam Regulations</u>

Wetlands, 21 GCA 60101

Real Property requirement implemented by 18 GAR - Land Management, Chapter 3 - Territorial Planning Commission, Article 5 - Wetland Areas. The purpose of these regulations is to establish procedural guidelines and performance standards for development and conservation, mapping and identification of wetland areas pursuant to Executive Orders No. 78-21 and 90-13 (Protection of Wetlands). These regulations apply to those land and water areas delineated as Wetland Areas of Particular Concern on an official map of wetlands as approved by the Guam Land Use Commission.

4.1.2 North

4.1.2.1 Andersen Air Force Base (AFB)

<u>Surface Water</u>

Andersen AFB does not contain any surface water resources Impervious areas on Andersen AFB amount to 1,766 ac (714.7 ha), or 11.47% of the total Andersen AFB area of 15,400 ac (6,233 ha). Storm runoff from impervious surfaces is currently directed via concrete lined culverts to underground injection control wells, which are permitted and regulated by GEPA (Andersen AFB 2008).

<u>Groundwater</u>

Andersen AFB overlies the northern portion of three groundwater subbasins: the Finegayan subbasin under the western third of the base; the Agafa Gumas subbasin under the central portion of the base, which includes Northwest Field; and the Andersen subbasin under the eastern portion of the base. Approximately 100 dry wells were drilled to facilitate the flow of stormwater into the underlying basins. While this method has the potential to cause groundwater contamination from stormwater runoff, proper implementation of the Andersen AFB Stormwater Pollution Prevention Plan (SWPPP) has prevented extensive groundwater contamination (Navy 2009).

<u>Nearshore Waters</u>

Important nearshore waters around Andersen AFB include Tarague Basin. Use of this area is primarily recreational; more information can be found in Volume 2, Chapter 9, Recreational Resources. The coastline off Andersen AFB is mainly composed of a relatively narrow margin of beach interspersed with basalt or limestone rock formations. Beach deposits consist of beach sand and gravel, beach rock in the intertidal zone, and patches of recently emerged detrital limestone (COMNAV Marianas 2001b).

Nearshore waters around Andersen AFB are classified as M-1 (GEPA 2001). At Andersen AFB, the marine environment supports a rich diversity of species associated with the coral reef complex including fishes, corals and other invertebrates, and algae. The Andersen AFB Marine Resource Preserve was designated in 1993 to conserve and manage important seed stock resources for recreational, commercial, and other marine species. GovGuam established the Pati Point Marine Preserve in 1999 (Air Force 2002).

Wetlands

There are no known wetland areas on Anderson AFB (Andersen AFB 2008).

4.1.2.2 Finegayan

The Finegayan area consists of Naval Computer and Telecommunications Station (NCTS) Finegayan and Finegayan South, both of which are located in the northwest portion of Guam. A discussion of each area follows.

NCTS Finegayan

Surface Water

There are no surface water resources in the Finegayan project area. Impervious areas on NCTS Finegayan amount to 132 ac (53.4 ha), or 5.5% of the total NCTS Finegayan area of 2,415 ac (977 ha).

Groundwater

The Finegayan Subbasin of the NGLA is overlain by the Finegayan project area. The description of the NGLA in Section 4.1.1.31 is applicable to Finegayan's groundwater resources as well.

Nearshore Waters

Nearshore waters at Finegayan front Haputo Beach. Use of the Haputo area is primarily recreational. More information can be found in Volume 2, Chapter 9, Recreational Resources. The coastline is composed of a beach interspersed with basalt or limestone rock formations. Beach deposits consist of beach sand and gravel, beach rock in the intertidal zone, and patches of recently emerged detrital limestone (USGS 1992 in Anderson AFB 2008).

Nearshore waters at Finegayan are classified as M-1. However, sampling conducted at Tanguisson Point in association with the 2008 Water Quality Monitoring and Assessment Report under the CWA determined that one or more designated uses for this water quality classification were not being met and that a Total Maximum Daily Load limitation was needed (GEPA 2008a).

Wetlands

There are no known wetland areas within NCTS Finegayan (COMNAV Marianas 2001b).

South Finegayan

Surface Water

There are no surface water resources in the South Finegayan project area. Impervious areas on South Finegayan amount to 8.7 ac (3.5 ha), or 3.0% of the total South Finegayan area of 290 ac (117 ha).

Groundwater

The Finegayan Subbasin of the NGLA is overlain by the South Finegayan project area. The description of the NGLA in Section 4.1.1.31 is applicable to Finegayan's groundwater resources as well.

Nearshore Waters

There are no nearshore waters at South Finegayan as the project area is located between 1 and 2 mi (1.6 – 3.2 km) from the ocean.

Wetlands

There are no known wetland areas within South Finegayan (COMNAV Marianas 2001b).

4.1.2.3 Non-Department of Defense (DoD) Land

In northern Guam, the non-DoD land consists of the former Federal Aviation Administration (FAA) parcel and the Harmon Annex, both of which are located in the northwest section of Guam. A discussion of each area follows.

<u>Former FAA Parcel</u>

Surface Water

There are no areas of surface water in the former FAA parcel project area. Impervious areas at the former FAA parcel amount to 30 ac (12.1 ha), or 4.4% of the total former FAA parcel area of 680 ac (275 ha).

Groundwater

The former FAA parcel project area overlies the Finegayan Subbasin of the NGLA. The description of the NGLA in Section 4.1.1.31 is applicable to groundwater resources in the former FAA parcel.

Nearshore Waters

Nearshore waters at the former FAA parcel front Haputo Beach. Use of the Haputo area is primarily recreational. More information can be found in Volume 2, Chapter 9, Recreational Resources. The coastline is composed of a beach interspersed with basalt or limestone rock formations. Beach deposits consist of beach sand and gravel, beach rock in the intertidal zone, and patches of recently emerged detrital limestone (USGS 1992 in Anderson AFB 2008).

Nearshore waters at the former FAA parcel are classified as M-1. However, sampling conducted at Tanguisson Point in association with the 2008 Integrated Water Quality Monitoring and Assessment Report under the CWA determined that one or more designated uses for this water quality classification were not being met and that a Total Maximum Daily Load limitation was needed.

Wetlands

There are no known wetland areas at the former FAA parcel (USFWS 2009).

<u>Harmon Annex</u>

Surface Water

There are no areas of surface water in the former Air Force Harmon Annex (herein referred to as Harmon Annex) project area. Impervious areas on the Harmon Annex amount to 13 ac (5.3 ha), or 4.0% of the total Harmon Annex area of 326 ac (132 ha).

Groundwater

The Harmon Annex project area overlies the Finegayan Subbasin of the NGLA. The description of the NGLA in Section 4.1.1.31 is applicable to the groundwater resources in the Harmon Annex area.

Nearshore Waters

There are no nearshore waters located at the Harmon Annex as the project area is located approximately 0.5 to 2 mi (0.8 to 3.2 km) from the ocean.

Wetlands

There are no known wetland areas within the Harmon Annex (USFWS 2009).

4.1.2.4 Off Base Roadways

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the Federal Highway Administration (FHWA). This section provides a detailed description of the water resource environment that would be impacted by the proposed roadway improvement project. Figure 4.1-6 presents a map of the surface waters and affected watersheds in each region of the proposed roadway projects. The roadway discussion for wetlands is in the Terrestrial Biological Resources section, refer to Section 10.1.2. Potential impacts on water resources from proposed roadway projects are discussed in Volume 6 of this EIS/OEIS.

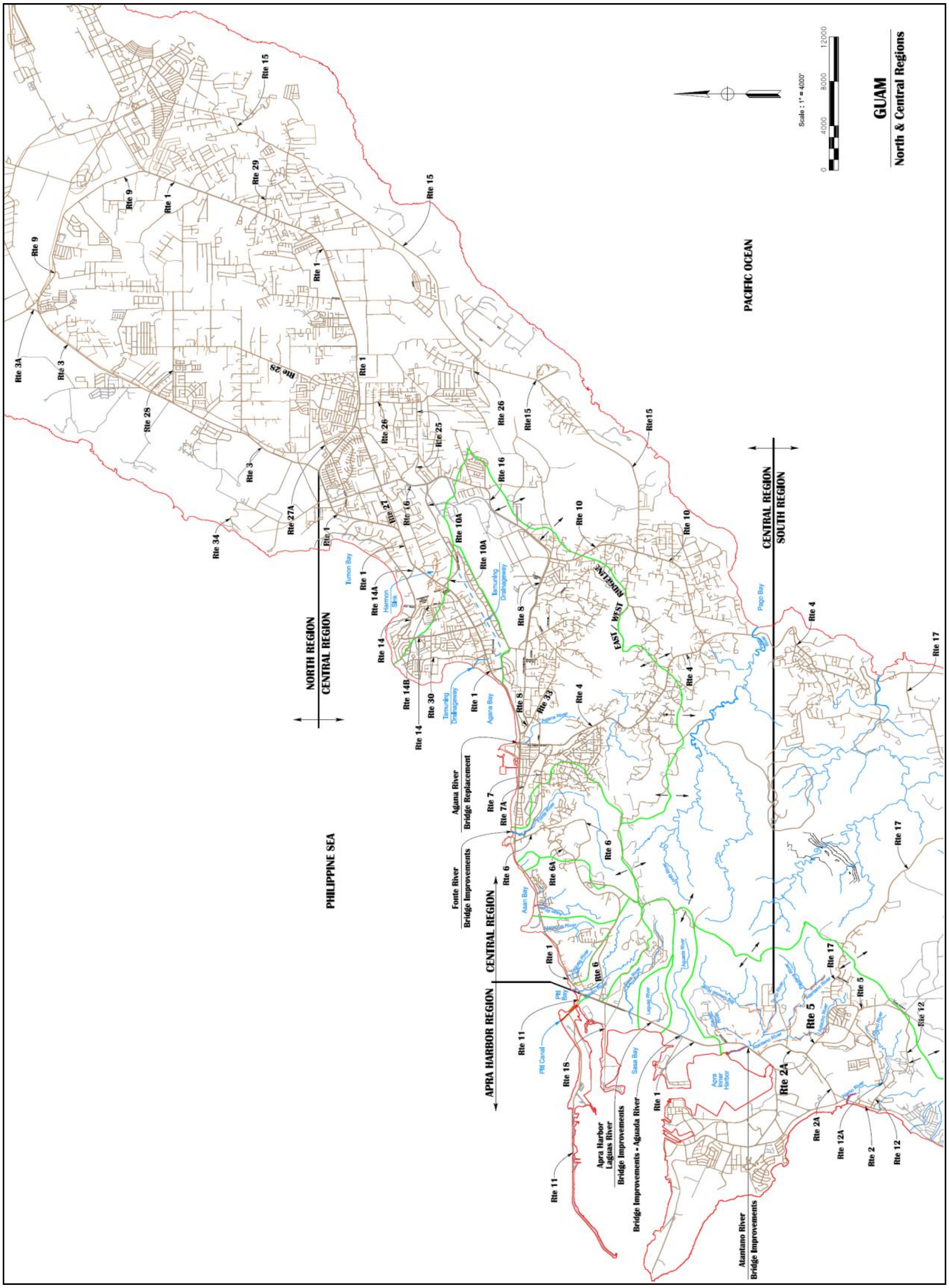

Figure 4.1-6. Significant Surface Waters and Watersheds within Roadway Project Limits

Proposed Guam Road Network (GRN) projects in the north region include improvements along Routes 1, 3, 9, and 28. In general, the roadways in this area are well maintained with good runoff and drainage characteristics. Roads are crowned without curbs enabling sheet flow to vegetated swales or strips along the roadside as shown in Figure 4.1-7 (Route 9) and Figure 4.1-8.

Figure 4.1-7. Typical Roadway Surface along Route 9

Figure 4.1-8. Grass Swale along Route 1 in North Area

Surface Water

The north region has no perennial streams because of the porosity of its coralline rock formation. Rainfall percolates rapidly to the freshwater groundwater aquifer below. Road surfaces in this area are relatively flat, and heavy precipitation generally flows by sheets into swales, then into depressions/retention basins, where it percolates into the ground or is channeled into stormwater wells. Dry injection wells that use the porous limestone bedrock to assist in stormwater migration into the groundwater aquifers below are located throughout the area. The subsoil is composed of highly porous limestone covered with a soil layer generally less than 2 ft (0.6 m) thick. Percolation rates are high, generally from 8 ft (2.4 m) to 24 ft (7.3 m) per day. Because of the high permeability of the limestone substrate, no perennial streams exist on the northern end of the island. Because the runoff from roadways in this area generally sheet flows off the pavement to grassy swales or flat strips of grass, the runoff from the roadway is generally filtered prior to its conveyance to offsite drainages. No impaired water bodies are identified on the federal 303(d) list of impaired water bodies in this area. There are no coastal resources or coastal barriers in the vicinity of the roadway projects in this area, nor is there any surface waters listed as "National Wild and Scenic Rivers." The affected environment for wetlands (marine and terrestrial) in this area is discussed in the Biological Resources sections of this EIS/OEIS.

The Federal Emergency Management Agency (FEMA) has mapped flood hazard areas throughout the island for the National Flood Insurance Program (NFIP) and has designated the areas on Flood Insurance Rate Maps (FIRMs). Figure 4.1-9 and Figure 4.1-10 display FIRM Map 6600010125D for the western (Routes 3 and 28) and eastern (Routes 1 and 9) portions of the north region, respectively. As shown, various depressions are located throughout the area and have been designated as Flood Hazard Zone X (areas of less than 1.1-ft [0.3-m] depth or areas with less than 1 square mi (mi^2) [259 ha] of contributing drainage area).

Figure 4.1-9. FEMA Map – North Area – West Side

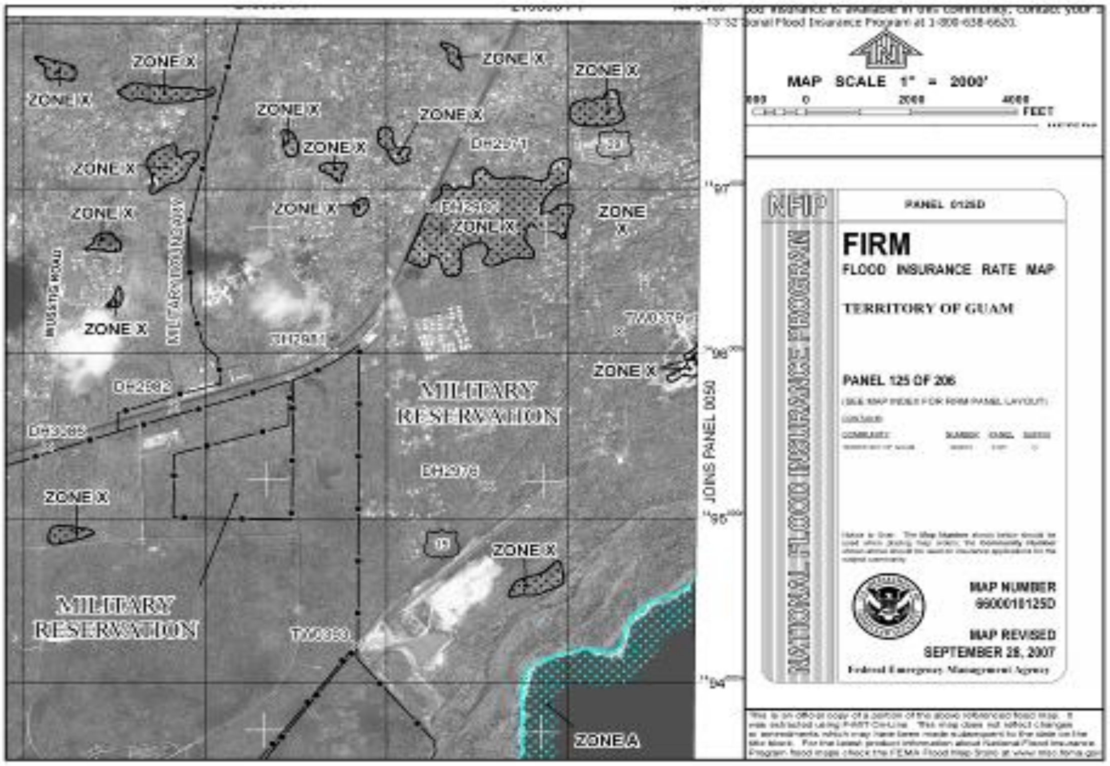

Figure 4.1-10. FEMA Map – North Area – East Side

<u>Groundwater</u>

The north region includes the Northern Limestone Plateau, which is characterized by exposed rock referred to as Mariana limestone. The Mariana limestone consists of a high percentage of clay and fragmented and worn rocks. Here the groundwater is contained within the NGLA. The NGLA serves as the primary source of potable groundwater for the island. Rainfall in this area percolates rapidly through the limestone to the groundwater lens. The subsoil is composed of highly porous limestone covered with a soil layer generally less than 2.0-ft (0.6-m) thick. Percolation rates are high, generally from 8 ft (2 m) to 24 ft (7 m) per day; therefore, rainfall and surface water runoff in this area percolates rapidly through the limestone to the groundwater lens below. The overall groundwater quality of the NGLA is “good;” however, it is significantly vulnerable to contaminants, including chloride contamination induced from over pumping of water supply wells and groundwater well influence by surface water or raw sewage from leaking sewer pumps or sewer pipes. GEPA is facilitating the assessment, planning, and pollution control activities required improving water quality that is compliant with local standards. The GEPA has formulated draft guidance to determine the source of potential “groundwater under the influence of surface water”. In 2006, the NGLA was found impaired by bacteria, nutrients, chlorides, and toxic contaminants. There is very limited groundwater production in the unconfined aquifer underlying the southern half of the island; consequently, very limited groundwater quality data are available for this area.

4.1.3 Central

4.1.3.1 Andersen South

Surface Water

The Andersen South project area does not contain any surface water resources. Impervious areas on Andersen South amount to 132 ac (53.4 ha), or 6.4% of the total Andersen South project area of 2,061 ac (834 ha).

Groundwater

The Andersen South project area is underlain primarily by very permeable limestone in the Yigo Subbasin within the larger NGLA. The description of the NGLA in Section 4.1.1.31 is applicable to Andersen South's groundwater resources. Water levels in Andersen South wells indicate the presence of para-basal water at higher elevations due to a basement of less permeable volcanic rock, unlike other areas of the NGLA. In southern Guam, most surface water drainage features (e.g., streams and rivers) begin as seeps or springs where groundwater surfaces.

Of the approximately 37 MGd (140 million liters per day [mld]) of water withdrawn from the NGLA, 2.5 MGd (95 mld) is pumped by Andersen AFB; Andersen AFB receives this water from wells located in Andersen South. Water is currently supplied from wells located in the MARBO Annex, stored, disinfected and fluoridated, then pumped to Andersen AFB. The nine production wells are located at Andersen South Annex and the Tumon area and draw water from the NGLA, Yigo Subbasin. Water is currently supplied to Andersen AFB from seven of the nine off-base water production wells. Two wells, Marbo Well No. 2 and Tumon Maui Well, are currently not operational due to the detection of volatile organic compounds (VOCs) in the groundwater at concentrations that exceed USEPA MCLs for drinking water. Other active drinking water wells are either upgradient of or a sufficient distance away from contaminated areas, and are not at risk of contamination. An analysis of chloride concentrations in Andersen AFB water supply wells at Andersen South indicates that chloride is increasing in approximately half of the wells and concentrations in several wells exceed the Secondary MCL (NAVFAC Pacific 2008).

The Agency for Toxic Substances and Disease Registry (Agency) evaluated past exposure to contaminants in the affected production wells and determined that drinking this water would not harm individuals or increase their likelihood of developing adverse health effects. The Agency also concluded that it does not expect any public health effects, now or in the future, as a result of individuals drinking water from the Andersen AFB water supply or any other wells on Guam. Several reasons for this include: 1) the military's remediation actions are further reducing contamination at the base; 2) dispersion (i.e., natural mixing of contaminated with uncontaminated water) dilutes chemical contaminants to concentrations well below levels of public health concern; and 3) the mixing of drinking water in the base's distribution system further dilutes the levels of any contaminants in the water before the water reaches the taps. On the basis of its evaluation of available environmental information, the Agency concluded that exposures to contaminants in groundwater, surface soil, and local plants and animals harvested for consumption are below levels that would cause adverse health effects. The Agency has categorized the base as "no apparent public health hazard" because of the Air Force's education efforts, access restrictions and monitoring programs at Andersen AFB (NAVFAC Pacific 2008).

Nearshore Waters

Located inland, the Andersen South project area does not contain any nearshore waters.

<u>Wetlands</u>

There are no known wetland areas within Andersen South (USFWS 2009).

4.1.3.2 Non-DoD Land

In Central Guam, the non-DoD land includes the area referred to as the Route 15 project area, which is located between the ocean and Andersen South, on Guam's central east shore.

<u>Surface Water</u>

The Route 15 project area does not contain any surface water resources. Impervious areas on the Route 15 parcel amount to 71 ac (28.7 ha), or 3.5% of the total Route 15 project area of 2,031 ac (822 ha).

<u>Groundwater</u>

Like much of northern Guam, Route 15 land overlies Mariana Limestone, which is part of the NGLA. The description of the NGLA in Section 4.1.1.3 is applicable to the Route 15 project area groundwater resources.

<u>Nearshore Waters</u>

The Route 15 project area is located along the eastern coast of Guam along Pagat Point. Nearshore waters along the Route 15 project area parcel are classified as Tier I beaches and are mostly inaccessible to the public because they either are under private or military control, have limited access due to environmental constraints or because they do not contain public beaches (GEPA 2008a). Nearshore waters in this area are classified as M-1 and fully support the designated uses of this water quality classification (GEPA 2008a).

<u>Wetlands</u>

There are no known wetland areas within potentially-impacted non-DoD land (USFWS 2009).

4.1.3.3 Barrigada

The Barrigada project area consists of the Navy Barrigada and the adjacent Air Force Barrigada. Both areas are located just east of the central portion of Guam, away from the ocean. A discussion of each area follows.

<u>Navy Barrigada</u>

Surface Water

The Navy Barrigada project area does not contain any surface water resources. Impervious areas on the Navy Barrigada amount to 5 ac (2.0 ha), or 0.4% of the total Navy Barrigada project area of 1,418 ac (574 ha).

Groundwater

The Navy Barrigada project area is also underlain primarily by very permeable limestone in the Finegayan Subbasin of the NGLA. The description of the NGLA in Section 4.1.1.31 is applicable to the Navy Barrigada groundwater resources.

Nearshore Waters

Located more than 1 mi (1.6 km) inland, the Navy Barrigada project area does not contain any nearshore waters.

Wetlands

The 2001 Integrated Natural Resources Management Plan (INRMP) indicates the presence of several small man-made ponds in the vicinity of the Nimitz Golf Course (COMNAV Marianas 2001b). These and other potential wetland areas were investigated in 2007 (NAVFAC Marianas, unpublished data) and some were found to lack wetland vegetation and/or hydrology. Two wetland areas, BARR-03 and BARR-04, were identified and are discussed under Air Force Barrigada. In addition, areas north and east of the Nimitz Golf Course are part of an additional investigation to verify presence of existing wetlands using remotely sensed data verified by ground truthing. Results of the investigation will be incorporated into the Final EIS for this proposed project.

Air Force Barrigada

Surface Water

The Air Force Barrigada project area does not contain any surface water resources. Impervious areas on the Air Force Barrigada amount to 8 ac (3.2 ha), or 1.9% of the total Air Force Barrigada project area of 430 ac (174 ha).

Groundwater

The Air Force Barrigada project area is also underlain primarily by very permeable limestone in the Finegayan Subbasin of the NGLA. The description of the NGLA in Section 4.1.1.3 is applicable to the Air Force Barrigada groundwater resources as well.

Nearshore Waters

Located inland, the Air Force Barrigada project area does not contain any nearshore waters.

Wetlands

There are delineated and NWI-indicated wetland areas on and adjacent to Air Force Barrigada (NAVFAC Marianas unpublished data, USFWS 2009). The delineated areas consist of BARR-03 and BARR-04 (Figure 4.1-11). BARR-03 is a wetland located close to the southern end of the Nimitz Golf Course and is a sinkhole depression surrounded on three sides by a relatively steep limestone ridge. BARR-04 is located at the edge of the Communications Annex property and is a sinkhole wetland that slopes gradually down to the southwest (NAVFAC Marianas 2009). Counting these two areas (BARR-03 and BARR-04), the delineated and NWI-indicated areas within or adjacent to Air Force Barrigada total approximately 5.4 ac (2.2 ha). The NWI-indicated potential wetland areas may represent historical data, as recent informal observation by biologists did not detect any obvious wetland areas (Table 4.1-2). In addition, the areas indicated on the NWI maps are currently devoted to agricultural activities and do not reflect a typical wetland condition; thus, the NWI-indication may no longer be current and no wetlands are present. In addition, this area is part of an additional investigation to verify presence/absence of wetlands using remotely sensed data verified by ground truthing. Results of the investigation will be incorporated into the Final EIS.

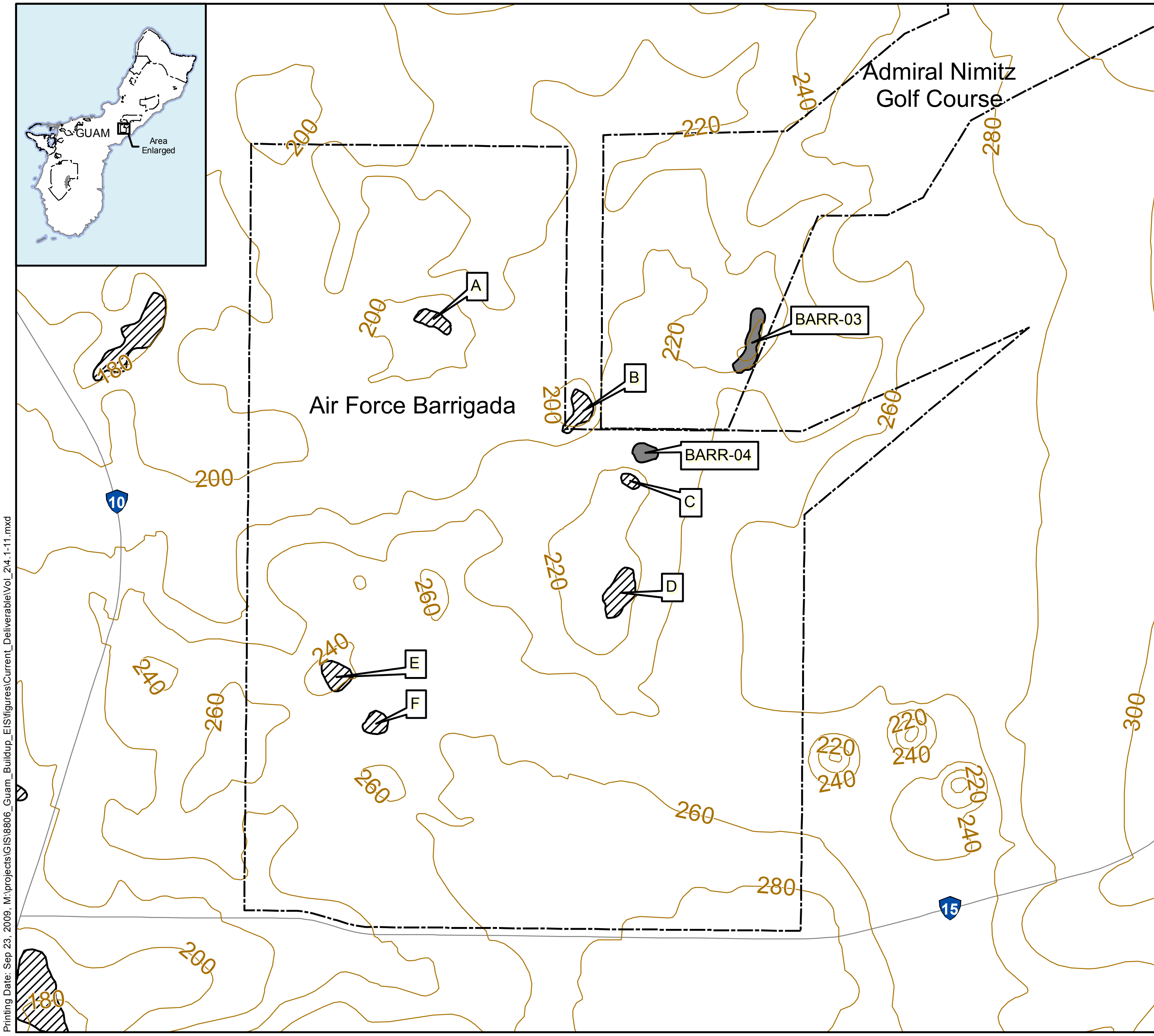

Figure 4.1-11
Delineated and NWI-Indicated Wetland Areas in Air Force Barrigada Project Area

Sources: NAVFAC Marianas 1998 unpublished data and USFWS 2009

Table 4.1-2. Summary of Delineated and NWI-Indicated Wetland Areas in and adjacent to Air Force Barrigada

Wetland Area	*Size (ac/ha)*
BARR-03[a,b]	1.0/0.4
BARR-04[a]	0.4/0.2
A[1]	0.6/0.2
B[1]	0.8/0.3
C[1]	0.2/0.1
D[1]	1.2/0.5
E[1]	0.7/0.3
F[1]	0.5/0.2
Total	5.4/2.2

Notes: [a] Delineated wetland area
[b] Wetland area located adjacent to Air Force Barrigada
[1] NWI-indicated potential wetland area
Source: NAVFAC Marianas unpublished data, 1998 and USFWS 2009.

4.1.3.4 Roadway Projects

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA. The roadway discussion for wetlands is in the Terrestrial Biological Resources section, refer to Section 10.1.3.

The central region covers a relatively large area of the island that encompasses two different hydrologic regimes – the northern broad sloping limestone plateau in the north area and the southern mountainous region composed of eroded volcanic formations in the south area. Descriptions of affected water resources have therefore been split into the northern and southern parts of the central region. Roadway projects located in the north central area include improvements along Routes 1, 8, 8A, 10, 15, 16, 26, and 27. Roadway projects in the south central area include improvements to several bridges along Route 1 along the west side of the island. Potential impacts on water resources from proposed roadway projects are discussed in Volume 6 of this EIS/OEIS.

Surface Water

The hydrologic regime within the northern Central Region exhibits characteristics very similar to those of the north region, with few streams and several sinks, the largest of which is referred to as the Harmon Sink. This sink has been mapped as a Flood Hazard Zone AE (locations where the 100-year water surface has been determined) by FEMA on FIRM Map Panel 6600010084D and crosses Route 1, as shown in Figure 4.1-12, with a high water elevation of 93 ft (28 m) above mean sea level. In general, the sink acts as an outlet for local stormwater runoff, including street drainage (Figure 4.1-13, where the sink is located adjacent to Route 1). Here, Route 1 is curbed with drainage flowing into a storm drain system outletting to the sink. Downstream of the Harmon Sink and south of Route 10A, Route 1 follows the Tamuning Drainageway (located along the east side of Route 1) that drains southward toward Agana Bay. This flow path has been designated as a floodway by FEMA, crossing Route 1 immediately south of Route 30 (Figure 4.1-14). In this location, Route 1 is curbed with roadway runoff conveyed through a storm drain system that outlets into the Tamuning Drainageway (with no apparent treatment prior to discharge) west of the highway (Figure 4.1-15 and Figure 4.1-16). There are no impaired water bodies listed in the federal 303(d) list for the northern central region of the island. In general, new development in this area is required to treat surface water runoff from impervious surfaces by utilizing Best Management Practice (BMP) treatment schemes, such as detention basins that allow settleable solids to settle out prior to entering a storm drainage system, to protect surface water. Other roadways in this area are curbed and convey concentrated flow to low points in the street that connect directly to some of the sinks located in the vicinity, as exhibited in Figure 4.1-17 and Figure 4.1-18 along Route 16 where flow from the street (see Figure 4.1-17) flows directly to an adjacent sink (see Figure 4.1-18) that is also designated as flood hazard zone X on the FEMA FIRMs. There are also some areas in the center of the island that have not been recently developed; therefore, they lack the detention basins or other treatment BMPs to control sedimentation and non-point pollution runoff, such as along Route 27 (Figure 4.1-19) where inadequate drainage along the pavement edge has created subsidence and cracking in the paved areas. There are no coastal resources or coastal barriers in the vicinity of the roadway projects in the north central area, nor are there any surface waters listed as "National Wild and Scenic Rivers". The affected environment for wetlands (marine and terrestrial) for roadways in this area is discussed under the Biological Resources sections of this EIS/OEIS.

