NOTICE

Volume 4 of this Final Environmental Impact Statement (EIS) presents the analysis of impacts associated with construction and use of a deep draft berthing capability in Guam for transient (visiting) nuclear powered aircraft carriers. The Final EIS identifies site specific alternatives within Apra Harbor for location of the transient berth and analyzes the impacts associated with development and use of a transient aircraft carrier berth at those alternative locations. Apra Harbor is the only deep water port on the Island of Guam and is the only location with sufficient road, utility, and naval infrastructure to support a transient aircraft carrier berth. The Draft EIS identified several alternatives within Apra Harbor as potential transient aircraft carrier berth locations. Some of those alternatives were eliminated from detailed analysis based on operational and environmental factors. Volume 4 contains a brief explanation regarding why a particular alternative initially considered was eliminated from detailed analysis. Polaris Point was identified as the preferred transient aircraft carrier berth site in the Draft EIS and remains the Navy's preferred site for construction of a berth to accommodate transient aircraft carriers. Final site selection will occur only after completion of project (site-specific) level National Environmental Policy Act (NEPA) analysis and Clean Water Act (CWA) permitting processes.

Comments received on the Draft EIS from Federal agencies, Guam agencies, the Guam legislature and private parties were critical of the marine resources analysis and other analyses presented in the Draft EIS regarding the proposed transient aircraft carrier berth. Some commenters also suggested consideration of other sites or reconsideration of alternative sites that had been eliminated from detailed analysis. Those comments were carefully considered and some changes/additions were made to the analysis that was presented in the Draft EIS. In the view of the Department of the Navy, the analysis now presented in the Final EIS, including the marine resources impacts analysis, provides the information necessary to allow the decision-maker to fully consider the direct, indirect and cumulative environmental impacts of locating a transient aircraft carrier berth within Apra Harbor, the only deep draft harbor on the island of Guam. Department of Defense (DoD) and the Navy engaged in lengthy discussions with the Environmental Protection Agency (EPA), National Oceanic and Atmospheric Administration (NOAA), and Department of Interior (DOI), explaining the basis for the Navy's analysis and discussing changes to be incorporated in the Final EIS. Based on those discussions, EPA, NOAA, and DOI acknowledged that the Navy's analysis would be sufficient to support a programmatic decision to locate a deep draft transient berth for a CVN on Guam.

The discussions with EPA, NOAA, and DOI also led to a better understanding on the part of the Navy regarding the concerns of the regulatory agencies and the public about the analysis presented in the Draft EIS. The discussions also clarified concerns about the sufficiency of the information that would be required to support future site selection and Federal permitting actions to allow for construction of the proposed transient aircraft carrier berth once a specific site for the transient berth is selected. Based on the level of concern expressed in comments on the Draft EIS, continued discussions with cooperating agencies under NEPA, and the Navy's continuing commitment to environmental stewardship, the Navy has elected to forego selection of a specific site for the transient aircraft carrier berth within Apra Harbor for the near term. The Navy will continue to proceed toward a decision whether to locate a transient aircraft carrier berth generally within Apra Harbor but will defer a decision on a specific site for the transient berth. Discussions with EPA, NOAA and DOI identified additional data these agencies would prefer were available for use in analyzing specific sites for the CVN transient berth. The Navy will voluntarily collect additional data on marine resources in Apra Harbor at the alternative transient aircraft carrier berth sites still under consideration by the Navy as set out in Volume 4 of the Final EIS. The type and scope of the additional data to be collected has been developed cooperatively with EPA, NOAA, and DOI and is described in the "Final Scope of Work Elements for Marine Surveys of the CVN Transient Berth Project Area, Potential Mitigation sites, and Habitat Equivalency Analysis" included in Volume 9, Appendix J. The additional data collected, associated analysis, and any other data that may be required by the United States Army Corps of Engineers (USACE) during the CWA permitting process, will be used in the future to inform the subsequent selection of a specific site for the transient aircraft carrier berth and to support any future CWA permitting decisions for the selected site, including compensatory mitigation. The additional data collected and analyzed for specific sites will be used by the Navy as provided in the Council of Environmental Quality (CEQ) regulations governing supplemental and tiered environmental impact analysis (40 CFR §§ 1502.09 and 1502.20).

The election by the Navy to defer a decision on a specific site for a transient aircraft carrier berth does not affect the discussion and analysis that follows in the remainder of Volume 4 or other portions of this Final EIS. The analysis will remain the foundation for the conclusions reached in the Final EIS and for the decision regarding whether to create a transient berth on Guam for a CVN.

Final

Environmental Impact Statement

GUAM AND CNMI MILITARY RELOCATION

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

Reader's Guide

July 2010

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Pearl Harbor, HI 96860

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Guam and CNMI Military Relocation EIS

Reader's Guide

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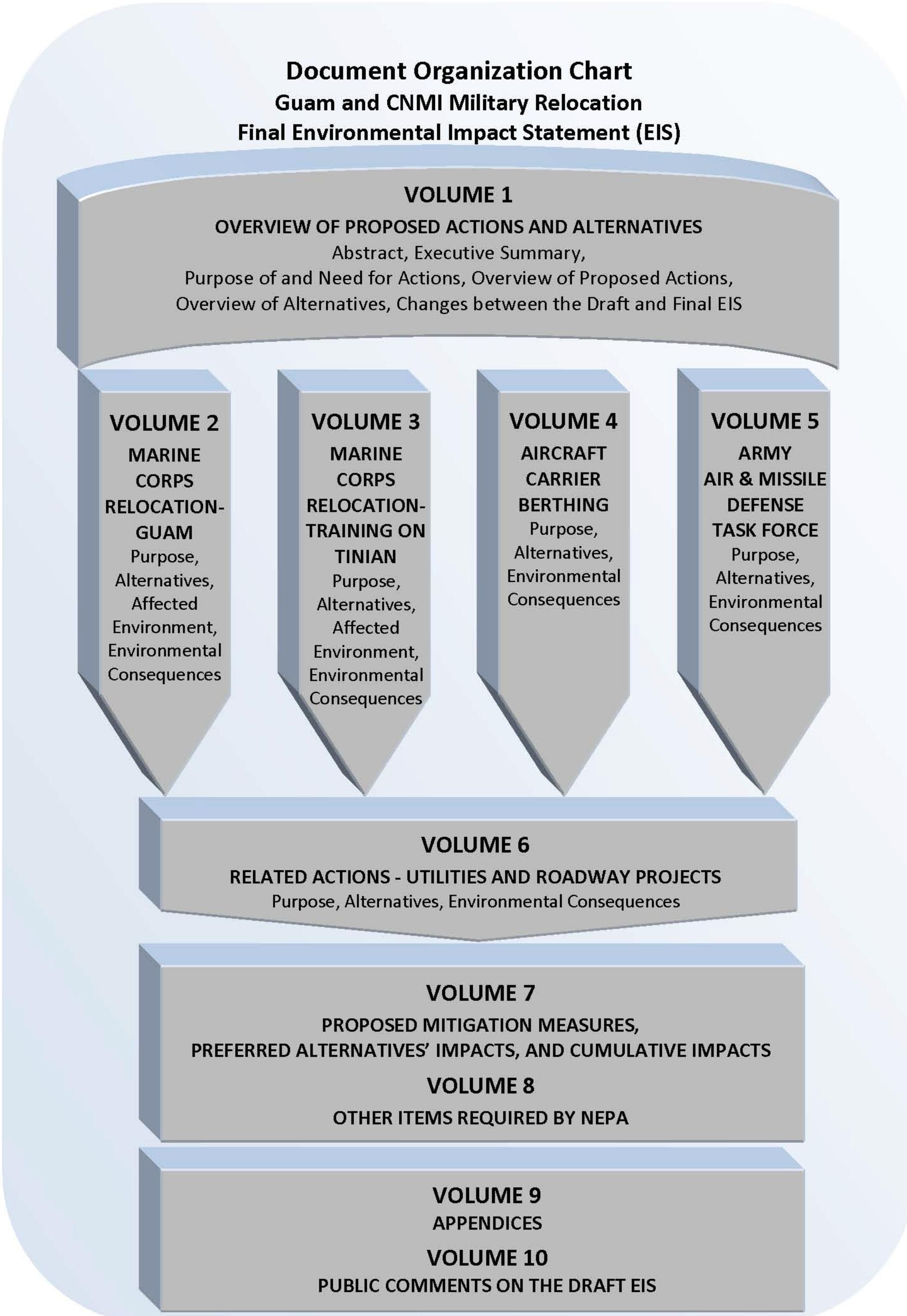

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AREAS OF INTEREST

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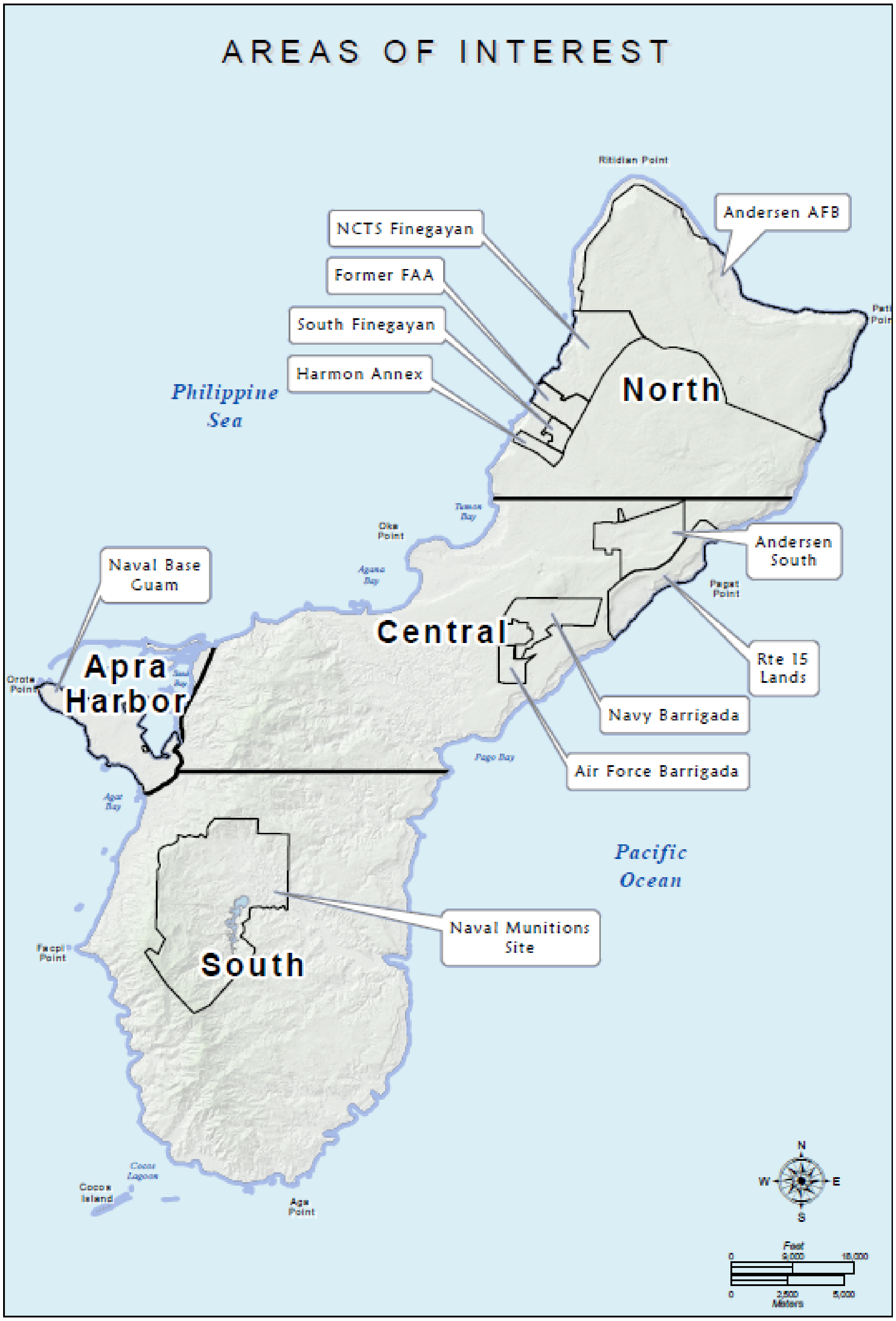
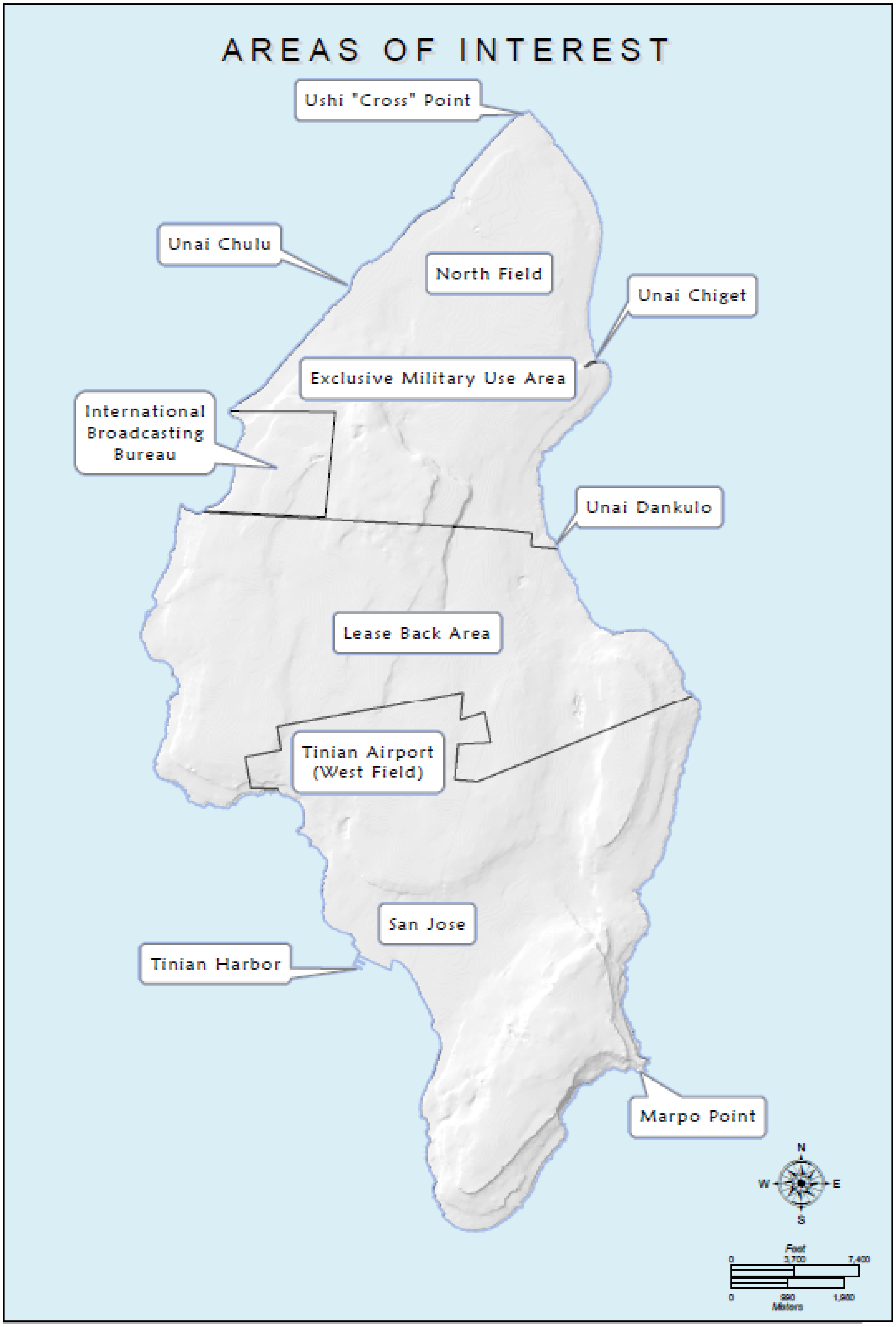