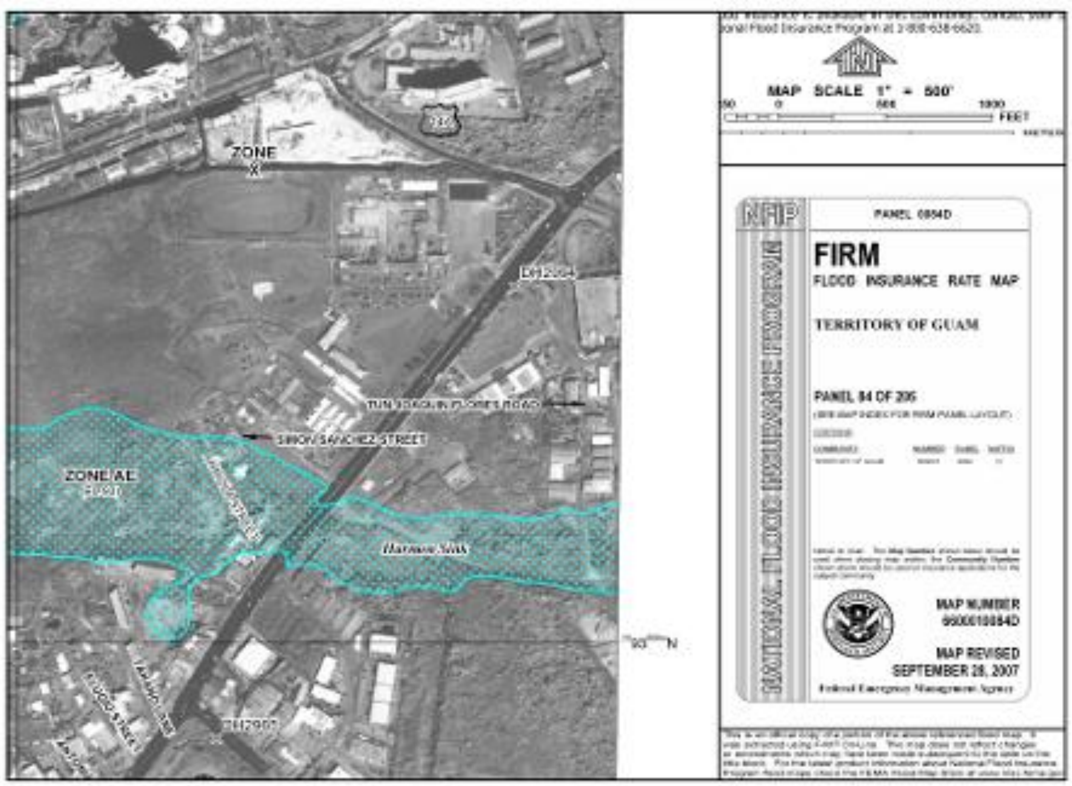

Figure 4.1-12. FEMA Map – Harmon Sink

Figure 4.1-13. Harmon Sink at Route 1

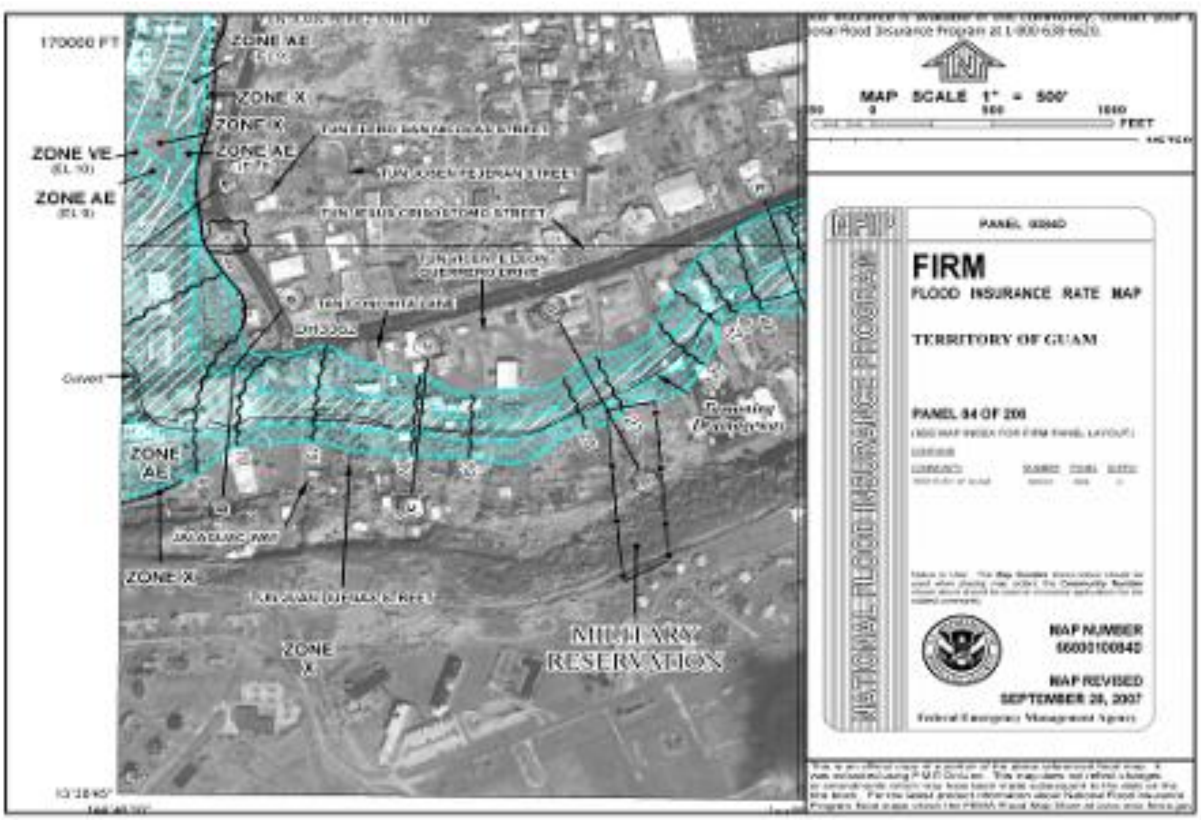

Figure 4.1-14. FEMA Map – Tamuning Drainageway

Figure 4.1-15. Tamuning Drainageway Outlet

Figure 4.1-16. Tamuning Drainageway Downstream Channel

Figure 4.1-17. Route 16 – Curb Outlet at Low Point to Sink

Figure 4.1-18. Sink Adjacent to Route 16

Figure 4.1-19. Route 27 Asphalt Damage

Proposed GRN projects within the southern part of the central region are generally on the west side of the island where the hydrologic regime is characterized by eroded volcanic formations with streams that are short with steep gradients and drainage areas of less than 3 mi^2 (777 ha) each. These streams are generally deeply channeled within the volcanic slopes that outlet into shallow fringing coral reefs at the mouths of the streams. Route 1 is located very close to the mouths of several of these streams that outlet into several bays connected to the Philippine Sea or Apra Harbor. These include (1) the Agana River that outlets into Agana Bay; (2) the Fonte River that outlets into Hagatna Bay; (3) the Asan River with two tributaries that outlet into Asan Bay; (4) the Matgue, Taguag, and Masso Rivers that outlet into Piti Bay; (5) the Sasa, Laguas, and Aguada Rivers that outlet into the Sasa Bay Marine Preserve; and (6) the Atantano River that outlets into the Apra Inner Harbor. The Agana, Fonte, Asan, and Masso Rivers are designated as floodways by FEMA. Other rivers are designated as Flood Hazard Zone X areas with minimal flooding potential. The floodways of the Agana, Fonte, Asan, and Masso River crossings along Route 1 are shown in Figures 4.1-20, 4.1-21, 4.1-22, and 4.1-23.

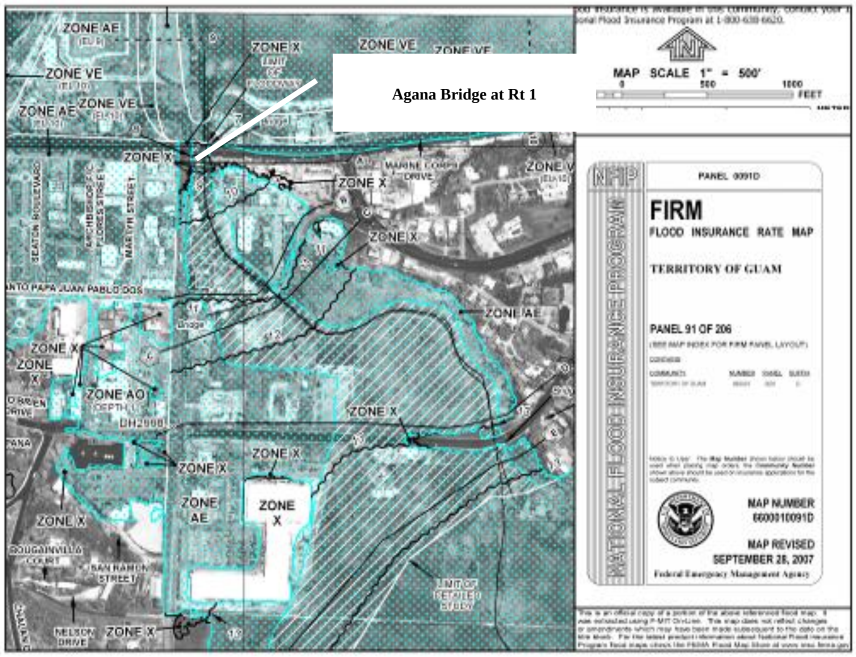

Figure 4.1-20. FEMA Map of Agana Floodplain

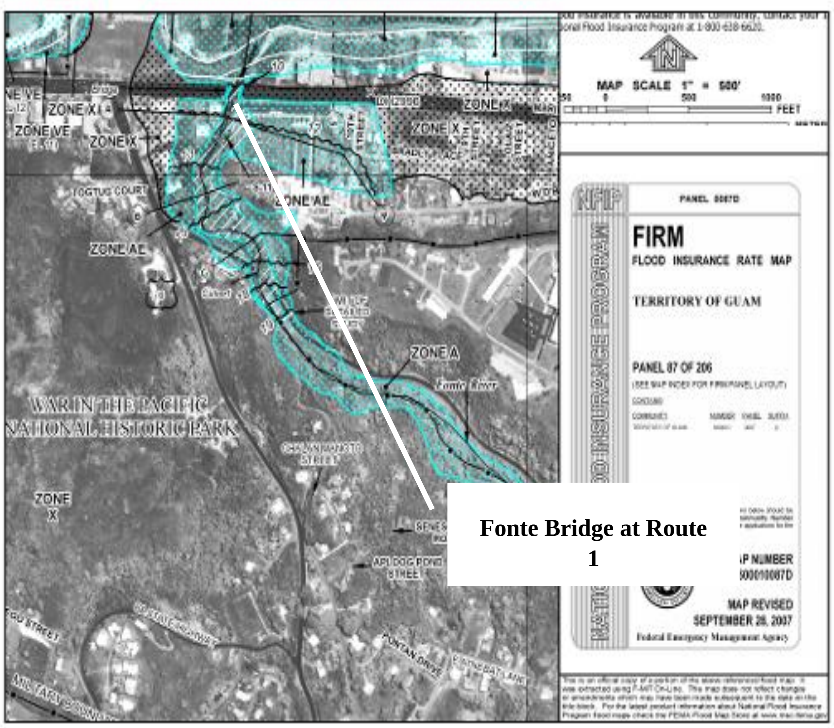

Figure 4.1-21. FEMA Map of Fonte Floodway

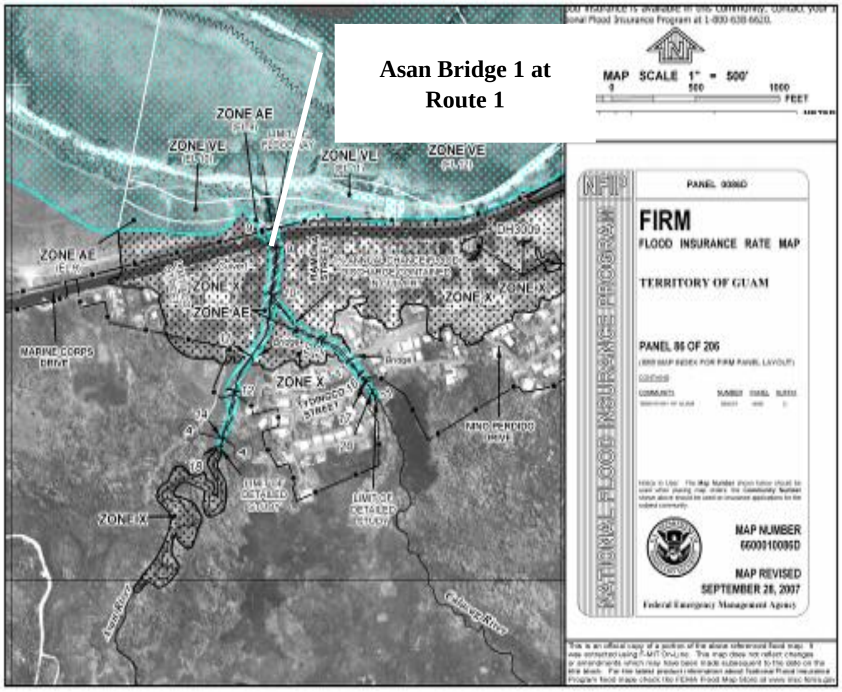

Figure 4.1-22. FEMA Map of Asan Floodway

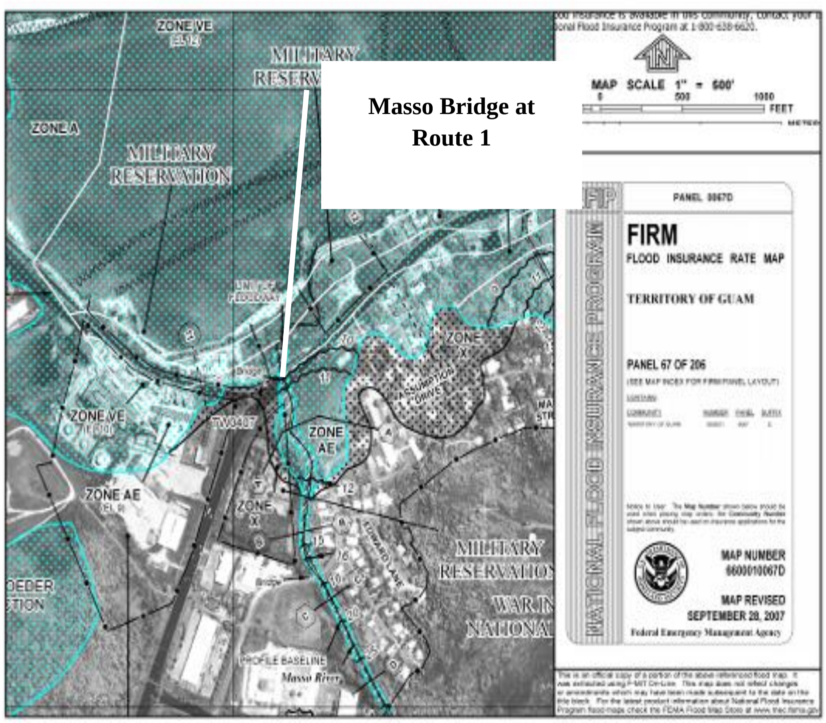

Figure 4.1-23. FEMA Map of Masso Floodway

Field investigations indicate the following issues for the various bridges:

- Agana Bridge – This concrete structure spans 42 ft (13 m) over the Agana (Hagatna) River for a length of 87 ft (26 m) under Route 1 and shows signs of decay through severe cracking, delamination, and spalling of concrete. Erosion along the abutments was apparent on the upstream side of the bridge.
- Fonte Bridge – This five-span concrete-frame structure spans 78 ft (24 m) over the Fonte River for a length of 100 ft (30 m) under Route 1. Hairline vertical cracks are located on the pier walls with some delamination, spalling, and exposed rebar shown in some of the piers on the downstream side.
- Asan Bridge #1 – This four-barrel concrete box culvert spans 48 ft (15 m) over the Asan River for a length of 68 ft (21 m) under Route 1. Spalling of concrete is apparent with exposed rebar at several locations. The downstream channel is unlined and shows little erosion along the vegetated embankments.
- Asan Bridge #2 – This two-barrel concrete box culvert spans 30 ft (9 m) over the Asan River for a length of 106 ft (32 m) under Route 1. Erosion is evident at the corners of the upstream and downstream headwalls.
- Masso Bridge – This three-barrel concrete box culvert spans 30 ft (9 m) over the Masso River for a length of 87 ft (32 m) under Route 1. Debris is dense downstream of the culvert, causing an apparent backwater effect on the culvert. Erosion has occurred along the concrete floor, and minor cracking is apparent in the interior and exterior walls.
- Sasa Bridge – This single-span box-girder bridge spans 46 ft (14 m) over the Sasa River for a length of 82 ft (25 m) under Route 1. While the bridge is in good condition, significant debris was visible throughout and upstream of the structure most likely due to utility lines crossing underneath the bridge.
- Laguas Bridge – This single-span box-girder bridge spans 46 ft (14 m) over the Laguas River for a length of 81 ft (25 m) under Route 1. The bridge exhibits moderate cracking and spalling in the beams and scour in the north abutment. The bottom of the channel upstream of the bridge had been removed of vegetation, increasing erosion potential along the channel bottom.
- Agueda Bridge – This three-barrel concrete box culvert spans 27 ft (8 m) over the Agueda River for a length of 81 ft (25 m) under Route 1. Downstream obstructions have produced backwater effects upstream of the culvert, since at the time of inspection, the culvert openings were inundated. Erosion was apparent at the upstream wingwalls.
- Atantano Bridge – This three-span cast-in-place concrete T-beam structure spans 46 ft (14 m) over the Atantano River for a length of 81 ft (25 m) under Route 1. Abutment settlement, cracking of the pier walls and deck and spalling at the deck corners is apparent. Vegetation along the channel embankment is thick with some apparent erosion under the high water mark, leaving the embankments unlined at several locations. Here the embankment exhibits relatively steep slopes which could lead to additional erosion along the upstream segment.

As shown in Figure 4.1-19 through Figure 4.1-23 , Route 1 parallels the coastline from Apra Harbor northward to Agana Bay. Along this section of roadway, several locations are designated within FEMA Flood Hazard Zone V or VE, which is defined as a coastal flood zone with velocity hazard due to wave action. Currently, these areas are protected from erosion by gabion walls or riprap slope protection. Figure 4.1-24 and Figure 4.1-25 show areas along Route 1 within the coastal flood zone and where coastal erosion control has been used along the embankment in the form of riprap revetment. The only waterbody within this area listed as impaired on the federal 303(d) list is the Agana River, which is listed for bacteria. The Agana River, also referred to as the Hagatna River, drainage basin extends from the Hagatna Swamp to Agana (Hagatna) Bay and is subject to flooding during moderate to heavy rain. The flooding is primarily attributed to the limited capacity of the Agana River due to the small capacity of the river and relatively flat topography. Flooding that is a natural occurrence on the Agana River has become a greater problem because of recent development in the watershed, especially in the downstream watershed area of the Hagatna Swamp (located immediately east of Route 1). During high flows, flood waters exceeding the storage capacity of the swamp fan out over the flat basin floor in a north-northwest direction toward the downtown area of Hagatna. The estimated flow at which flooding and subsequent damage occur is approximately 900 cubic feet per second. The capacity of the bridge under Route 1 is estimated to be approximately 2,700 cubic feet per second (Figure 4.1-26). Erosion along the upstream side of the bridge is readily apparent and should be addressed in the future to reduce downstream sediment deposition that is a continual issue along the shoreline. Sediments have been found to contain heavy metals, such as copper and zinc, in Agana (Hagatna) Bay. There are no areas subject to the Coastal Barrier Act in the vicinity of the roadway projects in this area, nor is there any surface waters listed as "National Wild and Scenic Rivers". Coastal resources within this area include (1) Agana Bay, located at the outlet of the Agana River and Tamuning Drainageway; (2) Asan Bay, located at the outlet of the Asan River; and (3) Piti Bay, located at the outlet of the Masso and Taguag Rivers. These areas are within the Coastal Zone Management Program (GEPA 2000) and fall under Section 309 of the CZMA which evaluates and regulates dredging activities within the harbors and bays of Guam. The affected environment for wetlands (marine and terrestrial) in this area is discussed under the Biological Resources sections of this EIS/OEIS.

Figure 4.1-24. Coastal Erosion Protection along Route 1

Figure 4.1-25. Coastal Erosion Protection along Route 1

Figure 4.1-26. Agana River Bridge at Route 1 - Upstream

Groundwater

In the southern half of the island, groundwater primarily occurs in volcanic rock of low permeability. There is very limited groundwater available in the unconfined aquifers underlying this area, and infiltration characteristics are low, reducing the potential for impact of surface water on the groundwater regime in this area.

4.1.4 Apra Harbor

4.1.4.1 Harbor

Apra Harbor is the largest U.S. deepwater port in the western Pacific and the busiest port in Micronesia. The harbor is the only deep lagoon on Guam and is enclosed on its north and northwest sides by the Glass Breakwater and on its southwest by Orote Peninsula. There are four distinct areas of the harbor: (1) Outer Apra Harbor, deep water with direct access to the Philippine Sea at Orote Point, (2) GovGuam-dredged Commercial Port, (3) Sasa Bay located north of Polaris Point, and (4) Inner Apra Harbor. The Outer Harbor extends from Polaris Point and the Ship Repair Facility (SRF) wharves north and westward to Orote Island and the tip of the Glass Breakwater. GovGuam commercial port is located at the northeast extent of the outer harbor. The Inner Harbor extends from Abo Cove northward to Polaris Point and the SRF wharves. More detailed information on Apra Harbor is provided in Volume 2, Chapter 14, Marine Transportation.

<u>Surface Water</u>

Four rivers flow into Apra Harbor (Atantano, Sasa, Laguas, and Aguada), with one emptying into Inner Apra Harbor (Atantano River), and the other three emptying into Sasa Bay (Figure 4.1-27).

<u>Groundwater</u>

Apra Harbor is located over 4 mi (7 km) west of the NGLA and is not located within the groundwater protection zone (GEPA 2001).

<u>Nearshore Waters</u>

Nearshore Water Quality

At or near Apra Harbor, ship repair, petroleum, oil and lubricants (POL) transfer and storage, and electricity generation have been ongoing for years, while an oil refinery had been operating nearby in the 1970s. The Navy re-supplied nuclear submarines and other surface ships at Apra Harbor, operated dry cleaning and printing plants, treated building materials with preservatives, transferred munitions and weapons, etc. Many of these activities continue and are now carefully regulated to control pollutants but this was not the case before environmental protection laws and regulations were passed beginning in the 1970s. Industrial activities currently located near or within harbor areas include vehicle and ship repair/maintenance, marine cargo handling, power production, and fuel transfer and storage.

Outer Apra Harbor is a deep (>100 ft [30 m]) lagoon characterized by little variation in temperature, salinity, pH and nutrients, while particulates (total suspended solids, turbidity and chlorophyll) are more variable. Water quality conditions within the Outer Harbor are representative of well-mixed open coastal waters showing little spatial variation in temperature, salinity and pH. Surface water flow is generally westward but will vary as a function of wind direction. By contrast, subsurface waters tend to flow in an easterly direction. In general, currents within the harbor are primarily wind driven during trade wind conditions, and characterized by an opposing two-layer flow pattern. This two-layer flow results from the movement of the surface layer out of the harbor (westward) being balanced by an inward moving (eastward) deeper layer. Outhouse Beach, Family Beach, and Port Authority Beach on Cabras Island in northern Apra Harbor are impaired due to bacteria, with >10% of samples exceeding GWQS. Outer Harbor waters appear to have little influence from terrestrial runoff as indicated by low nutrient concentrations and particulate levels (USACE 2007).

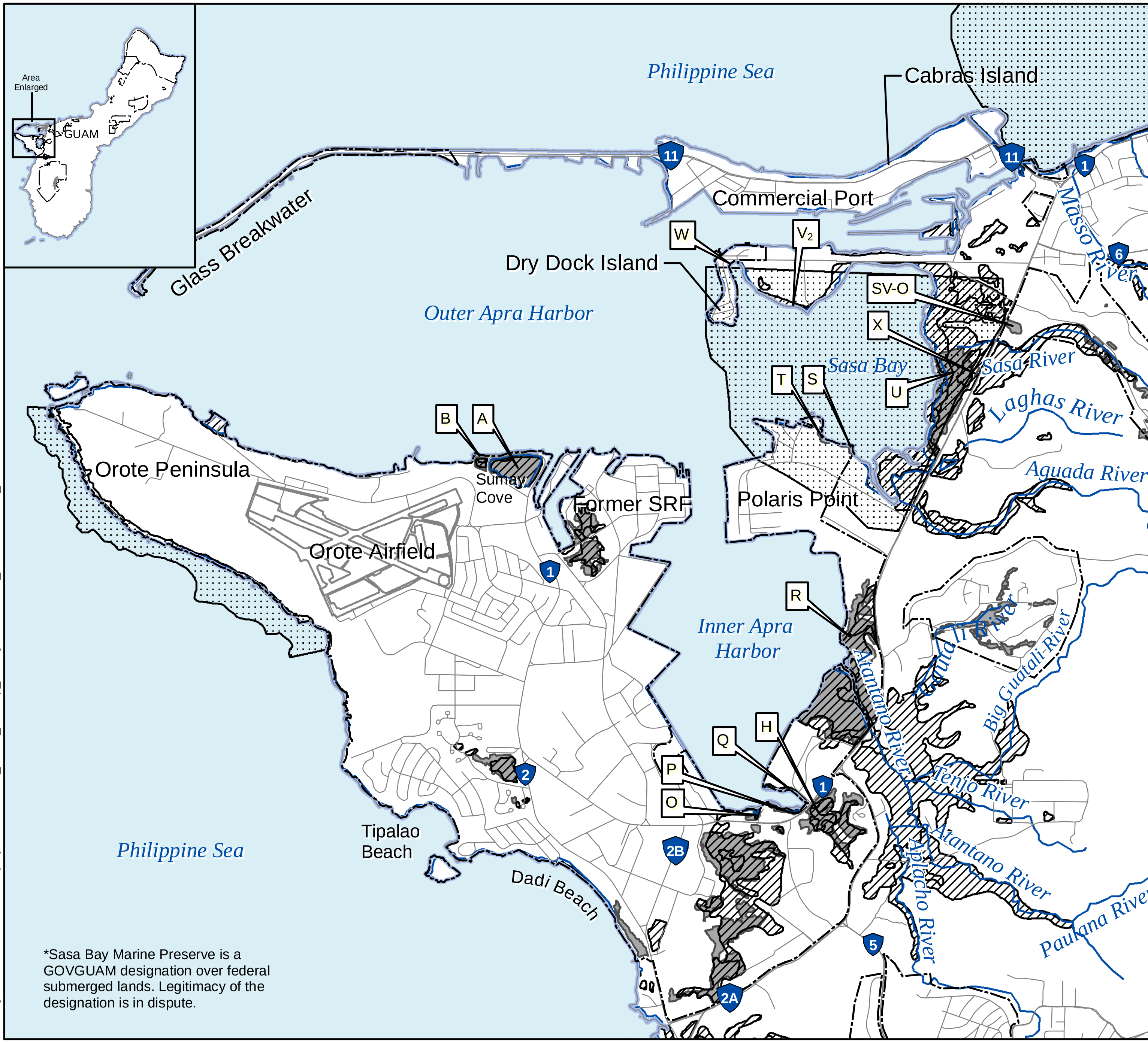

Figure 4.1-27
Apra Harbor Water Resources

Source: NAVFAC Marianas 1998, unpublished data

*Sasa Bay Marine Preserve is a GOVGUAM designation over federal submerged lands. Legitimacy of the designation is in dispute.

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In November 2008, a Finding of Violation was issued for Apra Harbor Wastewater Treatment Plant for noncompliance with NPDES permitting specifications (NPDES Permit No. GU0110019). According to the Finding, required self-monitoring reports submitted by the Navy demonstrated that, since at least April 2005, established effluent limitations were exceeded on numerous occasions for both outfalls 001 and 002, including those established for copper, aluminum, nickel, e*nterococci* bacteria, total residual chlorine, biochemical oxygen demand and total suspended solids (USEPA 2008).

Marine Sediment

Marine surveys conducted in the Inner Apra Harbor in 2003 (COMNAV Marianas 2006) reported an "extreme permanent sediment load" in the water column that accounts for very little or no colonization of the harbor bottom. Sediment accumulation is attributed to accelerated soil erosion in the Sasa Watershed and shoreline erosion of the Inner Apra Harbor shoreline. Underwater visibility during the marine surveys was generally <10 ft (3 m) and frequently <1 ft (0.3 m). When ships are underway in the inner harbor, visibility is reduced to zero over substantial sections of the inner harbor. The resuspended sediment settles very slowly due to a very fine particle size (COMNAV Marianas 2006).

Marine Sediment Quality

Sediment quality investigations in Inner and Outer Apra Harbor were conducted at three locations at Apra Harbor in 2006. The sites were being considered as potential locations for berthing an aircraft carrier. The three sites were: 1) former Charlie Wharf located at Polaris Point east of the Inner Apra Harbor Channel in Outer Apra Harbor, 2) northern coastline of the former SRF area, located west of Inner Apra Harbor Channel entrance in Outer Apra Harbor, and 3) Sierra Wharf on the western edge of Inner Apra Harbor (NAVFAC Pacific 2006). The Charlie, Sierra and SRF Wharf Sediment Characterization Study was conducted to facilitate selection of an appropriate site for construction of a new deep water wharf in Apra Harbor, Guam. This reconnaissance level effort was performed consistent with guidance outlined in the Ocean Testing Manual (USEPA and USACE 1991). The purpose of the study was to delineate the distribution and magnitude of chemicals of potential concern within the material to be dredged from these three potential wharf sites. Subsequent to the 2006 sediment study, the aircraft carrier berthing alternatives were limited to the two Outer Apra Harbor areas on either side of the Inner Apra Harbor Channel, as described in Volume 4 of this EIS/OEIS. Although Sierrra Wharf is no longer a viable alternative for the aircraft carrier berthing, wharf improvements and dredging in this area are required to support the proposed Marine Corps amphibious training escort ships, as described in Chapter 2, Volume 2 (this volume) of this EIS/OEIS..

Charlie Wharf is a term used in the sediment characterization report to describe the northern shoreline area of Polaris Point adjacent to Bravo Wharf. However, there is no wharf present at the site though remnants of a wharf or mooring are present in the water. This area is the preferred location for the aircraft carrier wharf described in Volume 4 of this EIS/OEIS. Water depths in this area range from -20 to -80 ft (-6 to -24 m) mean lower low water (MLLW). The SRF site is the alternative site for the aircraft carrier wharf described in Volume 4 of this EIS/OEIS. Water depths in this area range from -20 to -73 ft (-6 to -22.3 m) MLLW, with the exception of a shallow reef that lies immediately north of the site. Sierra Wharf is a 1,986 ft (605 m) long wharf and water depths in this area range from -20 to -40 ft (-6 to -12 m) MLLW.

Sediment core samples were collected at multiple locations within the dredging footprints for the three dredging areas (Figure 4.1-28). The number of samples and the compositing of samples within geographic areas were consistent with common practice for USACE dredging permit applications for Hawaii and Guam dredging projects. Within nine geographic areas (Table 4.1-3), the core samples were composited

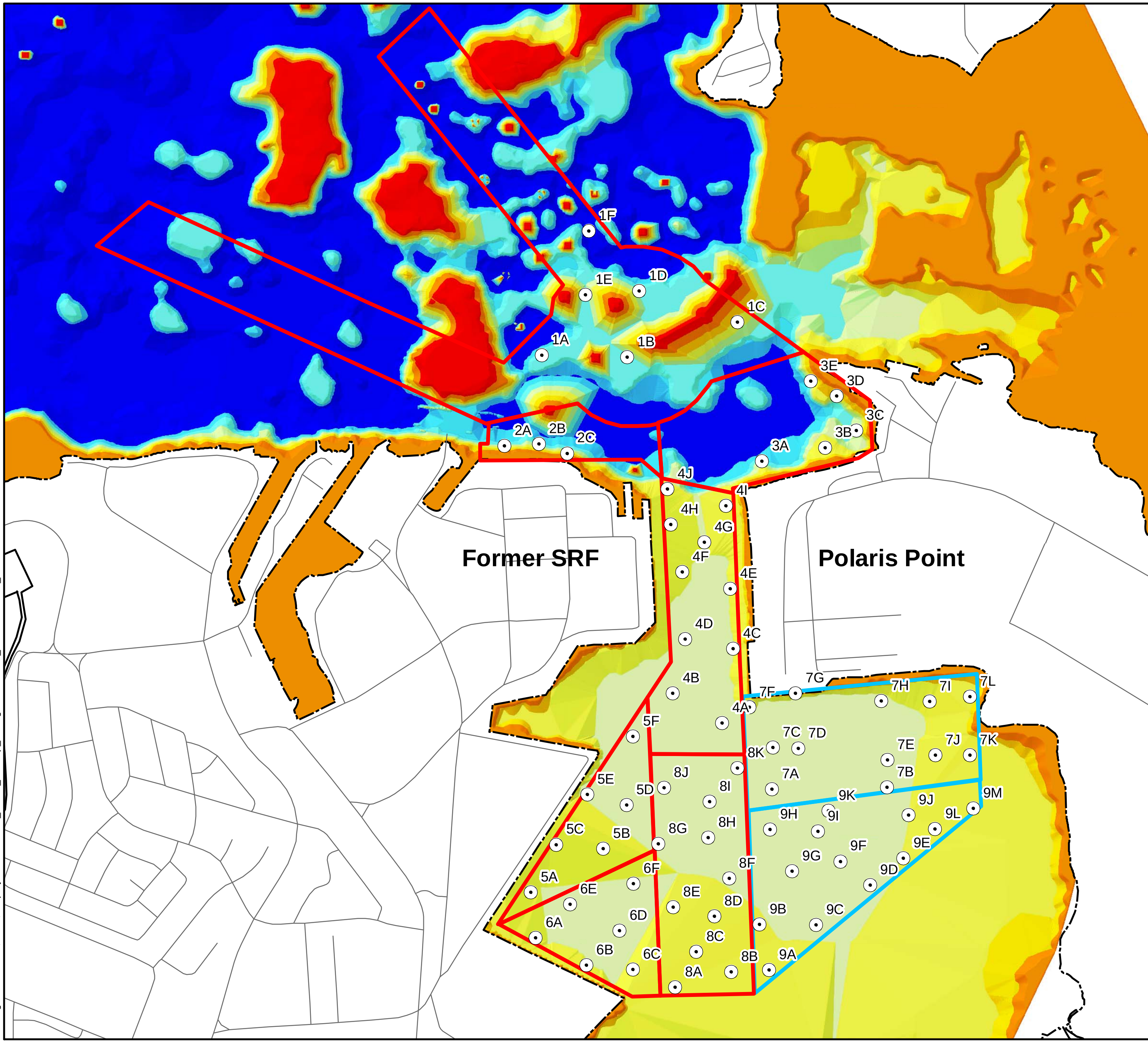

Figure 4.1-28
Sample Locations and Compositing Scheme for Sediment Characterization for Construction Dredging Feasibility Study at Charlie, Sierra and SRF Wharves, Apra Harbor, 2006

Legend

Military Installation

Sampling Location & ID

Dredge Depth (ft MLLW)

-40

-50

Bathymetry (ft MLLW)

-10

-20 to -10

-30 to -20

-40 to -30

-50 to -40

-60 to -50

-70 to -60

> -70

Source: Weston Solutions Inc. 2006

N W E S

Meters: 0, 215, 430

Feet: 0, 590, 1,180

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Table 4.1-3. Sediment Sampling Summary Table

Analyte	*ER-L/ ER-M*	*Composite*							
		Outer Apra Harbor			*Inner Apra Harbor*				
		1	*2*	*3*	*4*	*5*	*6*	*8*	*9*
TOC (%)		0.13	0.17	0.5	0.16	0.64	0.66	0.72	0.75
Arsenic	8.2/70	3.76	3.76	7.55	4.14	6.80	7.52	**8.76**	**10.10**
Cadmium	1.2/9.6	0.27	0.15	0.10	0.08	0.06	0.04J	0.03J	0.06
Chromium	81.0/370	11.50	13.30	53.90	15.3	57.30	77.00	77.10	**98.3**
Copper	34.0/270	4.85	23.60	17.90	12.4	19.60	29.20	33.00	48.1
Lead	46.7/218	4.08	18.60	8.71	9.35	2.57	3.42	6.20	12.6
Mercury	0.15/0.71	0.04	0.12	0.05	0.1	0.02	0.03	0.05	0.1
Nickel	20.9/51.6	4.91	5.41	**21.50**	**5.42**	**27.70**	**39.10**	**38.30**	**47.8**
Silver	1.0/3.7	<0.025	<0.025	<0.025	<0.025	0.03J	0.04J	0.05	0.06
Zinc	150/410	6.96	24.80	26.80		20.20	26.80	32.30	
Total PAH	4022/ 44792	34.00	1115.10	129.30		29.40	73.80	57.70	
Arochlor 1260	-	<10	22.2	<10		<10	<10	<10	

Legend: **BOLD**= Concentration exceeds ER-L; <= Below method detection limit; J= Analyte detected at concentration below the reporting limit and above method detection limit. Reported value is estimated.
Source: NAVFAC Pacific 2006.

and the composited samples were analyzed. Composites 1 (six sample locations) and 2 (three sample locations) were representative of the area to be dredged for aircraft carrier turning basin and berthing at the SRF area (see Figure 4.1-28); Composites 1 (six sample locations) and 3 (five sample locations) are representative of the area to be dredged for aircraft carrier turning basin and berthing at Charlie Wharf (Polaris Point); and Composites 4 (ten sample locations), 5 (six sample locations), 6 (six sample locations), 7 (12 sample locations), 8 (11 sample locations) and 9 (13 sample locations) (see Figure 4.1-28) are representative of the proposed dredged area at Sierra Wharf (NAVFAC Pacific 2006).

The following paragraphs summarize the results from each of these sampling areas. Refer to the source document for additional details and data (NAVFAC Pacific 2006). The results of the sediment quality analysis indicate that, with the exception of Area 3 adjacent to Charlie Wharf (see Figure 4.1-28), sediments in Outer Apra Harbor (Areas 1 and 2) were coarser-grained and comprised predominantly of a gravelly sand. In Area 3 and all the Inner Apra Harbor Areas, material was predominantly composed of a finer-grained, silty clay material.

Chemical analyses were conducted according to USEPA and American Society for Testing and Materials standards. The results were compared to Effects Range-Low (ER-L) and Effects Range-Median (ER-M) values, and regulatory levels or total threshold limit concentration values (TTLC). The ER-L value represents the concentration below which adverse effects rarely occur and the ER-M value represents the concentration above which adverse effects frequently occur. Samples or study areas in which many chemicals exceed the ER-M values and exceed them by a large degree may be considered more contaminated than those in which none of the sediment quality guidelines (SQGs) were exceeded. Samples in which ER-L concentrations are exceeded, but no ER-M values are exceeded, may be given intermediate ranks. The effects range values are helpful in assessing potential significance of elevated test results related to biological impacts. The ER-L and M values were developed from a large data set of benthic organism effects. ER-L represents the lower 10^{th} percentile of observed effects concentration and ER-M represents the 50^{th} percentile of the observed effects concentrations. These values are useful in identifying sediment contaminants but actual biological testing would be conducted as part of the testing required for ODMDS disposal. General chemistry parameters (i.e., total organic carbon (TOC), ammonia, sulfides, oil and grease and total recoverable petroleum hydrocarbons) do not have ER or TTLC values.

In general, sediment contamination was low throughout all the areas sampled. Special handling of dredged material would not be required and it is likely that the dredged material would meet the testing requirements for ocean disposal. None of the composite samples exceeded any of the ER-M values. Three (Composites 1, 2 and 4) of the nine samples did not exceed any of the ER-L values. There were minor exceedences of the ER-L values in the remaining six composites for nickel (Composites 3, 5, and 6), copper (Composites 7 and 8), and arsenic (composite 8). Nickel occurs naturally in the environment and these exceedances are not expected to classify the dredged material as unsuitable for ocean disposal.

Other analytes detected at levels lower than the ER-L included polyaromatic hydrocarbons and Arochlor-1260 (polychlorinated biphenyl (PCB) in Composite 2 and tributyltin in Composite 4. All other analytes (e.g., PCBs (aroclor and individual congeners), chlorinated pesticides, organotins, phenols, phthalates were non-detect or reported at less than the laboratory detection limits. Composite 3 had the lowest ammonia level and Composite 6 had the highest. Composite 2 had the lowest total sulfides levels and Composite 7 had the highest (NAVFAC Pacific 2006).

The results from this study, when compared to other recently conducted dredged material evaluations in Apra Harbor, provide sufficient information to suggest the sediments would be deemed suitable for ocean disposal or upland placement, assuming a preferred beneficial use option was not available and that no special handling of dredged material would be required.

Additional sediment and bioassay/bioaccumulation testing was conducted on Apra Harbor sediments in the project area in 2007 as part of the Tier III Analysis Evaluation to support various construction and dredging projects that were proposed in the harbor. The tiered approach is consistent with federal procedures to implement requirements in the CWA § 404(b)(1) Guideline for evaluation of potential contaminant-related impacts associated with the discharge of dredged material in fresh, estuarine, and saline (near-coastal) waters. The tiered approach involves four levels of testing, which are summarized below.

Tier I - Involves an examination of existing information to determine (1) whether or not there is "reason to believe" that the material needs to be tested for potential adverse effects, and (2) identification of any contaminants of concern relative to testing in later tiers. Material may be excluded from further testing if there is reasonable assurance that (1) it is not a carrier of contaminants, or (2) it is adjacent and similar to the disposal site material, and dispersal of the discharge can be controlled. Some limited testing may be necessary to confirm such exclusions.

Tier II - Is concerned solely with sediment and water chemistry. Tier II provides useful information through screening tools, but not all possible determinations can be reached at this tier. It presently consists of (1) measuring dissolved contaminants, (2) evaluation of state WQS compliance using a numerical mixing model, and (3) an evaluation of theoretical bioaccumulation potential for nonpolar organic chemicals.

Tier III - Employs well-defined, nationally accepted bioassays including: (1) water column laboratory toxicity tests, (2) whole sediment laboratory toxicity tests, and (3) whole sediment bioaccumulation tests. Appropriately sensitive organisms are recommended, including benchmark species for evaluating the sensitivity of regional species. Summaries of test conditions and test acceptability criteria for all recommended bioassay species are also provided. Toxicity testing emphasizes acute responses, generally survival. Water column toxicity evaluations consider mixing of the dredged material at the discharge site.

Benthic bioaccumulation testing provides for the determination of bioavailability through 28-day exposure tests. Tier III testing will usually provide sufficient information for use in the overall decision-making process for compliance with the Guidelines.

Tier IV - Is only used in special cases, where results from tests in earlier tiers are insufficient to determine the potential adverse effects of the material to be discharged. Tier IV, like Tier III, uses toxicity and bioaccumulation tests, however: (1) toxicity tests may involve field (rather than laboratory) exposures, different end-points (e.g., chronic rather than acute), different species, or longer laboratory exposures; (2) bioaccumulation tests may involve field (rather than laboratory) exposures using transplanted or resident organisms, or longer laboratory exposures. Tier IV can also include benthos studies.

For this evaluation samples were collected from the outer harbor near Kilo Wharf and in the inner harbor near Sierra and X-Ray Wharves. The samples were analyzed for grain size, bulk sediment chemistry and toxicity. Samples collected in the vicinity of Sierra Wharf under the Tier III testing program overlapped with areas proposed for dredging under the Marine Corps relocation to Guam. Specifically, Composites C, D and E of the Tier III testing program were located in the area proposed for dredging for the Marine Corps relocation to Guam and are considered representative of the material proposed for dredging. The results of the Tier III testing program for these composite samples are described in detail in the following paragraphs.

The results of the grain size analysis indicated that sediments in the vicinity of Sierra Wharf ranged from 42.4 to 87.1 percent fine-grained materials throughout the site.

The samples collected in the various proposed project areas were composited and submitted for bulk chemistry analyses and compared to NOAA ER-L and ER-M values. Analytes included, metals (including tributyl tin [TBT]), PCBs, pesticides and polyaromatic hydrocarbons (PAHs).

The results of the bulk chemistry analyses on the samples collected from Sierra Wharf contained detectable concentrations of metals, total PCBs, pesticides and PAHs. The results of the bulk chemistry analysis of Composites C, D and E samples are summarized in Table 4.1-4.

Table 4.1-4. Results of 2007 Apra Harbor Bulk Sediment Chemistry Analysis Sampling Summary

Analyte	*ER-L*	*ER-M*	*Comp C*	*Comp D*	*Comp E*
METALS (ppm)					
Arsenic (As)	8.2	70	7.9	7.7	8.5
Cadmium (Cd)	1.2	9.6	0.3	0.2	0.4
Chromium (Cr)	81	370	48.1	42.6	92.7
Copper (Cu)	34	270	59.5	27.9	37.6
Lead (Pb)	46.7	218	91.0	9.2	91.0
Mercury (Hg)	0.15	0.71	0.25	0.08	0.25
Nickel (Ni)	20.9	51.6	18.6	19.2	23.7
Zinc (Zn)	150	410	69.0	25.5	144.4
TOTAL PCBs (ppb)	22.7	180	276.1	11.3	155.5
PESTICIDES (ppb)					
4,4' DDD	2	20	<1	<1	125.0
4,4'-DDE	2.2	27	5.0	<1	58.8
Total DDTs	1.58	46.1	5.0	0.0	183.8
PAHs (ppb)					
Acenaphthene	16	500	1.58J	<1	3.67J
Acenaphthylene	44	640	9.4	2.45J	43.8
Anthracene	85.3	1100	20.1	5.8	72.9

Analyte	*ER-L*	*ER-M*	*Comp C*	*Comp D*	*Comp E*
Benz[a]anthracene	261	1600	24.8	11.4	208.0
Benzo[a]pyrene	430	1600	159.2	22.0	1050.6
Benzo[b]fluoranthene	-	-	148.0	21.4	983.0
Benzo[e]pyrene	-	-	79.6	16.3	566.2
Benzo[g,h,i]perylene	-	-	79.8	19.3	465.6
Benzo[k]fluoranthene	-	-	156.0	21.1	925.7
Chrysene	384	2800	35.2	18.0	390.3
Dibenz[a,h]anthracene	63.4	260	20.6	6.1	146.3
Fluoranthene	600	5100	18.9	11.8	106.6
Fluorene	19	540	<1	<1	3.2J
Indeno[1,2,3-c,d]pyrene	-	-	107.5	24.1	655.2
Naphthalene	160	2100	3.2J	<1	<1
Phenanthrene	240	1500	6.8	2.6J	13.6
Pyrene	665	2600	69.4	14.5	317.6
Total Detectable PAHs	4022	44792	984.4	202.4	6171.5

Composite C

The Composite C sample was predominantly fine-grained material consisting of 26.3% silt and 33.1% clay (Table 3-2). The coarse-grained fraction consisted of 9.2% gravel and 31.5% sand. The sediment was classified as an inorganic fat clay (CH).

The sample contained 0.64% TOC. Oil and grease and TRPH were not detected in the sample.

Only three metals were detected at concentrations slightly above their ER-L values, including copper (measured concentration of 59.5 milligrams per kilogram (mg/kg), with an ER-L of 34 mg/kg), lead (measured concentration of 91.0 mg/kg, with and ER-L of 46.7 mg/kg) and mercury (measured concentration of 0.25 mg/kg, with and ERL of 0.15 mg/kg). All remaining metals were detected below ER-L values, with concentrations ranging from 0.3 mg/kg for cadmium to 69.0 mg/kg for zinc. All individual PAHs were measured at concentrations below their ER-L values. Total detectable PAHs were calculated at a concentration of 984.4 µg/kg, well below its ER-L value of 4,022 µg/kg. Only one chlorinated pesticide was detected; 4,4'-DDE was measured at a concentration of 5.0 µg/kg which was above its ER-L value of 2.2 µg/kg but well below its ER-M value of 27 µg/kg. Twenty-one individual PCB congeners were detected. Total PCBs (276.1 µg/kg) was calculated at a concentration above its ER-M (180 µg/kg). Aroclor 1254 and Aroclor 1260 had concentrations of 36.9 µg/kg and 76.6 µg/kg, respectively. TBT was measured at a concentration of 7.2 µg/kg (no sediment quality guidelines).

Composite D

The Composite D sample was composed predominantly of fine-grained material (67.1%) with 26.7% silt and 40.4% clay (Table 3-2). The remaining 32.9% coarse-grained material consisted of 6.5% gravel and 26.4% sand. The sediment was classified as an inorganic fat clay (CH).

TOC in the sample was 0.60%. Oil and grease and TRPH were not detected in the sample. None of the metals' concentrations were above their respective ER-L values. Concentrations of metals ranged from 0.08 mg/kg for mercury to 42.6 mg/kg for chromium. Several PAHs were measured, but all were at concentrations below their respective ER-L values. Total detectable PAHs were below the ER-L value (4,022 µg/kg) with a concentration of 202.4 µg/kg. Six individual PCB congeners were measured, but were at concentrations below the MRL and total detectable PCBs were calculated at a concentration of 11.3 µg/kg, below its ER-L value of 22.7 µg/kg. The concentration of TBT was determined to be 3.5 µg/kg. Chlorinated pesticides and Aroclor PCBs were not detected in the sample.

Composite E

The composite E sample consisted 51.9% fine-grained and 48.2% coarse-grained material.

The fine-grained fraction consisted of 21.1% silt and 30.8% clay; the coarse-grained fraction consisted of 10.2% gravel and 38.0% sand (Table 3-2-1). The sediment was classified as an inorganic fat clay (CH).

The sample contained 0.52% TOC. Oil and grease and total recoverable petroleum hydrocarbon were not detected in the sample. Cadmium (0.4 mg/kg) and zinc (144.4 mg/kg) were detected at low concentrations below their respective ER-L values. All remaining metals were detected at concentrations slightly above their respective ER-L values; no metals were detected above their respective ER-M values. The PAHs, benzo[a]pyrene, chrysene and dibenz[a,h]anthracene were detected above their ER-L values with concentrations of 1,050.6 μg/kg, 390.3 μg/kg and 146.3 μg/kg, respectively. Total detectable PAHs were also calculated above the ER-L value with a concentration of 6,171.5 μg/kg. The DDT derivatives, 4,4'-DDE and 4,4'- DDD were detected above their ER-M values at concenctrations of 58.8 μg/kg and 125.0 μg/kg, respectively. Total detectable DDTs, therefore, were also above the ER-M value (46.1 μg/kg) with a concentration of 183.8 μg/kg. Sixteen individual PCB congeners were detected and two Aroclors(Aroclor 1254 [33.5 μg/kg] and Aroclor 1260 [49.0 μg/kg]) were detected. Total detectable PCBs were calculated at a concentration of 155.5 μg/kg, above the ER-L value of 22.7 μg/kg but below the ER-M value of 180 μg/kg. TBT was the only organotin detected, having a concentration of 11.2 μg/kg. Phenols were not detected in the P-436E composite sample.

Toxicity Testing of Composites C, D and E

Solid phase toxicity tests were conducted on elutriate samples derived from Composites C, D and E project sediment and site water. This test determines the bioavailability of chemicals in sediment by exposing test organisms directly to sediment suspended in solution. Results from these tests showed no toxic effect to test organisms. Based on the results of these bioassay tests, the proposed dredged material was recommended as suitable for ocean disposal.

Solid phase toxicity tests were conducted on project sediments Composites C, D and E. Results from these tests showed no toxic effect to test organisms exposed to Composites D and E sediment. Toxic effects were observed in amphipods (A. abdita), but not marine polychaetes (N. arenaceodentata), exposed to Composite C sediment. Based on the results of these bioassay tests, proposed dredged material from Composite D and E areas were recommended as suitable for ocean disposal. Proposed dredged material from the Composite C area was technically not suitable for ocean disposal based on criteria outlined in the Ocean Testing Manual (USEPA and USACE 1991). However, it was recommended that this material be considered for ocean disposal because it only failed to meet the limiting permissible concentration (LPC) requirements by one percentage point in one SP test (i.e., survival of amphipods was 70% and was 21% lower than survival in control sediment, 91%).

Bioaccumulation potential tests were conducted on tissues from organisms exposed to composite project area sediments. Elevated tissue concentrations in Composites D and E were compared to Environmental Residual Effects Database (ERED) and critical body residue data. All comparisons to contaminant concentrations in tissues from organisms exposed to project composite sample sediments were below published relevant effect levels. In addition, none of the chemicals in project area composite samples that were measured above concentrations in tissues from reference test organisms have a tendency to biomagnify in marine food webs, with the exception of PCBs in the areas of Composites C and E. Based on the results of the BP tests on tissues from organisms exposed to project sediments the proposed dredged material was recommended as suitable for ocean disposal.

Implications to Current Sediment Quality

Generally speaking, contaminant concentrations obtained under the most recent sediment testing program conducted within the areas proposed for dredging for the Marine Corps relocation to Guam were similar to or less than those obtained during the Tier III study. Nickel was the only sediment contaminant concentration that was substantially higher in the most recent sediment testing program. Since the material from the Tier III testing program was either deemed suitable for ocean disposal or recommended to be considered for ocean disposal it is likely that, based on the most recent bulk chemistry testing results, the material proposed for dredging under the Marine Corps relocation project would also be suitable for ocean disposal and would not require any special handling. However, there will be additional sampling and analysis within the dredged area to support the USACE permit application and the dredged material management plan.

Wetlands

The wetland areas of the Waterfront Annex and Fleet and Industrial Supply Center (FISC) were originally delineated and mapped in 1998 (NAVFAC Marianas 1998). In March, May, and September 2007, biologists revisited the wetlands areas delineated in 1998 and found that the 1998 boundaries have not changed in most locations (NAVFAC Marianas 2009).

Based on the original 1998 survey and the recent 2007 survey, there are approximately 343 ac (139 ha) of wetlands in 48 separate wetlands within and adjacent to Apra Harbor and Naval Base Guam. These wetlands range in size from 0.04 to 88.73 ac (0.02 to 35.90 ha). In addition, there is a large 100-ac (40.5-ha) wetland complex in Camp Covington. Figure 4.1-27 presents the approximate locations of potential wetland areas and delineated wetland areas as delineated in 2007 (NAVFAC Marianas 1998, 2009) in accordance with the 1987 Wetland Delineation Manual (USACE 1987) and as indicated by USFWS NWI maps (USFWS 2009). The 2007 wetland delineations have not been certified by the USACE.

Of the wetland areas presented in Figure 4.1-27, certain wetland areas (those designated with an alpha code) are discussed in site-specific detail due to their proximity to the proposed action alternatives. The other wetland areas, while in the project area, are not discussed in detail as they are not likely to be directly or indirectly impacted under the proposed action alternatives. Wetland areas adjacent to Apra Harbor are discussed in the following paragraphs; those located on Naval Base Guam are discussed in Section 4.1.4.2, Wetlands.

Wetlands A and B (see Figure 4.1-27) are located on the southern shore of Outer Apra Harbor. Wetland A is a 17.88-ac (7.23-ha) lacustrine, limnetic, permanent open water, diked/impounded wetland. Wetland B, separated to the west of Wetland A by a roadway berm, is a 1.97-ac (0.79-ha) palustrine, open water, permanent, diked/impounded wetland (NAVFAC Marianas 1998, 2009).

Wetlands O, P, Q, and R are located on the southern and eastern shores of Inner Apra Harbor. Wetland O, located at the southernmost extent of Inner Apra Harbor, is a 1.65-ac (0.67-ha) estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal water regime wetland. Wetland P, located along the southern shore of Abo Cove, is a 2.00-ac (0.81-ha) estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal regime wetland. Wetland Q, located along the northern shore of Abo Cove is a 2.53-ac (1.02-ha) estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal regime wetland. Wetland R, commonly known as the Atantano Wetlands, is located along the eastern shore and inland of Inner Apra Harbor and consists 88.73 ac (35.90 ha) of various wetland types. The Atantano Wetlands encompass the mouth of the Atantano River, which drains the Guatali, Tenjo, and Alpacho Rivers, and have been cited as containing the best developed and most mature mangrove swamp on Guam. The most dominant classification is estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal wetland, consisting of 54.75 ac (22.16 ha) (NAVFAC Marianas 1998, 2009).

Wetlands T, S, U, W, and V2 are located along the shores and inland of Sasa Bay. Wetland T, located inside the southern shore of Sasa Bay, consists of 1.09 ac (0.44 ha) of estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal wetland. Wetland S, located just east of Wetland T, consists of 1.45 ac (0.59 ha) of estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal wetland. Wetland U is located in and adjacent to the eastern shoreline of Sasa Bay and consists of 37.80 ac (15.30 ha) of predominantly estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal wetland. Wetland W, located at the top of a small inlet in the north of Sasa Bay, consists of 0.24 ac (0.10 ha) estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal wetland. Wetland V2 is located along and adjacent to the northern shore of Sasa Bay and consists of a 3.23-ac (1.31-ha) of predominantly estuarine, intertidal, scrub/shrub, broad-leaved evergreen, regular tidal wetland (NAVFAC Marianas 1998, 2009).

The aforementioned delineated highlighted wetlands located in and adjacent to Apra Harbor total 158.57 ac (64.16 ha) and represent a range of wetland classifications. Table 4.1-5 presents a summary of the delineated wetland areas located in and adjacent to Apra Harbor. In addition, areas south of Apra Harbor extending just past the existing landfill and along Apra Harbor up to Agana Bay are part of an additional investigation to verify presence of wetlands using remotely sensed data verified by ground truthing. Results of the investigation will be incorporated into the Final EIS.

Table 4.1-5. Summary of Wetland Areas in and Adjacent to Apra Harbor

Wetland Area	*Size (ac/ha)*
A	17.88/7.23
B	1.97/0.79
O	1.65/0.67
P	2.00/0.81
Q	2.53/1.02
R	88.73/35.90
T	1.09/0.44
S	1.45/0.59
U	37.80/15.30
W	0.24/0.10
V2	3.23/1.31
Total	158.57/64.16

Sources: NAVFAC Marianas 1998, 2009.

4.1.4.2 Naval Base Guam

Surface Water

The Atantano River transitions to the Atantano Wetlands in Naval Base Guam on its way to Inner Apra Harbor. In addition, there is a large 100-ac (40.5-ha) freshwater pond that contains both open surface water and a wetland complex in Camp Covington. Impervious areas on Naval Base Guam amount to 504 ac (204 ha), or 14.7% of the total Naval Base Guam area of 3,429 ac (1,388 ha).

Groundwater

Like the surrounding areas of south Guam, the low permeability of the aquifer materials preclude groundwater being pumped in any usable quantities, and Naval Base Guam is located over 4 mi (7 km) west of the NGLA.

Nearshore Waters

The south and west facing shores of the peninsula include beaches and rocky shoreline, and nearshore waters, including Tipalao Bay, Agat Bay, and Dadi Beach, that are used for recreation. Recent studies have shown that nearshore waters may be contaminated from chemicals found at the Orote Landfill. The Navy and GEPA are engaged in ongoing investigations and discussions to determine what actions are required to ensure protection of human health and the environment (GEPA 2006).

Wetlands

In addition to the overall wetlands discussion presented in Section 4.1.4.1, Apra Harbor, there are three wetland areas located on Naval Base Guam that warrant discussion: Wetlands H, X, and SV-O. Wetland H is located east of Abo Cove, on the inland side of Marine Drive and is part of the larger (100 ac [40.5 ha]) open surface water and wetland complex located in Camp Covington. Wetland H is approximately 24.7 ac (10 ha) and contains both estuarine and palustrine systems. Wetland X is located just to the east of Wetland U and Marine Drive. This small, 0.10 ac (0.04 ha) palustrine, emergent, persistent, seasonal water regime wetland extends parallel to Marine Drive along a Navy pipeline easement. Wetland SV-O, located at the southwestern corner of the FISC perimeter fence line and Marine Drive, is a 2.02 ac (0.82 ha) palustrine, emergent, persistent, seasonal water regime wetland (NAVFAC Marianas 1998, 2009). In addition, this area is a part of an additional investigation to verify presence of wetlands using remotely sensed data verified by ground truthing. Results of the investigation will be incorporated into the Final EIS

The aforementioned delineated highlighted wetlands located on Naval Base Guam total 124.80 ac (50.09 ha). Table 4.1-6 presents a summary of the delineated wetland areas on Naval Base Guam.

Table 4.1-6. Summary of Wetland Areas on Naval Base Guam

Wetland Area	*Size (ac/ha)*
H	100.00/40.5
X	24.7/10.00
SV-O	0.10/0.04
Total	**124.8/50.09**

Source: NAVFAC Marianas 1998, 2009

4.1.4.3 Roadway Projects

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA. The roadway discussion for wetlands is in the Terrestrial Biological Resources section, refer to Section 10.1.4.

The proposed GRN projects within the Apra Harbor Region include improvements along Routes 1, 2A, and 11. The large harbor at Apra covers more than 3 mi^2 (777 ha), and the Navy's Inner Apra Harbor encompasses approximately 1.4 mi^2 (263 ha). Potential impacts on water resources from proposed roadway projects are discussed in Volume 6 of this EIS/OEIS.

Surface Water

Sasa Bay, which is the outlet for the Sasa, Laguas, and Aguada Rivers (that cross under Route 1 immediately upstream of the harbor [Figure 4.1-29]), is located along the shoreline of the large harbor. The Atantano River flows into the Inner Harbor, crossing under Route 1 immediately upstream of the inner harbor (Figure 4.1-30). Route 1 in this area is crowned with roadway runoff sheet flowing off the pavement to swales that outlet into the rivers crossing the road to the harbor. FEMA Floodplain Mapping indicates that much of the Harbor is within FEMA Flood Zone A, defined as a 100-year flood hazard zone with no base flood elevations determined (Figure 4.1-31). Route 11 is the main entry to Apra Harbor, which is also shown to be within the flood zone. The Commercial Port Bridge along Route 11 crosses the Piti Canal at the edge of the flood zone. Figure 4.1-32 and Figure 4.1-33 display the downstream side of the bridge crossing where the canal is within the tidal zone. Here, the downstream canal is concrete lined for a short distance, where it transitions to riprap lining. Slight downstream erosion along the embankments has occurred. Route 11, located at the entry to Apra Harbor, is well protected from coastal erosion by grouted riprap revetment, as shown in Figure 4.1-34. The harbor is within the coastal zone and falls under the Coastal Zone Management Program (GEPA 2000) developed as part of the CZMA, Section 309, which evaluates and regulates dredging activities within the harbors and bays of Guam. It is not considered to fall within the Coastal Barrier Resources of 2000. There are no "National Wild and Scenic Rivers" in this area. The affected environment for wetlands (marine and terrestrial) in this area is discussed under the Biological Resources sections of this EIS/OEIS.

Figure 4.1-29. Route 1 at Laguas River Bridge

Figure 4.1-30. Route 1 at Atantano Bridge

Figure 4.1-31. FEMA Map of Apra Harbor Floodplain

Figure 4.1-32. Route 11 Bridge over Piti Canal

Figure 4.1-33. Piti Canal Downstream of Route 11

Figure 4.1-34. Coastal Erosion Protection along Route 11

Groundwater

In the southern half of the island, groundwater primarily occurs in volcanic rock of low permeability. There is very limited groundwater available in the unconfined aquifers underlying this area, and infiltration characteristics are low, reducing the potential for impact of surface water on the groundwater regime in this area.

4.1.5 South

4.1.5.1 Naval Munitions Site

Surface Water

Numerous rivers are located within NMS (Figure 4.1-35). The Fena Reservoir watershed and the Lost River watershed occupy the southern half and northern half, respectively, of NMS. All rivers flowing out of NMS merge outside of its boundary to the east into the Talofofo River, which flows to Guam's southeast coast where it empties into Talofofo Bay. With a size of 23 mi^2 (59.6 km^2), the Talofofo River watershed is the largest watershed on Guam and is partially regulated at the upper end of the drainage by the Fena Reservoir that also acts as a sediment trap and diversion for the island's drinking water supply (COMNAV Marianas 2008). Impervious areas on NMS amount to 548 ac (221.8 ha), or 6.34% of the total NMS area of 8,645 ac (3,499 ha).

Water Availability

The Fena Reservoir watershed is located in the western sector of the Talofofo River drainage area. It is composed of the Imong, Sadog Gago, Almagosa, and Maulap Rivers. Total drainage area at the Fena Reservoir dam spillway is 5.9 mi^2 (15.3 km^2) (Yeung 2004). It is a relatively hilly to very steep, undeveloped watershed, except for the Navy's munitions storage area. The watershed is composed of grass-covered hills and barren "Badlands" that drop into densely vegetated jungle ravines and gullies. The western part is a limestone karst terrain with a thin granular clayey cover. While it is probable that wetlands associated with the reservoir margin occur wherever water backing up behind the dam inundates a broad or low-sloping shore, much of the shoreline of lower Fena Reservoir consists of steep cliffs.

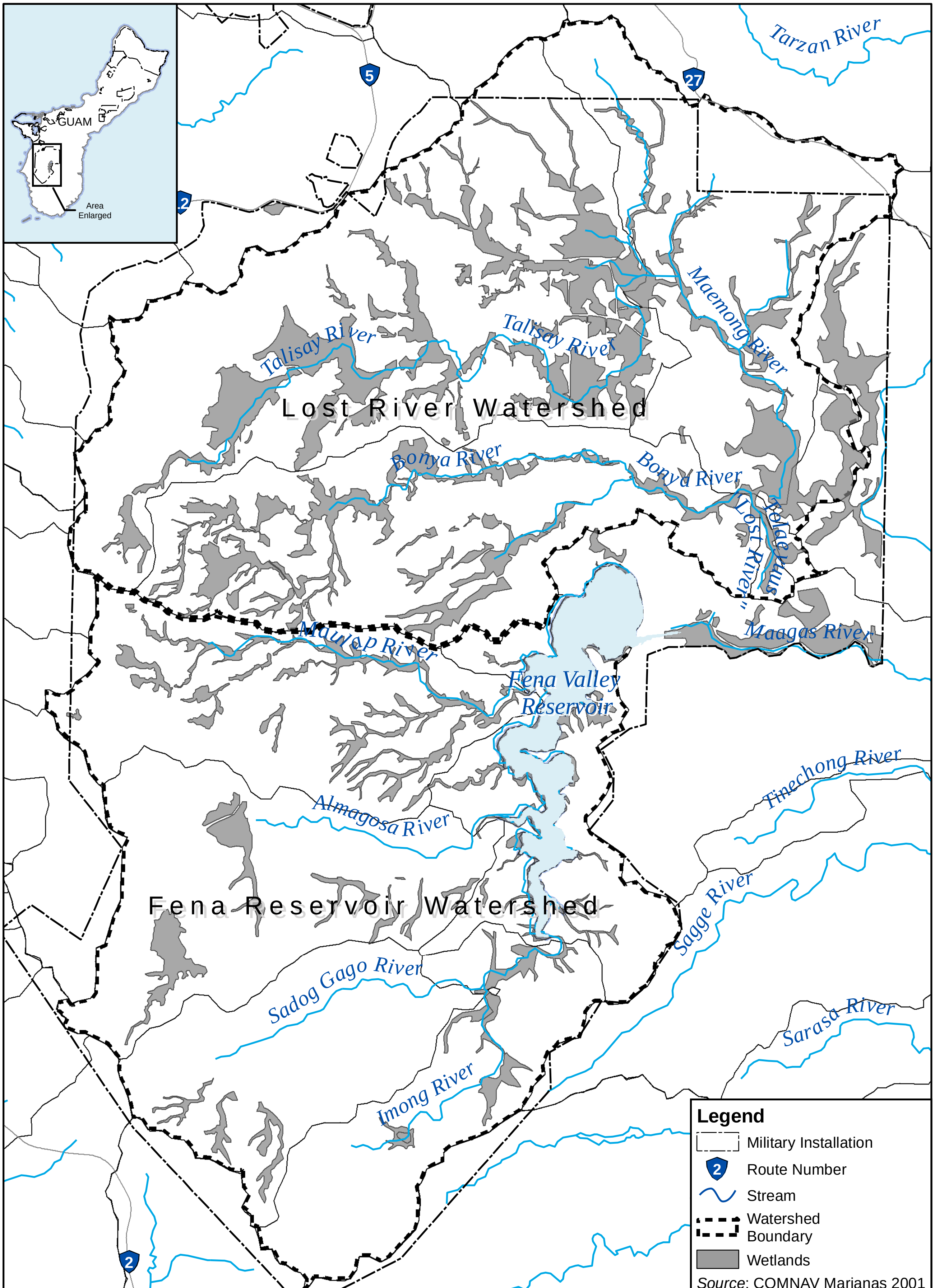

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Figure 4.1-35
Fena Reservoir and Lost River Watersheds

Sediment influx to the reservoir has reached levels whereby the Navy has contracted with the Division of Forestry and Soil Conservation, Guam Department of Agriculture to reforest portions of the watershed that drain into the reservoir. GWQS designate the upper, lower, and southeastern portions of the watershed as S-1, S-2, and S-3, respectively. Both S-1 and S-2 designations protect recreational uses, including swimming, and all stages of aquatic life. The marine waters into which the Talofofo waters are discharged are designated as M-2, which is fully protective of recreation and marine aquatic life.

Four of the streams (Imong, Sadog Gago, Maulap and Almagosa) have relatively steep gradients and flow into Fena Reservoir. Built in 1951, the Fena Reservoir has a capacity of approximately 7,050 acre-feet (8,696,000 m^3) of water, which, along with surface water redirected from Almagosa and Bona springs, is pumped to the Fena Water Treatment Plant and then into Navy and municipal distribution systems, that is the major source of potable water for naval activities and meets approximately 30% of Guam's current water requirements (NAVFAC Pacific 2008).

The Lost River watershed is located to the north of the Fena Reservoir watershed and is composed of several streams that converge with the Maagas River before meeting the Talofofo River east of NMS (refer to Figure 4.1-35). These include the Bonya, Talisay, and Maemong flowing to the Tolaeyuus. The Tolaeyuus River in northern NMS is known as the Lost River where it disappears underground in karst terrain near where it joins the Maagas River below Fena Reservoir and resurfaces again. The Lost River is located in a basin bounded by the natural stream banks to east and west, by the limestone cliff to the north, and by an existing low-head sheet pile dam at its southern end.

The lower Talofofo watershed is composed of deeply weathered volcanic derived sediments with thicker sections of alluvial deposits near the lower sections (Ward et al. 1965). The Talofofo Valley is a wide flat river bottom, with jungle or wetland vegetation throughout. Dense jungle covers much of the adjacent hillsides. Sections of the bottom land are used for agriculture.

Water Quality

Water quality from Fena Reservoir and springs is generally high, requiring minimum treatment and chlorination for domestic use. Threats to NMS water quality include sedimentation from accelerated erosion and fecal material contamination from deer, feral animals,, and other animals (Navy 2009).

The Fena Valley Reservoir contains low alkalinity (or "soft") water that has a slightly alkaline pH, is low in minerals, and contains a significant amount of organic matter. Turbidity tends to be high, especially in the rainy season when measurements may exceed 40 Nephelometric Turbidity Units. The Imong River is a significant source of sediment in the reservoir due to the susceptibility of soil within the river watershed to erosion. Surveys in 1973, 1979, and 1990 indicated that approximately 9.1 mg (34.4 million liters [ml]) of reservoir capacity is lost each year due to sedimentation. Anthropogenic contaminants originating from pesticides, herbicides, and fertilizers have been detected in the reservoir at levels less than regulatory limits (Navy 2009).