3.2 CNMI


AREAS OF INTEREST
Ushi "Cross" Point
Unai Chulu
North Field
Unai Chiget
Exclusive Military Use Area
International Broadcasting Bureau
Unai Dankulo
Lease Back Area
Tinian Airport (West Field)
San Jose
Tinian Harbor
Marpo Point
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CHAPTER 4. GLOSSARY

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Cumulative Impact—the impact on the environment which results from the incremental impact of the action when added to the other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other actions. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Upland—an area of land of higher elevation.

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

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

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

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CHAPTER 5.
ACRONYM AND ABBREVIATION LIST

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

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

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

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

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

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

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

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

Final

Environmental Impact Statement

GUAM AND CNMI MILITARY RELOCATION

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

Volume 4: Aircraft Carrier Berthing

July 2010

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Guam and CNMI Military Relocation EIS
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CHAPTER 1.
PURPOSE OF AND NEED FOR ACTION

1.1 INTRODUCTION

1.1.1 Introduction to Proposed Action

Volume 4 focuses on the proposed construction of a new deep-draft wharf with shoreside infrastructure improvements, creating the capability to support a transient nuclear powered aircraft carrier in Apra Harbor, Guam.

An aircraft carrier is manned by over 5,600 military personnel and is accompanied by aircraft and escort ships, collectively referred to as a Carrier Strike Group (CSG). The number of port visits and duration of visits to Apra Harbor by an aircraft carrier has varied throughout the past 10 years because of operational requirements. For example, in 2008, the schedule included four visits for 4 days each (Port Operations 2008). Apra Harbor currently supports an average of two CSG port calls for an average of up to 7 days in duration per year, though actual port visits and durations are subject to change based upon Fleet operational requirements.

Under the proposed action with a transient-capable port, the aircraft carrier would visit for a cumulative total of up to 63 visit days per year, with an anticipated length of 21 days or less per visit. This capability is required to support increased aircraft carrier operational requirements in the Western Pacific and Indian Oceans. Previous nuclear powered aircraft carrier berthing has been at Kilo Wharf, which is also located in Apra Harbor. Increased transient aircraft carrier days, coupled with increased ordnance operational days, exceed the berthing days available at Kilo Wharf (as discussed in Section 1.1.3.6 of this Volume), necessitating the proposed dedicated transient aircraft carrier wharf. Additionally, Kilo Wharf is the only DoD ammunition wharf in the Western Pacific and serves 12 to 14 ammunition ships in the area of operations.

Due to the length of a transient visit, shoreside infrastructure for utilities (i.e., power, wastewater management, potable water supply) must be improved to minimize or eliminate reliance on shipboard systems while in port.

This Volume is organized as follows.

- *Chapter 1:* Purpose of and Need for Actions. This chapter states the purpose of and need for the proposed action and presents background information about the proposed action.
- *Chapter 2:* Proposed Action and Alternatives. This chapter describes the siting criteria and the screening process to evaluate and identify the reasonable alternatives, the proposed action and reasonable alternatives, and the no-action alternative.
- *Chapters 3-19:* Resource Sections. These chapters describe existing conditions and identify potential impacts to the respective resources:
- Chapter 3: Geological and Soil Resources
- Chapter 4: Water Resources
- Chapter 5: Air Quality
- Chapter 6: Noise

- Chapter 7: Airspace
- Chapter 8: Land and Submerged Lands Use
- Chapter 9: Recreational Resources
- Chapter 10: Terrestrial Biological Resources
- Chapter 11: Marine Biological Resources
- Chapter 12: Cultural Resources
- Chapter 13: Visual Resources
- Chapter 14: (Marine) Transportation (Volume 6 covers roadway transportation)
- Chapter 15: Utilities
- Chapter 16: Socioeconomics and General Services
- Chapter 17: Hazardous Materials and Waste
- Chapter 18: Public Health and Safety
- Chapter 19: Environmental Justice and the Protection of Children
- Chapter 20: References

1.1.2 Purpose and Need

As discussed in Volume 1, the overarching purpose for the proposed actions is to locate United States (U.S.) military forces to meet international agreement and treaty requirements and to fulfill U.S. national security policy requirements to provide mutual defense, deter aggression, and dissuade coercion in the Western Pacific Region. The need for the proposed actions is to meet the following criteria based on U.S. policy, international agreements, and treaties:

- Position U.S. forces to defend the homeland including the U.S. Pacific territories
- Provide a location within a timely response range
- Maintain regional stability, peace and security
- Maintain flexibility to respond to regional threats
- Provide a powerful U.S. presence in the Pacific region
- Increase aircraft carrier presence in the Western Pacific
- Defend U.S., Japan, and other allies' interests
- Provide capabilities that enhance global mobility to meet contingencies around the world
- Have a strong local command and control structure

The proposed action, creating a capability on Guam to support a transient nuclear powered aircraft carrier, would provide greater aircraft carrier presence in the Pacific region through enhanced rotational presence and would meet the overarching purpose and need.

1.1.3 Global Perspective

Aircraft carriers are deployed worldwide in support of U.S. interests and commitments. Aircraft carriers are generally the first to respond to a crisis (Navy 2009). They can respond to global crises in ways ranging from deterrence through their presence in peacetime to launching operations in support of armed conflict. Together with their on-board air wing (including a mixture of different aircraft, air logistics, weapons, maintenance support and administrative functions) the carriers have vital roles across the full spectrum of conflict. U.S. aircraft carriers and other warships are recognized as sovereign U.S. territory.

While the U.S. military would have to make special arrangements with a foreign nation to set up a land military base or airfield, it can move a carrier and it's CSG all over the globe to project power from the sea in accordance with the Navy's "Sea Power 21" vision (Navy 2002). Naval aircraft, including bombers and fighters, can fly a variety of missions into enemy territory and then return to the carrier. In most cases, the Navy can continually replenish (resupply) the CSG, allowing it to maintain its position for extended periods of time. Eventually, however, the ships must return to a port for maintenance and crew rest.

1.1.3.1 Background

The employment of an aircraft carrier and its associated CSG are integral to supporting U.S. interests and meeting treaty and alliance requirements, both globally and regionally. The aircraft carrier's mission is to:

- Provide a credible, sustainable, independent presence and conventional deterrence in peacetime
- Operate as the cornerstone of joint/allied maritime expeditionary forces in times of crisis
- Launch and support aircraft attacks on enemies, protect friendly forces, and engage in sustained independent operations in war (Navy 2009)

As discussed in Volume 1, the Navy's proposed action is based upon treaty and alliance requirements and the Department of Defense's (DoD) Quadrennial Defense Review (QDR). One of the QDR conceptual policy initiatives is that the U.S. should strive to position strike forces, which include aircraft carrier and airwing capabilities, in forward locations that support flexibility and speed of response to anywhere in an unpredictable environment. The Pentagon's strategic QDR of 2006 (DoD 2006) stated the following:

> *"The Fleet will have a greater presence in the Pacific Ocean consistent with the global shift of trade and transport. Accordingly, the Navy plans to adjust its force posture and basing to position at least 6 operationally available and sustainable carriers and 60% of its submarines in the Pacific to support engagement presence and deterrence."*

This guidance reflected a need to supplement existing ship deployments and the aircraft carrier base (homeport) in the Pacific. The policy initiative of the QDR was to provide a near continuous presence of multiple carrier strike groups in the Western Pacific and/or Indian Ocean. Accordingly, the Navy began to identify how to meet: 1) treaty and alliance requirements, as well as the QDR, 2) freedom of action (use of a base without restrictions, including implementation of force protection measures to deter/avoid terrorist attacks), and 3) response times to potential areas of conflict. The most current QDR in 2010 reconfirms the Navy's capability for a "robust forward presence." Further, Guam is to be "a hub for security activities in the region" (DoD 2010).

Starting in 2005 the U.S. Navy began exercising this concept of operations by developing a series of multi-carrier strike group exercises commonly known as "Valiant Shield" in the Marianas Islands. Traditional thinking had been, to assure continuous military presence in an area, a ship or forces needed to have a forward homeport or base from which to operate. The U.S. Navy, however, validated the concept of continuous rotation of strike groups to increase presence in the region as desired by the QDR. To support the continual rotational presence, a new concept was developed: a transient-capable port that would provide maintenance and logistics support for aircraft carriers close to the area of responsibility (AOR). The proposed transient port capability on Guam, as discussed below, fulfills the operational requirement for continuous strike capability without the financial, political, and environmental issues associated with a forward homeport.

The Navy currently bases (homeports) six aircraft carriers in the Pacific AOR: three in San Diego, California; two in Washington State; and one in Yokosuka, Japan (Figure 1.1-1). A homeport provides the full plethora of support services to the ship and airwing and the dependent families of personnel assigned to the carrier strike group. These services include full depot level maintenance, quality of life support services for dependents, and other related services. When ships deploy they visit other harbors.

The length of stay, reasons for stay and other factors determine whether the visit is characterized as a "port" visit or "transient" visit. The length of stay and purpose of a visit are dictated by military mission requirements. Port visits are brief and may be determined by international political concerns, operational requirements and other factors.

Port visits require minimal or no shoreside support and do not necessarily require a berth. When port visits are made to locations without an available berth (anchorages), there is limited time and capability for ship maintenance and crew rest. Because a port visit is brief and independent of shoreside utility support, the aircraft carrier has the ability to get underway with minimal delay. This ability to mobilize quickly is an important force protection consideration, allowing CSG port visits to take place in foreign locations.

In contrast to port visits, the Navy proposes to develop a transient berthing capability which provides the ship and carrier airwing operational support requirements, including emergent (unscheduled) repair and maintenance capabilities and crew quality of life. There would be no dependent quality of life support nor full depot maintenance as this support is provided at the ship's homeport. To accomplish a transient capability, the berth must have "hotel services" for the ship and meet security requirements. The wharf would have to be of sufficient length and strength to safely accommodate the vessel while having adequate depth. In addition, the transient capability includes the ability to ensure quality of life and safety for the crew and ship for a duration of stay longer than is normal for a port visit. These longer stays with a ship relying on shoreside utilities increase force protection concerns; however, the advantage of a transient port capability is that a ship can be re-supplied or maintained without returning to its homeport. Development of a transient-capable port close to the AOR increases aircraft carrier presence, as required by the QDR, by reducing the non-availability that occurs when a carrier must perform a long transit to its homeport. The creation of a transient-capable port comes without the additional expense, political or environmental concerns raised by creation of a forward homeport. It also maintains adequate response times to potential conflicts.

1.1.3.2 Treaty and Alliance Requirements

Five of the seven U.S. Mutual Defense Treaties are with countries in the Western Pacific: the Philippines, Australia/New Zealand (joint treaty), Korea, Japan, and Thailand. For example, the U.S.–Japan (1960) treaty, known as the *Treaty of Mutual Cooperation and Security*, contains general provisions on the further development of international cooperation and on improved future economic cooperation. Both parties assumed an obligation to maintain and develop their capacities to resist armed attack and assist each other in the event of an armed attack on Japanese territories. This provision is carefully crafted to be consistent with Japan's Constitution that limits its military capabilities to defensive capabilities only. U.S. treaty commitments with the other nations listed above also require a timely response to incidents and a consistent U.S. presence of force as a deterrent in the Pacific region.