Fena Reservoir is facing eutrophication due to persistent conditions of low dissolved oxygen, causing frequent phosphate release from sediment in the reservoir. During the dry season, mixing in the reservoir is very limited resulting in anoxic conditions mobilizing phosphorous previously bound in the sediments. Also, runoff during wet season further increases the nutrient load in the reservoir that leads to even greater biological productivity. The nutrient imbalance caused by the eutrophication of Fena Reservoir needs to be further studied and best management practices must be implemented to preserve the ecology of the reservoir (Navy 2009).

Water quality tests were conducted in the Lost River area in February 1995. A single water quality sample was obtained from the Lost River at the project site to characterize a typical condition, and for comparison with Fena Reservoir water. Water quality was generally good, with low suspended solids concentration and turbidity. All metals, with the exception of antimony, were non-detectable or below maximum levels stipulated for drinking water under Safe Drinking Water Act regulations. Antimony occurs naturally in soils, groundwater, and surface water. It is also associated with automotive batteries, explosives, and flame retardants. The sample registered antimony concentrations of 0.017 mg/L; the Safe Drinking Water Act-mandated level is 0.006 mg/L. Antimony was not detected in Fena Reservoir raw water at surface and mid-depths, and was 0.001 mg/L at the bottom (Navy PWC 1996).

Groundwater

Groundwater in the NMS project area is found in low permeability volcanic rocks or older limestone which produces an elevated water table that in places intersects the ground surface through springs (e.g., Bonya Spring). The low permeability of these geologic formations does not support municipal quantities of groundwater extraction like the NGLA. There currently is no pumping of the groundwater found at NMS. The low permeability of the aquifer material and the ready supply of surface water make any future use of groundwater unlikely (Gingerich 2003).

Nearshore Waters

There are no nearshore waters located near NMS due to its interior location on Guam.

Wetlands

A total of 129 wetlands, totaling 1,469 ac (594 ha), have been mapped at NMS. All of the wetlands are classified as palustrine, except for the Fena Reservoir, which is classified as surface water (COMNAV Marianas 2008). Wetland studies in portions of NMS, particularly the northern portion, are ongoing. Wetlands in the Fena Reservoir watershed perform an important ecological function as they retain sediment that may otherwise be deposited into Fena Reservoir. The extensive wetlands downstream of Fena reservoir and around Fena reservoir (central and to the east) and the potential magazine areas are part of an upcoming wetland investigation using remotely sensed data verified by ground truthing. The results of the investigation will be incorporated into the Final EIS.

A recent wetland investigation conducted in accordance with the 1987 Wetland Delineation Manual (USACE 1987) delineated wetlands in the project area (NAVFAC Marianas 2009). From that report, this discussion focuses on the wetland areas located in the vicinity of the project area. As shown in Figure 4.1-36, the wetland areas of note are delineated wetland areas 32, 33, 51, 52, 53, and 56. These wetland areas are located adjacent to magazine storage area options and are summarized in Table 4.1-7.

Table 4.1-7. Summary of Wetland Areas in the Vicinity of Magazine Storage Options, NMS

Wetland Area	*Size (ac/ha)*
32	9.5/3.8
33	61.7/25.0
50	27.5/11.1
51	67.2/27.2
52	2.7/1.1
53	4.7/1.9
56	77.2/31.2

Sources: NAVFAC Marianas 2009.

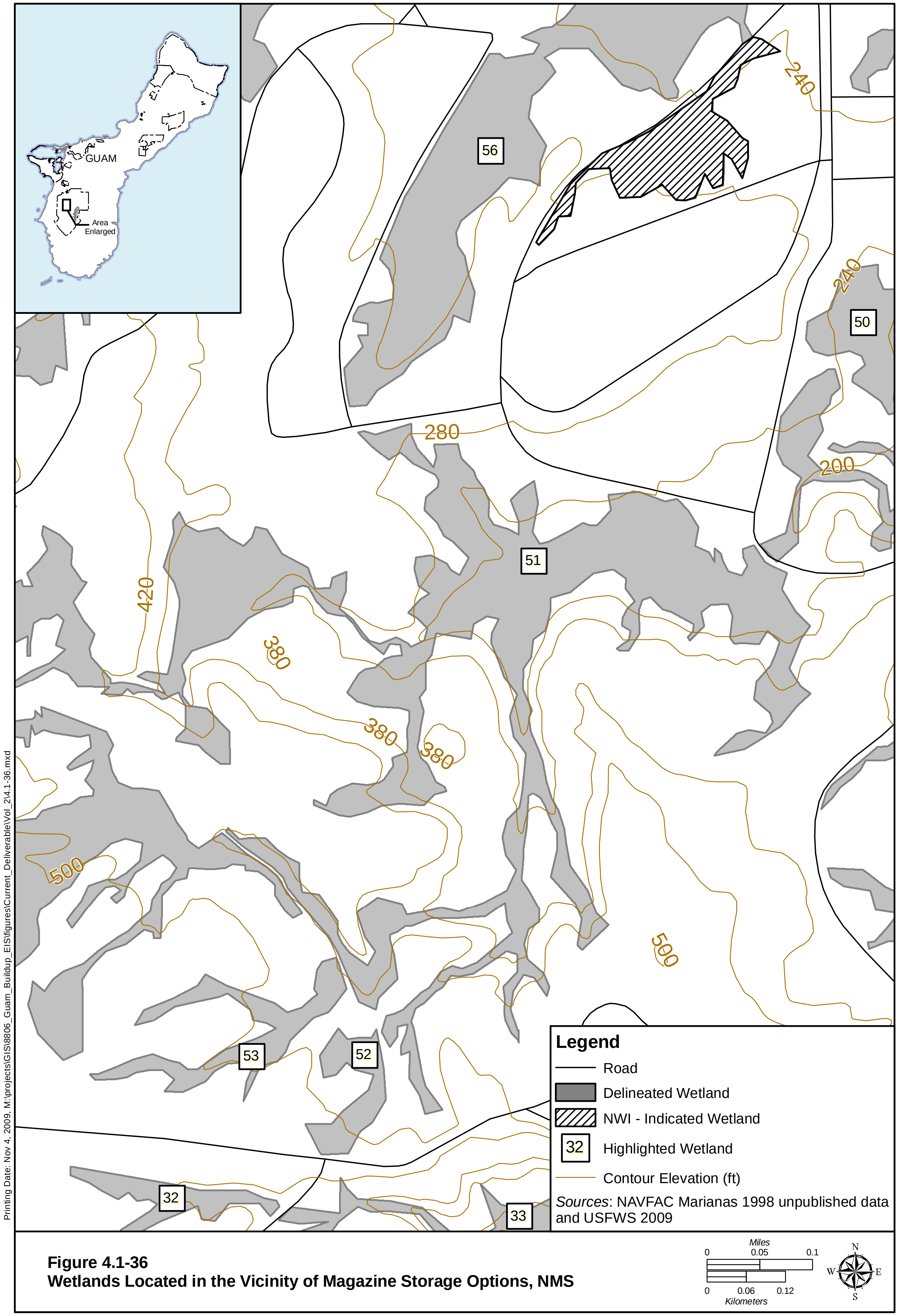


Figure 4.1-36
Wetlands Located in the Vicinity of Magazine Storage Options, NMS

4.1.5.2 Non-DoD Land

This section provides a description of the water resources found in and adjacent to potential Access Road Alternatives A and B. Unless noted otherwise, this discussion is applicable to all three potential access road areas.

Surface Water

The potential access road alternatives all cross through the Fena Reservoir and Lost River watershed; therefore, the general surface water discussion for NMS is applicable to the non-DoD land. Refer to Section 4.1.5.1. Alternatives A and B do no cross any surface water resources as they are an existing hiking trail and unimproved road, respectively.

Groundwater

Groundwater beneath the two potential non-DoD access roads is found in low permeability volcanic rocks or older limestone. The low permeability of these geologic formations does not support municipal quantities of groundwater extraction like the NGLA. The low permeability of the aquifer material and the ready supply of surface water make any future use of groundwater unlikely (Gingerich 2003).

Nearshore Waters

There are no nearshore waters located adjacent to the non-DoD land access roads due to their interior location on Guam.

Wetlands

There are no known wetland areas located within the potential access road footprint (refer to Figure 4.1-7).

4.1.5.3 Roadway Projects

The proposed action includes on base roadway construction projects that would be implemented by the DoD. An affected environment description for on base roadway construction projects is included beneath the appropriate subheadings in other sections of this chapter. The following section describes the affected environment for off base roadway construction projects that would be implemented by the FHWA. The roadway discussion for wetlands is in the Terrestrial Biological Resources section, refer to Section 10.1.5.

The proposed GRN projects within the South Region include improvements along Route 5 (pavement strengthening only) and Route 12 (relocation of military access point). These routes are within the upper reaches of the Antantano River and Namo River watersheds located along the southwest portion of the island. The Antantano River flows westerly into the Inner Apra Harbor, while the Namo River flows westerly to Agat Bay. Potential impacts on water resources from proposed roadway projects are discussed in Volume 6 of this EIS/OEIS.

Surface Water

The hydrologic regime is characterized by eroded volcanic formations with short streams and steep gradients in the upper portions of the watersheds and drainage areas of less than 3 mi^2 (777 ha) each. These streams are deeply channeled within the volcanic slopes that outlet into the shallow fringing coral reefs at the mouths of the streams. These receiving water bodies are not listed as impaired on the federal 303(d) list of impaired water bodies. In accordance with FEMA FIRMs, the road improvement areas are located outside of any floodplains. The roads are generally crowned in this area with no curbs so that runoff sheet flows to adjacent swales located along the road.

Groundwater

In the southern half of the island, groundwater primarily occurs in volcanic rock of low permeability. There is very limited groundwater available in the unconfined aquifers underlying this area, and infiltration characteristics are low, reducing the potential for impact of surface water on the groundwater regime in this area.

4.2 ENVIRONMENTAL CONSEQUENCES

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

4.2.1 Approach to Analysis

4.2.1.1 Methodology

The environmental consequences of each alternative and the no-action alternative are presented in this section. Available literature was used to assess existing conditions and to establish a baseline for the assessment, as described in the affected environment section (Volume 2, Chapter 4, Section 4.1.1). The methodology for identifying, evaluating, and mitigating impacts to water resources has been established based on federal and GovGuam laws and regulations as described in Volume 2, Chapter 4, Section 4.1.1.

The environmental consequences evaluation for water resources includes a qualitative and quantitative analysis of surface water, groundwater, nearshore waters, and wetlands to the extent possible given available project data. Environmental impact assessments were made and compared to baseline conditions, items of public concern, and significance criteria to determine the magnitude of potential impacts to water resources. Potential impacts on water resources from proposed roadway projects are discussed in Volume 6 of this EIS/OEIS; however, potential impacts associated with the NMS Access Road Options A and B are addressed in this volume.

The proposed action analysis is separated into two main activities: construction and operations (consisting of non-training and operations). Each of these activities has potential impacts. The analysis of potential impacts considers both direct and indirect impacts. Direct impacts are those that may occur during the construction phase of the project and cease when the project is complete or those that may occur as a result of project operations following the completion of construction. Indirect impacts are those that may occur as a result of the completed project or those that may occur during operations but not as a direct result of the construction or operational action.

Sustainability Requirements and Goals

Implementation of the proposed action would be consistent with Navy policy in compliance with laws and executive orders whereby DoD entities are required to reduce demand for indoor water by as much as 20% and outdoor water use by 50% by the end of fiscal year 2015. Outdoor water use would include consumption for landscape management and equipment washing. Concurrent with these mandates is the Navy/Marine Corps policy to pursue and facilitate Leadership in Energy and Environmental Design

(LEED) Silver certification for their facilities. LEED is a voluntary point system tool that measures the degree of sustainability features incorporated into a development.

Water resource sustainability is addressed in two categories: minimize water demand and maximize the quantity and quality of groundwater recharge. Elements identified to achieve minimum water use are:

- Water Conservation - identify and specify appropriate minimum water demand fixtures and devices
- Irrigation - minimize use of irrigation systems and water
- Grey Water Use - evaluate options for use of grey water for irrigation. Greywater is non-industrial wastewater generated from domestic processes such as dishwashing, laundry, and bathing.
- Rainwater Harvesting - investigate harvesting, storage, and distribution systems

The quantity and quality of groundwater recharge is addressed in the existing Unified Facility Code Low Impact Development (LID) Manual, which would be followed. This manual includes specific Integrated Management Practices to be considered and included in the drainage design of the proposed action sites. In addition, NPDES permitting requirements, LEED goals, and recent laws (e.g., the Energy Independence and Security Act of 2007), mandate certain drainage quantity and quality performance standards. Thus, the proposed action includes incorporating post-construction drainage quality, quantity, and velocity dissipation measures to approximate (or improve upon) pre-construction conditions at the property line.

<u>Best Management Practices</u>

In many sections of the water resource analysis contained in this EIS/OEIS, the reader will find implementation of BMPs as an impact-reducing measure for both construction and operation activities. Thus, it is important to note a few things about BMPs, and in particular stormwater-related BMPs, in this section of the EIS/OEIS. Choosing an effective stormwater BMP is one of the key challenges to ensuring maximum protection for receiving waters. As part of this, having access to studies of BMP performance helps make better decisions to ensure not just BMPs, but rather, *effective BMPs* are selected and implemented.

For example, research on BMP treatment system performance from available monitoring data drawn from the International Stormwater Best Management Practices Database (BMP Database 2009) investigated whether there are any differences in treatment performance based on BMP category (e.g., detention basin, media filter, wetland basin, etc.). The study analyzed the average influent and effluent concentrations of BMPs for various constituents. Of note, suspended solid concentrations (of particular concern during construction) decreased most notably through the implementation of detention pond and media filter BMPs. Conversely, these same BMP categories were not effective removers of total nitrogen or total phosphorus, whereas wetland basin BMPs were (Geosyntec Consultants 2008).

BMP treatment success percentage (by concentration) is just part of the BMP effectiveness story; there are many factors to consider. As part of the BMP decision process, a wide variety of factors must be considered, including pollutant removal potential, stormwater volume reduction, installation considerations, capital costs, maintenance costs, hydrologic regime, and other factors. In particular, there are three important areas to consider when attempting to evaluate a BMP's potential performance: concentration, volume, and total load (USEPA 2009b). Choosing the right BMP for the right area is critical; thus, a sufficient understanding of the site-specific concentration, volume, and total load factors is necessary.

In developing a list of potential BMPs for actions analyzed in this EIS/OEIS (Table 4.2-1), the aforementioned key considerations and areas have been and will continue to be identified and refined. While the list of potential BMPs in Table 4.2-1 is general, they cover the wide-range of potential needs for BMP measures to reduce potential impacts stemming from proposed action analyzed in this EIS/OEIS. Table 4.2-1 also identifies the applicable action phase (construction and/or operation) and region on Guam where each listed BMPs would likely be most effective. This list presents those BMPs already in use at DoD installations on Guam and/or identified by GovGuam (Navy 2008, CNMI and Guam 2006). A notable BMP is the preparation and implementation of a SWPPP. As described in SWPPPs, BMP implementation includes performing frequent visual inspections and benchmark monitoring to determine BMP effectiveness. Monitoring results are then analyzed in relationship to the identified water quality objectives and if the benchmarks were not being reached, the BMPs would be modified. In this manner, the effectiveness and applicability for selected BMPs (specific to unique situations on Guam) can be measured and then altered, as necessary, to minimize potential impacts to water resources on Guam.

Table 4.2-1. Stormwater BMPs

Number	*Potential BMP*	*Action Phase*		*Geographic Applicability*				*Description*
		Construction	*Operation*	*Northern*	*Central*	*Apra Harbor*	*Southern*	
1	Erosion Control Plan (ECP)	●	●	●	●	●	●	Per 10 Guam Code Annotated (GCA), Chapter 47, an ECP is required before any properties can be cleared and graded to eliminate and/or minimize nonpoint source pollution within Guam's waters such as fertilizers, pesticides and other polluting substances carried by sediment.
2	Stormwater Management Plan (SWMP).	●		●	●	●	●	In compliance with the federal CWA under section 401 the proposed action would require a SWMP. A SWMP is a document that describes the minimum procedures and practices used to reduce the surface flow and subsequent discharge of pollutants to storm drainage systems.
3	Stormwater Pollution Prevention Plan (SWPPP)		●	●	●	●	●	DoD facilities are required to comply with the SWPPP during day to day operations, to ensure that stormwater remains free of contaminants. A SWPPP is a self-implementing plan for compliance with an installation's stormwater permit. It requires development of pollution prevention measures, including BMPs, to reduce and control pollutants in stormwater discharge.
4	Water Quality Monitoring Plan (WQMPs)	●	●	●	●	●	●	WQMPs may be required to evaluate the effectiveness of any number of different environmental permits and/or performance standards. Monitoring plans are formulated to identify ambient or control conditions at a particular site and to capture deviations from those conditions resulting from a project or operations of a facility.
5	Check Dam	●	●	●	●	●	●	Small barriers or dams constructed of stone, bagged sand or gravel, or other durable material across a drainage way. The purpose is to reduce erosion in a drainage channel by restricting the velocity of flow in the channel.

Number	*Potential BMP*	*Action Phase*		*Geographic Applicability*				*Description*
		Construction	*Operation*	*Northern*	*Central*	*Apra Harbor*	*Southern*	
6	Diversion Dike/Swale	●		●	●	●	●	A temporary diversion dike is a berm or ridge of compacted soil, located in such a manner as to channel water to a desired location. The purpose is to prevent runoff from entering disturbed areas by intercepting and diverting it to a stabilized outlet or to intercept sediment laden water and divert it to a sediment trapping device, and to direct runoff to a sediment trapping device, thereby reducing the potential for erosion and off site sedimentation.
7	Level Spreader	●	●	●	●	●	●	A non-erosive outlet for concentrated runoff constructed to disperse flow uniformly across a slope. The purpose is to convert concentrated flow to sheet flow and release it uniformly over a stabilized area.
8	Perimeter Dike/Swale	●		●	●	●	●	A temporary ridge of soil excavated from an adjoining swale located along the perimeter of the site or disturbed area built to prevent off site storm runoff from entering a disturbed area and to prevent sediment laden storm runoff from leaving the construction site or disturbed area.
9	Sediment Basin	●	●	●	●	●	●	A barrier or dam constructed across a drainage way or at other suitable locations to intercept sediment laden runoff and to trap and retain the sediment to protect drainage ways, properties, and rights-of-way below the sediment trap from sedimentation.
10	Sediment Trap	●	●	●	●	●	●	A sediment control device formed by excavation and/or embankment to intercept sediment laden runoff and retain the sediment in order to protect drainage ways, properties, and rights-of-way below the sediment trap from sedimentation.
11	Silt Fence	●		●	●	●	●	A barrier of geotextile fabric installed on the contours across a slope used to intercept sediment laden runoff from small drainage areas of disturbed soil to reduce runoff velocity and effect deposition of transported sediment load.
12	Storm Drainage Inlet Protection	●		●	●	●	●	A temporary, somewhat permeable barrier, installed around inlets in the form of a fence, berm or excavation around an opening, trapping water and thereby reducing the sediment content of sediment laden water by settling to prevent heavily sediment laden water from entering a storm drain system through inlets.
13	Straw Bale Dike	●		●	●	●	●	A temporary barrier of straw, or similar material, used to intercept sediment laden runoff from small drainage areas of disturbed soil to reduce runoff velocity and effect deposition of the transported sediment load.
14	Vegetated and Lined Waterways	●	●		●	●	●	A natural or man-made channel of parabolic or trapezoidal cross-section that is below adjacent ground level and is stabilized by suitable vegetation or concrete, stone, or other

Number	*Potential BMP*	*Action Phase*		*Geographic Applicability*				*Description*
		Construction	*Operation*	*Northern*	*Central*	*Apra Harbor*	*Southern*	
								permanent material to intercept and convey runoff to stable outlets at non-erosive velocities.
15	Rock Outlet Protection	●	●	●	●	●	●	A section of rock protection placed at the outlet end of the culverts, conduits, or channels to reduce the depth, velocity, and energy of water, such that the flow will not erode the receiving downstream reach.
16	Erosion Control Blankets	●	●	●	●	●	●	Erosion control blankets (geotextiles) are porous fabrics (filter fabrics, road rugs, synthetic fabrics, construction fabrics, or simply fabrics) placed to minimize or prevent erosion on exposed soils.
17	Stabilization with Vegetation, Sod, Mulch, or Topsoil	●	●	●	●	●	●	Providing erosion control protection to a critical area for an interim period or establishing grasses with other forbs and/or shrubs to provide perennial vegetative cover on disturbed, denuded, slopes subject to erosion to provide temporary and/or permanent erosion and sediment control.
18	Low Impact Development (LID)		●	●	●	●	●	LID is a design technology that makes use of innovative methods to capture stormwater that would otherwise flow into nearby watersheds using a combination of retention devices and vegetation to allow stormwater to be retained and managed at the source, rather than relying on downstream efforts to control the flow of water and contaminants. The purpose is to improve the quality of receiving waters and stabilize flow rates of nearby streams by reducing water pollution and increasing groundwater infiltration.
19	Stormwater Ponds (Retention/ Detention)		●		●	●	●	Practices that have a combination of permanent pool and extended detention capable of treating the water quality volume treatment.
20	Stormwater Wetlands		●		●	●	●	Practices that include significant shallow marsh areas, and may also incorporate small permanent pools or extended detention storage to achieve the full water quality volume treatment.
21	Infiltration Practices		●	●	●			Practices that capture and temporarily store the water quality volume before allowing it to infiltrate into the B and/or C soil horizons. Runoff that discharges directly into limestone areas requires treatment via another approved management practice.
22	Filtering Practices		●	●	●	●	●	Practices that capture and temporarily store the water quality volume and pass it through a filter bed of sand, organic matter, soil, or other media.

Number	*Potential BMP*	*Action Phase*		*Geographic Applicability*				*Description*
		Construction	*Operation*	*Northern*	*Central*	*Apra Harbor*	*Southern*	
23	Open Channel Practices		●		●	●	●	Practices explicitly designed to capture and treat the full water quality volume within dry or wet cells formed by check dams or other means, or within the channel itself through a slow velocity and relatively long resistance time.
24	Minimizing Exposure		●	●	●	●	●	Minimize the exposure of manufacturing, processing, and material storage areas to rain and run-off by locating these industrial materials and activities inside or protecting them with storm resistant coverings.
25	Preventive Maintenance		●	●	●	●	●	A preventive maintenance program involving regular inspection, testing, maintaining, and repairing of all industrial equipment and storage systems prior to or during normal use.
26	Spill Prevention and Response Procedures	●	●	●	●	●	●	Written procedures for cleaning up spills or leaks, notifying the appropriate personnel, and following the reporting procedures.
27	Routine Facility Inspections		●	●	●	●	●	Qualified facility personnel must regularly inspect all areas of the facility where industrial materials or activities are exposed to stormwater for ongoing good housekeeping, spill control equipment, and outdoor storage.
28	Employee Training		●	●	●	●	●	Training must be given to all employees who work in areas where industrial materials or activities are exposed to stormwater, and must include spill response, good housekeeping, and material management practices.

Note: *The DoD* and GovGuam are working on an amendment to the Stormwater Management Manual; many of these BMPs are taken from the 2006 Manual and may be further refined in the amendment.

The hydrologic regime at a specific site is also critical on Guam when deciding which BMPs are most appropriate. The northern broad sloping limestone plateau has little surface runoff, high infiltration rates, and concerns about groundwater contamination (i.e., impacts to the NGLA) while the southern mountainous region composed of eroded volcanic formations is dominated by surface runoff, erosion concerns, and has little groundwater storage. In the limestone dominated areas (northern and portions of central Guam) BMPs for operation impacts would need to focus on channeling runoff to temporary storage and filtration (BMP #23) and a comprehensive removal of contaminants prior to allowing stormwater recharge (BMP #22) to the sensitive NGLA. In the volcanic dominated areas (southern and parts of central Guam), BMPs for operation impacts would need to focus on minimizing erosion (BMP #s 7 and 18), removal of suspended sediment (BMP #s 9, 21, and 24), and reduction in peak flow (BMP #20) to surface waters.

As part of this EIS/OEIS, the Navy is also preparing a stand-alone LID study and complementary comprehensive drainage study to determine stormwater runoff quantities and qualities under the action alternatives. The two studies will work in tandem, using such resources as USEPA (2009b) to identify and implement LID planning utilizing a variety of natural and built features that reduce the rate of runoff, filter out pollutants, and facilitate the infiltration of water into the groundwater basins. This LID planning will ultimately provide the foundation for the basis of design for permanent stormwater infrastructure. Potential LID measures are identified in following sections.

4.2.1.2 Determination of Significance

Surface Water

Surface water issues include:

- Water quality
- Flooding
- Flow path alterations

Surface water quality impacts are evaluated by examining the potential increase of contamination including chemicals, heavy metals, nutrients, and/or sediments in the surface water as a result of the proposed action. The analysis is performed by comparing existing water quality data with possible increases in water quality contaminants in the surface water. Potential impacts to surface water quantity and velocity are analyzed by examining changes in drainage volumes and patterns associated with the proposed action.

For construction activities, some of the key effects include stormwater discharges which may contain elevated sediment concentrations and spills and leaks of chemicals such as lubricants, fuels, or other construction materials that may increase pollutant loading in the surface water. In addition, direct construction or alteration of stream channels or reservoirs may cause erosion, sedimentation, and increased contamination potential. If flow paths or patterns are altered, additional studies, such as instream flow analysis, would be conducted to ensure the human uses and/or biological services are preserved.

Operational effects include stormwater discharges which may increase erosion rates, the volume of sediment loading to the surface water as well as increase contaminants from vehicle maintenance, household discharge, privately-owned vehicles, and animal waste. Contamination of surface water from leaks or spills of hazardous, or otherwise regulated materials, is also a potential impact. Increased water usage may reduce the water availability in the reservoirs and/or reduce instream flows. Increased impervious areas may increase the runoff and increase the potential for flooding. Development in the floodplain could result in potential damage from flooding. Diversion of water courses for municipal water consumption may impact the ecological services that the resource provides.

Groundwater

Groundwater impact concerns include water quality and water quantity. Groundwater quality is assessed by examining the potential risk of a hazardous or regulated waste release, as well as approximating the amount of additional stormwater and associated non-point source pollution that enter the groundwater.

Potential groundwater impacts associated with construction activities include spills, leaks, and sedimentation having direct impacts to stormwater runoff that can contribute to groundwater contamination, well as direct contamination of groundwater resources through percolation.

The possible impacts connected with operational activities include increases of impervious areas, waste-generating activities, storage of potential contaminants, and landfill leaching. The direct impacts include an increase in polluted stormwater runoff and contamination from leaks or spills of hazardous or regulated materials. In addition, the increased water usage may increase the depletion of groundwater resources (Volume 6, Chapter 3, Section 3.1.2, Potable Water). The potential impacts include decreases in groundwater recharge from increased impervious areas and saltwater intrusion from increased aquifer pumping.

Nearshore Waters

The nearshore water impact analysis focuses on water quality. Recreational nearshore issues are addressed in Volume 2, Recreational Resources. The potential increases of contamination including chemicals, heavy metals, nutrients, and/or sediments in nearshore waters as a result of the proposed action are assessed by comparing existing water quality data with the projected changes in water quality.

Potential impacts associated with construction activities include construction spills and leaks that may discharge to nearshore waters, an increase in stormwater discharge that may increase non-point source pollution, and physical impacts to nearshore waters from dredging.

Operation effects include potential non-point source and point-source pollution. The point-source pollution consists of chemicals, heavy metals, nutrients, and/or sediments that may runoff from the increase in impervious, urban areas. The point source pollution would be related to direct discharges to the nearshore waters such as wastewater effluent.

Wetlands

The wetland impact areas of concern include:

- Pollutants
- Loss of area
- Loss of functionality

The potential for pollutants to impact a wetland was evaluated by examining the risk of hazardous materials leaking or spilling and their proximity to the wetlands. The loss of area was assessed by the total amount of delineated wetland area that would be directly removed either in loss of area or function as a result of the proposed action. The wetland functionality refers to the ability of the wetland to trap sediment and nutrients, receive and retain water, maintain wildlife habitat (both flora and fauna), and provide recreational uses. The impacts to wildlife habitat associated with wetlands are addressed in Chapter 10, Terrestrial Biological Resources.

For construction activities, the effects associated with activities in close proximity to any designated wetland or activities in the wetlands themselves are considered. Runoff from nearby construction sites may contain increased chemicals, heavy metals, nutrients, and/or sediment that could adversely affect those wetlands. Wetland impacts could result from changes in land uses and/or spills or leaks from construction operations and equipment. Loss of functionality can also occur if construction operations occur directly within the designated wetlands. Loss of wetland area would occur if the proposed action involves the direct removal of wetlands.

The effects associated with operations include an increase in potential spills and leaks from hazardous materials that may be stored in close proximity to designated wetlands. An indirect impact to existing wetlands may occur by altering (i.e., diverting or restricting) the surface water flowing into the wetlands. Indirect impacts to wetlands could also occur as a result of altered sedimentation of watercourses or drainage conveyances connected to wetland areas.

<u>Significance Criteria</u>

The following factors are considered in evaluating impacts to water resources:

- Reducing availability or accessibility of water resources
- Noncompliance with all applicable water quality standards, laws, and regulations
- Increasing risk associated with environmental hazards or human health
- Decreasing existing and/or future beneficial use
- Increasing risk of flooding
- Depletion, recharge, or contamination of a usable groundwater aquifer for municipal, private, or agricultural purposes
- Reducing the amount of wetlands available for human use or ecological services
- Long-term increased inundation, sedimentation, and/or damage to water resources

If an activity is deemed as having an impact, the activity then can be evaluated to determine if the impact is significant or insignificant. For a significant impact, a determination is made as to whether the impact can be mitigated to less than a significant impact.

4.2.1.3 Issues Identified during Public Scoping Process

As part of the analysis, concerns relating to water resources that were mentioned by the public, including regulatory stakeholders, during scoping meetings were addressed. These included:

- Describing water quality with respect to public health requirements, drinking water regulations, and applicable water quality standards
- Estimating quality and quantity of stormwater runoff to be generated by increased impervious surface, methods of contaminant removal, methods of runoff redirection to recharge the aquifer, and groundwater under the direct influence of surface water
- Accidental or intentional contamination of groundwater
- Capacity of water resources to meet agricultural needs
- Stormwater management controls to prevent pollution during construction and subsequent operations
- Construction that could potentially cause runoff and pollute the beaches and destroy marine life
- Effects of training and dredging on sedimentation stress for the coral reefs and other marine life
- Identifying ways to monitor and mitigate indirect impacts from sediments on coral reefs

4.2.2 Alternative 1

4.2.2.1 North

<u>Andersen AFB</u>

Construction

Surface Water. Under Alternative 1, proposed munitions storage (12 new munitions storage magazines and support facilities) and airfield (North Ramp, South Ramp, North Gate, and Access Road) construction activities at Andersen AFB would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, construction-specific BMPs would be implemented to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. General construction BMPs are presented in Table 4.2-1. In addition, roadway-specific BMPs as identified in the Commonwealth of the Northern Mariana Islands (CNMI) and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Proposed construction activities would not occur within the 100-year flood zone. Therefore, construction activities associated with Alternative 1 at Andersen AFB would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1, construction activities at Andersen AFB would include surface water protection measures that would also serve to protect groundwater quality. These BMPs would reduce the pollutant loading potential into stormwater and thus the underlying groundwater subbasins. Therefore, construction activities associated with Alternative 1 at Andersen AFB would result in less than significant impacts to groundwater.

Nearshore Waters. Though construction activities under Alternative 1 on Andersen AFB would be >0.5 mi (0.8 km) from the coastline, the entire island of Guam is classified as a coastal zone under the CZMA. Alternative 1 would have no direct impact to the nearshore waters surrounding Andersen AFB, although there would be a potential for indirect impacts (e.g., potential increase in sediment reaching nearshore waters) to occur. These indirect impacts would be lessened through the implementation of BMPs as referenced in the surface water discussion. Therefore, construction activities associated with Alternative 1 at Andersen AFB would result in less than significant impacts to nearshore waters.

Wetlands. No wetlands are located in or near the construction areas associated with Alternative 1 on Andersen AFB. Therefore, construction activities associated with Alternative 1 at Andersen AFB would result in no impacts to wetlands.

Operation

This analysis assumes that proposed aviation training activity (flight operations) and new SUA airspace would have no impact to water resources as flight operations are not expected to affect water resources. However, the potential impacts from the storage, use, and disposal of materials used to support proposed flight operations is analyzed in this section.

Surface Water. Under Alternative 1, the increase in impervious area at Andersen AFB would result in an associated relatively minor increase in stormwater discharge intensities and volume. This increase would be accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm event to minimize potential impacts to surface water quality. Stormwater flow paths would continue to mimic pre-development flows through area topography. Examples of stormwater infrastructure LID measures are described below.

Alternative 1 would incorporate the concept of LID in the final planning, design, and permitting of the stormwater runoff and drainage design. The goals of LID are too closely match the post-development topography and stormwater runoff hydrology to the pre-development status. The intent of LID is to control non-point source runoff through the implementation of plant-soil-water and man-made, where appropriate, mechanisms that protect and sustain the ecological integrity of the receiving water bodies and wetlands. In areas of karst geology such as Andersen AFB, LID techniques must also protect groundwater quality. LID designs focus on small scale, close to the source stormwater management, where such techniques can achieve the water quality goals. LID technologies are well suited to reduce stormwater runoff loadings for a variety of potential contaminants including sediment, nutrients, and heavy metals. LID practices at the planning level are in conformance with USEPA non-structural Pollution Prevention strategies.

It is anticipated that several LID techniques would be used during the final planning, design, and permitting of Alternative 1. These measures could include a series of integrated management practices (IMPs) to match as closely as possible the "pre-/post-" hydrologic conditions in the development areas. The IMPs reduce flow peaks, intercept flows resulting from all levels of rainfall intensities, and provide water quality treatment. The projects may incorporate downspout disconnections, re-vegetation, and bio-retention to reduce pollutant loads and stormwater volumes. Additional appropriate measures are expected to be included such as the use of bio-retention cells, bio-retention strips, oil/water separators, a combination of bioswales and vegetated swales, and detention/retention basins.

As part of LID planning, areas for vehicle parking may use pervious paving designs when practicable. The potential use of such paving systems would be balanced with the requirement to avoid percolation of contaminated stormwater into groundwater; this protection of groundwater would have the highest priority when considering such paving designs. Drainage swales instead of stormwater conveyance piping systems are also being considered as a way to reduce the quantity and velocity of stormwater while simultaneously improving stormwater quality. The combination of LID technologies and compliance with federal and GovGuam regulations would reduce potential impacts to the storm drainage system and nearby receiving water bodies. With the implementation of LID measures to reduce impacts, stormwater flow paths would continue to mimic area topography and no diversion or restriction of surface water flow would occur.

Alternative 1 would potentially increase the amount of POLs, hazardous waste, pesticides, and fertilizers being stored, transported, and utilized on the proposed facilities. Increasing the storage, transportation, and use of these substances would increase the potential for releases to receiving waters. The stormwater runoff would continue to have the potential to have elevated contaminants such as sediment, nutrients, heavy metals, organic and inorganic compounds, and detrimental microorganisms.

Alternative 1 would be conducted in accordance with all applicable orders, laws, and regulations (see Table 3.1-1, Volume 8). SWPPPs and Stormwater Management Plans (SWMPs) are documents designed to identify ways to reduce the potential impacts associated with potential pollution sources, and potential erosion and sedimentation impacts, respectively. In addition, the Oil Pollution Act (OPA) mandates the implementation of the Spill Prevention, Control, and Countermeasure (SPCC) Plan that is used to prevent and control potential leaks and spills. Implementation of the required plans and permits with their associated protective measures would minimize potential impacts of runoff, spills and leaks. The combination of LID technologies and compliance with federal and GovGuam regulations would ensure that no significant impacts to receiving water bodies would result from Alternative 1. Therefore, operations associated with Alternative 1 at Andersen AFB would result in less than significant impacts to surface water.

Groundwater. Following construction, the existing procedures governing these recharge activities would continue to be followed to ensure that no extensive groundwater contamination would occur. Specifically, the provisions of the SWPPP and associated erosion control activities would ensure that the surface water flowing into the groundwater recharge wells would be of acceptable quality. As a high percentage of rain falling on Andersen AFB eventually infiltrates to the NGLA, the increase in stormwater runoff could result in a quicker flowpath time to the recharge wells; however, the increased potential for higher evaporation rate associated with the increase in impervious surface would likely mostly cancel the reduction in infiltration times except during the most intense rainfall events. Therefore, operations associated with Alternative 1 at Andersen AFB would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed, such as increased runoff, could potentially result in indirect impacts that could alter nearshore water quality including sedimentation, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These indirect effects would be minimized by complying with all applicable orders, laws and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the Northern Watershed Restoration Strategy. The intent of these documents is to encourage federal and non-federal agencies, other organizations and interested citizens to work in a collaborative manner to restore priority watersheds. For example, under the Northern Watershed Restoration Strategy, the major focus of the restoration strategy for the northern watershed is the documentation, investigation, and eventual reduction of potential contaminant sources located in the northern watershed. Therefore, operations associated with Alternative 1 at Andersen AFB would result in less than significant impacts to nearshore waters.

Wetlands. No wetland areas would be affected by operational activities associated with Alternative 1 as no delineated wetland areas are located near the proposed operational areas. Therefore, operations associated with Alternative 1 at Andersen AFB would result in no impacts to wetlands.

Finegayan

Under Alternative 1, construction and operational activities would occur at NCTS Finegayan and South Finegayan. Therefore, this analysis evaluates potential impacts at both locations.

As part of the overall study of the potential Marine Corps relocation to Guam, the Navy has recently awarded a contract to prepare a comprehensive drainage study to determine the pre- and post-development hydrology of the potential Main Cantonment site at Finegayan. The study will determine the stormwater runoff quantities and qualities that would be need to be accommodated at the site under construction scenarios. This characterization of stormwater runoff will allow LID planning to proceed, utilizing a variety of natural and built features that would reduce the rate of runoff, filter out pollutants, and facilitate the infiltration of water to the ground. Upon completion of the study, the relevant information will be incorporated into this EIS/OEIS to enhance the level of site-specific detail with respect to potential stormwater impacts and associated LID measures to reduce potential impacts.

NCTS Finegayan

Construction

Surface Water. Under Alternative 1, proposed cantonment, housing/community support, and non-fire training facility construction activities at NCTS Finegayan would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, general construction BMPs (see Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Proposed construction activities would not occur within the 100-year flood zone. Therefore, construction activities associated with Alternative 1 at NCTS Finegayan would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1, cantonment, housing/community support, and non-fire training facility construction activities at NCTS Finegayan would include surface water protection measures that would also serve to protect groundwater quality. These BMPs and follow-on measures and plans would reduce the pollutant loading potential into stormwater and then thus the underlying groundwater subbasins. Therefore, construction activities associated with Alternative 1 at NCTS Finegayan would result in less than significant impacts to groundwater.

Nearshore Waters. Alternative 1 on NCTS Finegayan is adjacent to the coastline, and the entire island of Guam is classified as a coastal zone under the CZMA. Due to the proximity of the activity, Alternative 1 has the potential for impacting nearshore water quality. Specifically, Alternative 1 has the potential for impacting nearshore water quality if large quantities of sediment loaded runoff enters the large sink holes in the main cantonement or concentrated flows are directed toward the cliff edge above the Haputo Beach and conservation area. These potential impacts would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore, construction activities associated with Alternative 1 at NCTS Finegayan would result in less than significant impacts to nearshore waters.

Wetlands. No wetlands are located in or near the construction areas associated with Alternative 1 on NCTS Finegayan. Therefore, construction activities associated with Alternative 1 at NCTS Finegayan would result in no impacts to wetlands.

Operation

Surface Water. Under Alternative 1, the total amount of impervious area at NCTS Finegayan would increase by 809 ac (327 ha). This increase from 5.5% to 39% impervious area, for a total of 941 ac (381 ha), would result in an associated increase in stormwater discharge intensities and volume. This increase would be primarily accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm event in order to reduce potential impacts to surface waters. Stormwater flow paths would continue to mimic pre-development flows through area topography. Examples of stormwater infrastructure LID measures are described below.

Alternative 1 would be conducted in accordance with all applicable orders, laws, and regulations including the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks. In addition, outside non-fire training activities would not include the use of pyrotechnics, ammunition, or simulated ammunition, and the indoor small arms range operation would be confined to the interior of the facility; therefore, no surface water quality impacts from non-fire training operations would occur.

Alternative 1 at NCTS Finegayan would also include the incorporation of LID into the final planning, design, and permitting of the stormwater runoff and drainage design, as described in detail in Section 4.2.2.1, Andersen AFB Surface Water. Selected IMPs would reduce flow peaks, intercept flows resulting from all levels of rainfall intensities, and provide water quality treatment. Example control practices that could be a part of LID technologies could include integrated pest management, native plant landscaping, avoidance of pesticides and fertilizers, implementation of household hazardous waste collection programs, and the use of transit/shuttle programs to minimize single occupancy vehicles and their related pollutants. These and other water quality protection measures would control or attenuate residential stormwater runoff before stormwater would enter ponding basins and recharging underlying groundwater resources. The combination of LID technologies and compliance with federal and GovGuam regulations would ensure that less than significant impacts to the storm drainage system, nearby receiving water bodies, and underlying groundwater resources would result from Alternative 1. Therefore, operations associated with Alternative 1 at NCTS Finegayan would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1 at NCTS Finegayan, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality.

Under all alternatives, groundwater production is expected to increase by a total of no more than approximately 16.2 MGd (61.7 mld), from the Gana, Mangilao, Andersen, Agafa-Gumas, Finegayan, and Yigo-Tumon subbasins (NAVFAC Pacific 2008). When this increase is added to existing pumping rates, the new projected pumping rate of 54.7 MGd (207 mld) would still be less than the sustainable yield of 80.5 MGd (304.7 mld). The Navy recently initiated a study to re-evaluate the sustainable yield of the NGLA. The results of the re-evaluation will be incorporated into future versions of the EIS/OEIS.

Water resource managers would continue to proactively monitor groundwater chemistry data to ensure increased pumping does not adversely affect military or non-military sources of drinking water. Careful monitoring of the chloride concentrations in the subbasins and the capability to shift pumping to wells further from impacted subbasins if high chloride concentrations are detected would reduce any potential negative impacts on the groundwater resource. Implementation of aforementioned sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. Therefore, operations associated with Alternative 1 at NCTS Finegayan would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 1 at NCTS Finegayan would result in less than significant impacts to nearshore waters.

Wetlands. No wetland areas would be affected by operational activities associated with Alternative 1 as no delineated wetland areas are located near the proposed operational areas. Therefore, operations associated with Alternative 1 at NCTS Finegayan would result in no impacts to wetlands.

<u>South Finegayan</u>

Construction

Surface Water. Under Alternative 1, proposed housing/community support construction activities at South Finegayan would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, general construction BMPs (Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Proposed construction activities would not occur within the 100-year flood zone. Therefore, construction activities associated with Alternative 1 at South Finegayan would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1, proposed housing/community support construction activities at South Finegayan would include surface water protection measures that would also serve to protect groundwater quality. These BMPs and follow-on measures and plans would reduce the pollutant loading potential into stormwater and then thus the underlying groundwater subbasins. Therefore, construction activities associated with Alternative 1 at South Finegayan would result in less than significant impacts to groundwater.

Nearshore Waters. Alternative 1 on South Finegayan is located well-away from the coastline; however, the entire island of Guam is classified as a coastal zone under the CZMA. Potential impacts to nearshore waters would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore, construction activities associated with Alternative 1 at South Finegayan would result in less than significant impacts to nearshore waters.

Wetlands. No wetlands are located in or near the construction areas associated with Alternative 1 on South Finegayan. Therefore, construction activities associated with Alternative 1 at South Finegayan would result in no impacts to wetlands.

Operation

Surface Water. Under Alternative 1, the total amount of impervious area at South Finegayan would increase by 290 ac (117 ha). This increase from 3.0% to 100% impervious area, for a total of 290 ac (117 ha), would result in an associated increase in stormwater discharge intensities and volume. This area would not be entirely converted to impervious area (i.e., unpaved open areas between buildings would be present). However, an increase to 100% impervious area for South Finegayan is assumed for this analysis and represents the maximum environmental adverse impact scenario. This increase would result in an associated substantial increase in stormwater discharge intensities and volume for South Finegayan. However, this increase would be accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm event, in order to minimize impacts to surface waters. Stormwater flow paths would continue to mimic pre-development flows through area topography.

Alternative 1 would be conducted in accordance with all applicable orders, laws, and regulations including the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks. In addition, outside non-fire training activities would not include the use of pyrotechnics, ammunition, or simulated ammunition, and the indoor small arms range operation would be confined to the interior of the facility; therefore, no surface water quality impacts from non-fire training operations would occur.

Alternative 1 at South Finegayan would also include the incorporation of LID into the final planning, design, and permitting of the stormwater runoff and drainage design, as described in detail in Section 4.2.2.1, Andersen AFB Surface Water. Selected IMPs would reduce flow peaks, intercept flows resulting from all levels of rainfall intensities, and provide water quality treatment. Example control practices that could be a part of LID technologies could include integrated pest management, native plant landscaping, avoidance of pesticides and fertilizers, implementation of household hazardous waste collection programs, and the use of transit/shuttle programs to minimize single occupancy vehicles and their related pollutants. These and other water quality protection measures would control or attenuate residential stormwater runoff before stormwater would enter ponding basins and recharging underlying groundwater resources. The combination of LID technologies and compliance with federal and GovGuam regulations would ensure that less than significant impacts to the storm drainage system, nearby receiving water bodies, and the underlying groundwater resources would result from Alternative 1. Alternative 1 would be conducted in accordance with all applicable orders, laws, and regulations (see Table 3.1-1, Volume 8), including the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Therefore, operations associated with Alternative 1 at South Finegayan would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1 at South Finegayan, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality. Therefore, operations associated with Alternative 1 at South Finegayan would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 1 at South Finegayan would result in less than significant impacts to nearshore waters.

Wetlands. There are no known wetland areas near the proposed operational areas. Therefore, operations associated with Alternative 1 at South Finegayan would result in no impacts to wetlands.

Non-DoD Land

Non-DoD land in the north consists of former FAA parcel and the Harmon Annex for Alternative 1. For each alternative evaluated, the amount of non-DoD land varies, yet for the purpose of this resource area the proposed activities at non-DoD land are the same for all action alternatives. The former FAA parcel would be a part of the main cantonment as described in the Finegayan sub-section above and the Harmon Annex would be used for housing/community support.

Construction

Surface Water. The potential impacts to surface water on non-DoD land resulting from proposed cantonment, housing/community support, and non-fire training facility construction activities would be similar to the impacts discussed in Section 4.2.2.1, South Finegayan, Surface Water. Therefore, construction activities associated with Alternative 1 on non-DoD land would result in less than significant impacts to surface water.

Groundwater. The potential impacts to groundwater on non-DoD land resulting from proposed cantonment, housing/community support, and non-fire training facility construction would be similar to the impacts discussed in Section 4.2.2.1, South Finegayan, Groundwater. Therefore, construction activities associated with Alternative 1 on non-DoD land would result in less than significant impacts to groundwater.

Nearshore Waters. The potential impacts to nearshore waters adjacent to non-DoD land resulting from proposed cantonment, housing/community support, and non-fire training facility construction would be similar to the impacts discussed in Section 4.2.2.1, South Finegayan, Nearshore Waters. Therefore, construction activities associated with Alternative 1 on non-DoD land would result in less than significant impacts to nearshore waters.

Wetlands. No wetlands are located in the non-DoD land project area. Therefore, construction associated with Alternative 1 on non-DoD land would result in no impacts to wetlands.

Operation

Surface Water. The operational phase of Alternative 1 at the former FAA parcel and Harmon Annex would include the development of approximately 680 ac (275 ha) and 326 ac (132 ha), respectively, resulting in 100% impervious surface for both parcels. While these areas would not be entirely converted to impervious area (i.e., unpaved open areas between buildings would be present), an increase to 100% impervious area for these two parcels is assumed for this analysis and represents the maximum environmental adverse impact scenario. This increase would result in an associated significant increase in stormwater discharge intensities and volume for both parcels. However, this increase would be accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm event in order to minimize impacts to surface waters. Stormwater flow paths would continue to mimic pre-development flows through area topography.

Implementation of Alternative 1 on non-DoD land would be in compliance with all federal, GovGuam, and military orders, laws, and regulations (see Table 3.1-1, in Volume 8), as well as include the implementation of BMPs, Plans, and LID. The combination of LID technologies, residential pollution control measures, and compliance with federal and GovGuam regulations and implementation of BMPs and stormwater management plans would ensure that less than significant impacts to the storm drainage system, nearby receiving water bodies, and underlying groundwater resources would result from Alternative 1. In addition, outside non-fire training activities would not include the use of pyrotechnics, ammunition, or simulated ammunition, and the indoor small arms range operation would be confined to the interior of the facility; therefore, no surface water quality impacts from non-fire training operations would occur. Therefore, operations associated with Alternative 1 on non-DoD land would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1 on non-DoD land, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality. Therefore, operations associated with Alternative 1 on non-DoD land would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam’s Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 1 on non-DoD land would result in less than significant impacts to nearshore waters.

Wetlands. No wetlands are located in the non-DoD land project area. Therefore, operations associated with Alternative 1 on non-DoD land would result in no impacts to wetlands.

4.2.2.2 Central

Andersen South

Two site plans have been developed for the training range complex and supporting facilities at Andersen South, reflecting slight differences in configuration. In general terms from a water resources impact perspective, potential impacts from implementing either alternative would be nearly identical. Thus, the following impact analysis addresses potential impacts from these alternative plans as the same for water resources under both construction and operation activities.

Construction

Surface Water. Under Alternative 1, proposed construction activities for non-fire training facilities (consisting of MOUT Complexes, Maneuver Training Areas, Advanced Motor Vehicle Operators Course, two landing zones, fencing, and gates) at Andersen South would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, general construction BMPs (see Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Proposed construction activities would not occur within the 100-year flood zone. Therefore, construction activities associated with Alternative 1 at Andersen South would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1, construction activities for non-fire training facilities at Andersen South would include surface water protection measures that would also serve to protect groundwater quality. These BMPs and follow-on measures and plans would reduce the pollutant loading potential into stormwater and thus the underlying groundwater subbasins. Therefore, construction activities associated with Alternative 1 at Andersen South would result in less than significant impacts to groundwater.

Nearshore Waters. Implementation of Alternative 1 at Andersen South would occur > 0.5 mi (0.8 km) from the coastline, yet the entire island of Guam is classified as a coastal zone under the CZMA. Due to the proximity of the activity, Alternative 1 has the potential to impact nearshore water resources. These potential impacts would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore, construction activities associated with Alternative 1 at Andersen South would result in less than significant impacts to nearshore waters.

Wetlands. No known wetlands are located in or near the construction areas associated with Alternative 1 on Andersen South. Therefore, construction activities associated with Alternative 1 at Andersen South would result in no impacts to wetlands. This finding will be confirmed once additional information is obtained through the planned remote-sensing wetlands delineation. Results should be available for the Final EIS.

Operation

This analysis assumes that proposed aviation training activity (flight operations) associated with the two new landing zones at Andersen South would have no impact to water resources as flight operations are not expected to intersect water resources.

Surface Water. The operational phase of proposed non-fire training operations of Alternative 1 at Andersen South would result in a minor increase in the area of impervious surface as a result of training buildings and complexes, which would result in an associated relatively minor increase in stormwater discharge intensities and volume. This increase would be minor and would be accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm, in order to minimize impacts to surface waters. Stormwater flow paths would continue to mimic pre-development flows through area topography. Alternative 1 would include the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks.

Proposed training activities would include vehicle movement, foot traffic, amphibious warfare exercises, the use of pyrotechnics, and simulated weapons firing. As a result of such activities, the following potential surface water quality impacts may occur: contamination of surface drainage areas from runoff; contaminant accumulation in waters from leaks or spills of POLs and hazardous materials; situation and formation of sediment plumes; and heavy metal and hazardous materials leaching from munitions and explosives of concern (MEC). In addition, the low volume use of pyrotechnics during training activities could result in a potential for a very small amount of remaining, non-consumed material to remain in the remaining explosive case. However, these residual compounds would not present a significant threat to water quality due to their relatively low volume of use and large areal extent in which they would be used. Furthermore, existing BMPs governing the use of pyrotechnics would be followed to reduce the potential for indirect water quality impacts.

Governing procedures for the use of training areas, ranges, and airspace operated and controlled by the Commander U.S. Naval Forces, Marianas including instruction and procedures for the use of Guam is included in COMNAV Marianas Instruction 3500.4 (Marianas Training Handbook [COMNAV Marianas 2000]). This guidance identifies specific land use constraints to enable protection of environmental resources during military training, and would be followed during training activities. Implementation of Alternative 1 at Andersen South would be in compliance with all federal, GovGuam, and military orders, laws, and regulations (see Table 3.1-1, in Volume 8), as well as the implementation of BMPs and LID measures. Regulatory compliance and implementation of protective measures and plans would minimize potential impacts to surface water resources. Therefore, operations associated with Alternative 1 at Andersen South would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1 at Andersen South, proposed non-fire training operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality. The increase in impervious surface cover would result in a reduction in local groundwater recharge rates and volumes as the previously undeveloped, higher-infiltration capacity soil is covered with impermeable surfaces. However, through the implementation of BMPs and LID measures, the goal is to approximate the existing hydrology and thus minimize the potential for a reduction in localized groundwater recharge rates and in turn, a reduction in groundwater feeder flow to springs and seeps. While rainfall falling on a developed site would no longer reach the groundwater basin directly below the now-developed area, through the implementation of BMPs and LID measures, runoff would flow to groundwater recharge areas and/or surface water features in the vicinity, thus likely resulting in little impact to area groundwater recharge rates and volumes and in turn, stream flows. Therefore, operations associated with Alternative 1 at Andersen South would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 1 at Andersen South would result in less than significant impacts to nearshore waters.

Wetlands. No delineated wetland areas are located near the proposed operational areas.Therefore, operations associated with Alternative 1 at Andersen South would result in no impacts to wetlands. This finding will be confirmed once additional information is obtained through the planned remote-sensing wetlands delineation. Results should be available for the Final EIS.

<u>Non-DoD Land</u>

Construction

Surface Water. Under Alternative A for the training range complex, proposed construction, including ranges, range control buildings, access roads, bridges, fences, and gates on non-DoD land (Route 15 lands) in the central area, would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. Furthermore, the movement of nearly 323,000 cubic yards (CY) (247,000 cubic meters) of soils to relocate a 1.7-mi (2.8-km) segment of Route 15, and the associated importing of 65,000 CY (50,000 cubic meters) of soil for the range complex would increase the potential for soil to reach drainages during transport, potentially leading to a increase in sediment loading in surface waters. To minimize these potential impacts, general construction BMPs (Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Proposed construction activities would not occur within the 100-year flood zone. Therefore, construction activities associated with this alternative would result in less than significant impacts to surface water.

Under Alternative B for the training range complex, construction impacts to surface water would be similar to those described above for Alternative A; however, Alternative B would require 1.7 million cy (1.3 million cubic meters) of fill, considerably greater than Alternative A. Conversely, the amount of road construction would be less under Alternative B as Route 15 would not be relocated. While there are differences between the two alternatives, with the application of BMPs and impact-minimization measures as described for Alternative A, potential impacts under Alternative B would be similar to those described under Alternative A. Therefore, construction activities associated with Alternative B on Route 15 lands would result in less than significant impacts to surface water.

Groundwater. Training range complex construction activities on non-DoD land (Route 15 lands) in the central area would include surface water protection measures that would also serve to protect groundwater quality. These BMPs and follow-on measures and plans would reduce the pollutant loading potential into stormwater and then thus the underlying groundwater subbasins. Therefore, construction activities associated with Route 15 lands would result in less than significant impacts to groundwater.

Nearshore Waters. Proposed firing range complex construction activities on non-DoD land (Route 15 lands) in the central area would be adjacent to the coastline, and the entire island of Guam is classified as a coastal zone under the CZMA. Due to the proximity of the activity, Alternative 1 has the potential to impact nearshore water resources. These potential impacts would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore, construction activities associated with Alternative 1 on Route 15 lands would result in less than significant impacts to nearshore waters.

Wetlands. No known wetlands are located in or near the construction areas associated with Alternative 1 on non-DoD land in the central area. Therefore, construction activities associated with Alternative 1 on Route 15 lands would result in no impacts to wetlands. This finding will be confirmed once additional information is obtained through the planned remote-sensing wetlands delineation. Results should be available for the Final EIS.

Operation

Surface Water. The operational phase of Alternative 1 on non-DoD land in the central area would result in a minor increase in the area of impervious surface as a result of training buildings and complexes, which would result in an associated relatively minor increase in stormwater discharge intensities and volume. This increase would be minor and would be accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm event in order to minimize impacts to surface waters. Stormwater flow paths would continue to mimic pre-development flows through area topography. Alternative 1 would include the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks.

Proposed training activities would include the use of explosives and weapons firing. As a result of such activities, the following potential surface water quality impacts may occur: contamination of surface drainage areas from runoff; contaminant accumulation in waters from leaks or spills of POLs and hazardous materials; situation and formation of sediment plumes; and heavy metal and hazardous materials leaching from MEC. Standard range maintenance activities and range management BMPs (e.g., lead mining) would reduce the potential for lead or other contaminants to reach receiving water bodies. In addition, the low volume use of explosives during training activities could result in a potential for a very small amount of remaining, non-consumed material to remain in the remaining explosive case. However, these residual compounds would not present a significant threat to water quality due to their relatively low volume of use and large areal extent in which they would be used. Furthermore, existing BMPs governing the use of explosives, ammunition, and pyrotechnics would be followed to reduce the potential for indirect water quality impacts.

Implementation of Alternative 1 on non-DoD land in the central area would be in compliance with all federal, GovGuam, and military orders, laws, and regulations, including COMNAV Marianas Instruction 3500.4 (see Table 3.1-1 in Volume 8), as well as the implementation of BMPs and LID. Regulatory compliance and implementation of protective measures and plans would minimize potential impacts to surface water resources. Therefore, operations associated with Alternative 1 on Route 15 lands in the central area would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality. The increase in impervious surface cover would result in a reduction in local groundwater recharge rates and volumes as the previously undeveloped, higher-infiltration capacity soil is covered with impermeable surfaces. However, through the implementation of BMPs and LID measures, the goal is to approximate the existing hydrology and thus minimize the potential for a reduction in localized groundwater recharge rates and in turn a reduction in groundwater feeder flow to springs and seeps. While rainfall falling on a developed site would no longer reach the groundwater basin directly below the now developed area , through the implementation of BMPs and LID measures, runoff would flow to groundwater recharge areas and/or surface water features in the vicinity, thus likely resulting in little impact to area groundwater recharge rates and volumes and in turn, stream flows. Therefore, operations associated with Alternative 1 on Route 15 lands in the central area would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with the SWMP and all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy.

As shown in Figure 2.3-16 in Volume 2, Chapter 2, the Surface Danger Zone (SDZ) associated with the training range complex would overlap nearshore waters by 4,439 ac (1,796 ha) and 6,003 ac (2,429 ha), respectively. There is a very small chance that an expended projectile would fall outside of the range footprint, within the SDZ. There would be an even smaller chance for an expended projectile to fall within the nearshore water portion of the SDZ. Due to its larger size, there would be a slightly greater chance for an expended projectile to fall within the nearshore water SDZ associated with Alternative B. However, due to the small number of potential projectiles that could fall into the nearshore SDZ and the relatively small size of the projectiles, potential impacts to nearshore water quality from these projectiles would be negligible under both alternatives for the training range complex. Therefore, operations associated with Alternative 1 on Route 15 lands in the central area would result in less than significant impacts to nearshore waters.

Wetlands. No delineated wetland areas are located near the proposed operational areas. Therefore, operations associated with Alternative 1 on Route 15 lands in the central area would result in no impacts to wetlands. This finding will be confirmed once additional information is obtained through the planned remote-sensing wetlands delineation. Results should be available for the Final EIS.

Barrigada

Navy Barrigada

Alternative 1 would not occur at Navy Barrigada; there would be no construction or operations at this location. Therefore, Alternative 1 at Navy Barrigada would result in no impacts to water resources.

Air Force Barrigada

Alternative 1 would not occur at Air Force Barrigada; there would be no construction or operations at this location. Therefore, Alternative 1 at Air Force Barrigada would result in no impacts to water resources.

4.2.2.3 Apra Harbor

Harbor

This discussion of potential impacts to water resources at Apra Harbor focuses on potential impacts to nearshore waters and wetlands specific to Apra Harbor, with a focus on potential impacts from proposed dredging activities. Potential impacts to surface water resources and groundwater resources are discussed under Naval Main Base.

Construction

Nearshore Waters. Under Alternative 1, proposed wharf improvements may disturb existing lead and PCB-containing material potentially in the wharfs. Prior to starting improvements, the wharf would be inspected for such materials; any discovered materials would be removed in accordance with all applicable regulations to ensure that there would be no impacts to water resources. Wharf improvements at Victor/Uniform Wharves to support amphibious assault vehicle ships and high speed vessels would involve the replacement of sheetpile bulkheads and other upgrades required to meet seismic and typhoon design standards. Localized and temporary increases in turbidity and total suspended solids are anticipated as a result of in-water wharf repair activities, including the placement (driving) of sheetpiles. Similarly, wharf strengthening at Sierra/Tango Wharves, in order to support escort combatant ships, would also have temporary localized impacts on nearshore waters from in-water construction work. Upon completion of construction, water quality is expected to return to pre-construction conditions and would not be significant.

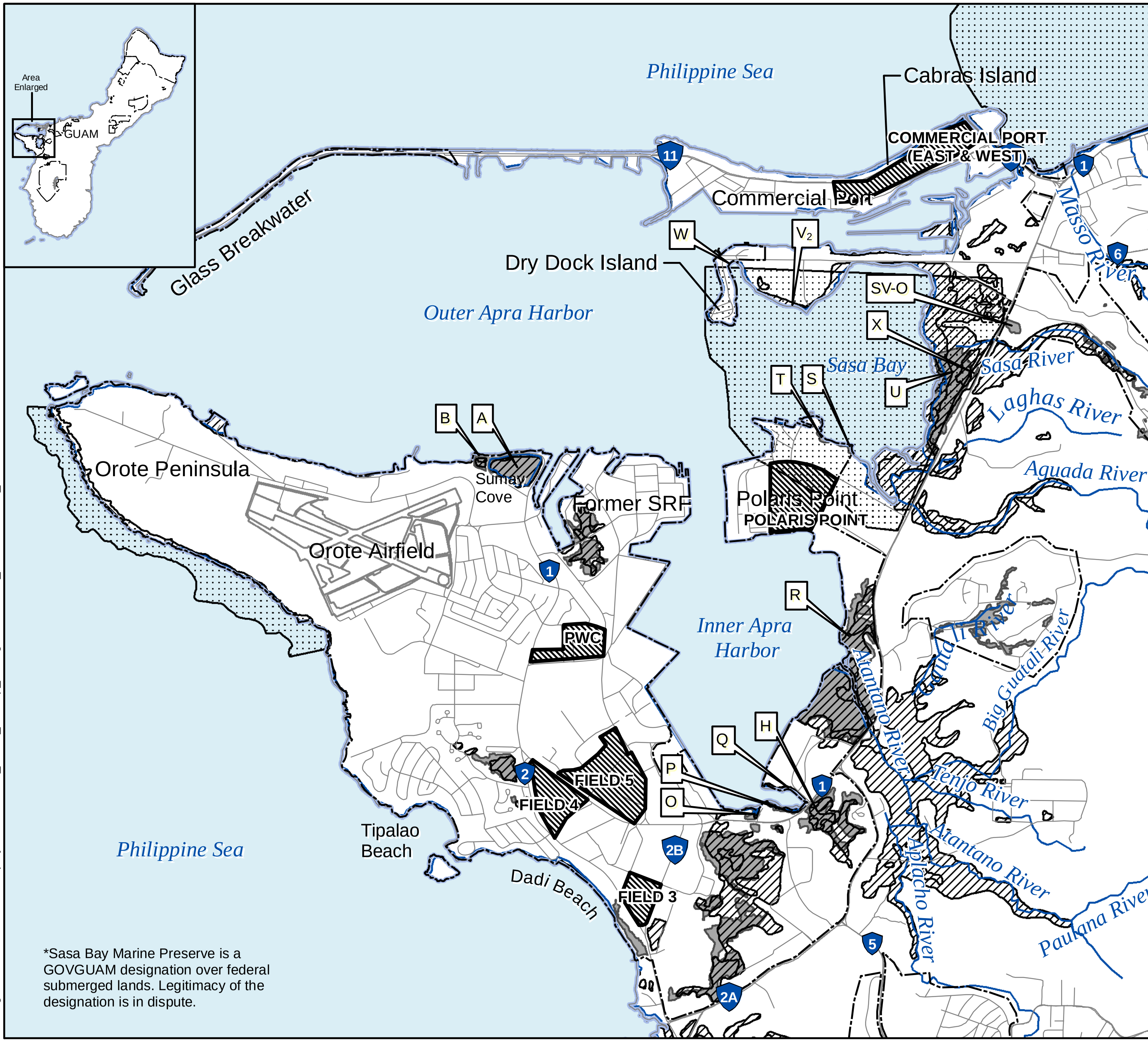
Under Alternative 1, the placement of precast concrete sections below the water line and the paving of the intertidal areas would result in localized impacts to nearshore water quality from resuspended sediment; however, these localized impacts would be minimized by implementing BMPs. Assuming an extreme tidal range of 3.5 ft and the additional 3 ft proposed to extend below mean low water, the approximately square footage of paved intertidal area for each ramp would be approximately 712.7 ft^2 and 150 ft^2 for a total paved intertidal area of 862.5 ft^2. Upon completion of construction, water quality is expected to return to pre-construction conditions. The remaining construction activities would be limited to the upland area and would be conducted in accordance with all applicable stormwater and erosion and sediment control regulations. As a result, they are not anticipated to have any impact on nearshore waters.

The proposed upgrades to Papa/Oscar Wharves to support U.S. Coast Guard (USCG) relocation would not require demolition or replacement of the support structure. Wharf improvement contractors would ensure that construction debris generated by nearshore and above water construction work would not enter or impact navigable waters. All applicable local, state and federal certifications and permits would be obtained prior to construction, including: Department of Army permit under Section 10 of the Rivers and Harbors Act, Section 404 of the CWA and GEPA, and Section 401 WQC.

Contaminated runoff or spills and leaks would have the potential to be transported, or directly released, to nearshore waters during construction activities in and adjacent to Apra Harbor. However, the OPA that mandates the implementation of the SPCC Plan would reduce the potential for spills and leaks of POLs and hazardous materials. As discussed in the above sub-section, Surface Water, all federal, GovGuam, and military orders, laws, and regulations, as well as protective measures such as the implementation of BMPs and the LID Plan, would be followed, which would also serve to reduce potential impacts to nearshore waters.

Under Alternative 1, the total dredged volume from Inner Apra Harbor (adjacent to Sierra and Tango Wharves) would be approximately 508,900 CY (386,000 cubic meters), including the overdredged material. Dredging would cover an area of approximately 0.2 mi^2 (0.5 km^2) and would remove approximately 5 ft (1.3 m) of substate including overdredged material deepening the area from -35 ft (-11 m) to -40 ft (-12 m). There is a potential to utilize dredged materials for beneficial purpose(s), including landfill cover, road base, backfill, beach re-nourishment, etc. Beneficial reuse is preferred and would be examined on a case-by-case basis. However, for the purposes of this analysis, the EIS/OEIS conservatively assumes that all dredged sediments would be placed at one of five potential upland sites at Naval Base Guam (Figure 4.2-1) for dewatering and reuse, or placed in a USEPA-approved Ocean

Figure 4.2-1
Potential Dredge Upland Placement Sites and Water Resources, Apra Harbor



*Sasa Bay Marine Preserve is a GOVGUAM designation over federal submerged lands. Legitimacy of the designation is in dispute.

Legend

- Military Installation
- Route Number
- Delineated Wetland
- NWI - Indicated Wetland
- *Marine Preserve/ Ecological Area
- Stream
- Highlighted Wetland
- Upland Placement Sites

Sources: NAVFAC Marianas 1998 unpublished data and USFWS 2009

N E S W

Feet 0 1,875 3,750
Meters 0 500 1,000

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Dredged Material Disposal Site (ODMDS) for Guam, or a combination of the two approaches (i.e., ocean disposal and upland placement). If a portion of the dredged sediments are utilized for beneficial reuse, then potential impacts at either of the analyzed disposal options would be reduced by an associated percentage. The receiver of any dredged material for a beneficial use would be responsible for any disposal or reuse. The EIS/OEIS impact analysis considers four scenarios for the placement of dredged material: 100% disposal in a proposed ODMDS, 100% disposal upland, 100% beneficial reuse, and 20-25% beneficial reuse/75-80% ocean disposal. The following sections present an analysis of the potential impacts to nearshore waters from proposed dredging activity.