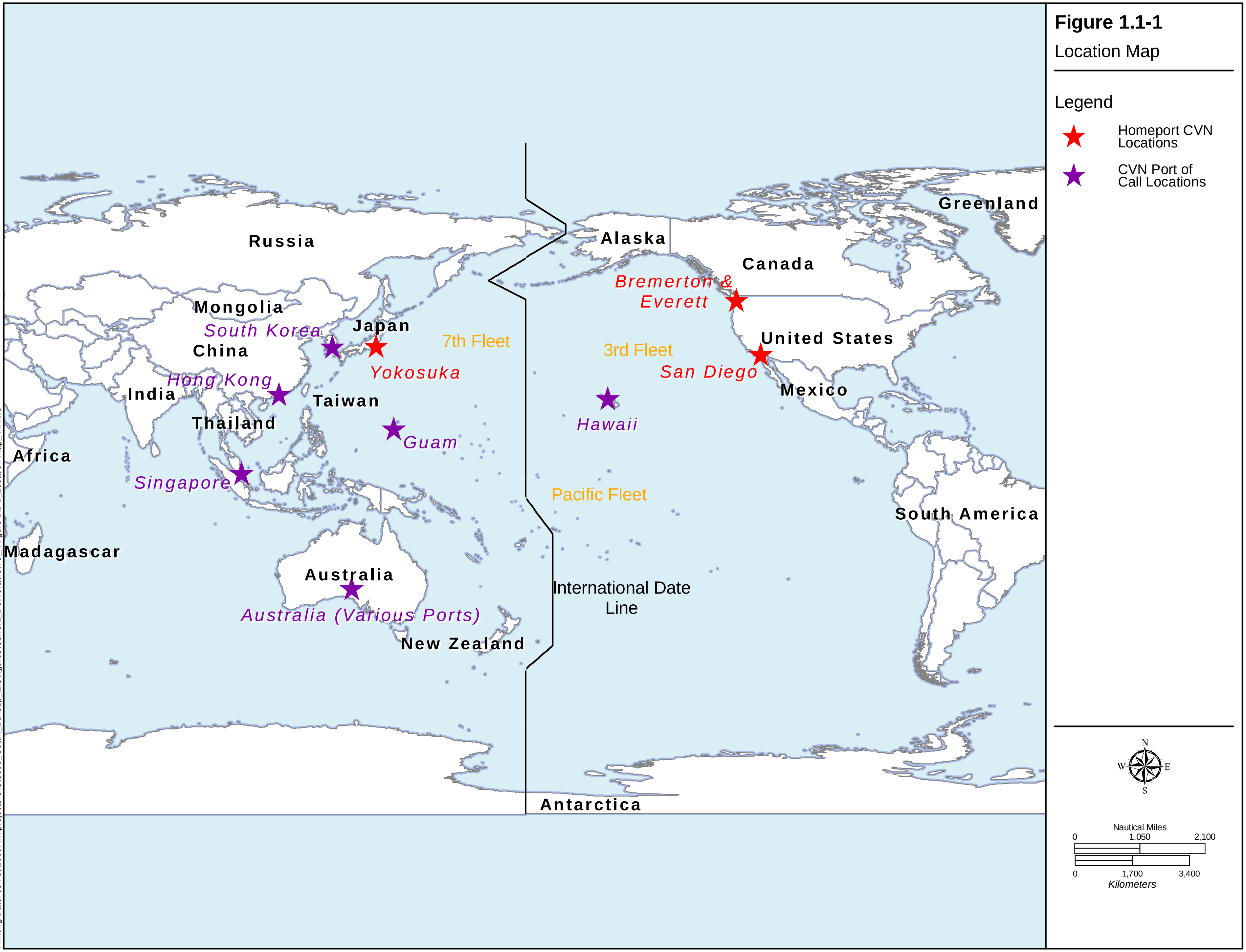

Figure 1.1-1
Location Map

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The Pacific Fleet's AOR extends from the west coast of the contiguous U.S. to the eastern shore of Africa. The AOR includes the world's five largest foreign armed forces: People's Republic of China, Russia, India, North Korea and Korea. More than half of the world's population lives within the AOR. In addition, more than 80% of the population within the Fleet's AOR lives within 500 miles (805 kilometers) of the oceans and more than 70% of the world's natural disasters occur in this region (Navy 2008).

When the Navy examined potential locations to support a greater carrier presence in the Pacific, it was mindful of the critical precept of the Integrated Global Presence and Basing Strategy to place visiting U.S. forces only where those U.S. forces are wanted and welcomed by the host government. Accordingly, because some countries within the region have indicated their hesitancy and inability to host more U.S. forces on their lands, the U.S. military shifted its focus to basing on U.S. sovereign soil.

1.1.3.3 Freedom of Action and Force Protection

In the context of creating a transient-capable port, as discussed above, a crucial factor is freedom of action. Freedom of action is the ability of the U.S. to use ports, training facilities, and bases (including the ability to re-supply and conduct mid-level maintenance), freely and without restriction at a particular locale, as well as affording the U.S. the ability to engage in force protection, rapid force posture movements, and contingency response. U.S. relations in the Pacific and Indian Ocean regions are based upon multiple bilateral treaties and international law. Within this legal framework, the U.S. and its Pacific allies have mutual defense commitments; however, access and level of support varies for like operations throughout the region. In short, U.S. forces responding to contingencies still have greater freedom of action when responding from U.S. territory.

The reliance on shoreside utility support for a transient-capable port reduces the aircraft carrier's ability to get underway quickly. Compared to port visits, the longer berthing times and the delay in getting underway are important considerations for force protection. The CSG concentrates a large contingent of military personnel (greater than 7,000) along with hundreds of millions of dollars of military assets when it is in a transient port, so force protection is critical. In assessing possible locations for transient-capable ports, the unique requirements for emergent (unscheduled) repairs, full shoreside utility support, and the increased force protection and security requirements that accompany the longer duration of visits make U.S. sovereign locations for the transient-capable port preferable.

Force protection concerns increase as the duration of the visit increases. Given the importance of the CSG, the Navy determined that it must have maximum flexibility to protect the CSG. While force protection concerns are met in foreign ports, accomplishment of this requirement is more feasible in U.S. territory. Under these criteria, force protection can be more easily met on Guam, Hawaii, Washington, and California; therefore, these areas are preferred over other countries because they provide the most flexibility in the combined requirements for force protection and freedom of action.

1.1.3.4 Response Times

To meet the QDR stated policy initiatives, a comparative analysis of the potential response times from existing homeports and traditional port visit locations was conducted. The travel distances depicted in Figure 1.1-2 and the response times in Table 1.1-1 show the challenge of siting a transient-capable port to ensure that aircraft carriers can rapidly respond to a crisis in the Western Pacific while providing for the critical freedom of action and force protection requirements this asset requires. Ports in the region that have previously accommodated U.S. aircraft carriers for brief port visits were considered as potential locations for a transient port. Non-U.S. ports that have had port visits in the Western Pacific are located in Australia, Singapore, Hong Kong, and Japan. U.S. port locations that already support aircraft carriers include Hawaii, Guam, Washington, and California. Hawaii is located approximately 3,300 nautical miles (nm) (6,112 kilometers [km]) northeast of Guam in the opposite direction of the Western Pacific/Indian Ocean AOR. Hawaii is also outside of the AOR for Western Pacific operations. Transit times from the AOR to the West Coast are even longer. The transit time to Hawaii from the AOR nearly doubles when compared to Guam. The transit time to California is four times the distance from the AOR. Because of this additional transit time, restriction of transient-capable ports to Hawaii or California would significantly strain the capability to rapidly respond to a crisis in the Western Pacific or Indian Ocean.

Accordingly, these locations were eliminated from further consideration based on their inability to meet the purpose of and need for the proposed action. Australia, Singapore, Hong Kong, Japan, and Guam are much closer to potential crises areas and the response times would be significantly shorter; therefore, they were retained as potential locations for development of extended aircraft carrier transient capabilities.

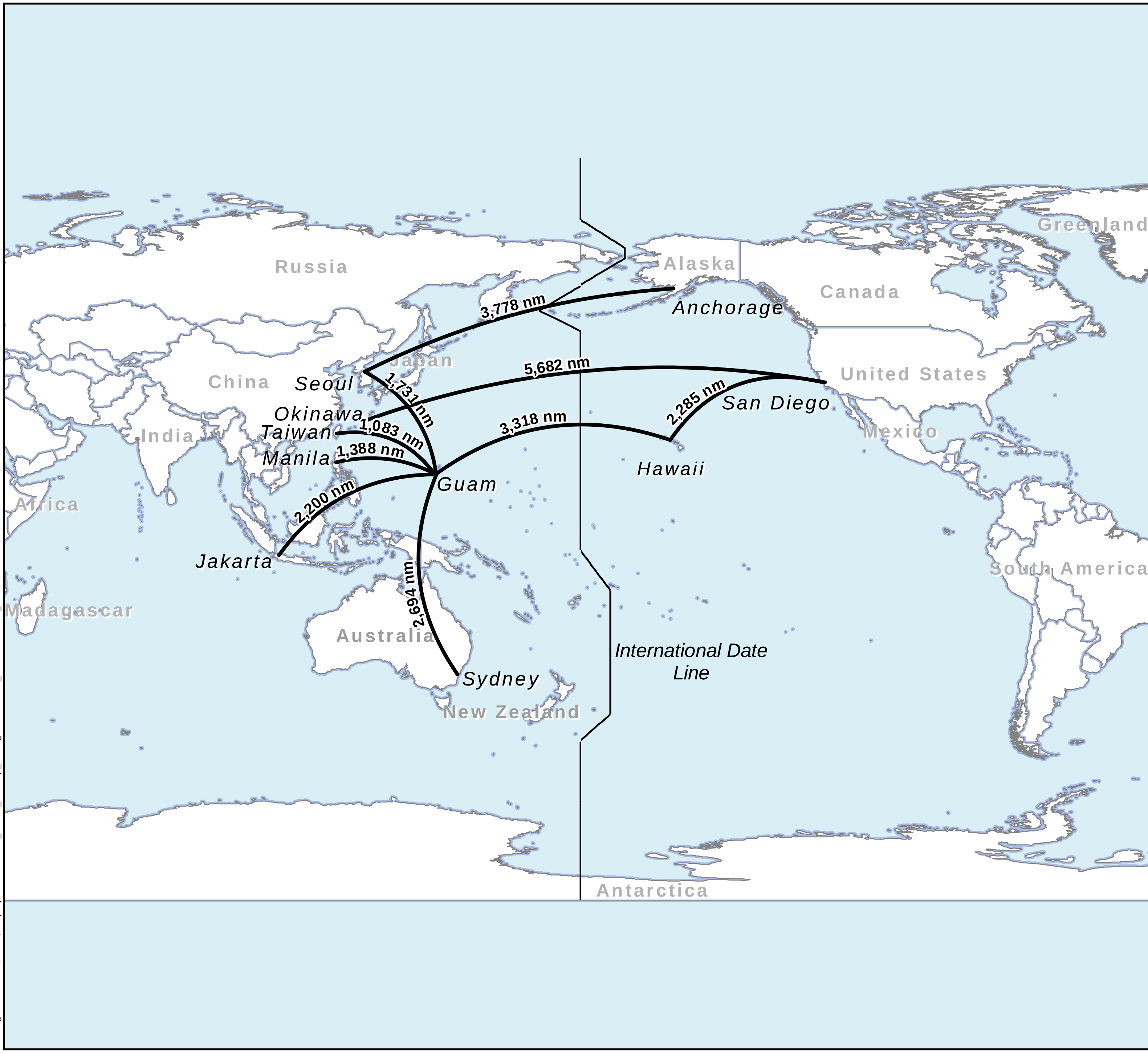
Table 1.1-1. Representative Response Times to Southeast Asia by Sea

	Hawaii	*Alaska*	*California*	*Guam*
Sea Deployment [1]				
Okinawa	8.5 days	NA[2]	15 days	3.8 days
Taiwan	9.6 days	NA[2]	16 days	5 days

Notes:
[1] Sea deployment times are based on ship speed of 20 knots (23 mph).
[2] There are no seaports in Alaska capable of CSG deployment. However, Alaska is included in this table because it is U.S. territory in the Pacific Rim.
Source: Navy 2008.

Utilization of a location in the Western Pacific would satisfy the QDR given that maintenance and supplies would be obtained closer to the area of operations, in effect, increasing the availability and presence of carriers in the Pacific due to the reduction in transits to other locations outside of the Western Pacific AOR. The greater availability and presence would enable quick responses to potential crises due to short travel times and distances to our allied nations and potential hot spots within the region.

Figure 1.1-2
Travel Distances within the Pacific Region



Source: Navy 2009

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1.1.3.5 Summary of Global Alternatives Analysis for Proposed Transient-Capable Port

Overall, Guam, Hawaii, California, and Washington pose no limitation on freedom of action, and all have some available infrastructure to support an aircraft carrier visit. Similarly, the Commonwealth of the Northern Mariana Islands (CNMI) would pose no limitation on freedom of action but in contrast to the other locations, none of the islands possess infrastructure to support an aircraft carrier visit. Further, the deep water port in Saipan is already encumbered by maritime pre-positioned vessels strategically placed in Saipan to support U.S. military operations. Except for California and Washington, which are presently aircraft carrier homeport locations, none of the locations discussed have an aircraft carrier transient-capable pier. California, Washington, and Hawaii locations, however, would increase response times compared with locations within the Western Pacific AOR and constrain the U.S. ability to uphold treaty obligations. Those treaty obligations require that certain forces be within range to project power, to deter aggression and dissuade coercion in the Western Pacific. The aircraft carrier homeport in Japan is within the desired range; however, this pier is a dedicated homeported nuclear powered aircraft carrier pier and there is no additional capability to meet the requirements of a transient nuclear powered aircraft carrier as specified by the QDR. The CNMI and Guam are close enough to many of the likely contingency areas in the region and potential threats to ensure rapid response, comply with treaty obligations, and assure the deterrent presence that U.S. forces bring to the region. Development of a transient port capability in this region, because of the proximity to the Western Pacific/Indian Ocean AOR, would enable multiple CSGs to maximize time in the Western Pacific/Indian Ocean AOR. Transient port capability meets the defense and national security policy initiatives of the QDR. Finally, the combined requirements of freedom of action and force protection can be met while meeting the required operational flexibility on Guam or the CNMI, although Guam best meets these requirements since it is sovereign U.S territory.

Creating an aircraft carrier transient capable port in the CNMI was infeasible because it lacks other key features that are integral to the development of transient-capable port. In contrast, these features were present on Guam as outlined below:

- Guam maintains adequate infrastructure for shoreside utilities.
- Naval Base Guam already possesses emergent nuclear repair, radiation response and radioactive waste management capabilities.
- The Navy's Munitions Storage Area on Guam is in close proximity to Apra Harbor, providing the capability to re-supply the aircraft carrier with munitions.
- Guam has an existing logistics support network through the Defense Logistics Agency that is co-located on Naval Base Guam. While in port, the aircraft carrier continues to support the on-board military personnel while continuing its daily operations and maintenance of the ship and its aircraft. Food and other supplies must be reliably available for the ship.
- Guam provides adequate quality of life amenities. One of the primary reasons for the extended transient port visits is to provide for quality of life for Sailors and airmen deployed for extended periods of time to the Western Pacific associated with enhanced rotational presence. Studies have shown that extended deployments at sea may have detrimental effects on individual readiness unless adequate shoreside quality of life amenities are available for rest and relaxation when the ship is in port. Morale and quality of life of individual Sailors is important to maintain a combat ready unit.
- Guam provides existing transient aircraft capabilities at Andersen Air Force Base (AFB) for visiting air wings.