Physical Impacts to Nearshore Waters from Dredging. Nearshore water quality would be temporarily impacted by turbidity and sediment generated during the dredging process. Dredged materials would be transported to existing upland disposal sites for dewatering or disposed of at an offshore site, if available and the dredged material is determined to be suitable.

Due to the fine-grained quality of the sediment, mechanical dredging using a traditional clamshell bucket would be used for analysis because it represents the maximum adverse environmental impact scenario in terms of water quality impacts. However, the use of an enclosed (i.e., environmental) bucket may required by permitting agencies to reduce the resuspension of sediments. Bucket dredges usually excavate a heaped bucket of dredged material, but during hoisting turbulence washes away part of the load. Once the bucket clears the water surface, additional losses may occur through rapid drainage of entrapped water and slumping of the material heaped above the rim of the bucket. The fit and condition of the bucket, the hoisting speed, and the properties of the sediment also influence loss of material (SAIC 2001).

The primary physical impact from mechanical dredging involves a disturbance to the marine environment that generally leads to re-suspension of sediments and increases in turbidity that could adversely affect marine corals and filter-feeding invertebrates. Selection and operation of the type of dredge as well as the type of sediment being dredged affect the degree of adverse impacts during dredging. Sediment loss to the water column reduces the efficiency of the dredging process, increases the size of the residual sediment plume, and compounds the impacts to the marine environment. The source of the suspended sediment plume is the sediment loss that occurs throughout the dredging process. The mechanical disturbance applied to the sediment, the ambient currents, and the composition of the sediment determines the magnitude of this loss (SAIC 2001).

The nature, degree, and extent of sediment re-suspension around a dredging operation are controlled by many factors including: the particle size distribution, solids concentration, and composition of the dredged material; the dredge type and size, operational procedures used; and finally the characteristics of the receiving water in the vicinity of the operation, including seawater density, turbidity, and hydrodynamic forces (i.e., waves, currents, etc.) causing vertical and horizontal mixing. The relative importance of the different factors would vary significantly from site to site (SAIC 2001).

Even under ideal conditions, substantial losses of loose and fine sediments would usually occur. Sediment loss during a typical mechanical bucket dredging operation occurs throughout the water column from the following specific sources: impact of the bucket on the seabed; material disturbance during bucket closing and removal from the bed; material spillage from the bucket during hoisting; material washed from the outer surfaces of the bucket during hoisting; leakage and dripping during bucket swinging; aerosol formation during bucket re-entry; and residual material washed during bucket lowering (SAIC 2001).

Based on limited measurements, it appears that, depending on current velocities, the uncontrolled turbidity plume downstream of a typical clamshell operation may extend approximately 990 ft (302 m) at the surface and 1,650 ft (503 m) near the bottom. Maximum concentrations of suspended solids in the surface plume should be <0.5 ppt in the immediate vicinity of the operation and decrease rapidly with distance from the operation due to settling and dilution of the material. Average water-column concentrations should generally be <0.1 ppt. The near-bottom plume would probably have a higher solids concentration, indicating that re-suspension of bottom material near the clamshell impact point is probably the primary source of turbidity in the lower water column. The visible near-surface plume would probably dissipate rapidly within an hour or two after the operation ceases (SAIC 2001).

A primary influence on the plume is the composition of the sediment. If the sediment is sand, for instance, material released to the water column quickly settles out. Fine grained, silty sediment produces higher turbidity and would remain suspended in the water column while being subject to advection and diffusion, resulting in a larger plume footprint. It has been demonstrated that elevated suspended solids concentrations are generally confined to the immediate vicinity of the dredge or discharge point and dissipate rapidly at the completion of the operation (SAIC 2001). Sediment grain size analyses conducted for a Construction Dredging Feasibility Study at Charlie, Sierra and SRF Wharves indicates that sediments in the area of the navigation channel and proposed turning basin consists primarily of sand and gravel with silty sediments being found along the proposed berthing areas (NAVFAC Pacific 2006).

The fine grain size of the material to be dredged at Sierra Wharf indicates that resuspended sediment would be slower to settle out of the water column when compared to Outer Harbor sediments. Mobile marine life would be able to avoid the sediment plume; however, sessile species would likely be removed by the dredging action and could become smothered during sediment settling.

Dredging of Inner Apra Harbor and subsequent handling of the dredged materials would require Section 404(b) and Section 10 of the Rivers and Harbors Act permits from the USACE and WQC from the GEPA. These permits would stipulate procedures and mitigation requirements. Elevation of 1 Nephalometric Turbidity Unit or 10% total suspended solids (TSS) over ambient conditions represents an exceedance of water quality standards for the project area, which is designated as M-2 or an area of “Good” water quality. Historically, the use of silt curtains and other potential mitigation measures have been implemented during dredging operations in Apra Harbor in order to protect corals and filter-feeding invertebrates by limiting the lateral dispersion of the dredged sediments. Dispersion modeling of suspended sediment from dredging activities in Apra Harbor was conducted in March 2009 as part of the CVN berthing study and a detailed summary is included in Appendix D of Volume 9 (Ericksen 2009). Input parameters utilized for the model included: dredging production rate, percent bucket loss (TSS load), current patterns, sediment grain size distribution, water depth, and dredge location. The effects of silt curtains on TSS was also considered based on data collected during the previous dredging of Alpha-Bravo wharves. For that dredging project, TSS and turbidity was monitored both inside and outside of the silt curtain for 145 days. The results of the monitoring determined that the average TSS levels outside of the silt curtain were only 10% of the level inside the curtain (i.e., silt curtains retained 90% of the material inside). Possible maximum adverse environmental conditions were simulated by approximating the highest 10% TSS levels recorded outside of the silt curtain during the Alpha-Bravo dredging project, during strong trade wind conditions. Model runs were completed for nine different locations throughout the project area. The results of the modeling were that surface turbidity plumes exceeding background levels of 3 mg/L were generally predicted to occur only directly at the dredge site. Bottom plume concentrations exceeding the background levels of 3 mg/L typically extended 262 to 394 ft (80 to 120 m,) from the dredge site. The plumes rapidly dissipated following dredging.

Under Alternative 1, similar controls would be implemented to prevent sediments from migrating beyond the action area, including silt containment, and frequent monitoring during construction to ensure the effectiveness of suspended sediment containment would be performed. Any exceedances of water quality standards would result in the interruption of the construction activities until the TSS levels returned to acceptable levels. The sedimentation controls would prevent significant impacts to aquatic communities and water quality outside of the action area.

Chemical Impacts to Nearshore Waters from Dredging. Resuspended sediment plumes may have chemical impacts on water quality by increasing the biological oxygen demand of the water column that could affect marine organisms, both on the seabed and in the water column as a result of a decrease in dissolved oxygen (DO). In addition, since contaminants have a tendency to adhere to sediment particles, a portion of the chemical burdens in the sediment would be released into the water column.

DO reduction due to dredging is a function of the amount of resuspended sediment in the water column, the oxygen demand of the sediment, and the duration of resuspension (LaSalle et al. 1991). Studies have indicated wide variations in DO levels associated with dredging from minimal, or no measurable reduction, to large reductions in DO levels (USACE 1998). The release of organic rich sediments during dredging or dredged material disposal can result in the localized removal of oxygen from the surrounding water. The resuspension of this material creates turbid conditions and decreases photosynthesis. The combination of decreased photosynthesis and the release of organic material with high biological oxygen demand can result in short-term oxygen depletion to aquatic resources (Nightingale and Simenstad 2001b in NOAA 2008). According to Herbich (2000), elevated suspended solids concentrations, and subsequent impacts on DO levels, are generally confined to the immediate vicinity of the dredge or discharge point and dissipate rapidly at the completion of the operation.

Contaminants are sequestered in the TOC fraction of sediments (USEPA 2003a in NOAA 2008, USEPA 2003b in NOAA 2008, USEPA 2003c in NOAA 2008). Dredging and disposal causes resuspension of the sediments into the water column and the contaminants that may be associated with the sediment particles. The disturbance of bottom sediments during dredging can release metals (e.g., lead, zinc, mercury, cadmium, copper), hydrocarbons (e.g., PAHs), hydrophobic organics (e.g., dioxins), pesticides, pathogens, and nutrients into the water column and allow these substances to become biologically available either in the water column or through trophic transfer (Wilbur and Pentony 1999 in NOAA 2008, USEPA 2000 in NOAA 2008, Nightingale and Simenstad 2001b in NOAA 2008).

Sediment grain size analyses conducted for a Construction Dredging Feasibility Study at Charlie, Sierra and SRF Wharves indicates that sediments in the area of Sierra Wharf consists primarily of fine grained materials with relatively high amounts of TOC (≤ 0.17 % dry weight) (NAVFAC Pacific 2006). As a result, these sediments have a higher potential to temporarily release contaminants to the water column and reduce DO when resuspended by dredging. Ambient water quality conditions are expected to return shortly after the completion of dredging, however, based on historical practices, controls would be implemented to prevent sediments from migrating beyond the action area, including silt containment and frequent monitoring of effectiveness of suspended sediment containment. The sedimentation controls would prevent significant impacts to aquatic communities and water quality outside of the action area.

Physical Impacts of Ocean Disposal of Sediment. There is the possibility that an ODMDS would be available for the placement of dredged material generated by this project should the dredged material pass chemical testing parameters for ocean disposal. A detailed discussion of the ODMDS is contained in the EIS for the ODMDS designation (USEPA 2009a).

There are a number of physical water quality effects resulting from the ocean disposal of dredged material. These effects include elevated suspended material concentration during hopper dumping, resuspension of sediments by currents, and a change in dredged sediment characteristics (size distribution or sorting coefficient) versus adjacent unaffected areas. The extent of suspended materials concentrations increase during and after hopper dumping at open water disposal sites has been studied by transmissometer. NOAA (1974; 1975b,c in Navy 2004) showed that the suspended material concentration returned to ambient levels in both surface and near-bottom waters in under one hour.

As part of the Ocean Current Study conducted by Weston (NAVFAC Pacific 2007), the distribution of sediment during disposal activities was modeled using SSFATE. The modeling of a single disposal event predicted coarse grained material to settle to the seafloor within 32 hours of the disposal event, with gravel material settling directly beneath the disposal site and sand material being deposited within 4.1 nautical miles (nm) (7.6 km), nearly radially, of the disposal site. Only a small percentage of the fine-grained material settled within the time limits of the model, with silt and clay deposits predicted over the entire area (219 square nm [nm^2] [752 km^2]).

As the current data would suggest, the footprint of material deposited on the seafloor is elongated toward the northeast having a width of 6.5 nm (12.0 km) and a length of 8.1 nm (15.0 km). This is most evident in the disposal of fine-grained material that would tend to stay in suspension the longest. At the proposed ODMDS, the footprint of deposits thicker than 0.04 inch (1 millimeter) is contained within a bathymetric depression, in depths of approximately 8,530 ft (2,600 m) at the disposal site and shoaling at the northwestern, northeastern and southeastern edges of the footprint to about 7,220 ft (2,200 m).

The possibility of resuspension of dumped sediments has been studied at open water disposal sites (SAIC 1980, 1989) as part of the disposal area monitoring system monitoring. Generally, these studies have found that ocean disposal mounds sited within depositional areas at proper depth were quite stable even during storm events. As a result, there would be no significant impacts to nearshore waters from the disposal of dredged material at an ODMDS.

Chemical Impacts of Ocean Disposal of Sediment. As part of monitoring studies of disposal sites in Long Island Sound (CT/NY), chemical measurements suggested that only minor and transient alterations in the water column occurred during hopper discharges. As expected the redox potential (Eh), pH, turbidity, DO, suspended or volatile solids all showed some seasonal variation in concentration but no consistent patterns relative to disposal site proximity were noted (NOAA 1974 in Navy 2004; 1975a,b,c,d,e in Navy 2004; 1976a,b in Navy 2004). The DO concentration in near-bottom waters only decreased 30%, returning to pre-disposal levels in less than 40 minutes (NOAA 1975b in Navy 2004). The pH was reduced very slightly after a hopper discharge but returned to pre-placement values in less than 30 minutes. Surface turbidity in the barge wake quickly disappeared. Suspended and volatile solids increased dramatically in near-bottom waters following a hopper dump but returned to background values in less than 33 minutes (NOAA 1975c in Navy 2004). Occasionally there were transient and slight increases in TOC within 1 mi (1.6 km) of the disposal buoy (NOAA 1975b in Navy 2004). Water column currents aid in the dissipation of any chemical effect. Given relatively high currents in the water column over the proposed ODMDS, the chemical effects of hopper discharge are expected to disperse rapidly and the ambient conditions return shortly after disposal.

Dredged material disposal is expected to produce temporary and localized impacts at the proposed ODMDS, including increased turbidity and decreased light transmittance due to the suspension of sediments (finer-grained silts and clays). The degree of suspension of sediments from dredged material disposal depends on four main variables; size, density and quality of the dredged material; method of disposal; hydrodynamic regime of disposal area; and ambient water quality and characteristics of the disposal site. During suspension and settling, changes in physical and chemical conditions may lead to the desorption of particulate-bound contaminants into the water column. Potential toxicity and bioaccumulation could potentially result from biologically available, desorbed heavy metals and anthropogenic organics. Dissolved contaminants may in turn be sequestered from the water column by mechanisms such as the re-adsorption (onto sediment particles which eventually settle out of the water column), precipitation processes, redox transformations, uptake by aquatic life, degradation, and volatilization. The release of organic-rich sediments during disposal into environments adapted to low nutrient conditions can also result in eutrophication effects such as the localized confiscation of oxygen in the surrounding water column.

All material would be tested for the presence of contaminants as well as the potential for toxicity and bioaccumulation prior to dredging using national testing guidance (USEPA and USACE 1991). Numerical modeling may be conducted using chemistry concentrations of proposed dredged material to determine the diluted concentration of potential contaminants in the water column. These modeled results would be compared to water quality criteria to determine suitability for ocean disposal. Only dredged material deemed suitable under these protocols would be permitted for disposal at an ODMDS. Screening of the dredged material would ensure that no significant effects to water quality would result from the ocean disposal of the dredged material at the ODMDS.

Overall, potential impacts on water quality from suitable dredged material permitted for ocean disposal at the ODMDS site are expected to be transient and localized (i.e., contained within the overall boundary of the disposal site) within four hours of the initial disposal activity (USEPA 2009a). Significant dilution is expected to mitigate any potential impacts caused by sediments remaining in suspension beyond the boundary of the disposal site for longer than four hours. With the implementation of potential mitigation measures as identified in Section 4.2.2.6, construction activities associated with Alternative 1 at Apra Harbor would result in less than significant impacts to nearshore waters.

Impacts of Upland Placement Site Placement to Nearshore Waters. During most rainfall events, stormwater runoff from within the upland placement facilities is not expected; however, during extended periods of intense rain, infiltration rates may be exceeded and temporary discharge of stormwater may occur. Stormwater runoff could flow to the Inner Apra Harbor, Outer Apra Harbor or the Pacific Ocean, depending on the upland placement site chosen. In NAVFAC Pacific (2005), the stormwater effluent constituents of concern identified were ammonia as nitrogen, copper, cyanide, mercury, total sulfide, and tributyltin. Predicted concentrations of these analytes, except tributyltin, would require dilution at the discharge point to attain the GEPA chronic marine standards. Total sulfide concentrations would require the greatest dilution (a factor of 9). Based on the analysis, GEPA chronic marine WQS would be met at 9.5 ft (2.9 m) from the discharge point. According to GEPA (GEPA 2001), mixing zones (i.e., dilution of effluent at receiving water as treatment) may be permitted during the NPDES permit process on a case-by-case basis after analysis of the nature of the effluent. A mixing zone that provides a 9:1 dilution would reduce all contaminant concentrations to below GWQS.

The potential impacts associated with Polaris Point upland placement site are addressed in *Final Environmental Assessment Inner Apra Harbor Dredging, Guam* (Navy 2003). This document stated there would be no significant impact to nearshore waters. It stated that there would be a return flow and runoff from the upland placement site to the Inner Apra Harbor. The length of the mixing zone associated with contaminants, except ammonia-N would be less than 10 ft (3 m). To meet the Guam marine WQS for ammonia-N, a mixing zone of approximately 1,400 ft (427 m) would be required. Management controls for discharge would include controlling weir height and water retention, and water quality monitoring. Discharges would be temporary and not anticipated to disrupt the use of the water body. The potential impacts associated with upland placement sites, Field 3 and Field 5 are discussed in *Environmental*

Assessment Alpha-Bravo Wharves Improvement, Apra Harbor Naval Complex, Guam, Mariana Islands (Navy 2006). This document states that there would be minor construction phase impacts to nearshore waters, yet the GWQS would be met.

The dredged material would be dewatered in accordance with USACE and Guam permitting requirements. Therefore, with the implementation of mitigation measures as identified in Section 4.1.2.4, construction activities associated with Alternative 1 would result in less than significant impacts to nearshore waters.

Wetlands. During dredging activities, there is the potential for sediment to increase turbidity in the vicinity of harbor wetlands. The nearest wetlands to the dredging operations in Inner Apra Harbor are the Atantano Wetlands located approximately 2,000 ft (610 m) east of the nearest extent of proposed dredging operations (Figure 4.2-2). Other wetland areas (Wetland Areas O, P, and Q) located in the south/southeastern portion of Inner Apra Harbor are located approximately 3,600 ft (1,098 m) at their nearest extent to proposed dredging operations (see Figure 4.2-2).

Silt curtains and other potential mitigation measures would be used, consistent with past dredging operations in Apra Harbor, to protect sensitive areas including wetlands. While no direct impact (i.e., loss of wetland area) would occur, activities associated with Alternative 1 could temporarily impact the function of the wetland areas. For example, dredge activities could introduce additional sediment into the water column which could then (depending on the currents) be transported to wetland areas where it could settle out in the wetland area. However, these potential impacts would be lessened due to the implementation of dredging BMPs and associated potential mitigation measures, distance to the wetlands, and the prevailing currents (i.e., the prevailing surface water motion in Inner Apra Harbor is generally westward, away from the wetland areas). Therefore, construction activities associated with Alternative 1 at Naval Base Guam would result in less than significant impacts to wetlands.

Operation

Nearshore Waters. Due to the frequency and duration of the amphibious task force visits, the ships require more shoreside utility support than is currently provided. There would be utility, infrastructure and wharf improvements at Victor, Uniform and Sierra Wharves to allow the ships to turn-off all onboard utility systems and rely entirely on shoreside systems for wastewater and bilge oily waste treatment system. A new bilge oily waste treatment system facility would be constructed at Victor Wharf but serve other wharves including Sierra and Uniform Wharves. As a result the increase in bilge oily waste would have no impact on nearshore water quality as it would be properly treated and disposed of.

The landing craft air cushion vessels and amphibious assault vehicles would be washed on wash racks. While the final design of the wash system is pending, the facility would include sedimentation, oil/water separator/filter pressure buster pumps and pressure, and filters. The wastewater from the system would then be discharged into the sanitary sewer. Therefore, operations associated with Alternative 1 at the Apra Harbor area would result in less than significant impacts to nearshore waters.

Wetlands. The construction and operation water treatment systems would not affect wetland areas in Inner Apra Harbor. Therefore, operations associated with Alternative 1 at the Apra Harbor area would result in no impacts to wetlands.

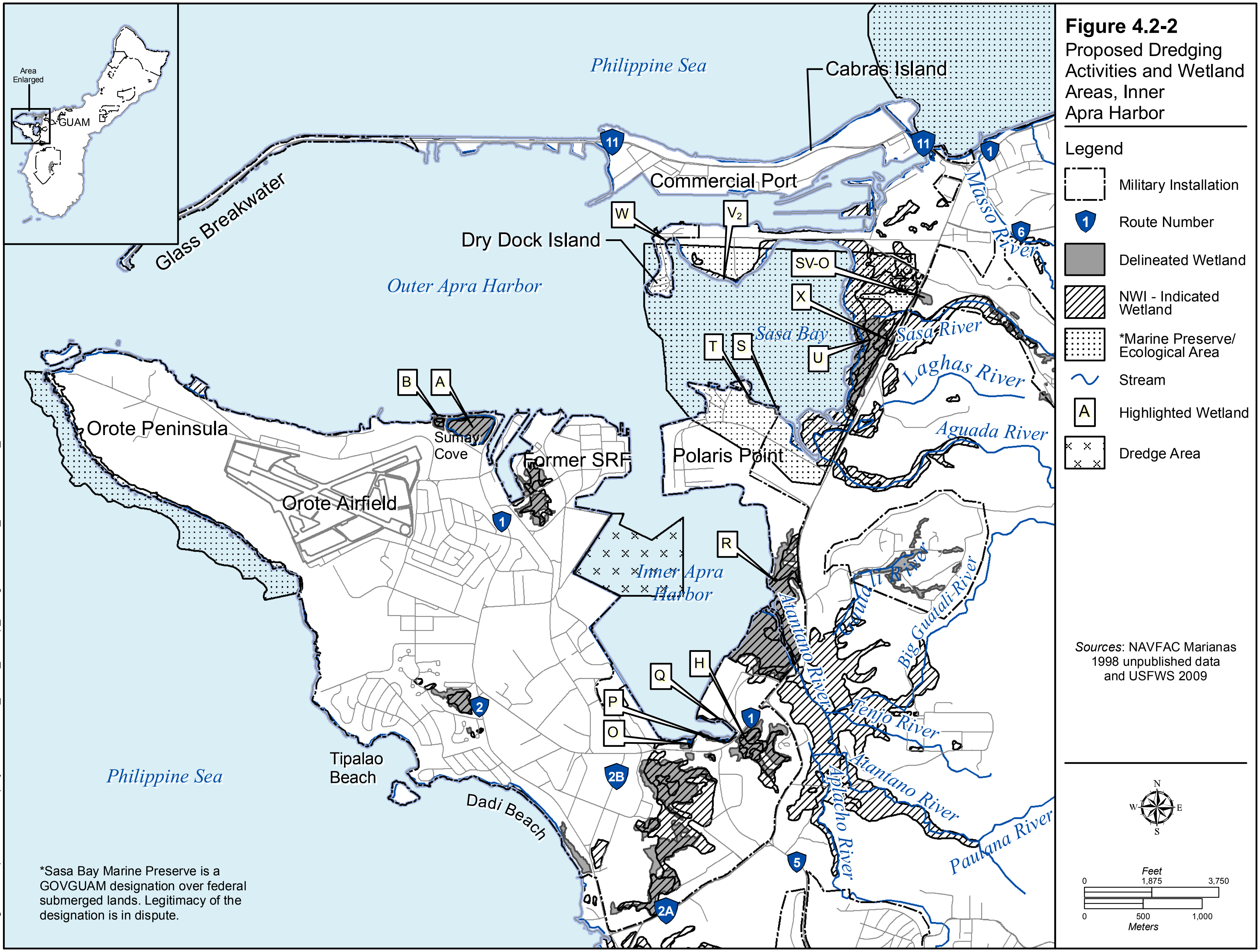

Figure 4.2-2
Proposed Dredging Activities and Wetland Areas, Inner Apra Harbor

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Naval Base Guam

Construction

Surface Water. Under Alternative 1, proposed construction of the embarkation facility, landing craft air cushion vessel parking area, medical/dental complex, MWDK relocation area, and USCG cutter support facilities would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, general construction BMPs (see Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts.

The closest proposed construction activity in support of waterfront functions would be located more than 1,500 ft (457 m) from any of the four streams that flow into Apra Harbor. Due to the lack of close proximity to the streams, implementation of Alternative 1 is not anticipated to directly impact these streams. However, during the construction phase of the proposed project, there is a potential to increase the amount of sediment in the runoff that could eventually flow into area streams. The sediment can transport other constituents such as nutrients, heavy metals, organic and inorganic compounds, and detrimental microorganisms. In addition, there is an increased potential for leaks and spills of POLs or other contaminants from equipment. To minimize these potential impacts, construction-specific BMPs (see Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and water quality impacts. Proposed construction activities would not occur within the 100-year flood zone.

Under Alternative 1, dredged material would be placed in upland placement facilities, bounded by confinement dikes or structures to enclose the disposal area, thereby isolating the dredged material from its surrounding environment. Five potential upland placement facilities have been identified at Naval Base Guam, none of which would be located on a surface water feature (refer to Figure 4.2-1). Upland placement facilities would consist of a fully diked area located above the water line and out of wetland areas. Following placement of dredged material, the sediments would be allowed to consolidate, settle, and dewater. Water would evaporate or percolate into the ground.

Water generated from mechanically dredged material (i.e., effluent) would not require discharge because infiltration rates of the foundation soils are greater than effluent production rates (NAVFAC Pacific 2005). To facilitate rapid infiltration, trenches would be constructed to allow water to reach foundation soils. The exterior slope of the dredge upland placement facility berms would be seeded with grass to minimize erosion. Based on recent Inner Apra Harbor maintenance dredged material placement experience that used the same dredging and dredged material handling methods, little water would accumulate in the upland placement sites. Therefore, construction activities associated with Alternative 1 at Naval Base Guam would result in less than significant impacts to surface water.

Groundwater. Although the project area at Naval Base Guam is located over 4 mi (7 km) west of the NGLA, spills and leaks from POLs or hazardous materials would have the potential to impact groundwater quality in the project area. The BMPs and follow-on measures and plans identified under the surface water discussion would also serve to protect groundwater quality in the area. Therefore, construction activities associated with Alternative 1 at Naval Base Guam would result in less than significant impacts to groundwater.

Nearshore Waters. During construction operations under Alternative 1 at Naval Base Guam, contaminated runoff or spills and leaks could be transported to or directly released to nearshore waters. However, the OPA that mandates the implementation of the SPCC Plan would reduce the potential for spills and leaks of POLs and hazardous materials. As discussed in the above sub-section, Surface Water, all federal, GovGuam, and military orders, laws, and regulations, as well as protective measures such as the implementation of BMPs and the LID Plan, would be followed, which would also serve to reduce potential impacts to nearshore waters. Therefore, construction activities associated with Alternative 1 at Naval Base Guam would result in less than significant impacts to nearshore waters.

Wetlands. Known wetland areas are at least approximately 250 ft (76 m) from the construction areas associated with Alternative 1 at Naval Base Guam and even further from potential dredged material upland placement sites (see Figure 4.2-1); therefore no direct impacts to wetlands would occur during construction activity. Potential indirect impacts are not likely due to implementation of surface water BMPs. Therefore, construction activities associated with Alternative 1 at Naval Base Guam would result in no impacts to wetlands.

Operation

This analysis assumes that proposed aviation training activity (flight operations) associated with the Orote Landing Zone at Naval Base Guam would have no effect on water resources. Consequently, no impact analysis of flight operations on water resources was conducted.

Surface Water. Under Alternative 1, the total amount of impervious area at Naval Base Guam would increase by approximately 16 ac (6 ha) from 14.7% to 15.2% impervious area, for a total of 520 ac (211 ha). This increase of 0.5% impervious area would result in an associated relatively minor increase in stormwater discharge intensities and volume. This increase would be accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm event, in order to minimize impacts to surface waters. Stormwater flow paths would continue to mimic pre-development flows through area topography. Furthermore, stormwater would be pre-treated to remove contaminants prior to discharge into the harbor, as detailed in a design-phase plan that would cover the entire project area.

Alternative 1 would be conducted in accordance with all applicable orders, laws, and regulations, including the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks. Alternative 1 at Naval Base Guam would also include the incorporation of LID into the final planning, design, and permitting of the stormwater runoff and drainage design, as described in detail in Section 4.2.2.1, Andersen AFB Surface Water. Selected IMPs would reduce flow peaks, intercept flows resulting from all levels of rainfall intensities, and provide water quality treatment.

Implementation of Alternative 1 at Naval Base Guam would be in compliance with all federal, GovGuam, and military orders, laws, and regulations (refer to Table 3.1-1, Volume 8), as well as the implementation of BMPs and LID. Regulatory compliance and implementation of protective measures and plans would minimize potential impacts to surface water resources. Therefore, operations associated with Alternative 1 at Naval Base Guam would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1 at Naval Base Guam, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect local groundwater quality. Therefore, operations associated with Alternative 1 at Naval Base Guam would result in no significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 1 at Naval Base Guam would result in less than significant impacts to nearshore waters.

Wetlands. No wetland areas would be affected by operational activities associated with Alternative 1 as no delineated wetland areas are located near the proposed operational areas. Therefore, operations associated with Alternative 1 at Naval Base Guam would result in no impacts to wetlands.

4.2.2.4 South

Naval Munitions Site

Construction

Surface Water. Under Alternative 1, proposed munitions storage and non-fire training construction activities at the NMS would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, general construction BMPs (see Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Therefore, construction activities associated with Alternative 1 at NMS would result in less than significant impacts to surface water.

Groundwater. Although southern Guam is volcanic rock with low permeability, spills and leaks from POLs or hazardous materials have the potential to impact local groundwater basins. Under Alternative 1, construction activities would include surface water protection measures that would also serve to protect groundwater quality. These BMPs and follow-on measures would reduce the pollutant loading potential into stormwater and, thus, groundwater. Therefore, construction activities associated with Alternative 1 at NMS would result in less than significant impacts to groundwater.

Nearshore Waters. Construction activities associated with Alternative 1 would occur more than 1 mi (1.6 km) from the coastline. Due to the distance of the activity, the activity would not result in direct impacts to the nearshore waters, but could potentially indirectly impact nearshore water resources. These potential impacts would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore, construction activities associated with Alternative 1 at NMS would result in less than significant impacts to nearshore waters.

Wetlands. Based on the original conceptual drawings for the magazines under Option 1 (Parsons Road Area) and Option 2 (High Road Area) direct impacts (fill) of wetland areas would have occurred. In the course of analyzing potential impacts, the EIS/OEIS team recognized this potential impact and also the potential opportunity to shift the footprint of the magazines slightly to avoid wetland areas. After considering this potential change in design, planners determined it was possible to shift the magazines slightly to avoid direct impacts to Wetland Area 52 and the NWI-indicated wetland area (Figure 4.2-3). This revision resulted in avoiding 0.68 ac (0.28 ha) and 0.04 ac (0.01 ha) of direct impacts to wetland areas under Option 2 and 1, respectively. This finding will be confirmed once additional information is obtained through the planned remote-sensing wetlands delineation. Results should be available for the FEIS.

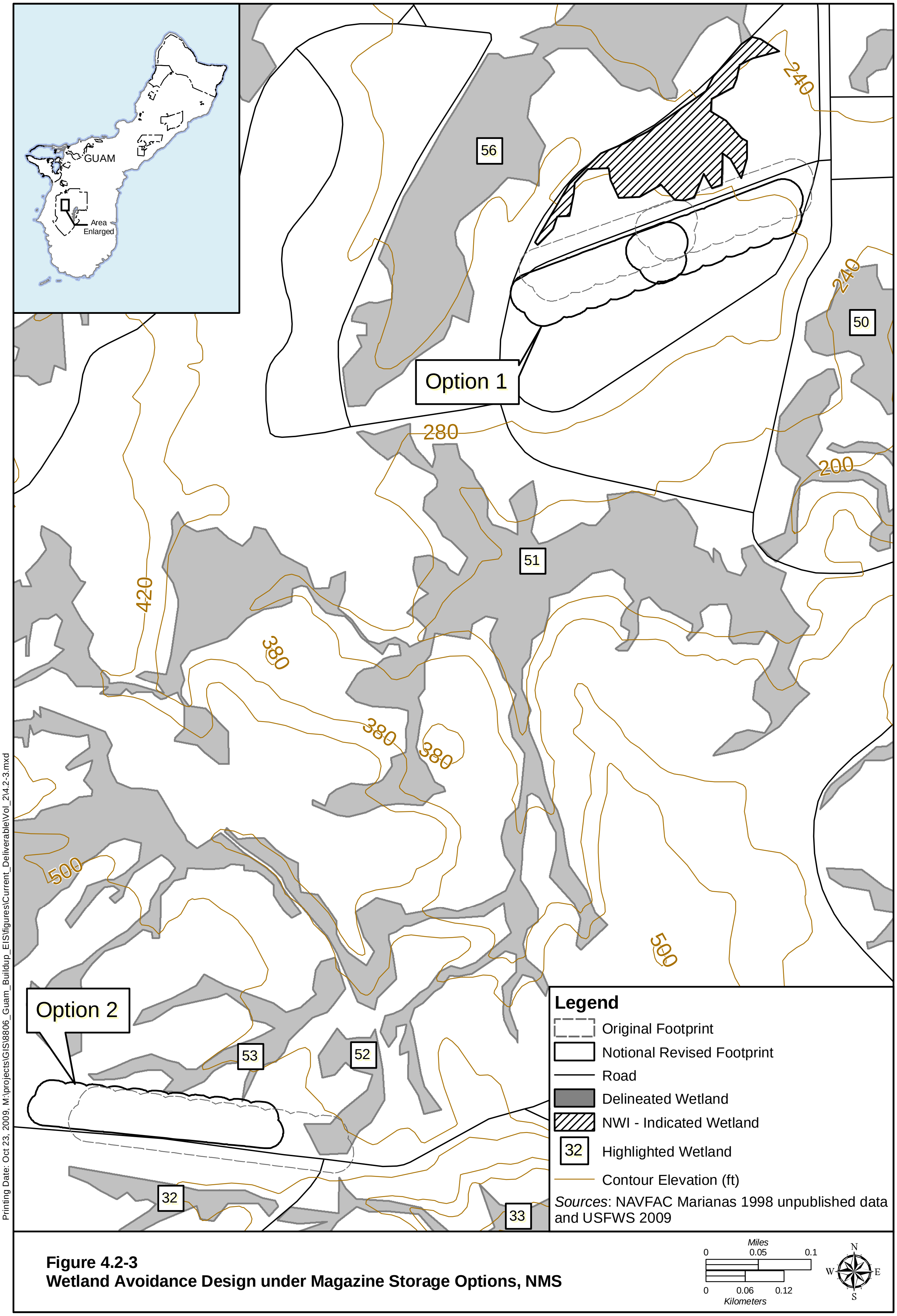

Figure 4.2-3
Wetland Avoidance Design under Magazine Storage Options, NMS

During construction, indirect impacts to nearby wetland areas (i.e., 32, 33, 52, 53, 50, 51, and 56) would be minimized by incorporating site-specific appropriate BMPs (see Table 4.2-1) which would reduce the potential for construction impacts to these wetland areas. Therefore, Alternative 1 at NMS would result in less than significant impacts to wetlands.

Operation

This analysis assumes that proposed aviation training activity (flight operations) with the four new landing zones at NMS would have no effect on water resources. Consequently, no impact analysis of flight operations on water resources was conducted.

Surface Water. No live fire maneuver training would occur at NMS and the majority of the maneuver training area is located south and downgradient of Fena Reservoir. The grass-covered magazines would not alter existing stormwater runoff volumes due to their surface cover consistency with the surrounding vegetation. Stormwater flow paths would continue to mimic pre-development flows through area topography. In addition, the Navy plans to conduct a Watershed Assessment of Fena Reservoir, which would include a follow-on watershed management plan. The results of the assessment and elements of the watershed management plan will be incorporated into future interations of this EIS/OEIS.