In summary, the fundamental requirements to support the treaties and alliances, which ensure peace and stability in the region, as well as Guam's unique geography and port infrastructure, make it the best and only location to create a transient-capable carrier port to increase aircraft carrier presence in the Western Pacific.

1.1.3.6 Transient Berthing Capability and Operation on Guam

The Navy plans to have six operationally available and sustainable aircraft carriers in the Pacific Fleet AOR, with the majority deployed in the Western Pacific and Indian Oceans, including the referenced transient carrier. To maximize operational availability, the carriers would remain deployed for longer periods of time and utilize the proposed wharf for unscheduled repairs. This can only be accomplished if the carrier docks in Apra Harbor for crew changes, logistics support, and crew recreation.

The present projected operational requirements indicate a proposed schedule for aircraft carrier transient visits with a cumulative total of up to 63 visit days per year, with an anticipated length of 21 days or less per visit. Schedules are subject to operational, contingency, and geopolitical considerations. The aircraft would continue to be accommodated at Andersen AFB on a space available basis. The aircraft carrier escort ships would be accommodated at Inner Apra Harbor, as is current practice.

The number of Guam transient port days would be directly related to the treaty and alliance requirements, operational requirements including contingency operations, geopolitical considerations, and the QDR as periodically updated. Aircraft carrier port visits are currently accommodated at Kilo Wharf, as it is the only Navy wharf on Guam that meets strength, security, and operational water depth requirements (-49.5 feet [ft], -15 meters [m] mean lower low water [MLLW]). However, it does not provide full hotel services. During current port visits, the aircraft carriers do not require shoreside utility support. During these brief stays, the aircraft carriers rely entirely on their own shipboard utilities while pier side.

Kilo Wharf is also DoD's only dedicated munitions wharf in the AOR serving the 12 to 14 ammunitions ships in the AOR. Navy Munitions Command Detachment Guam (NMC-DET Guam) provides munitions logistics support to the operational forces of the 5th and 7th Fleets. Access to the wharf and vicinity is restricted during munitions operations for safety reasons. There is a Department of Defense and Explosive Safety Board (DDESB) approved explosive safety arc delineating the area of restricted access. When there are no munitions operations at the wharf, other types of ships can berth at Kilo Wharf at the discretion of Port Operations.

On average, ammunition operations occur at Kilo Wharf 275 days per year (COMNAV Marianas 2007). These operations include loading or unloading ammunition to or from a ship and staging the ammunition on Kilo Wharf after it has been unloaded from a ship or in preparation of an ammunition ship arrival. Kilo Wharf is unavailable during unfavorable weather (tropical storms) or high seas, which occur an estimated 40 to 50 non-consecutive days per year (COMNAV Marianas 2007).

In addition to the days the wharf is unavailable due to munitions operations (275 days) and ocean or weather conditions (average 45 days), there are an estimated 40 to 45 days per year that the wharf is unavailable for use by the aircraft carrier due to maintenance work aboard cargo munitions ships that are docked at Kilo Wharf. Unscheduled repairs to these ships while loaded are restricted to Kilo Wharf because of the explosive safety considerations. If they require maintenance and are carrying munitions, Kilo Wharf is the only wharf in Apra Harbor that has a DDESB approval for large quantities of munitions. A waiver is required from DDESB and Naval Ordnance Safety and Security Activity for ships carrying ammunition to berth in Inner Apra Harbor. These waivers are not readily granted because the large quantities of explosives berthed at a wharf that is unauthorized for large net explosive weights would represent an increased safety risk to nearby populations (NMC-DET Guam 2009).

Kilo Wharf usage is near capacity (estimated 275 days per year of use) without considering the aircraft carrier visits estimated at approximately 63 total days per year (NMC-DET Guam 2009). The aircraft carrier visits are managed through scheduling, but are disruptive to munitions operations and limit flexibility in carrier scheduling. Fleet and Military Sealift Command customers have been turned away due to the unavailability of Kilo Wharf (Commander Navy Installations Command 2006).

There are other challenges associated with an aircraft carrier berthing at Kilo Wharf that are manageable for the recent short duration port visits, but would be untenable for longer transient berthing requirements that include logistics, maintenance, and Morale Welfare and Recreation (MWR) support. Dependents, vendors, commercial delivery vehicles and non-DoD personnel are prohibited from entering the explosive safety arcs around Kilo Wharf. There is limited space for MWR activities at Kilo Wharf (NMC-DET Guam 2009).

Beginning in 2014, the munitions operations are projected to increase from 275 to 315 days per year at Kilo Wharf to support the programmed Navy, Marine Corps and Air Force missions (Commander Navy Installations Command 2006). The additional estimated 90 days of wharf unavailability due to ocean conditions, weather, and ship maintenance would exceed the Kilo Wharf annual capacity by an estimated 40 days per year. Adding the anticipated 63 visit days per year for the proposed action would exceed the Kilo Wharf annual capacity by an estimated 103 days. Regularly requesting waivers from DDESB to allow munitions cargo ships into Inner Apra Harbor is not a viable option. No other wharves in Apra Harbor meet the wharf requirements, including depth and security requirements associated with the transient capability for an aircraft carrier; consequently, a new wharf and shoreside infrastructure improvements are proposed.

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CHAPTER 2.
PROPOSED ACTION AND ALTERNATIVES

Chapter 2 provides an overview of the proposed action and alternatives evaluated in this Environmental Impact Statement (EIS) for the proposed aircraft carrier berthing. The chapter begins with a description of operation, facilities and design standards that are common to both action alternatives. Then the chapter summarizes the alternatives that were considered and dismissed, and continues with a detailed description of the alternatives carried forward for analysis in this EIS. The chapter ends with a description of the no-action alternative.

Chapter 2:

2.1 OVERVIEW

The Navy proposes to construct a new deep-draft wharf with shoreside infrastructure improvements in Apra Harbor, Guam to provide for a transient nuclear powered aircraft carrier. The nuclear powered aircraft carrier is the largest ship in the Navy's fleet. The environmental planning and preliminary design of the wharf, support infrastructure, and harbor accommodations are projected to meet the requirements of both the USS Nimitz Class (CVN 68) as well as the next generation of carrier, the Gerald R. Ford Class (CVN 78) that is anticipated to be operational in 2015.

The transient capability would increase the number of in-port days for the aircraft carrier from approximately 16 to a cumulative total of up to 63 visit days per year. The anticipated increase in the duration of visits along with the additional support requirements needed for transient capability requires shoreside utility capability. The visiting transient carrier does not require housing for crew, new training or maintenance facilities but may require limited shoreside facilities for recreation, laundry, support for transportation shuttle services, and food and beverage sales. Up to 59 aircraft including strike, surveillance, control, and other logistic and combat aircraft, would either remain onboard the ship or fly to Andersen Air Force Base (AFB) where they would be assigned airfield space on a space-available basis. No airfield facility improvements are proposed. Training requirements for the carrier and its associated air wing would be fully met by existing training ranges and covered by appropriate environmental compliance documentation including the Mariana Islands Range Complex (MIRC) Final EIS (DoN 2010) and Establishment and Operation of an Intelligence, Surveillance, Reconnaissance, (ISR) and Strike Capability EIS (PACAF 2006). Maintenance requirements can be met with existing shoreside maintenance support.

A number of alternative wharf locations were considered for the proposed berthing of the transient aircraft carrier in Apra Harbor. These considerations included new wharf sites and improvements to existing wharves, operational/navigational issues, security/protection considerations, wharf alignment options, channel access, turning basin configurations and locations, structural designs, and environmental considerations. These considerations are documented in Section 2.3. The derivation of the individual elements dismissed and those carried forward created distinct alternatives each with different environmental impacts. The result of this analysis was the selection of two locations for siting the new wharf under the proposed action: 1) Polaris Point (preferred), and 2) the Former Ship Repair Facility (SRF). The alternative sites are both located at the entrance to the Inner Apra Harbor channel and the navigational approach to both is similar. Both wharves would be aligned with one edge along the coastline. In addition to these two action alternatives, the no-action alternative is described in this chapter.

2.2 ELEMENTS COMMON TO BOTH ACTION ALTERNATIVES

2.2.1 Operation

To support forward operations, Commander, United States (U.S.) Pacific Fleet plans to conduct aircraft carrier transient visits throughout the year. The present projected operational requirements indicate a proposed schedule for aircraft carrier transient visits with a cumulative of up to 63 visit days per year, with an anticipated length of 21 days or less per visit. Schedules are subject to operational, contingency, and geopolitical considerations.

Assumptions regarding operational concepts would be the same for both action alternatives and include the following.

- Aircraft carriers that would visit Guam are Nimitz Class, such as CVN 68 (currently visits Guam) and Ford Class (the next generation aircraft carrier), such as CVN 78 (see Section 2.2.1.1 for aircraft carrier specifications).
- Aircraft carrier escort vessels, which may include destroyers, a cruiser, a submarine, and support ships such as a fast combat support ship/T-AKE would be accommodated at existing Apra Harbor wharves on a space available basis, as is the current practice for port visits. The support ships would need to be accommodated at Kilo Wharf to onload/offload munitions, Delta/Echo Wharf to onload fuel, and X-ray Wharf to onload dry and refrigerated stores to support the Carrier Strike Group (CSG). For information concerning improvements and increased usage of Apra Harbor, refer to Volume 2, Sections 2.5 and 2.6.1.5 of this EIS. For long term and cumulative impacts for increased usage of Apra Harbor, refer to Volume 7.
- Up to 59 aircraft (including strike, surveillance, control, and other logistic and combat aircraft) could fly off from the aircraft carrier and beddown (park) at Andersen AFB on a space-available basis, where they would follow all transient operational requirements, as is the current practice.
- A typical air wing might include:
    - 2 Hornet squadrons – 10 aircraft each
    - 2 Super Hornet squadrons – 5 aircraft each
    - 1 EA-6B squadron – 5 aircraft (EA-6B to be replaced by F-18 G in 2014)
    - E-2C – 4 aircraft
    - SH-60 – 6 aircraft
- Pilots may need aircraft carrier landing practice during extended visits of approximately 21 days at a time. This landing practice and any other increased fixed wing aircraft operations associated with the visiting aircraft carrier are accounted for in Volume 2, Chapter 6, Noise. All other

training activities, including use of Farallon de Medinilla for aerial bombing, associated with aircraft carrier activities is captured in existing documentation including the Mariana Islands Range Complex (MIRC) EIS (Navy 2009) and Establishment and Operation of an Intelligence, Surveillance, Reconnaissance, (ISR) and Strike Capability EIS (PACAF 2006).

- Aircraft carrier munitions transfers are anticipated to occur at sea.
- Nuclear reactor re-fueling operations would not occur in Apra Harbor.
- Aircraft carrier scheduled maintenance and repairs would not be done on Guam. Scheduled maintenance and repairs refers to those maintenance operations that are regularly scheduled throughout the life a ship. Scheduled maintenance includes high-level maintenance on aircraft carriers that occurs approximately every 8 years in a dry dock for a 2-year period, as well as depot-level maintenance that occurs usually at the ship's homeport approximately every 2 years for a 6-month period.
- Emergent, or unscheduled, repairs and emergency maintenance would be provided by repair teams from Hawaii or the west coast of the U.S. mainland and use existing maintenance facilities on Guam.
- It is anticipated that a transient aircraft carrier and its escort ships would rely on shoreside utility infrastructure for water, wastewater, and solid waste after 2015. Electric power would be provided in accordance with customer service agreements between Guam Power Authority (GPA) and the U.S. Navy. Any GPA commitments for additional power to support the aircraft carrier and its escort ships will be determined by future CSA modifications. Any changes in the shoreside power requirements for the aircraft carrier and its escort ships may require additional NEPA review.
- Aircraft carrier crew is estimated to be 5,680 people:
  - Ship's company: 3,200 people
  - Air wing: 2,480 people
- Morale, Welfare, and Recreation (MWR) services would be provided using existing base facilities. Additionally, there would be some temporary pier-side Sailor support services at the wharf that could include tent facilities for portable laundromats, telephones, and/or food vendors.
- Shuttle services would be provided during port calls to support movement within the base, as well as to off base locations.
- Operations at the wharf would be available 24 hours per day during aircraft carrier visits.
- Up to four tugboats would be required to assist in navigating the aircraft carrier through the harbor, as is the current practice.
- All nuclear powered aircraft carriers require a minimum of 6 ft (2 m) beneath the keel to ensure cooling and firefighting system intakes do not get clogged or damaged by mud and debris from the seafloor. A water depth of -49.5 feet (ft) (-15 meters [m]) is required for nuclear powered aircraft carriers to meet this requirement under all ship loading and tidal conditions.

Daily operations at the wharf would include people arriving or waiting to depart the wharf area via bus or car, personnel congregating around the wharf's temporary facilities, and shoreside and in-water security patrols. There would be shuttle buses provided to Naval Base Guam as well as to other Guam recreation and shopping areas. Traffic would also include taxis and private vehicles.

Periodically, there would be truck traffic to the wharf to re-supply the ship. The trucks may be from Navy supply or direct from commercial vendors. The cargo movement would likely require mobile cranes or other material handling equipment, such as forklifts, to load the ship. This equipment would be brought to the wharf as needed. The frequency of deliveries would be dependent on the status of supplies on board.

There also would be temporary solid and hazardous waste storage areas provided at the site that would be managed in accordance with current Naval Base Guam practices.

All alternatives include electronic surveillance (closed circuit television), associated alarms, surface craft or swimmer detection, and underwater detection defined as electronic security systems on the landside and electronic harbor security systems on the waterside.

When the aircraft carrier is not in port, the proposed on-site Port Operations Support Building would be used for storage, including the security barriers that are deployed when the ship is docked. There would likely be other storage or administrative uses of the building when the aircraft carrier is not visiting.

2.2.1.1 Aircraft Carrier Specifications

Specifications for the nuclear powered aircraft carriers CVN 68 (Nimitz Class) and CVN 78 (Ford Class) are similar, as shown in Table 2.2-1. The specifications are based on various Navy documents and summarized in the *CVN-Capable Berthing Study* (NAVFAC Pacific 2008). This study is included in Volume 9, Appendix K.

Table 2.2-1. Vessel Characteristics

Vessel Characteristic	*CVN 68 ft (m) (Nimitz Class)*	*CVN 78 ft (m) (Ford Class)*
LOA	1,123 (342.29)	1,092 (332.84)
Length at waterline	1,040 (316.99)	1,040 (316.99)
Beam, with removable appurtenances	280 (85.34)	280 (85.34)
Beam, without appurtenances	256 (78.03)	256 (78.03)
Beam at waterline	134 (40.84)	134 (40.84)
Draft, maximum	40.8 (12.44)	40.8 (12.44)
Displacement[a]	104,200 LT	104,200 LT
Height at light load (air draft)	215 (65.53)	215 (65.53)

Legend: LOA = length overall; LT = long ton

[a] The weight of the volume of water that is displaced by the underwater portion of the hull is equal to the weight of the ship. This is known as a ship's displacement. The unit of measurement for displacement is the Long Ton (1 LT = 2,240 pounds [lbs]).

Source: NAVFAC Pacific 2008.

2.2.2 Support Facilities for Each Alternative

This section summarizes facilities and structures that would be required under either action alternative. The facilities not addressed here are the staging area and access; security; aids to navigation; and MWR facilities. While these facilities are common to both alternatives, there are differences that warrant separate treatment under the respective alternative discussions (see Section 2.5 and Section 2.6).

2.2.2.1 Structures

Facility requirements for the Nimitz Class (CVN 68) and Ford Class (CVN 78) aircraft carriers would be the same for both action alternatives. The requirements were compiled from various sources and described in the *CVN-Capable Berthing Study* (NAVFAC Pacific 2008).

Onshore requirements for either class of aircraft carrier are as follows:

- Wharf
  - Up to 1,325 ft (404 meters [m]) in length
  - 90 ft (27 m) wide
  - Deck height: +12 ft (+3.6 m) mean lower low water (MLLW)
  - Pier strength: 800 pounds per square foot
  - Mobile crane load: 2,140 tons (1,941 metric tons)
  - Bollards: 100-ton (91 metric tons) posts, 100 ft (30 m) intervals along length of wharf to attach mooring lines
  - Storm bollards: four 200-ton bollards at each end of wharf
  - Port Operations Support Building: 10,000 square feet (ft2) (929 square meters [m2]); a permanent, all concrete, unoccupied, storage shed with shelves and restrooms
  - Air Compressor Building: 1,195 ft2 (111 m2); storage for compressed air for aircraft carrier requirements
  - Water Treatment Building: 1,249 ft2 (116 m2); a permanent structure for taking potable water from the existing infrastructure system and treating it to Grade A quality dedicated to the aircraft carrier
  - Boiler House: 1,120 ft2 (104 m2); a permanent facility to house two marine oil fired boilers to provide steam to the aircraft carrier while in berth
  - 13,210 Gallon Fuel Tank: 968 ft2 (90 m2) (surrounded by a containment berm)
  - Electrical Substation: 10,125 ft2 (941 m2)
  - Bilge and Oily Wastewater (BOW) Pump Station: 625 ft2 (58 m2) and Bilge and Oily Wastewater Treatment System (BOWTS): 5,000 ft2 (465 m2); system used to treat the bilge water from the hull of the ship to remove oils, grease, and other pollutants prior to discharge into the domestic wastewater system
  - Security watch towers: 797 ft2 (74 m2), 30–50 ft (9–15 m) in height
  - Guard Booth: 3,100 ft2 (288 m2); provides security at the entrance to the pier area
  - MWR area (3-inch [in] [7.6-centimeter {cm}] asphalt with utility tie-ins for temporary MWR structures); this area would provide services such as tent facilities for portable laundromats, telephones, and/or food vendors
  - Security measures: landside and waterside
- In-water requirements for either class of aircraft carrier are as follows:
  - 600 ft (183 m) of clearance in front of wharf; (Alternative 1 Polaris Point) provides only 442 ft [135 m]) but this clearance has been approved for safe navigation
  - Minimum dredged depth: -49.5 ft (-15 m) MLLW plus 2 ft (0.6 m) of allowable overdredge
  - Turning basin (minimal): 1,092 ft (333 m) radius
  - Channel width: 600 ft (183 m)
  - Navigational aids
  - Security

2.2.2.2 Design Standards

All buildings would be designed to the current Guam building code and modified by the applicable Unified Facilities Code (UFC). Buildings would be designed to meet criteria for typhoon winds, seismic events, anti-terrorism force protection, sustainability, and other issues in accordance with UFC 1-200-01. Foundations can be shallow if soil improvement methods are utilized to consolidate the fill materials and native soils beneath to prevent liquefaction. Buildings would be all concrete construction. Leadership in Energy and Environmental Design (LEED) Silver criteria would be met for proposed facilities.

2.3 ALTERNATIVES CONSIDERED AND DISMISSED

This section presents a range of alternatives that were considered and dismissed for the proposed berth of the aircraft carrier in Apra Harbor, Guam. Numerous locations for the berthing site were evaluated and selection of wharf location alternatives in Apra Harbor involved evaluation of multiple parameters. The key parameters are described in this section. They are:

- Wharf alignment
- Turning basin
- Access through the channel
- Wharf structural design
- Dredging methods
- Dredge disposal sites

Selection of reasonable alternatives to be carried forward in the EIS analysis was based on consideration of the following criteria. A brief description of the criteria is provided below.

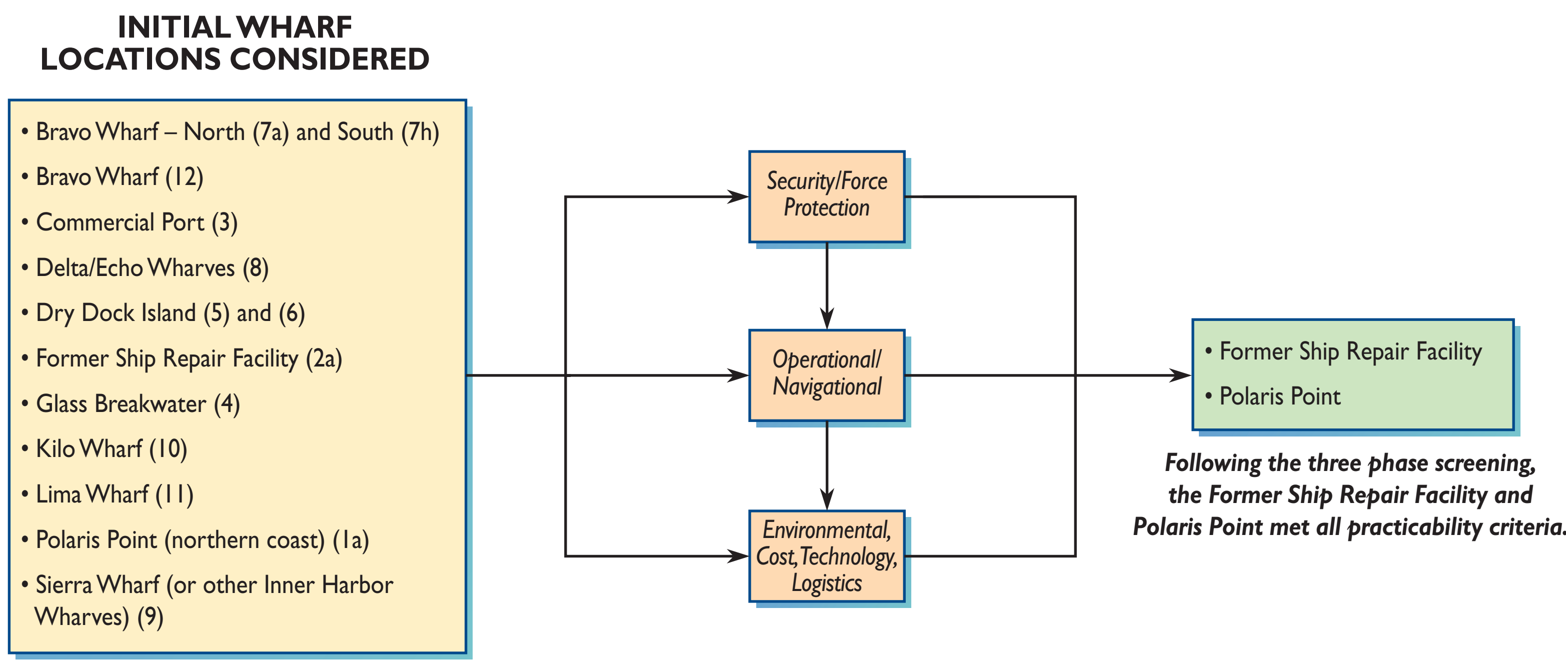
- Practicability (with sub-criteria)
    - Meets security/force protection requirements
    - Meets operational/navigational characteristics
    - Cost, technology, and logistics
- Avoids/minimizes environmental impacts to the extent practicable

Practicability

Practicability refers to whether an alternative is feasible or can be implemented. Although the criteria are not specifically weighted, it is imperative that security/force protection or operational requirements not be compromised. Any alternative that did not meet these fundamental military mission requirements was automatically dismissed. Figure 2.3-1 shows the screening process for the wharf locations.

Security/Force Protection

The suicide bombing attack against the U.S. Navy guided missile destroyer USS Cole (DDG 67) in Yemen on October 12, 2000 elevated security as a primary criterion for all ship berthing, including aircraft carriers. Security/force protection is related to the distance between Department of Defense (DoD) assets and potential sources of threats (non-DoD lands and ships). UFC 4-025-01 (*Waterfront Security Design*) describes the required security clearance zone on the water around ships in port. These areas are delineated by deployable floating port security barriers. At the lowest threat level, the recommended distance for the security barriers surrounding the aircraft carrier is 250 ft (76 m) as measured from the hull. In the event that force protection conditions are higher, the port security barriers would require an additional 200 ft (61 m) beyond the barriers for the lowest threat level. The proposed locations for the security barriers are shown later in this Chapter on Figure 2.5-2. In addition to the specified minimum distances, the Commander, U.S. Pacific Fleet has discretionary authority to determine separation distances based on site-specific assessments of potential threats. Wharf locations that did not meet security/force protection requirements were not considered feasible.



Note: Numbers in parenthesis denote the location on Figure 2.3-1.

Figure 2.3-1
Wharf Location Screening Process

Operational/Navigational

Apra Harbor is an active commercial and military harbor. Potential aircraft carrier berthing locations that would compromise or interfere with ongoing DoD or Guam Commercial Port operations were not considered feasible. The potential for bething locations to interfere or compromise DoD or Guam Commercial Port operations are discussed below.

Navigational considerations refer to the ability to safely maneuver the aircraft carrier into position during berthing and departure. As discussed under the Security/Force Protection criterion, any wharf location that could not accommodate safe maneuvering of the aircraft carrier was eliminated from further analysis.

Cost, technology, and logistics

Cost, technology, and logistics refers to how expensive the project would be, whether or not there would be technological limitations to project execution, or whether logistically, the project is not feasible due to distance from support facilities, for example. Factors associated with higher project costs could include construction techniques and/or labor or materials; these factors are often directly linked to the quality/type of the location where development is proposed. Wharf locations that did not meet the cost, technology, and logistics criterion were dismissed from further analysis.

Environmental

Environmental factors, such as the amount of fill and dredging and related impacts to coral reefs, were used to identify and screen potential wharf locations, wharf alignments, turning basin options, and channel alignments. The Navy identified the options that would minimize impacts to the environment to the extent practicable, while still meeting security/force protection and operational/navigational requirements.

2.3.1 Wharf Location Alternatives Considered

2.3.1.1 Wharf Locations Dismissed

As discussed in Chapter 1, Section 1.1.3 of this Volume, Guam was the only location that met the purpose and need. Within Guam, there are no other harbors, aside from Apra Harbor, capable of supporting Naval vessels for the proposed action. Other small boat harbor locations within Guam are not feasible, as Apra Harbor is the only harbor that provides the necessary security, potential channel capability, and potential wharf locations to support the aircraft carrier berthing. Aircraft carrier port visits are currently accommodated in Apra Harbor at Kilo Wharf, as it is the only Navy wharf that meets aircraft carrier draft (depth) requirements. However, for the reasons previously discussed in Chapter 1 and below, Kilo Wharf is not a feasible option and alternative wharf locations had to be considered.

Figure 2.3-2 shows the wharf locations in Apra Harbor that were considered. After applying the screening criteria as illustrated in Figure 2.3-1 Polaris Point and the Former SRF were the only locations that met the criteria and were therefore carried forward for analysis in the EIS.

This section also describes the reasons why certain wharf locations in Apra Harbor were dismissed from further analysis and identifies the screening criteria that were used to dismiss the individual wharf locations.

Table 2.3-1, located further in the Chapter, also summarizes wharf alignments (Section 2.3.2), turning basin and channel alignments (Section 2.3.3), wharf structural design (Section 2.3.4), and dredging methods and disposal options (Section 2.3.5) considered and dismissed in the noted sections below.