Alternative 1 would be implemented in accordance with all applicable orders, laws, and regulations, including the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks.

Proposed foot, wheeled, and tracked vehicle traffic near and through numerous surface water drainage feature crossings throughout the southern portion of NMS has the potential to result in localized, temporary impacts to surface water quality. To avoid excess sediment entering into stream channels, buffer zones would be established to prohibit training within 100 ft (30 m) of the stream channel except at designated crossings. Upon completion of transit through the stream crossing, any localized impacts to water quality would dissipate and revert to pre-disturbance conditions. There would be no anticipated long-term impairment to surface water drainage feature function due to the localized, temporary, and BMP-governed nature of operations in and around the surface water crossings.

Proposed training activities would also include the use of explosives. As a result of such activities, the following potential surface water quality impacts may occur: contamination of surface drainage areas from runoff; contaminant accumulation in waters from leaks or spills of POLs and hazardous materials; situation and formation of sediment plumes; and heavy metal and hazardous materials leaching from MEC. In addition, the low volume use of explosives during training activities could result in a potential for a very small amount of remaining, non-consumed material to remain in the remaining explosive case. However, these residual compounds would not present a significant threat to water quality due to their relatively low volume of use and large areal extent in which they would be used. Furthermore, existing BMPs governing the use of explosives and pyrotechnics would be followed to reduce the potential for indirect water quality impacts.

Implementation of Alternative 1 at Andersen South would be in compliance with all federal, GovGuam, and military orders, laws, and regulations (refer to Table 3.1-1, Volume 8), including COMNAV Marianas Instruction 3500.4, as well as the implementation of BMPs. Regulatory compliance and implementation of protective measures and plans would minimize potential impacts to surface water resources. Therefore, operations associated with Alternative 1 at NMS would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality. As noted in the baseline section, the increase in impervious surface cover would result in a reduction in local groundwater recharge rates and volumes as the previously undeveloped, higher-infiltration capacity soil is covered with impermeable surfaces. However, through the implementation of BMPs and LID measures, the goal is to approximate the existing hydrology and thus minimize the potential for a reduction in localized groundwater recharge rates and in turn a reduction in groundwater feeder flow to springs and seeps. While rainfall falling on a to-be-developed site would no longer reach the groundwater basin directly below the developed area, through the implementation of BMPs and LID measures, runoff would flow to groundwater recharge areas and/or surface water features in the vicinity, thus likely resulting in little impact to area groundwater recharge rates and volumes and in turn, stream flows. At NMS, the increase in impervious area would be minor, and LID measures would ensure that stormwater flow paths would continue to mimic pre-development flows, thus reducing the potential impact on groundwater recharge and surface base flow. Therefore, operations associated with Alternative 1 at NMS would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam’s Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 1 at NMS would result in less than significant impacts to nearshore waters.

Wetlands. Post-construction, wetland areas would potentially be subject to localized, temporary impacts from training traffic (i.e., foot traffic). However, existing training protocols encourage the avoidance of wetland areas. Vehicle traffic would avoid wetland areas during training activities. While short-term minor impacts to wetlands could occur from personnel operations, impacts would be less than significant due to the transient and low-impact nature of the activity. Surface water quality measures identified above would reduce the potential for contaminants from explosives and pyrotechnics from impacting wetland quality of function.

Both magazine storage alternatives would be constructed with earthen vegetated covers. This would reduce the potential for a change in surface water hydrology in the area as the resulting cover would be similar to surrounding vegetation and thus, minimize the potential for indirect impacts to adjacent wetlands. In addition, transient training operations would not alter the water flow to wetland areas; therefore, no indirect operational impacts to wetland areas are anticipated. Therefore, operations associated with Alternative 1 at NMS would result in less than significant impacts to wetlands.

Non-DoD Land

Construction

Under Alternative 1, either Access Road alternative A or B would be used. Under Access Road Alternative A, the existing trail would be improved, i.e., paved. Under Access Road Alternative B, no construction would occur. Therefore, no construction impacts to water resources would occur under Access Road Alternative B.

Surface Water. Under Access Road Alternative A, general construction BMPs (Section 4.1, Volume 1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and water quality impacts.

Therefore, access road construction activities associated with Alternative 1 on non-DoD land would result in less than significant impacts to surface water.

Groundwater. Although southern Guam is volcanic rock with low permeability, spills and leaks from POLs or hazardous materials during access road construction activities associated with Access Road Alternative A would have the potential to impact local groundwater basins. Under Alternative 1, access road construction activities would include surface water protection measures that would also serve to protect groundwater quality. These BMPs and follow-on measures would reduce the pollutant loading potential into stormwater and then thus the underlying groundwater subbasins. Therefore, access road construction activities associated with Alternative 1 on non-DoD land would result in less than significant impacts to groundwater.

Nearshore Waters. Construction activities associated with Alternative 1 would occur more than 1 mi (0.7 km) from the coastline. Due to the distance of the activity, the activity would not result in direct impacts to the nearshore waters, but could potentially indirectly impact nearshore water resources. These potential impacts would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore, access road construction activities associated with Alternative 1 on non-DoD land would result in less than significant impacts to nearshore waters.

Wetlands. No wetland areas would be affected by construction activities associated with Alternative 1, Access Road Alternative A as no delineated wetland areas are located in the existing roadway. Therefore, access road construction activities associated with Alternative 1 on non-DoD lands would result in no impacts to wetlands.

Operation

As part of proposed operations, under Access Road Alternative A the existing trail would be improved (paved) and receive about the same level of use as it does currently. However, under Aceess Road Alternative B, the trail would not be improved but the trail would get more use. However, the additional use under Alternative B would result in no impacts to water resources. Therefore, the following operation impact analysis focuses on potential operation impacts associated with Access Road Alternative A.

Surface Water. The operational phase of Alternative 1 on non-DoD lands would result in a minor increase in stormwater runoff due to changing the land cover to a more impervious surface for the improved road. This alteration would result in an associated nearly negligible increase in stormwater discharge intensities and volume. Stormwater flow paths would continue to mimic pre-development flows through area topography.

Implementation of Alternative 1 would be in compliance with all federal, GovGuam, and military orders, laws, and regulations (refer to Table 3.1-1, Volume 8), including COMNAV Marianas Instruction 3500.4. Regulatory compliance and implementation of protective measures and plans would minimize potential impacts to surface water resources. Therefore, operations associated with Alternative 1 on non-DoD land would result in less than significant impacts to surface water.

Groundwater. Under Alternative 1, proposed operations would be in compliance with the water protection measures identified in the Surface Water section above during operations, which would therefore also protect groundwater quality. Therefore, operations associated with Alternative 1 on non-DoD land would result in less than significant impacts to groundwater.

Nearshore Waters. Operations would comply with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 1 on non-DoD land would result in less than significant impacts to nearshore waters.

Wetlands. No wetland areas would be directly affected by operational activities associated with Alternative 1 as no delineated wetland areas are located near the proposed operational areas. No changes in surface hydrology are expected, and thus, indirect impacts to wetlands are not anticipated. Therefore, operations associated with Alternative 1 on non-DoD land would result in no impacts to wetlands.

4.2.2.5 Summary of Impacts

With the implementation of potential mitigation measures (Section 4.2.2.6 below) to compensate for direct impacts resulting from the dredging of Apra Harbor, there would be no reduction in the amount of wetlands on Guam, and there would be no reduction in the availability or accessibility of water resources. While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield and monitoring of groundwater chemistry would ensure no harm to existing or beneficial use. Increases in stormwater would be managed by stormwater infrastructure and aside from the potential for constructing six stream crossings on non-DoD land, no construction would occur in a flood zone; therefore, there would be no increase in flooding risk. Stormwater flow paths would continue to mimic area topography. Through the development and implementation of site-specific BMPs (Table 4.2-1), LID measures, and facility-specific plans and procedures, there would no increased risk from environmental hazards or to human health. Dredging-related BMPs would be the same as those discussed for Alternative 1 (Section 4.2.2.5) and are listed in Volume 7. During the dredging process, BMPs would be implemented to prevent pollutants from entering the water. Dredged material upland placement areas would be constructed and operated in accordance with all permit requirements. Project-related materials and equipment would be cleaned of pollutants prior to use in the water. A complete list of BMPs typically required by USACE dredging permit conditions is provided in Volume 7. Furthermore, all actions associated with Alternative 1 would be implemented in accordance with all applicable federal, GovGuam, and military orders, laws, and regulations (refer to Table 3.1-1, Volume 8), including COMNAV Marianas Instruction 3500.4. Therefore, with the implementation of impact avoidance and minimization measures, Alternative 1 would result in less than significant impacts to water resources.

4.2.2.6 Potential Mitigation Measures

The dredging of Inner Apra Harbor and subsequent handling of the dredged material would require Section 404(b) and Section 10 of the Rivers and Harbors Act permits from the USACE and WQC from the GEPA. These permits would stipulate procedures and mitigation requirements in addition to BMPs noted above. Examples of potential mitigation measures (from USACE 2001 and Palermo et al. 2008) include:

- Install physical barriers such as silt curtains or pneumatic (bubble) curtains.

- Dredge within seasonal windows to avoid impacts to larval coral and other sensitive aquatic species during peak spawning periods
- Avoid dredging during rough sea conditions to minimize turbidity curtain failures
- Prohibit barge overflow during dredging operations
- Limit dredging rates
- Monitor water quality

During the dredging process, potential mitigation measures as identified above would be implemented to prevent sediments from migrating beyond the action area, including silt containment measures and frequent monitoring of effectiveness of suspended sediment containment. The sedimentation controls and potential mitigation measures would prevent significant impacts to nearshore waters.

A detailed description of resource protection measures potentially required by regulatory mandates is in Volume 7. A more detailed explanation of potential regulatory permitting requirements is also available in Volume 8 (refer to Table 3.1-1).

4.2.3 Alternative 2 (Preferred Alternative)

Alternative 2 differs from Alternative 1 (Volume 2, Chapter 2, DOPAA) in the area of the main cantonment. For Alternative 2: the main cantonment, housing/community support, and non-fire training facility areas would be configured such that all facilities would be located on one contiguous parcel of land extending from NCTS Finegayan, through the former FAA parcel, and to South Finegayan. By placing all facilities on one contiguous parcel, the amount of area disturbed during construction would be slightly less than under Alternative 1, resulting in slightly less impacts to water resources under Alternative 2. However, this difference would be negligible when considered at the alternative scale. There would be no change in operations between the two alternatives. Therefore, as the discussion and analysis of potential impacts to water resources under Alternative 2 would be very similar to that provided under Alternative 1, the majority of the following impact analysis refers readers to the analysis provided under Alternative 1.

4.2.3.1 North

<u>Andersen AFB</u>

Construction

The proposed ammunition storage and airfield construction activities at Andersen AFB are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 at Andersen AFB would result in less than significant impacts to water resources.

Operation

The proposed operations at Andersen AFB are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 2 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 at Andersen AFB would result in less than significant impacts to water resources.

<u>Finegayan</u>

Under Alternative 2, construction and operational activities would occur at NCTS Finegayan and South Finegayan. Therefore, this analysis evaluates potential impacts at both locations.

NCTS Finegayan

Construction. Although some of the specific main cantonment laydown components are different and the area of development at NCTS Finegayan would be slightly larger, the proposed cantonment, housing/community support, and non-fire training facility construction activities at NCTS Finegayan under Alternative 2 are similar for those associated with Alternative 1; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 would be similar to the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 at NCTS Finegayan would result in less than significant impacts to water resources.

Operation. Under Alternative 2, the total amount of impervious area at NCTS Finegayan would increase by 2,104 ac (851 ha). This increase from 5.5% to 92.5% impervious area, for a total of 2,236 ac (905 ha) would result in an associated increase in stormwater discharge intensities and volume. However, this increase would be primarily accommodated by stormwater infrastructure and include the incorporation of LID capable of conveyance and storage of runoff associated with the 100-year storm as described under Alternative 1.

Proposed operational activities at NCTS Finegayan under Alternative 2 are similar for those associated with Alternative 1; therefore, potential operational impacts to water resources resulting from implementation of Alternative 2 would be similar to the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 at NCTS Finegayan would result in less than significant impacts to water resources.

South Finegayan

Construction. The area of development and the proposed construction activities at South Finegayan under Alternative 2 are identical to those associated with Alternative 1; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 at South Finegayan would result in less than significant impacts to water resources.

Operation. The proposed operational activities under Alternative 2 at South Finegayan are identical to those associated with Alternative 1; therefore, potential operational impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 at South Finegayan would result in less than significant impacts to water resources.

Non-DoD Land

Construction

The area of development and the proposed construction activities on non-DoD land (the former FAA parcel) under Alternative 2 are identical for those associated with Alternative 1; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1, except no construction and thus no impacts would occur at the Harmon Annex. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 on non-DoD land would result in less than significant impacts to water resources.

Operation

The proposed operational activities associated with the main cantonment laydown components on non-DoD land (the former FAA parcel) under Alternative 2 are identical to those associated with Alternative 1; therefore, potential operational impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1, except no operations and thus no impacts would occur at the Harmon Annex. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 on non-DoD land would result in less than significant impacts to water resources.

4.2.3.2 Central

Andersen South

Construction

The proposed construction activities at Andersen South are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 are identical to the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 at Andersen South would result in less than significant impacts to water resources.

Operation

The proposed operations at Andersen South are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 2 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 at Andersen South would result in less than significant impacts to water resources.

Barrigada

Navy Barrigada

Alternative 2 would not occur at Navy Barrigada; there would be no construction or operations at this location. Therefore, Alternative 2 at Navy Barrigada would result in no impacts to water resources.

Air Force Barrigada

Alternative 2 would not occur at Air Force Barrigada; there would be no construction or operations at this location. Therefore, Alternative 2 at Air Force Barrigada would result in no impacts to water resources.

Non-DoD Land

Construction

The proposed construction activities on non-DoD land (Route 15) are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 on Route 15 land would result in less than significant impacts to water resources.

Operation

The proposed operations on non-DoD land (Route 15) are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 on Route 15 land would result in less than significant impacts to water resources.

4.2.3.3 Apra Harbor

Harbor

Construction

The proposed construction activities at Apra Harbor are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, with implementation of mitigation measures as identified in Section 4.2.3.6, construction activities associated with Alternative 2 at Apra Harbor would result in less than significant impacts to water resources.

Operation

The proposed operations at Apra Harbor are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 2 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, Alternative 2 at the Apra Harbor would result in less than significant impacts to water resources.

Naval Base Guam

Construction

The proposed construction activities at Naval Base Guam are the same all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 at Naval Base Guam would result in less than significant impacts to water resources.

Operation

The proposed operations at Naval Base Guam are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 at the Naval Base Guam would result in less than significant impacts to water resources.

4.2.3.4 South

Naval Munitions Site

Construction

The proposed construction activities at NMS are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 at NMS would result in less than significant impacts to water resources.

Operation

The proposed operations at NMS are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 at NMS would result in less than significant impacts to water resources.

Non-DoD Land

Construction

Under Alternative 2, either Access Road alternative A or B would be used. Under Access Road Alternative A, the existing trail would be improved, i.e., paved. Under Access Road Alternative B, no construction would occur. Therefore, no construction impacts to water resources would occur under Access Road Alternative B.

In general, proposed access road construction activities are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1, non-DoD land. Therefore, with implementation of mitigation measures as identified in Section 4.2.3.6, access road construction activities associated with Alternative 2 on non-DoD land would result in no impacts to water resources.

Operation

The proposed operations on non-DoD land are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 on non-DoD land would result in no impacts to water resources.

4.2.3.5 Summary of Impacts

With the implementation of potential mitigation measures (refer to Section 4.2.2.6) to compensate for direct impacts resulting from the dredging of Apra Harbor , there would be no reduction in the amount of wetlands on Guam, and there would be no reduction in the availability or accessibility of water resources. While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield and monitoring of groundwater chemistry would ensure no harm to existing or beneficial useThrough the development and implementation of site-specific BMPs (see Table 4.2-1), LID measures, and facility-specific plans and procedures, there would no increased risk from environmental hazards or to human health. Dredging-related BMPs would be the same as those discussed for Alternative 1 (Section 4.2.2.5) and are listed in Volume 7. Furthermore, all actions associated with Alternative 2 would be implemented in accordance with all applicable federal, GovGuam, and military orders, laws, and regulations (Table 3.1-1, Volume 8), including COMNAV Marianas Instruction 3500.4. Therefore, Alternative 2 would result in less than significant impacts to water resources.

4.2.3.6 Potential Mitigation Measures

Potential mitigation measures for Alternative 2 would be the same as those proposed for Alternative 1. Refer to Section 4.2.2.5, Potential Mitigation Measures.

4.2.4 Alternative 3

Alternative 3 is only slightly different from Alternative 1 (refer to Volume 2); the main difference is that the proposed cantonment, housing/community support, and non-fire training facility areas would also configured such that all facilities would be spread out between NCTS Finegayan, South Finegayan, the Navy Barrigada, and the Air Force Barrigada. By constructing the facilities over several areas, the amount of area disturbed during construction would be slightly more than under Alternative 1, resulting in slightly greater impacts to water resources under Alternative 3. However, this small difference would be negligible when considered at the alternative scale. There would be no change in operations between the two alternatives. Therefore, as the discussion and analysis of potential impacts to water resources under Alternative 3 would be very similar to that provided under Alternative 1, the majority of the following impact analysis refers readers to the analysis provided under Alternative 1.

4.2.4.1 North

Andersen AFB

Construction

The proposed ammunition storage and airfield construction activities at Andersen AFB are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 3 at Andersen AFB would result in less than significant impacts to water resources.

Operation

The proposed operations at Andersen AFB are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 3 are the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 3 at Andersen AFB would result in less than significant impacts to water resources.

Finegayan

Construction

The area of development and the proposed construction activities at NCTS and South Finegayan under Alternative 3 are identical to those associated with Alternative 2; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 2. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 3 at NCTS and South Finegayan would result in less than significant impacts to water resources.

Operation

The proposed operational activities associated with the main cantonment laydown components at NCTS and South Finegayan under Alternative 3 are identical to those associated with Alternative 2; therefore, potential operational impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 2. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 3 at NCTS and South Finegayan would result in less than significant impacts to water resources.

Non-DoD Land

Alternative 3 would not occur on non-DoD land (the former FAA parcel and the Harmon Annex); there would be no construction or operations at these locations. Therefore, Alternative 3 on non-DoD land (the former FAA parcel and the Harmon Annex) would result in no impacts to water resources.

4.2.4.2 Central

Andersen South

Construction

Proposed construction activities at Andersen South are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 would be the same as to the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 3 at Andersen South would result in less than significant impacts to water resources.

Operation

The proposed operations at Andersen South are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 3 at Andersen South would result in less than significant impacts to water resources.

Barrigada

Navy Barrigada

Construction

Surface Water. Under Alternative 3, proposed cantonment, housing/community support, and non-fire training facility construction activities at Navy Barrigada would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, general construction BMPs (see Table 3.1-1, Volume 1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and water quality impacts. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Proposed construction activities would not occur within the 100-year flood zone. Therefore, construction activities associated with Alternative 3 at Navy Barrigada would result in less than significant impacts to surface water.

Groundwater. Under Alternative 3, construction activities at Navy Barrigada would include surface water protection measures that would also serve to protect groundwater quality. These BMPs and follow-on measures and plans would reduce the pollutant loading potential into stormwater and then thus the underlying groundwater subbasins. Therefore, construction activities associated with Alternative 3 at Navy Barrigada would result in less than significant impacts to groundwater.

Nearshore Waters. Construction activities associated with Alternative 3 at Navy Barrigada would occur more than 0.5 mi (0.8 km) from the coastline. Due to the distance of the activity, the activity would not result in direct impacts to the nearshore waters, but could potentially indirectly impact nearshore water resources. These potential impacts would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore, construction activities associated with Alternative 3 at Navy Barrigada would result in less than significant impacts to nearshore waters.

Wetlands. No wetlands are located in or near the construction areas associated with Alternative 3 at Navy Barrigada. This will be verified as part of an upcoming wetland investigation using remotely sensed data verified by ground truthing. Therefore, construction activities associated with Alternative 3 at Navy Barrigada would result in no impacts to wetlands.

Operation

Surface Water. Under Alternative 3, the total amount of impervious area at Navy Barrigada would increase by 377 ac (153 ha). This increase from approximately 0.35% to 27.4% impervious area, for a total of 382 ac (155 ha), would result in an associated increase in stormwater discharge intensities and volume. This increase would be primarily accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm. Stormwater flow paths would continue to mimic pre-development flows through area topography.

Alternative 3 would be conducted in accordance with all applicable orders, laws, and regulations, including the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks. In addition, outside non-fire training activities would not include the use of pyrotechnics, ammunition, or simulated ammunition, and the indoor small arms range operation would be confined to the interior of the facility; therefore, no surface water quality impacts from non-fire training operations would occur.

Alternative 3 at Navy Barrigada would also include the incorporation of LID into the final planning, design, and permitting of the stormwater runoff and drainage design, as described in detail in Section 4.2.2.1, Andersen AFB Surface Water. Selected IMPs would reduce flow peaks, intercept flows resulting from all levels of rainfall intensities, and provide water quality treatment. Example control practices that could be a part of LID technologies could include integrated pest management, native plant landscaping, avoidance of pesticides and fertilizers, implementation of household hazardous waste collection programs, and the use of transit/shuttle programs to minimize single occupancy vehicles and their related pollutants. These and other water quality protection measures would control or attenuate residential stormwater runoff before stormwater would enter ponding basins and recharging underlying groundwater resources. The combination of LID technologies and compliance with federal and GovGuam regulations would ensure that less than significant impacts to the storm drainage system, nearby receiving water bodies, and underlying groundwater resources would result from Alternative 3. Therefore, operations associated with Alternative 3 at Navy Barrigada would result in less than significant impacts to surface water.

Groundwater. Under Alternative 3 at Navy Barrigada, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality. Therefore, operations associated with Alternative 3 at Navy Barrigada would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 3 at Navy Barrigada would result in less than significant impacts to nearshore waters.

Wetlands. No wetland areas would be affected by operational activities associated with Alternative 3 at Navy Barrigada as no delineated wetland areas are located near the proposed operational areas. All currently known delineated and potential wetland areas are located at least 1,200 ft (366 m) and across varying topography (i.e., hills and depressions) from the project area associated with Alternative 3. This will be confirmed as part of an upcoming wetland investigation using remotely sensed data verified by ground truthing. Therefore, operations associated with Alternative 3 at Navy Barrigada would result in no impacts to wetlands.

Air Force Barrigada

Construction

Surface Water. Under Alternative 3, proposed cantonment, housing/community support, and non-fire training facility construction activities at Air Force Barrigada would result in the potential for a temporary increase in stormwater runoff, erosion, and sedimentation. To minimize these potential impacts, general construction BMPs (see Table 4.2-1) would be implemented to reduce the potential for erosion, runoff, sedimentation, and water quality impacts. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual (CNMI and Guam 2006) would be included in the planning, design, and construction of all roadways. Proposed construction activities would not occur within the 100-year flood zone. Therefore, construction activities associated with Alternative 3 at Air Force Barrigada would result in less than significant impacts to surface water.

Groundwater. Under Alternative 3, construction activities at Air Force Barrigada would include surface water protection measures would also serve to protect groundwater quality. These BMPs and follow-on measures and plans would reduce the pollutant loading potential into stormwater and then thus the underlying groundwater subbasins. Therefore, construction activities associated with Alternative 3 at Air Force Barrigada would result in less than significant impacts to groundwater.

Nearshore Waters. Construction activities associated with Alternative 3 at Air Force Barrigada would occur less than 0.5 mi (0.8 km) from the coastline. Due to the distance of the activity, the activity would not result in direct impacts to the nearshore waters, but could potentially indirectly impact nearshore water resources. These potential impacts would be lessened through the implementation of the surface water BMPs and adherence to all applicable orders, laws, and regulations relating to water quality. Therefore, construction activities associated with Alternative 3 at Air Force Barrigada would result in less than significant impacts to nearshore waters.

Wetlands. Implementation of Alternative 3 would result in direct impacts to Wetland Area BARR-04, a 0.4 ac (0.16 ha) sinkhole wetland (Figure 4.2-4). The Navy would strive to avoid directly impacting, to the greatest extent possible, this wetland area in the design and implementation phases of Alternative 3 at Air Force Barrigada; however, for the purposes of this analysis at this time, it is assumed direct impacts would occur. During construction, indirect impacts to other nearby down-gradient wetland areas (i.e., BARR-03) would be minimized by incorporating site-specific appropriate BMPs (Volume 1, Section 4.1) that would reduce the potential for construction impacts to these wetland areas. This finding will be confirmed once additional information is obtained through the planned remote-sensing wetlands delineation. Results should be available for the Final EIS.

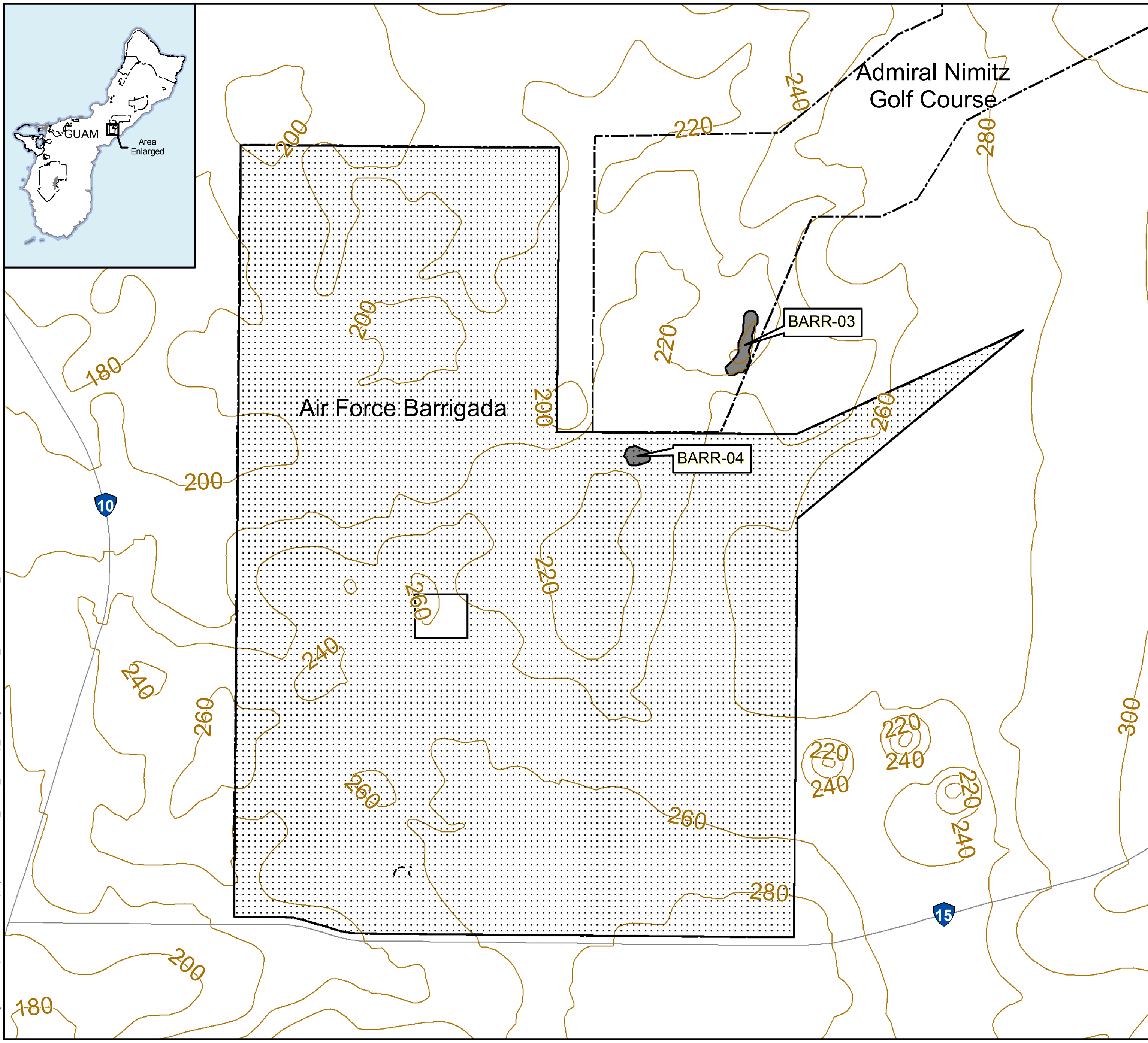

Figure 4.2-4
Project Footprint and Wetland Areas under Alternatives 3 and 8, Air Force Barrigada

Legend

- Military Installation
- Route Number
- Project Footprint
- Delineated Wetland
- Highlighted Wetland
- Contour Elevation (ft)

Sources: NAVFAC Marianas 1998 unpublished data and USFWS 2009

Feet 0 1,150 2,300
Meters 0 320 640

Printing Date: Sep 23, 2009, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_2\4.2-4.mxd

Aside from BARR-03 and BARR-04, the NWI-indicated wetland areas are not considered official wetland areas; they just indicate the potential for wetland type areas. As observations by wetland biologists did not indicate wetlands in these areas and the areas are currently devoted to agriculture activities, this analysis concludes that these potential wetland areas do not exist. Therefore, with implementation of the mitigation measures identified in Section 4.2.4.6, construction activities associated with Alternative 3 would result in less than significant impacts to water resources.

Operation

Surface Water. Under Alternative 3, the total amount of impervious area at Air Force Barrigada would increase by 430 ac (174 ha). This increase from 1.9% to 100% impervious area, for a total of 430 ac (174 ha) of impervious surface would result in an associated significant increase in stormwater discharge intensities and volume for Air Force Barrigada. This area would not be entirely converted to impervious area (i.e., unpaved open areas between buildings would be present). However, an increase to 100% in impervious area for Air Force Barrigada is assumed for this analysis and represents the maximum environmental adverse impact scenario. However, this increase would be accommodated by stormwater infrastructure capable of conveyance and storage of runoff associated with the 100-year storm. Stormwater flow paths would continue to mimic pre-development flows through area topography.

Alternative 3 would be conducted in accordance with all applicable orders, laws, and regulations, including the preparation and implementation of a SWPPP, SWMP, and SPCC Plans that would control runoff and minimize potential leaks and spills. Implementation of these protective measures would minimize potential impacts of runoff, spills and leaks. In addition, outside non-fire training activities would not include the use of pyrotechnics, ammunition, or simulated ammunition, and the indoor small arms range operation would be confined to the interior of the facility; therefore, no surface water quality impacts from non-fire training operations would occur.

Alternative 3 at Air Force Barrigada would also include the incorporation of LID into the final planning, design, and permitting of the stormwater runoff and drainage design, as described in detail in Section 4.2.2.1, Andersen AFB Surface Water. Selected IMPs would reduce flow peaks, intercept flows resulting from all levels of rainfall intensities, and provide water quality treatment. Example control practices that could be a part of LID technologies could include integrated pest management, native plant landscaping, avoidance of pesticides and fertilizers, implementation of household hazardous waste collection programs, and the use of transit/shuttle programs to minimize single occupancy vehicles and their related pollutants.

The combination of LID technologies and compliance with federal and GovGuam regulations would ensure that less than significant impacts to the storm drainage system, nearby receiving water bodies, and underlying groundwater resources would result from Alternative 3. Therefore, operations associated with Alternative 3 at Air Force Barrigada would result in less than significant impacts to surface water.

Groundwater. Under Alternative 3 at Air Force Barrigada, proposed operations would be in compliance with the water protection measures identified in the surface water section above during operations, which would therefore also protect groundwater quality. Therefore, operations associated with Alternative 3 at Air Force Barrigada would result in less than significant impacts to groundwater.

Nearshore Waters. Following construction, alterations to the watershed such as increased runoff could potentially result in direct and indirect impacts that could alter nearshore water quality including the addition of sediments, nutrients, detrimental microorganisms, heavy metals, and organic and inorganic compounds. These effects would be minimized by complying with all applicable orders, laws, and regulations. In addition, the planning process would be conducted in conjunction with the WPC. The project would also incorporate published guidance documents including but not limited to the Clean Water Action Plan, Protection and Restoring Guam's Waters, and the northern Watershed Restoration Strategy. Therefore, operations associated with Alternative 3 at Air Force Barrigada would result in less than significant impacts to nearshore waters.

Wetlands. No wetland areas would be affected by operational activities associated with Alternative 3 at Air Force Barrigada as following construction, no delineated wetland areas would be located near the proposed operational areas. Therefore, operations associated with Alternative 3 at Air Force Barrigada would result in no impacts to wetlands.

<u>Non-DoD Land</u>

Construction

The proposed construction activities on non-DoD land (Route 15) are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 3 on Route 15 lands would result in no impacts to water resources.

Operation

The proposed operations on non-DoD land (Route 15) are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 3 on Route 15 lands would result in no impacts to water resources.

4.2.4.3 Apra Harbor

<u>Harbor</u>

Construction

The proposed construction activities at Apra Harbor are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, with the implementation of mitigation measures as described in Section, 4.2.4.6, construction activities associated with Alternative 3 at Apra Harbor would result in less than significant impacts to water resources.

Operation

The proposed operations at Apra Harbor are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, Alternative 3 at the Apra Harbor would result in less than significant impacts to water resources.

<u>Naval Base Guam</u>

Construction

The proposed construction activities at Naval Base Guam are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1.

Operation

The proposed operations at Naval Base Guam are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated Alternative 3 at Naval Base Guam would result in less than significant impacts to water resources.

4.2.4.4 South

<u>Naval Munitions Site</u>

Construction

The proposed construction activities at NMS are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 3 at NMS would result in less than significant impacts to water resources.

Operation

The proposed operations at NMS are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 3 at NMS would result in less than significant impacts to water resources.

<u>Non-DoD Land</u>

Construction

Under Alternative 3, either Access Road alternative A or B would be used. Under Access Road Alternative A, the existing trail would be improved, i.e., paved. Under Access Road Alternative B, no construction would occur. Therefore, no construction impacts to water resources would occur under Access Road Alternative B.

In general, the proposed access road construction activities are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1, non-DoD land. Refer to Section 4.2.2.1. Therefore, with implementation of mitigation measures as identified in Section 4.2.4.6, access road construction activities associated with Alternative 3 on non-DoD land would result in less than significant impacts to water resources.

Operation

The proposed operations on non-DoD land are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 3 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 3 on non-DoD land would result in less than significant impacts to water resources.