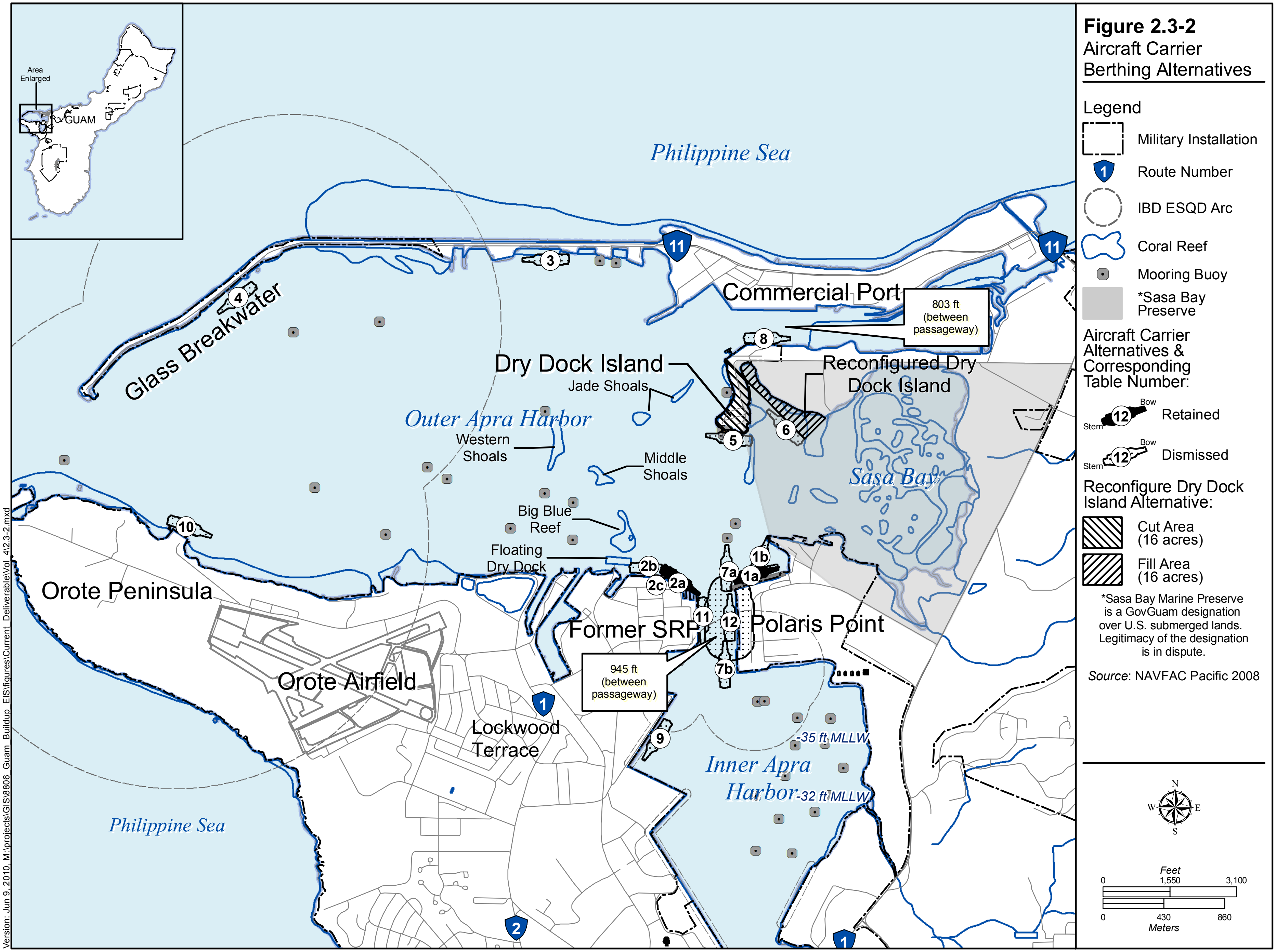


Figure 2.3-2
Aircraft Carrier Berthing Alternatives
Legend
Military Installation
Route Number
IBD ESQD Arc
Coral Reef
Mooring Buoy
*Sasa Bay Preserve
Aircraft Carrier Alternatives & Corresponding Table Number:
Retained
Dismissed
Bow
Stern
Reconfigure Dry Dock Island Alternative:
Cut Area (16 acres)
Fill Area (16 acres)
*Sasa Bay Marine Preserve is a GovGuam designation over U.S. submerged lands. Legitimacy of the designation is in dispute.
Source: NAVFAC Pacific 2008
Feet
0
1,550
3,100
0
430
860
Meters
Area Enlarged
GUAM
Philippine Sea
Glass Breakwater
Commercial Port
803 ft (between passageway)
Dry Dock Island
Jade Shoals
Reconfigured Dry Dock Island
Outer Apra Harbor
Western Shoals
Middle Shoals
Sasa Bay
Big Blue Reef
Floating Dry Dock
Orote Peninsula
Former SRF
Polaris Point
945 ft (between passageway)
Orote Airfield
Lockwood Terrace
Inner Apra Harbor
-35 ft MLLW
-32 ft MLLW
Philippine Sea
Version: Jun 9, 2010, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_4\2.3-2.mxd

Guam Commercial Port

The Guam Commercial Port was dismissed because of security/force protection and operational/navigational reasons, as discussed below. The Guam Commercial Port is located on the northern side of Apra Harbor. Several locations at the Guam Commercial Port were assessed. One location, shown by number (**3**) on Figure 2.3-2 would be a new deep-draft wharf. Initial planning has been conducted for construction of this wharf by the Port Authority of Guam. Other locations that were assessed were located within the port across the channel from Delta/Echo Wharves.

Security/Force Protection

Location number (**3**) was dismissed as a potential aircraft carrier berthing option because of security/force protection, due to the remote location and the narrow strip of land on which the site is located. Locations internal to the base are preferred as they would offer greater protection when the carrier is in port. Also, access to the site would be through non-DoD lands representing an additional force protection issue. DoD lands provide a higher level of complete security for personnel, equipment, and berthed vessels.

Operational/Navigational

Locations at the Commercial Port proximal to the channel across from Delta/Echo wharves were dismissed because the required buffer zones around the aircraft carrier would effectively close harbor access to the majority of the available commercial port operations including cargo handling. This is an untenable situation for Guam, which relies on receiving over 95% of its commodities by sea. There is not enough space between the buffer zones around the aircraft carrier and the Commercial Port shore to safely allow all vessel traffic into and out of the port channel. The distance between the face of the existing bulkhead at the Commercial Port wharf to the wharf structure at Delta/Echo wharves is approximately 850 ft (260 m). The combined encumbered width of either aircraft carrier (CVN 68 or CVN 78) (280 ft [85 m]) plus the minimum width of buffer zones under conditions of Charlie or Delta (450 ft [137 m]) is 730 ft (223 m) leaving approximately 120 ft (37 m) which is an insufficient width to berth a vessel at Commercial Port and allow safe passage to the interior portions of the Commercial Port. This same problem is evident at the Delta/Echo wharves and is discussed further below and depicted on Figure 2.3-3.

Glass Breakwater

Glass Breakwater was dismissed because of security/force protection and operational/navigational reasons, as discussed below. This location is a narrow strip of man-made land that separates the Philippine Sea to the north and Outer Apra Harbor to the south (see number [**4**] on Figure 2.3-2). There are no existing wharves or piers on the breakwater.

Security/Force Protection

A wharf at this location would also have security/force protection concerns, since it is remote and surrounded by open water. Locations internal to the base are preferred as they would offer greater protection when the carrier is in port. Also, access to the site would be through non-DoD lands representing an additional force protection issue. DoD lands provide a higher level of complete security for personnel, equipment, and berthed vessels.

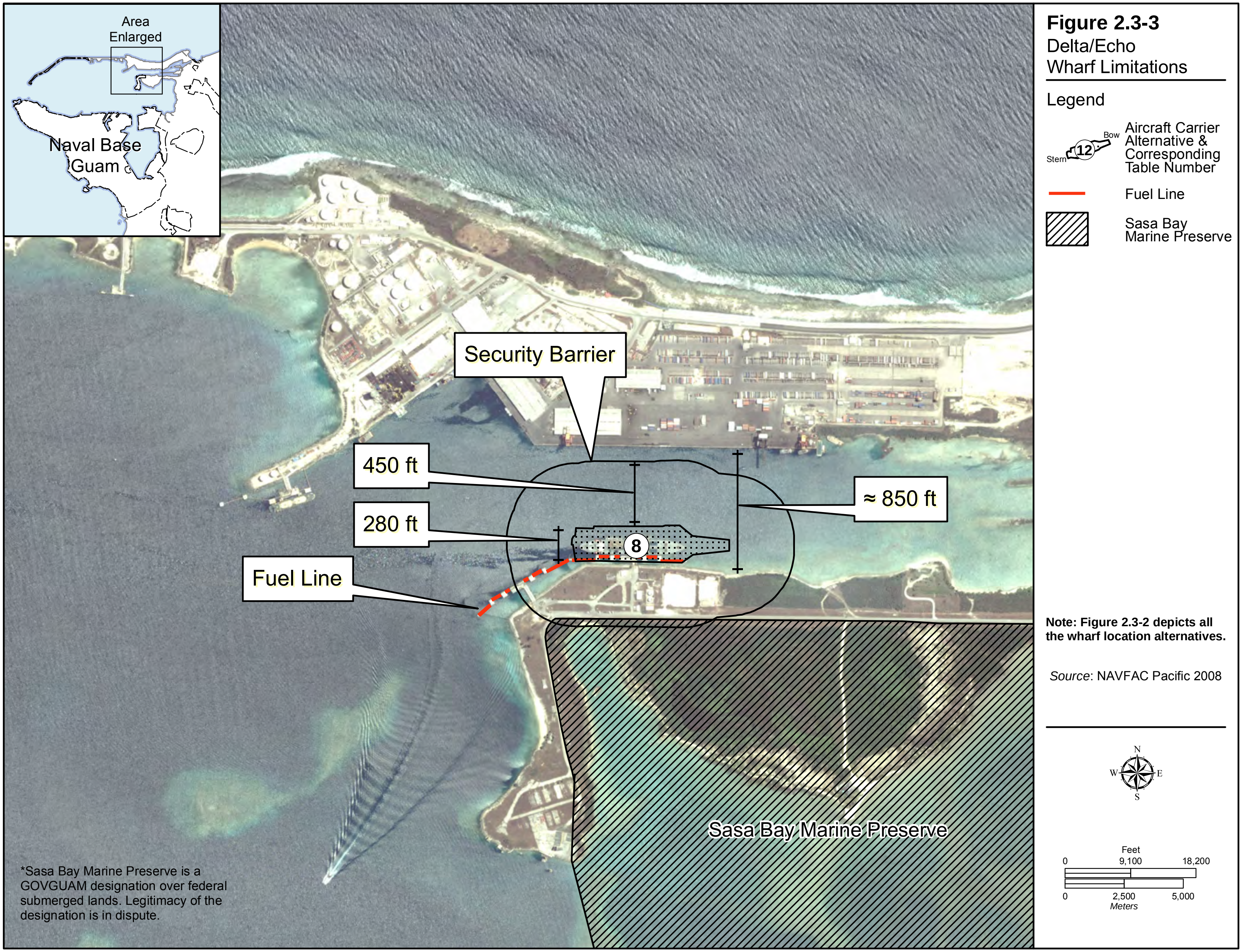


Figure 2.3-3
Delta/Echo Wharf Limitations

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Operational/Navigational

Berthing the aircraft carrier at this location would result in operational restrictions to Buoy 702 for ammunition ships. The explosive safety quantity distance arc associated with the Buoy would encumber the use of a wharf at this location for the aircraft carrier.

Environmental

Extensive open-water fill would be required to provide the amount of shoreside land area for activities and accommodate the movement of more than 5,600 personnel on and off the ship. Approximately 5 acres (ac) (2.0 hectares[ha]) are needed for a staging area to support the transient aircraft carrier (NAVFAC Pacific 2008). The Glass Breakwater is only a narrow section of land approximately 126 ft (38 m) wide.

Cost, Technology, and Logistics

Several reasons related to the cost and general feasibility of developing an aircraft carrier wharf at the Glass Breakwater preclude it from being preferable, including:

- There are no existing utilities in the vicinity of the remote site, and providing these utilities at the level an aircraft carrier requires would be cost prohibitive.
- The area is subject to wind and wave events that would require significant costs to meet structural design requirements.
- The single lane access road would require structural improvements to support two lanes for truck and bus traffic.
- The site is a great distance from the base (approximately 6 miles [9,656 m] from the berthing areas on the southside of Outer Apra Harbor), which is problematic for personnel quality of life activities and supply replenishment. Personnel would have to rely on bus service to access base amenities. The Navy Supply Wharf is X-Ray, which is at the southernmost point of Inner Apra Harbor.

2.3.1.2 Dry Dock Island

Dry Dock Island was dismissed because of operational/navigational and environmental reasons. Dry Dock Island is located south of the Guam Commercial Port, near the Sasa Bay Preserve. Dry Dock Island (see numbers [**5**] and [**6**] on Figure 2.3-2) was dismissed as described below.

Security/Force Protection

Access to the site would be through non-DoD land, representing a force protection issue. DoD lands provide a higher level of complete security for personnel, equipment, and berthed vessels.

Operational/Navigational

The Dry Dock Island contains the only Landing Craft Air Cushion (LCAC) landing site in Apra Harbor. This area is used for training and logistics support for Amphibious Readiness Group which would represent an operational conflict. The proximity to the commercial port also raises navigation and maritime traffic issues in the narrow channels that support the commercial port and Dry Dock Island. The turning basin that would be required for Dry Dock Island would disrupt commercial port activities and maritime traffic because it is located within the navigation channel for the commercial port.

Environmental

Extensive fill would be required to provide the amount of shoreside land area for activities and to accommodate the movement of more than 5,600 personnel on and off the ship. Also, as presented in Section 2.3.3.1, the required turning basin for this location would not avoid or minimize coral loss.

Cost, Technology, and Logistics

Several reasons related to the cost and general feasibility of developing an aircraft carrier wharf at Dry Dock Island preclude it from being preferable, including:

- The site is a great distance from the base (approximately 4 miles (6,437 m) from the berthing areas on the southside of Outer Apra Harbor), which is problematic for personnel quality of life activities and supply replenishment.
- The emergency response, unscheduled (emergent) repair, and radioactive waste management facilities are located on Polaris Point.
- The utilities on Dry Dock Island that support Echo and Delta Wharves do not have the capacity to support a carrier.
- The access road, which is a service road for the parallel petroleum, oil, and lubricants (POL) pipeline, and the pipeline itself would require structural improvements, and possibly relocation to support two lanes for truck and bus traffic.
- The site would create incompatible uses with existing recreational use of parts of Dry Dock Island. Areas near Dry Dock Island are used for fishing and crabbing.