4.2.4.5 Summary of Impacts

With the implementation of potential mitigation measures (refer to Section 4.2.2.6) to compensate for direct impacts resulting from the dredging of Apra Harbor, Wetland Area BARR-03 at Air Force

Barrigada, there would be no reduction in the amount of wetlands on Guam. While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield and monitoring of groundwater chemistry would ensure no harm to existing or beneficial use. Through the development and implementation of site-specific BMPs (see Table 4.2-1), LID measures, and facility-specific plans and procedures, there would no increased risk from environmental hazards or to human health. Dredging-related BMPs would be the same as those discussed for Alternative 1 (Section 4.2.2.5) and are listed in Volume 7. Furthermore, all actions associated with Alternative 3 would be implemented in accordance with all applicable federal, GovGuam, and military orders, laws, and regulations (Table 3.1-1, Volume 8), including COMNAV Marianas Instruction 3500.4. Therefore, Alternative 3 would result in less than significant impacts to water resources.

4.2.4.6 Potential Mitigation Measures

Potential mitigation measures for Alternative 3 would be the same as those proposed for Alternative 1. Refer to Section 4.2.2.6, Potential Mitigation Measures. In addition, to compensate for the potential filling of Wetland Area BARR-04, the Navy would first attempt to avoid impacts; if avoidance is not possible, then the Navy would minimize potential impacts. Potential impacts would then be mitigated, through restoring temporarily disturbed wetland areas and monitoring stream segments to determine and mitigate any loss of aquatic functions. Compensation for the unavoidable fill of the wetland area would be accomplished by creating new wetlands, restoring or enhancing existing wetlands or preserving existing wetland areas on Guam to, at a minimum, replace the area filled. The Navy would also obtain a USACE permit for actions within wetland areas and would comply with the permit requirements. If this alternative is chosen, the Navy understands that a LEDPA determination must be made as part of the permitting process.

4.2.5 Alternative 8

Alternative 8 differs from Alternative 1 (refer to Volume 2, Chapter 2) in that the main cantonment, housing/community support, and non-fire training facility areas would be configured such that all facilities would be spread out between NCTS Finegayan, the former FAA parcel, South Finegayan, and the Air Force Barrigada. By constructing the facilities over several areas, the amount of area disturbed during construction would be slightly more than under Alternative 1, resulting in slightly greater impacts to water resources under Alternative 8. However, this difference would be negligible when considered at the alternative scale. There would be no change in operations between the two alternatives. Therefore, as the discussion and analysis of potential impacts to water resources under Alternative 8 would be very similar to that provided under Alternative 1, the majority of the following impact analysis refers readers to the analysis provided under Alternative 1.

4.2.5.1 North

<u>Andersen AFB</u>

Construction

The proposed ammunition storage and airfield construction activities at Andersen AFB are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 8 at Andersen AFB would result in less than significant impacts to water resources.

Operation

The proposed operations at Andersen AFB are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 at Andersen AFB would result in less than significant impacts to water resources.

Finegayan

Construction

The area of development and the proposed construction activities under Alternative 8 are identical to those under Alternative 1; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 8 at NCTS and South Finegayan would result in less than significant impacts to water resources.

Operation

The proposed operational activities associated with the main cantonment laydown components at NCTS and South Finegayan under Alternative 8 are identical to those associated with Alternative 1;therefore, potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 at NCTS and South Finegayan would result in less than significant impacts to water resources.

Non-DoD Land

Construction

Proposed construction activities at the former FAA parcel under Alternative 8 are the same as those described under Alternative 1; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1, except no construction and thus no impacts would occur at the Harmon Annex. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 8 at the former FAA parcel would result in less than significant impacts to water resources.

Operation

Proposed operational activities at the former FAA parcel under Alternative 8 are the same as those under Alternative 1; therefore, potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1, except no operations and thus no impacts would occur at the Harmon Annex. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 at the former FAA parcel would result in less than significant impacts to water resources.

4.2.5.2 Central

Andersen South

Construction

The proposed construction activities at Andersen South are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 8 at Andersen South would result in less than significant impacts to water resources.

Operation

The proposed operations at Andersen South are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 at Andersen South would result in less than significant impacts to water resources.

Barrigada

Alternative 8 would not occur at Navy Barrigada; there would be no construction or operations. Therefore, Alternative 8 at Navy Barrigada would result in no impacts to water resources.

Construction

The proposed construction activities at Air Force Barrigada under Alternative 8 are the same as those described under Alternative 3; potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 3. Refer to Section 4.2.4.2. Therefore, with implementation of mitigation measures as identified in Section 4.2.5.6, construction activities associated with Alternative 3 at Air Force Barrigada would result in less than significant impacts to water resources.

Operation

The proposed operations at Air Force Barrigada under Alternative 8 are the same as those described under Alternative 3; potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 3. Refer to Section 4.2.4.2. Therefore, operations associated with Alternative 8 at Barrigada would result in less than significant impacts to water resources.

Non-DoD Land

Construction

The proposed construction activities on non-DoD land (Route 15) are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 8 on non-DoD land would result in less than significant impacts to water resources.

Operation

The proposed operations on non-DoD land (Route 15) are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 8, would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 on non-DoD land in the central area would result in less than significant impacts to water resources.

4.2.5.3 Apra Harbor

Harbor

Construction

The proposed construction activities at Apra Harbor are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, with implementation of mitigation measures as identified in Section 4.2.5.6, construction activities associated with Alternative 8 at Andersen South would result in less than significant impacts to water resources.

Operation

The proposed operations at Apra Harbor are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 at the Apra Harbor would result in less than significant impacts to water resources.

Naval Base Guam

Construction

The proposed construction activities at Naval Base Guam are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 8 at Naval Base Guam would result in less than significant impacts to water resources.

Operation

The proposed operations at Naval Base Guam are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 at Naval Base Guam would result in less than significant impacts to water resources.

4.2.5.4 South

Naval Munitions Site

Construction

The proposed construction activities at NMS are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 8 at the NMS would result in less than significant impacts to water resources.

Operation

The proposed operations at the NMS are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 at the NMS would result in less than significant impacts to water resources.

Non-DoD Land

Construction

Under Alternative 8, either Access Road alternative A or B would be used. Under Access Road Alternative A, the existing trail would be improved, i.e., paved. Under Access Road Alternative B, no construction would occur. Therefore, no construction impacts to water resources would occur under Access Road Alternative B.

In general, the proposed access road construction activities are the same for all action alternatives; therefore, potential construction impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1, Non-DoD Land. Refer to Section 4.2.2.1. Therefore, with implementation of mitigation measures as identified in Section 4.2.5.6, access road construction activities associated with Alternative 8 on non-DoD land would result in no impacts to water resources.

Operation

The proposed operations on non-DoD land are the same for all action alternatives; therefore, the potential operational impacts to water resources resulting from implementation of Alternative 8 would be the same as the potential impacts discussed under Alternative 1. Refer to Section 4.2.2.1. Therefore, operations associated with Alternative 8 on non-DoD land would result in no impacts to water resources.

4.2.5.5 Summary of Impacts

With the implementation of potential mitigation measures (refer to Section 4.2.2.6) to compensate for direct impacts resulting from the dredging of Apra Harbor, Wetland Area BARR-03 at Air Force Barrigada, there would be no reduction in the amount of wetlands on Guam. While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield and monitoring of groundwater chemistry would ensure no harm to existing or beneficial use. Through the development and implementation of site-specific BMPs (see Table 4.2-1), LID measures, and facility-specific plans and procedures, there would no increased risk from environmental hazards or to human health. Dredging-related BMPs would be the same as those discussed for Alternative 1 (Section 4.2.2.5) and are listed in Volume 7. Furthermore, all actions associated with Alternative 8 would be implemented in accordance with all applicable federal, GovGuam, and military orders, laws, and regulations (see Table 3.1-1, Volume 8), including COMNAV Marianas Instruction 3500.4. Therefore, Alternative 8 would result in less than significant impacts to water resources.

4.2.5.6 Potential Mitigation Measures

Potential mitigation measures for Alternative 8 would be the same as those proposed for Alternative 1. Refer to Section 4.2.2.5, Potential Mitigation Measures.

4.2.6 No-Action Alternative

4.2.6.1 Surface Water

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction or operations would occur; therefore, existing surface water conditions as presented in Section 4.1 would remain.

The identified surface water availability and quality concerns for Guam (e.g., construction-related discharges, sewage overflows, animal waste, and sediment erosion) would continue to exist. These threats to surface water would continue to be monitored by federal and Guam agencies, and appropriate regulatory action would continue to occur in order to maximize surface water quality and availability. In time, surface water quality is expected to slowly improve as point and non-point sources of pollution are identified and pollution loading to surface waters is reduced. Not relocating the Marines from Japan to Guam would not change the ongoing water quality concerns or protection actions for surface waters; these conditions and actions would continue to persist. Therefore, implementation of the no-action alternative would result in no impacts to surface water.

4.2.6.2 Groundwater

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction or operations would occur; therefore, existing groundwater conditions as presented in Section 4.1 would remain.

The identified groundwater availability and quality concerns for Guam (e.g., saltwater intrusion, leaky septic systems) would continue to exist. These threats to groundwater availability and quality would continue to be monitored by federal and Guam agencies to minimize potential impacts, and appropriate regulatory action would continue to occur in order to protect groundwater resources. Monitoring for saltwater intrusion and coordination amongst water users, as well as potential designations for groundwater resources is expected to ensure there is a dependable, safe supply of groundwater for Guam users. Not relocating the Marines from Japan to Guam would not change the on-going groundwater availability and quality concerns or the protection actions for Guam nearshore waters; these conditions and actions would continue to persist. Therefore, implementation of the no-action alternative would result in no impacts to groundwater.

4.2.6.3 Nearshore Waters

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction or operations would occur; therefore, existing nearshore conditions as presented in Section 4.1 would remain.

The identified nearshore water quality concerns for the marine waters of Guam (copper, aluminum, nickel, e*nterococci* bacteria, total residual chlorine, biochemical oxygen demand and total suspended solids) would continue to persist. These threats to nearshore water quality would continue to be monitored by federal and Guam agencies to minimize potential impacts, and appropriate regulatory action would continue to occur to protect nearshore waters. In time, nearshore water quality is expected to slowly improve as point and non-point sources of pollution are identified and pollution loading to nearshore waters is reduced. Not relocating the Marines from Japan to Guam would not change the on-going nearshore water quality concerns or the protection actions for Guam nearshore waters; these conditions and actions would continue to persist. Therefore, implementation of the no-action alternative would result in no impacts to nearshore waters.

4.2.6.4 Wetlands

Under the no-action alternative, Marine Corps units would remain in Japan and would not relocate to Guam. No construction or operations would occur; therefore, existing wetland conditions as presented in Section 4.1 would remain.

The identified primary threats to wetlands on Guam (feral ungulates, human disturbance, invasive plants species, sedimentation, and erosion) would continue to occur. These threats to wetland area and function are of concern and are therefore monitored by federal and Guam agencies to protect wetland areas. Not relocating the Marines from Japan to Guam would not change the on-going threats or protection actions for wetlands on Guam; these conditions and actions would continue to persist. Therefore, implementation of the no-action alternative would result in no impacts to wetlands.

Summary of Impacts Tables 4.2-2, 4.2-3, 4.2-4, and 4.2-5 summarize the potential impacts of each action alternative associated with the Main Cantonment, firing range training, ammunition storage, and NMS access roads. Table 4.2-6 summarizes the potential impacts of other training, airfield, and waterfront components of the proposed action. A text summary is provided below.

Table 4.2-2. Summary of Main Cantonment Impacts – Alternatives 1, 2, 3 and 8

Main Cantonment Alternative 1 (North)	*Main Cantonment Alternative 2 (North)*	*Main Cantonment Alternative 3 (North/Central)*	*Main Cantonment Alternative 8 (North/Central)*
Construction			
• SW: LSI. Potential temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach NGLA • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: NI	• SW: LSI. Potential temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach NGLA • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: NI	• SW: LSI. Potential temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach NGLA • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: SI-M. Direct impact (fill) of 0.4 ac (0.16 ha) wetland area	• SW: LSI. Potential temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach NGLA • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: SI-M. Direct impact (fill) of 0.4 ac (0.16 ha) wetland area
Operation			
• SW: LSI. Increase in stormwater intensity and volume • GW: LSI. Minor increase in aquifer recharge rates in the localized area around recharge wells; increase in pollutant loading potential; increase in annual groundwater production of 16.2 MGd (61.7 mld) • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI	• SW: LSI. Increase in stormwater intensity and volume • GW: LSI. Minor increase in aquifer recharge rates in the localized area around recharge wells; increase in pollutant loading potential; increase in annual groundwater production of 16.2 MGd (61.7 mld) • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI	• SW: LSI. Increase in stormwater intensity and volume • GW: LSI. Minor increase in aquifer recharge rates in the localized area around recharge wells; increase in pollutant loading potential; increase in annual groundwater production of 16.2 MGd (61.7 mld) • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI	• SW: LSI. Increase in stormwater intensity and volume • GW: LSI. Minor increase in aquifer recharge rates in the localized area around recharge wells; increase in pollutant loading potential; increase in annual groundwater production of 16.2 MGd (61.7 mld) • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI

Legend: SW = Surface water, GW = Groundwater, NW = Nearshore waters, WL = Wetlands, SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 4.2-3. Summary of Training Impacts – Firing Range Alternatives

Firing Range Alternative A (Central)	*Firing Range Alternative B (Central)*
Construction	
• SW: LSI. Potential for temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach NGLA • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: NI	• SW: LSI. Potential for temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach NGLA • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: NI
Operation	
• SW: LSI. Increase in stormwater intensity and volume; increase in training-related residual contaminants • GW: LSI. Increase in localized recharge rates and pollutant loading potential • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI	• SW: LSI. Increase in stormwater intensity and volume; increase in training-related residual contaminants • GW: LSI. Increase in localized recharge rates and pollutant loading potential • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI

Legend: SW = Surface water, GW = Groundwater, NW = Nearshore waters, WL = Wetlands, SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 4.2-4. Summary of Training Impacts – Ammunition Storage Alternatives

Ammunition Storage Alternative A (South)	*Ammunition Storage Alternative B (South)*
Construction	
• SW: LSI. Potential for temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach local aquifers • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: LSI. Potential for temporary changes in hydrology and pollutant loading	• SW: LSI. Potential for temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach local aquifers • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: LSI. Potential for temporary changes in hydrology and pollutant loading
Operation	
• SW: NI • GW: NI • NW: NI • WL: NI	• SW: NI • GW: NI • NW: NI • WL: NI

Legend: SW = Surface water, GW = Groundwater, NW = Nearshore waters, WL = Wetlands, SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 4.2-5. Summary of Training Impacts – NMS Access Roads Alternatives

Access Road Alternative A (South)	*Access Road Alternative B (South)*
Construction	
• SW: LSI. Potential temporary increase in stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach local aquifers • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: NI	• SW: NI • GW: NI • NW: NI • WL: NI
Operation	
• SW: LSI. Negligible increase in stormwater discharge intensities and volume • GW: LSI. Increased potential for local groundwater contamination • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI	• SW: NI • GW: NI • NW: NI • WL: NI

Legend: SW = Surface water, GW = Groundwater, NW = Nearshore waters, WL = Wetlands, SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Table 4.2-6. Summary of Other Training, Airfield, and Waterfront Component Impacts

Other Training (North/Central/South)	*Airfield (North)*	*Waterfront (Apra Harbor)*
Construction		
• SW: LSI. Potential for temporary increase in construction stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach aquifers • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: NI	• SW: LSI. Potential temporary increase in stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach local aquifers • NW: LSI. Potential minor increase in construction-related runoff and sedimentation • WL: NI	• SW: LSI. Potential temporary increase in stormwater runoff, erosion, and sedimentation • GW: LSI. Potential for construction stormwater to reach local aquifers • NW: SI-M. Potential minor increase in construction-related runoff and sedimentation; localized and temporary increases in turbidity and total suspended solids from dredging; sediment plumes; short-term reduction in DO concentrations; re-suspension of sequestered contaminants; decreased light transmittance; minor and transient chemistry alterations in water column; direct, permanent impact to 0.02 ac (<0.01 ha) of intertidal area • WL: LSI: potential for temporary disturbance from dredging operations
Operation		
• SW: LSI. Increase in stormwater intensity and volume; increase in training-related residual contaminants; minor, transient increases in turbidity at crossings • GW: LSI. Minor increase in aquifer recharge rates in the localized area around recharge wells; increase in pollutant loading potential • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: negligible, transient disturbances	• SW: LSI. Increase in stormwater discharge intensities and volume • GW: LSI. Increased potential for local groundwater contamination • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI	• SW: LSI. Increase in stormwater discharge intensities and volume • GW: LSI. Increased potential for local groundwater contamination • NW: LSI. Minor increase in runoff volume and pollutant loading potential • WL: NI

Legend: SW = Surface water, GW = Groundwater, NW = Nearshore waters, WL = Wetlands, SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact.

Implementation of the action alternatives would have the potential to impact the quality and quantity of stormwater runoff, during both the construction and operational phases of the project. Construction and range training activities would have the potential to cause erosion and sedimentation which could degrade surface water quality. In addition, the action alternatives would increase the potential for leaks and spills from contaminants. These potential impacts would be reduced through the combination of site-specific

BMPs (Table 4.2-1), LID measures, and monitoring programs. In addition, roadway-specific BMPs as identified in the CNMI and Guam Stormwater Management Manual would be included in the planning, design, and construction of all roadways. Increases in stormwater would be managed by stormwater infrastructure and no construction would occur in a flood zone; therefore, there would be no increase in flooding risk. Stormwater flow paths would continue to mimic area topography. While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield and monitoring of groundwater chemistry would ensure no harm to existing or beneficial use. With the implementation of BMPs and potential mitigation measures for the dredging of Apra Harbor, fill of wetlands, and fill of jurisdictional waters of the U.S, impacts to nearshore waters and wetlands would be less than significant. The action alternatives would be implemented in compliance with all federal, local, and military orders, laws, and regulations (Table 3.1-1, Volume 8), including COMNAV Marianas Instruction 3500.4, as well as the implementation of BMPs, LID, and monitoring.

4.2.7 Summary of Potential Mitigation Measures

Table 4.2-7 summarizes the potential mitigation measures.

Table 4.2-7. Summary of Potential Mitigation Measures

Alternative 1	*Alternative 2*	*Alternative 3*	*Alternative 8*
Surface Water			
Dredging: • Silt curtains or pneumatic (bubble) curtains • Dredge within seasonal windows to minimize impacts to larval coral and other sensitive aquatic species, • No barge overflow during dredging operations • Dredging rate limitations, • Water quality monitoring	Dredging: • Silt curtains or pneumatic (bubble) curtains • Dredge within seasonal windows to minimize impacts to larval coral and other sensitive aquatic species • No barge overflow during dredging operations • Dredging rate limitations • Water quality monitoring	Dredging: • Silt curtains or pneumatic (bubble) curtains • Dredge within seasonal windows to minimize impacts to larval coral and other sensitive aquatic species • No barge overflow during dredging operations • Dredging rate limitations • Water quality monitoring	Dredging: • Silt curtains or pneumatic (bubble) curtains • Dredge within seasonal windows to minimize impacts to larval coral and other sensitive aquatic species • No barge overflow during dredging operations • Dredging rate limitations • Water quality monitoring
Wetlands			
• None identified with implementation of identified potential dredging mitigation measures	• None identified with implementation of identified potential dredging mitigation measures	• Preserving existing areas • Compensate for the fill of the 0.4 ac (0.16 ha) wetland area by creating new wetlands or restoring, enhancing or preserving existing wetland areas to, at a minimum, replace the area filled • Mitigate temporary disturbance impacts by monitoring of stream segments to determine and mitigate potential loss of aquatic functions	• Preserving existing areas • Compensate for the fill of the wetland area by creating new wetlands or restoring, enhancing or preserving existing wetland areas on Guam to, at a minimum, replace the area filled • Mitigate temporary disturbance impacts by monitoring of stream segments to determine and mitigate potential loss of aquatic functions

4.2.8 Least Environmentally Damaging Practicable Alternative (LEDPA) for Waterfront Functions

Section 404 of the Clean Water Act (CWA) requires approval by the USACE for discharge of dredged or fill materials into waters of the United States. Proposed projects affecting jurisdictional areas under the CWA must identify the *least environmentally damaging practicable alternative* (LEDPA) as part of the environmental evaluation process. Permitting decisions are based on guidelines ("404(b) (1) Guidelines") developed jointly with the EPA that are now part of the Code of Federal Regulations (40 CFR 230).

Specifically, § 404(b)(1) of the CWA stipulates that no discharge of dredged or fill material into waters of the U.S., which include wetlands, shall be permitted if there is a practicable alternative which would have less adverse impact on the aquatic ecosystem, so long as the alternative does not have other significant environmental consequences. Furthermore, an alternative is considered practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of overall project purposes.

A Section 404 Permit would be applied for and obtained prior to construction. This analysis is to show that the screening and selection process used in the development of this EIS/OEIS has identified the LEDPA consistent with the Section 404(b) (1) guidelines. For those projects in Sections 4.1.2 (North) and 4.1.3 (Central) areas within Guam, the Section 404 permitting process is not applicable since there are no jurisdictional wetlands involved with these projects. Section 404 permitting is applicable to the proposed projects within Apra Harbor.

As previously discussed, the analysis and selection of reasonable alternatives for: 1) ship berthing for amphibious task force ships and their associated amphibious vehicles and boats, 2) LCAC/AAV laydown area, and 3) the USCG berthing were based on consideration of the following criteria:

- Operational Efficiency
  - Meets general purpose requirements of the amphibious task force
  - Meets operational/navigational characteristics, e.g. sufficient depth
  - Must have contiguous location of berths for the ships that carry the amphibious vehicles
- Minimize dredging
- Minimizes other unavoidable environmental impacts including minimizing impacts to coral reefs.

Section 2.5.1.2 of this Volume, along with Table 2.5-2, provides an overview of the location, purpose, and construction/improvement details for the berth improvements in western Inner Apra Harbor. The rationale for siting all proposed waterfront facilities at Apra Harbor is that it is the only on-island DoD harbor. The Navy's general purpose wharves that are suitable to meet the requirements of the amphibious task force needs are located on the western side of Inner Apra Harbor. Specific purpose berths have ship specific accommodations tailored to the vessels they support, e.g. submarine berthing or supply ship berthing that would not be equipped either at the berth and/or in the landside support facilities to accommodate the amphibious task force ships and associated vehicles and boats or the USCG vessels. The presentation below discusses the three proposed waterfront functions and the alternatives dismissed.

4.2.8.1 Ship Berthing for Amphibious Task Force Ships and Associated Amphibious Vehicles and Boats

The selected location for berthing the amphibious task force and associated amphibious vehicles and boats alternatives, Victor, Uniform, Sierra, and Tango Wharves satisfies the operational efficiency criterion. These general purpose wharves have been used before by the amphibious task force. The criteria to minimize environmental impact is met by placing the combatant escort ships in the area of the Sierra/Tango Wharves since this area has deeper water than the Victor/Uniform area thereby reducing the volume of dredging needed to support the combatant escort ships.

Dredging is required to deepen the depth of the Sierra/Tango wharves from -35 ft to -38 ft MLLW (-10.7 to -11.0 m) to accommodate the escort combatants' ships berthing needs of -34 ft (10 m) depth. Approximately 508,877 CY (389,064 m^3) of dredged material would be removed. The dredging method historically used in Guam is mechanical dredging with a barge-mounted crane attached to clamshell buckets to retrieve the sediment and deposit it on a scow (barge). Mechanical dredging using a traditional clamshell bucket is used for this EIS/OEIS analysis because it represents the maximum environmental adverse impact in terms of water quality impacts. It is likely that this method would be used for the proposed dredging; however, the decision would not be made until the final design. The EIS/OEIS impact analysis considers four scenarios for the placement of dredged material: 100% disposal in a proposed ocean dredged material disposal site (ODMDS), 100% disposal upland, 100% beneficial reuse, and 20-25% beneficial reuse/75-80% ocean disposal. Under the 100% upland placement scenario, five upland placement sites on Navy land have been identified for potential use in support of the proposed dredging action. These sites are referred to as Field 3, Field 4, Field 5, PWC Compound and Polaris Point and are described in Appendix D (Volume 9). Fields 3 and 5 and Polaris Point have been proposed for other dredging projects and have been addressed in a NEPA document. Field 4 and PWC Compound sites are addressed in this EIS/OEIS. Two of the alternative sites, Polaris Point and Field 5 sites, each have sufficient capacity to accommodate all of the anticipated dredged material from the proposed action. Used in combination with ODMDS and beneficial reuse, only a portion of the candidate sites would be required to accommodate the dredged material. Upland placement of the dredged material is planned to contain all of the mechanically-removed dredged material and does not involve an effluent discharge of slurry water from the upland placement sites. The term "upland disposal" is a common phrase used to describe the placement of the dredged material in an upland site while the material is allowed to dry and become easier and more cost effectively handled for beneficial re-use.

The project area is designated as M-2 or area of "Good" water quality. Historically, the use of silt curtains and other potential mitigation measures have been implemented during dredging operations in Apra Harbor in order to protect corals and filter-feeding invertebrates by limiting the lateral dispersion of the dredged sediments. Dispersion modeling of suspended sediment from dredging activities in Apra Harbor was conducted in March 2009 as part of the *CVN Capable Berthing Study* and a summary is included in Section 4.2. and in Appendix D of Volume 9 (Ericksen 2009). The results of this modeling are that turbidity impacts would be temporary and limited to the project area. Use of turbidity control measures such as turbidity curtains would be beneficial to controlling the impacts from suspended solids. Detailed discussion of Tier III sediment testing results consistent with 404(b)(1) guidelines is presented in Section 4.1 These 2007 test samples included samples representative of the areas to be dredged under this action. The overall results of the toxicity and bioaccumulation tests were that the materials were suitable for ocean disposal. Further, the most recent testing noted above resulted in concentrations of contaminants equal to or lower than the 2007 results with the exception of nickel. Inner Apra Harbor has been dredged previously with the approval of GEPA and no water quality impacts from other contaminants that would exceed GEPA water quality standards are expected. Additional testing of sediments in support of the water quality certification process and dredged material management plan would be obtained.

The Victor and Uniform Wharves are general purpose contiguous wharves with a sufficient depth alongside the wharf of 32 ft (9.7 m) to accommodate the amphibious force vessels and no dredging is required. All of the wharves require above and below water repairs. The wharf restoration would likely be conducted by using a barge in the water. Wharf improvement contractors would ensure that construction debris does not enter or impact navigable waters. The Victor/Uniform and Sierra/Tango berthing alternatives are available and capable of being implemented after taking into consideration cost, existing technology, and logistics in light of the overall project purpose. Construction at either combined wharf location would not result in dredging or filling of any wetlands.

Other alternatives considered but dismissed were specific use wharves or other general purpose wharves. Alpha/Bravo Wharves at Polaris Point east of the Inner Apra Harbor channel entrance are specific use wharves designated for the nuclear submarines and the submarine tender. X-Ray Wharf, in the southern portion of the Harbor, is designated as the supply wharf with large warehouses, including frozen and cold storage, conveniently located adjacent to the wharf to support these operations. The northwest area and associated wharves (Lima, Mike, Oscar, and Papa) are leased to GEDCA for ship repair.

All of Inner Apra Harbor is considered Essential Fish Habitat for bottomfish (see Figure 11.1-5), crustaceans (see Figure 11.1-6), and pelagic fish (see Figure 11.1-7) in all life forms from larval to adult but unlike Outer Apra Harbor is relatively devoid of marine life (COMNAV Marianas 2006). Section 11.1 provides detailed discussion on EFH in Inner Apra Harbor.

No impacts to corals from dredging are expected as the closest area to the Inner Apra Harbor where corals occur on the seafloor is in the outer reaches of the entrance channel of the Inner Apra Harbor which is approximately 1,500 feet (457 m.) from the proposed dredge area. In this area corals present include *P. rus* and *P. cylindrica* (Navy 2005).

4.2.8.2 Amphibious Craft (LCAC/AAV) Laydown Area

For the LCAC/AAV laydown area, space availability, noise impacts, and water spray damage to adjacent land uses are critical considerations to land use planners. There is 404(b) involvement with this project activity as it involves the construction of two new concrete ramps into the water similar to what is observed at marina boat ramps. Construction of the LCAC/AAV laydown area provides the best solution for reducing noise impacts to surrounding areas since there is sufficient distance from the Alpha/Bravo Wharves and CSS-15 personnel and no impacts on submarine berthing operations around the Tender are anticipated. No dredging or filling of wetlands would occur with the implementation of this project activity.

The other alternative considered but dismissed is located in the inlet where the Dry Dock is moored (see Figure 2.5-5). The AAV laydown would be located adjacent to EOD facilities on Navy land and the LCAC laydown area would be on land currently leased by GEDCA. The reasons for dismissal of this site alternative were noise interference with EOD operations and the need for dredging at the entrance to the inlet. In addition, proximity to Big Blue Reef and the desire to avoid any potential impacts to coral ecosystems was sufficient for dismissal.

4.2.8.3 USCG Berthing

There were three locations considered for the USCG berthing. The Oscar/Papa wharves (Ship Repair Facility) were selected primarily due to fewer disadvantages when compared to the other two alternatives (see Table 2.5-6). The USCG berth using the entire length of the Oscar and Papa Wharves (1,079 ft. [328.88 m]) meets the operational efficiency needs for the USCG vessel and, having sufficient depth, no dredging is required. Wharf upgrades include repair of the concrete bulkhead, a new fender system, and mooring hardware. There would be repairs to the concrete bulkhead, but the repairs would not require demolition or replacement of the support structure. Portions of the work may have to be conducted from the water on a barge moored at the wharf. Precautions would be required to prevent construction material or waste from entering the Harbor.

Placing the USCG berthing area at the Oscar/Papa wharves meets the environmental criterion in comparison to other alternatives as it is further away from Big Blue reef than one of the other alternatives and avoids the Sasa Bay Preserve that is adjacent to the third alternative.

The other two alternatives considered but dismissed in the site selection process (Figure 2.5-9) were the Big Blue location and the Reserve Craft Beach on Dry Dock Island. These two were dismissed from further consideration in this EIS/OEIS due to a number of functional concerns. These concerns included such mission requirements as AT/FP capability; quality of access; existence of waterfront facilities or capability to development such facilities; relationship to Apra Harbor; environmental concerns, particularly site contamination concerns; and physical size and layout.

Based on the above discussion, the selected locations for the three waterfront functions are consistent with the application of the 404(b) guidelines minimizing environmental impacts to the extent possible and being the LEDPA. The selected sites are existing wharf sites that would be improved/repaired to meet mission requirements. Avoidance of building new wharf sites as alternatives for the proposed project functions would result in less environmental impact than the alternatives chosen for the waterfront projects. Impacts to the aquatic ecosystem would be avoided and minimized to the greatest extent possible. Best management practices and compensatory mitigation would be provided as described in Volume 7, and at the end of each chapter in this Volume. Once final impacts through complete design are identified, a final mitigation plan would be prepared.

4.2.8.4 Wetlands-Onshore Impacts

The onshore impacts to wetlands are discussed in Sections 4.2.2, 4.2.3, 4.2.4, and 4.2.5 for Alternatives 1, 2, 3, and 8, respectively and are summarized in Table 2.6-4. There would be no direct filling of wetlands under Alternatives 1 and 2 but there would be direct filling of 0.4 ac (0.16 ha) wetlands under Alternatives 3 and 8. As noted in Section 4.2.4, the Navy would attempt to avoid impacts to Wetland Area BARR-04 at Air Force Barrigada (see Figure 4.2-4), but if avoidance is not possible, then the Navy would minimize and mitigate potential impacts and comply with USACE permit requirements. There would be no dredging of wetlands under any of the alternatives. Under all alternatives, temporary increase in turbidity and sedimentation would also occur in wetlands during construction activity, and transient minor increases in turbidity would occur under operation during training activities in NMS. Therefore, activities associated with Alternatives 1 and 2 would result in less than significant impacts to wetlands and with Alternatives 3 and 8 would result in significant impacts to wetlands mitigable to less than significant.

Indirect impacts to coastal wetlands as a result of the release of sediment into the water column to increase turbidity in the vicinity of wetlands may occur during dredging under all alternatives. As noted in Section 4.2.2.3 for Alternative 1, the nearest wetlands to the dredging operations in Inner Apra Harbor are the Atantano Wetlands located approximately 2,000 ft (610 m) east of the nearest extent of proposed dredging operations (see Figure 4.2-2). Other wetland areas (Wetland Areas O, P, and Q) located in the south/southeastern portion of Inner Apra Harbor are located approximately 3,600 ft (1,098 m) at their nearest extent to proposed dredging operations (see Figure 4.2-2). Construction activities in Apra Harbor would be the same for all action alternatives. These potential impacts would be lessened due to the implementation of dredging BMPs and associated potential mitigation measures, distance to the wetlands, and the prevailing currents (i.e., the prevailing surface water motion in Apra Harbor is generally westward, away from the majority of wetland areas in Apra Harbor and Sasa Bay). Therefore, construction activities associated with all action alternatives would result in less than significant impacts to wetlands.

4.2.8.5 LEDPA Summary for Potential Impacts to Wetlands and Jurisdictional Waters Under All Alternatives in Volume 2

Table 4.2-8 presents a summary for all of the potential impacts of the alternatives in Volume 2 that may occur, both directly and indirectly, to jurisdictional wetlands and waters of the U.S.

Table 4.2-8. Summary of Potential Impacts to Wetlands and Jurisdictional Waters of the U.S. under All Alternatives to Support LEDPA Discussion

Volume	*Alt.*	*Component (Figure 2.9-1 ID#)*	*Type and Area (ac/ha) of Impact*				*Impacted Feature*
			Direct	*Indirect*	*Temp.*	*Perm.*	
Marine Corps-Guam (Vol. 2)	1	Dredging	-	ND	●	-	Inner Apra Harbor
	1	NMS Access Road Alternative A	No impacts				
	1	NMS Access Road Alternative B	No impacts				
	2	Dredging (1)	-	ND	●	-	Inner Apra Harbor
	2	NMS Access Road Alternative A	No impacts				
	2	NMS Access Road Alternative B	No impacts				
	3	Dredging	-	ND	●	-	Inner Apra Harbor
	3	NMS Access Road Alternaqtive A	No impacts				
	3	NMS Access Road Alternative B	No impacts				
	3	Air Force Barrigada	0.3/0.12	-	-	●	sink hole wetland
	8	Dredging	-	ND	●	-	Inner Apra Harbor
	8	NMS Access Road Alternative A	No impacts				
	8	NMS Access Road Alternative B	No impacts				
	8	Air Force Barrigada	0.3/0.12	-	-	●	sink hole wetland

Legend: ND = not determined; temporary impacts not quantified. TBD = to be determined upon completion of on-going study. - = no impact, ● = impact. Four rivers are the Sagge, Sarasa, Malaja, and Ugum Rivers

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