<u>Bravo and Lima Wharves</u>

Bravo and Lima Wharves were dismissed because of security/force protection and operational/navigational reasons, as discussed below. Bravo Wharf locations are shown as numbers (**7a**), (**7b**), and (**12**) on Figure 2.3-2. Lima Wharf is shown as number (**11**) on Figure 2.3-2.

Security/Force Protection

As shown on Figure 2.3-2, Bravo and Lima Wharves are located within the narrow entrance channel to the Inner Apra Harbor. The narrow channel that provides access to the inner harbor could be obstructed by a disabled or sunken ship, and potentially trap the aircraft carrier if it were berthed near this area. Mobility and responsiveness are critical and the time required to remove an obstruction from the Inner Apra Harbor Channel would be unacceptable.

Operational/Navigational

The Inner Apra Harbor channel is difficult to navigate in high cross-wind conditions. In addition, the carrier presence in the channel with the required floating security barriers would interfere with ship traffic to and from Inner Apra Harbor wharves and restrict submarine access to Polaris Point Wharves, as shown on Figure 2.3-4. The current width of the narrow channel entering Inner Apra Harbor from Outer Apra Harbor is less than 950 ft (290 m). Under Charlie or Delta security conditions with the aircraft carrier at berth, approximately 730 ft (223 m) would be encumbered. The remaining distance to the other shoreline would not leave enough room for a ship to berth and provide safe passage for vessels entering or leaving Inner Apra Harbor.

Another operational limitation to using these locations is that nuclear submarines are already utilizing Alpha and Bravo Wharves.

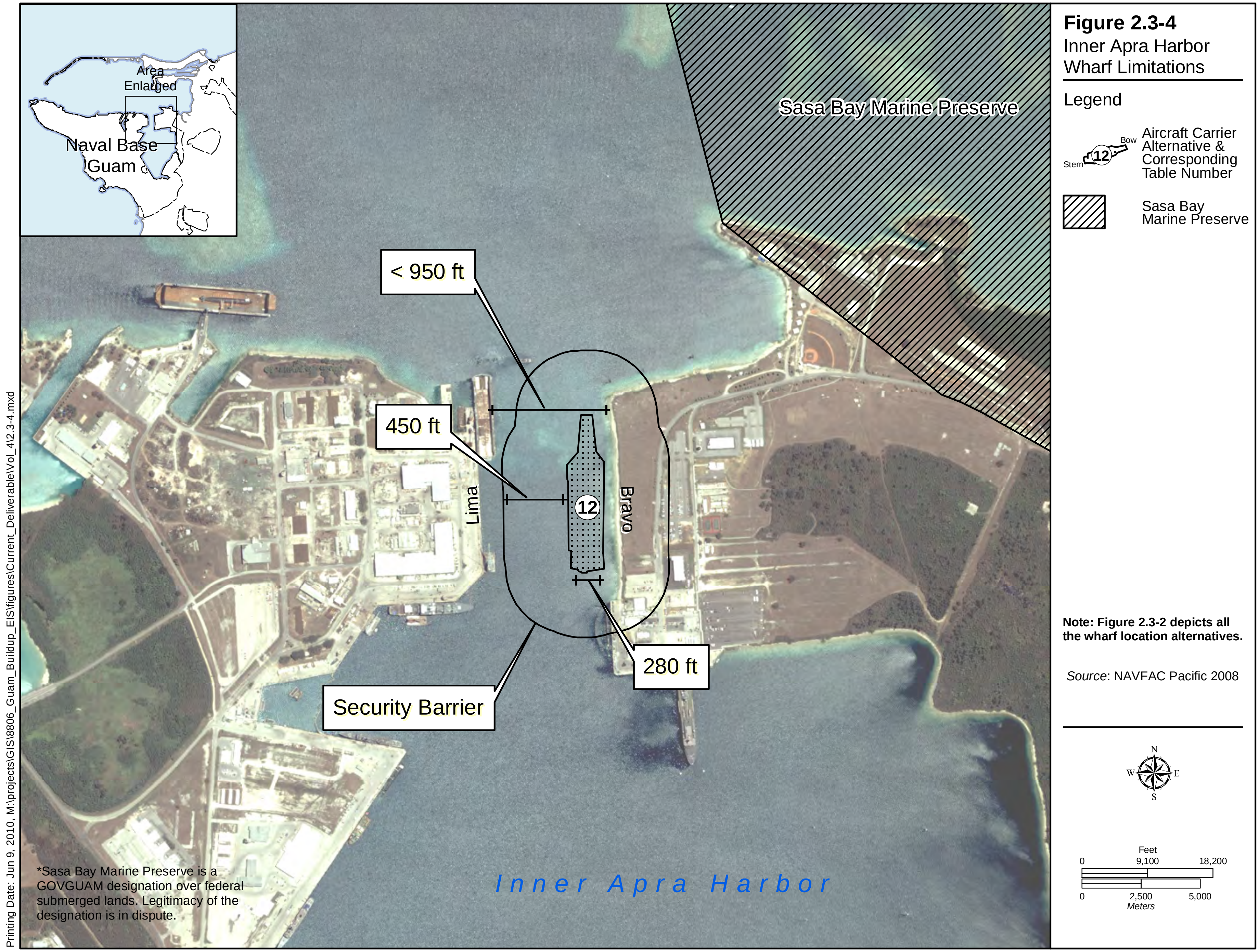

Figure 2.3-4
Inner Apra Harbor
Wharf Limitations
Legend
Bow
Stern
12
Aircraft Carrier Alternative & Corresponding Table Number
Sasa Bay Marine Preserve
Note: Figure 2.3-2 depicts all the wharf location alternatives.
Source: NAVFAC Pacific 2008
N
W
E
S
Feet
0
9,100
18,200
0
2,500
5,000
Meters
Area Enlarged
Naval Base Guam
Sasa Bay Marine Preserve
< 950 ft
450 ft
Lima
Bravo
280 ft
Security Barrier
Inner Apra Harbor
*Sasa Bay Marine Preserve is a GOVGUAM designation over federal submerged lands. Legitimacy of the designation is in dispute.
Printing Date: Jun 9, 2010, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_4\2.3-4.mxd

Delta/Echo Wharves

Delta/Echo Wharves were dismissed for security/force protection and operational/navigational reasons. Delta/Echo Wharves are located south of the Guam Commercial Port, within a channel that is 803 ft (245 m) wide. Please see number (**8**) on Figure 2.3-2 for the location of these wharves.

Security/Force Protection

Delta/Echo wharves are located across from the Guam Commercial Port, which presents a security/force protection risk. Since the port is so close to the Delta/Echo Wharves, there is an increased threat risk against the carrier both in the form of unsecured port vessels or landside-based terrorist attacks from non-DoD secured areas.

Operational/Navigational

Delta/Echo Wharves were dismissed because the required buffer zones around the aircraft carrier would obstruct harbor traffic as noted previously in the discussion for the Commercial Port (see Figure 2.3-3). Delta/Echo Wharves are identically designed wharves used specifically for fueling purposes. Delta/Echo Wharves do not currently have electrical shore power as ships typically being re-fueled remain on ship power. Delta/Echo Wharves are the only deep draft wharves in Apra Harbor that can adequately support a T-AOT class vessel without additional modifications (COMNAV Marianas 2004). T-AOT is a class designation for ships that provide transportation and storage of bulk petroleum products with the capability to support the Maritime Prepositioning Force operations. These ships have the capability to provide important ship to ship transfer of fuel while underway. Additionally, approximately 85 percent of the time that an aircraft carrier arrives in port, the supply-class replenishment ship (T-AOE, a fast combat support ship) that is part of the CSG must go to the Delta/Echo Wharves to onload fuel before returning to sea with the CSG.

Use of this location as a transient aircraft carrier wharf would preclude its use as a fueling pier for the DoD, adversely impacting the DoD mission on Guam.

Sierra Wharf (and all Inner Apra Harbor Locations)

Sierra Wharf and all Inner Apra Harbor locations were dismissed for security/force protection reasons. In order to access Sierra Wharf and other Inner Apra Harbor locations, a narrow channel must be navigated with the same conflicts with regard to berthing and vessel passage as noted above for the Bravo and Lima wharves. Sierra Wharf is identified as number (**9**) on Figure 2.3-2. These locations were dismissed as discussed below.

Security/Force Protection

The narrow channel that provides access to these locations could be obstructed by a disabled or sunken ship, and potentially trap the aircraft carrier if it were berthed at any of the Inner Apra Harbor Wharves. Mobility and responsiveness are critical and the time required to remove an obstruction from the Inner Apra Harbor Channel would be unacceptable.

Kilo Wharf

Kilo Wharf was dismissed for operational/navigational reasons. Kilo Wharf is located on the western edge of Apra Harbor on Orote Peninsula. Kilo Wharf is indicated as number (**10**) on Figure 2.3-2 and was dismissed, as discussed below.

Operational/Navigational

This wharf is DoD's only dedicated munitions wharf in the Western Pacific Region. Kilo Wharf is the only wharf in Apra Harbor that has approval for large quantities of munitions and a waiver is required for ships carrying ammunition to berth in Inner Apra Harbor. Kilo Wharf is already near capacity without considering the proposed transient aircraft carrier visits. The evaluation of the capacity of Kilo Wharf is based upon the wharf's use for loading and unloading ammunition-carrying ships. The smaller load-outs of ammunition to combatant ships are already accomplished at the berths in the inner harbor. No additional capacity can be created at Kilo Wharf as the capacity is based upon use of Kilo Wharf by ships not capable of performing their mission in the inner harbor. The waivers for ships carrying ammunition to berth in Inner Apra Harbor are not readily granted because the large quantities of explosives berthed at a wharf that is unauthorized for large net explosive weights would represent an increased safety risk to nearby populations.

For planning purposes, Apra Harbor currently supports an average of 16 days in port per year for aircraft carrier and CSG port calls (however, as described in Chapter 1, this schedule varies based on Fleet operational requirements). Currently, the visits are disruptive to munitions operations, but manageable. There are also other challenges associated with an aircraft carrier berthing at Kilo Wharf that are manageable for the short duration port visits, but would be untenable for longer transient berthing requirements that include logistics, maintenance, and MWR support. Dependents, vendors, commercial delivery vehicles and non-DoD personnel are prohibited from entering the explosive safety arcs around Kilo Wharf. Thus, there is limited space for MWR activities at Kilo Wharf. For these reasons, expanding Kilo Wharf or moving existing munitions operations to other wharves is not practical.

The proposed increased frequency and duration of carrier visits (a maximum of 63 days in port per year) coupled with expected increased ammunition ship operations would result in a significant negative impact on the ability of the Navy to meet their munitions mission, as described in Chapter 1 of this Volume.

Alternatives Provided by the Public on the Draft EIS

During the public comment period on the Draft EIS, the public provided a new site location between Kilo Wharf and Sumay Cove, in an area adjacent to San Luis beach, as well as design alternatives for Delta/Echo. Both alternatives are addressed in Volume 10 (response to public comments) and discussed below.

The suggested location at San Luis beach is a location with valuable marine and terrestrial resources including pristine coral reefs, endangered Moorhen habitat, and a historic resource site eligible for listing on the National Register of Historic Places. The location was considered and subsequently dismissed from further analysis in this Final EIS for a number of operational reasons. Operationally this location would potentially interfere with continued training operations at the in-water drop zone used for special warfare training activities and flight operations at the expeditionary airfield, commonly known as Orote Field. In addition a permanent berth at this location would impede potential future expansion of explosive cargo handling capabilities at Kilo Wharf.

The suggested design alternatives for Delta/Echo would involve carving out an area on the peninsula at Dry Dock Island to move the existing wharves inland to allow sufficient space around the aircraft carrier buffer zones for vessel traffic into and out of the channel to the Commercial Port. However, the DoD determined that in order to accomplish this, extensive dredging and fill would be required that would negatively impact nearby Sasa Bay and Jade Shoals. The turning basin that would be needed under this option would also require dredging that would be similar to that for the Polaris Point or Former SRF option. Under this option, the relocation of existing fuel lines at Delta/Echo wharves or addition of alternative fuel lines would be impractical and costly. Therefore, this design alternative was eliminated from further analysis in the Final EIS.

2.3.1.3 Alternative Wharf Locations Retained

Only the Polaris Point and Former SRF sites were able to meet both the security/force protection and operational/navigational requirements as described in Section 2.3, and consequently these alternatives were retained and carried forward for detailed impact analysis in this EIS.

Polaris Point

Security/Force Protection

Polaris Point is located to the north and east of the entrance channel to the Inner Apra Harbor in an internal part of the base; thus, there are no associated security/force protection concerns.

Operatational/Navigational

There would be no operational restrictions associated with this potential wharf location. Navigationally, the approach to the wharf location would follow the existing navigational channel with some modifications that would be required.

Cost, Technology, and Logistics

Several cost, technology, and logistics considerations of developing an aircraft carrier wharf at Polaris Point include:

- The site is located within the base which is beneficial for personnel quality of life activities and supply replenishment.
- The emergency response, unscheduled (emergent) repair, and radioactive waste management facilities are located on Polaris Point.
- The utilities on Polaris Point would require improvements to the electrical and wastewater systems; Alpha/Bravo Wharf Improvements improved the water distribution lines within Polaris Point. No new water improvements would be required to support the transient aircraft carrier.
- The existing Polaris Point access road would require improvements including the addition of a loop road for bus service and a new auxiliary access road to service the security tower that would be constructed as part of the berth improvements.

Environmental

- Dredging for the entrance channel to the berth and turning basin as well as pile driving for wharf construction would be required, which would result in direct and indirect impacts to corals, water quality, fish habitat, and sea turtles.

Former SRF

Security/Force Protection

The Former SRF is located to the north and west of the entrance channel to the Inner Apra Harbor in an internal part of the base that is currently under leasehold by the Guam Economic Development and Commerce Authority (GEDCA). The lease to GEDCA currently expires on October 1, 2012 and is being renewed by the Navy. The lease area could be reduced and the project area could be excluded from any new lease. As with Polaris Point, there are no associated security/force protection concerns.

Operational/Navigational

There would be some disruption of Guam shipyard activities from wharf construction and aircraft carrier visits. When the aircraft carrier is in port, the floating dry dock could not be used for docking or undocking. Further, force protection requirements, including deployment of the floating port security barriers, would conflict with continued use of the dry dock.

Navigationally, the approach to the wharf location would follow the existing navigational channel with some modifications that would be required.

Cost, Technology, and Logistics

Several cost, technology, and logistics considerations of developing an aircraft carrier wharf at the Former SRF include:

- The site is located within the base which is beneficial for personnel quality of life activities and supply replenishment.
- As noted previously, the emergency response, unscheduled (emergent) repair, and radioactive waste management facilities are located on Polaris Point and are approximately 3.2 miles (5.1 km) away from the Former SRF.
- The utilities at the Former SRF would require improvements to the electrical and wastewater systems. No new water improvements would be required to support the transient aircraft carrier.

Environmental

- Dredging for the entrance channel to the berth and turning basin as well as pile driving for wharf construction would be required, which would result in direct and indirect impacts to corals, water quality, fish habitat, and sea turtles.
- Approximately 20,000 cubic yards (cy) (15,291 cubic meters [m^3]) of additional fill would be required to fill the existing finger piers at the Former SRF site than what would be required at Polaris Point.

2.3.2 Wharf Alignments Considered

Wharf alignment describes the position of the wharf relative to the coastline. For example, the alignment can be parallel to the shore (marginal wharf) where the back edge of the wharf is land based. A wharf can also be aligned at an angle to the coastline where one terminus is land based and the other three edges are facing the water. Structural engineers were tasked with developing the best alignment options at the Polaris Point and Former SRF sites (NAVFAC Pacific 2008), since these were the two wharf locations retained as discussed previously. These wharf alignment options were evaluated based on coastal engineering considerations, avoiding or minimizing environmental impacts, and minimizing impacts on harbor operations.

<u>Polaris Point</u>

Two wharf alignments were assessed for Polaris Point: parallel to shore (east-west) and a diagonal alignment from Polaris Point across the bay (southwest to northeast) (see Figure 2.3-2). For the parallel to shore (east-west) alignment, two options for the aircraft carrier approach clearance were considered. The difference between the two options has to do with the clearance area provided in front of the wharf at the eastern end. The specifications for an aircraft carrier require an approach clearance area of 600 ft (183 m) extending from the edge of the entire length of the wharf (NAVFAC Pacific 2008). This area must be free of obstacles. To achieve the standard clearance distance for the parallel alignment, the land outcrop north of Polaris Point would have to be removed. Survey data indicated there is Pacific 2008s coral along the outcrop that would have to be removed to provide the 600 ft (183 m) of clearance in front of the wharf at the eastern end. To minimize impacts to coral, a reduced clearance option was proposed specifically to avoid the environmental impact associated with excavating this outcrop of land with coral cover. Port operations and harbor pilots were consulted and provided concurrence that this reduction in the berth was acceptable from a navigation perspective. Additionally, verbal concurrence was provided from Commander, U.S. Pacific Fleet and Naval Sea Systems Command (NAVSEA) with respect to this modification for the aircraft carrier berth.

In addition to minimizing environmental impacts, the parallel to shore (east-west) alignment minimizes the impact to navigation along the channel leading into Inner Apra Harbor. There would be security barriers associated with the aircraft carrier when in port that would have to be adjusted to allow for channel traffic as necessary. The new wharf and operations at the wharf would not interfere with harbor operations at the adjacent Bravo Wharf.

From a coastal engineering perspective, this wharf alignment is preferred over the diagonal Polaris Point option, as the likelihood of deck overtopping from waves would be reduced.

The diagonal alignment also would require removal of the land outcrop north of Polaris Point but to a greater extent than the parallel alignment (NAVFAC Pacific 2008). By dismissing this alternative, the potential direct impact of dredging more coral is avoided. A harbor control tower located at the point would have to be relocated. The diagonal alignment alternative has the primary storm wave energy perpendicular to the wharf structure rather than along the shore. Of all the alignment alternatives, the diagonal alignment is the one that would be most exposed to storm waves. A more substantial structure would be required to prevent buckling in deep water when subjected to wave forces. There would be additional construction costs to achieve the stability required. The comparative estimated costs between the diagonal to shore alignment versus the parallel to shore with the reduced turning basin radius is $368 million dollars for the diagonal alignment and $324 million dollars for the Polaris Point parallel to shore alignment (NAVFAC Pacific 2008). The diagonal alignment has the additional disadvantage of poor aesthetics. The nearby bay and beach are potential family recreational areas with planned amenities for the Polaris Point Field and recreation area. The massive wharf structure would obstruct views from the beach.

Therefore, for the reasons discussed above, the parallel to coast (reduced clearance) option was retained as the preferred wharf alignment option for Polaris Point.

Former SRF

Three berth alignments were studied at the Former SRF. The alignments considered were all parallel to shore. Two wharf alignments were considered but eliminated from further consideration in this EIS. The first, an east-west alignment along the existing coastline was dismissed because this alignment would permanently block access to the dry dock operations even when an aircraft carrier was not present. Figure 2.3-2 shows this alignment located closest to the dry dock and parallel to the coastline (shown as [**2b**]). The second dismissed alignment would also be aligned east-west, but would be recessed into the existing shoreline allowing the dry dock traffic to pass, but this option would excavate significant amounts of existing land area. This recessed alternative would be located south of the first east-west alternative described (shown as [**2c**] on Figure 2.3-2).

The wharf alignment alternative retained for further consideration in this EIS follows the current shoreline as it extends from the end of the finger pier at Lima Wharf in a north-westerly direction toward the current location of the floating dry dock (AFDB-8) (see [**2a**] on Figure 2.3-2). The precise final location in the onshore-offshore direction is subject to minor adjustment during final engineering design. The berth face runs approximately along the -50 ft (-15 m) MLLW contour, which meets the aircraft carrier requirement and minimizes the amount of dredging/excavation required at the shoreline. When the aircraft carrier is in port, there would be no access to the dry dock by other ships. The wharf alone would not interfere with dry dock access.

Based on the consideration of the various wharf alignment options, it was determined that the parallel to shore wharf alternative for Polaris Point and one of the parallel to shore wharf alternatives for the Former SRF near the finger piers would be retained.

2.3.3 Channel Options

The *CVN-Capable Berthing Study* (NAVFAC Pacific 2008) assessed three channel alignment options applicable to both alternative wharf locations that were retained as follows and as shown on Figure 2.3-5. These alignments include:

<u>Sharp bend (54 degrees)</u>

- Straight channel
- Slight bend

In that study, a high priority was placed on reducing dredging impacts to coral while still complying with published design criteria for nuclear powered aircraft carrier navigation As shown in Figure 2.3-5, the sharp bend option follows the same location as the existing navigational channel, but the channel would be widened to 600 ft (183 m) to meet the UFC channel width requirements for a nuclear powered aircraft carrier. Commercial shipping traffic would continue to use this existing navigational channel. To minimize and avoid impacts to coral, there would be a 54 degree angle bend in the vicinity of Jade and Western Shoals. Of the three channel alignment options, this is the least favorable for navigation but the least environmentally damaging. Tugboats would be required to assist an aircraft carrier through the channel and into the berth. No dredging would be required to accommodate ship movement leading up to the sharp bend from the west, but additional navigational aids may be required. The sharp bend channel option, while meeting operational requirements, is carried forward in the EIS because it also minimizes impacts to coral.

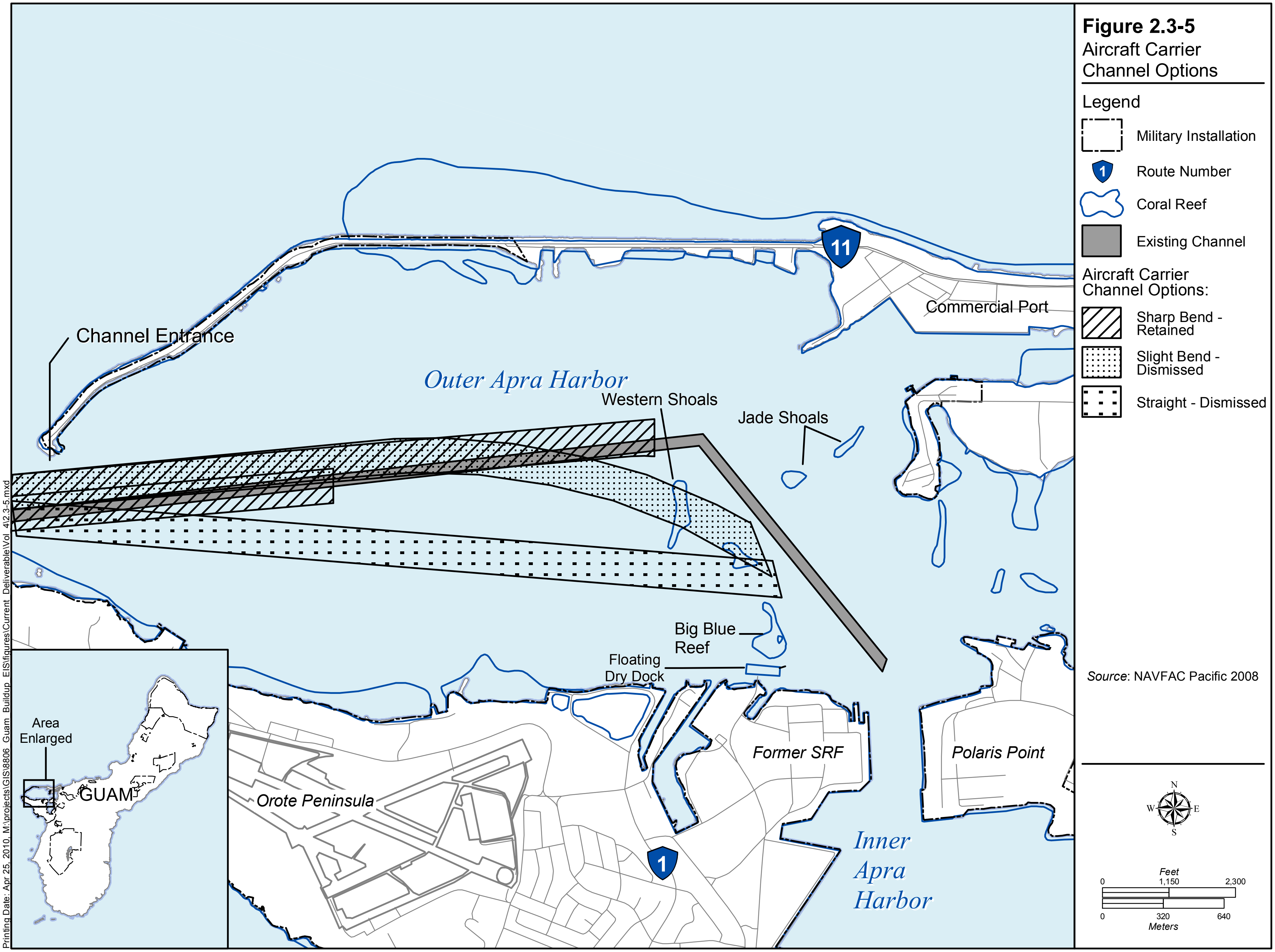

Figure 2.3-5
Aircraft Carrier Channel Options
Legend
Military Installation
Route Number
Coral Reef
Existing Channel
Aircraft Carrier Channel Options:
Sharp Bend - Retained
Slight Bend - Dismissed
Straight - Dismissed
Source: NAVFAC Pacific 2008
Channel Entrance
Outer Apra Harbor
Western Shoals
Jade Shoals
Commercial Port
11
Big Blue Reef
Floating Dry Dock
Former SRF
Polaris Point
Orote Peninsula
1
Inner Apra Harbor
Area Enlarged
GUAM
N
S
E
W
Feet
0
1,150
2,300
0
320
640
Meters
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The other two channel options considered, but dismissed, are located south of the sharp bend alignment and provide a more direct approach (Figure 2.3-5). These two channel options would require dredging through coral shoals and significantly increase the dredging volume and direct impact to coral. These two channel options were dismissed from further consideration in the EIS because of the direct impact to coral.

2.3.3.1 Turning Basin

Because of ship design, aircraft carriers are always berthed starboard (right side of carrier) to the wharf. To enable berthing of the carrier on the starboard side and its departure, a turning basin is required in front of Polaris Point or the Former SRF Wharves. A turning basin is a circular area free of obstruction that provides sufficient maneuver area for an aircraft carrier to be pivoted and then berthed on its starboard side. Because wind and waves exert uncontrolled additional forces on aircraft carrier movement in a harbor, tugboats are required to guide the aircraft carrier into a starboard position parallel to the wharf as well as assist during its departure. Because of the water depth requirements of an aircraft carrier, the turning basin would be dredged to a depth of -49.5 ft (-15.0 m) MLLW plus 2 ft (0.6 m) of allowable overdepth.

There are specifications (minimum and optimum) for establishing turning basins. The *CVN-Capable Berthing Study* (NAVFAC Pacific 2008) recommends the optimal radius of 2,200 ft (671 m) for an aircraft carrier; that is double the length overall of the ship. However, to reduce dredging and impact to coral, the minimal radius of 1,092 ft (333 m) for the turning basin was retained. Because of advanced navigational aids, Commander, U.S. Pacific Fleet has determined the minimum radius would allow the transient aircraft carrier with its tug escorts to be safely maneuvered in a 360 degree circle with appropriate margins of navigational safety. Further reductions of the turning basin radius were proposed and dismissed by the Navy because the radius retained is the minimum acceptable radius for navigational safety. Consideration was also given to a turning basin that was not a full circle; however, this option also had to be dismissed because of navigational safety.

As shown on Figure 2.3-6, the optimal radius turning basins considered but dismissed are shown as red circles. The retained turning basin radii are shown as green circles on the same figure. Figure 2.3-7 shows the positions of the aircraft carrier under the two action alternatives as well as the location of the turning basin in Inner Apra Harbor that was dismissed, as discussed below.

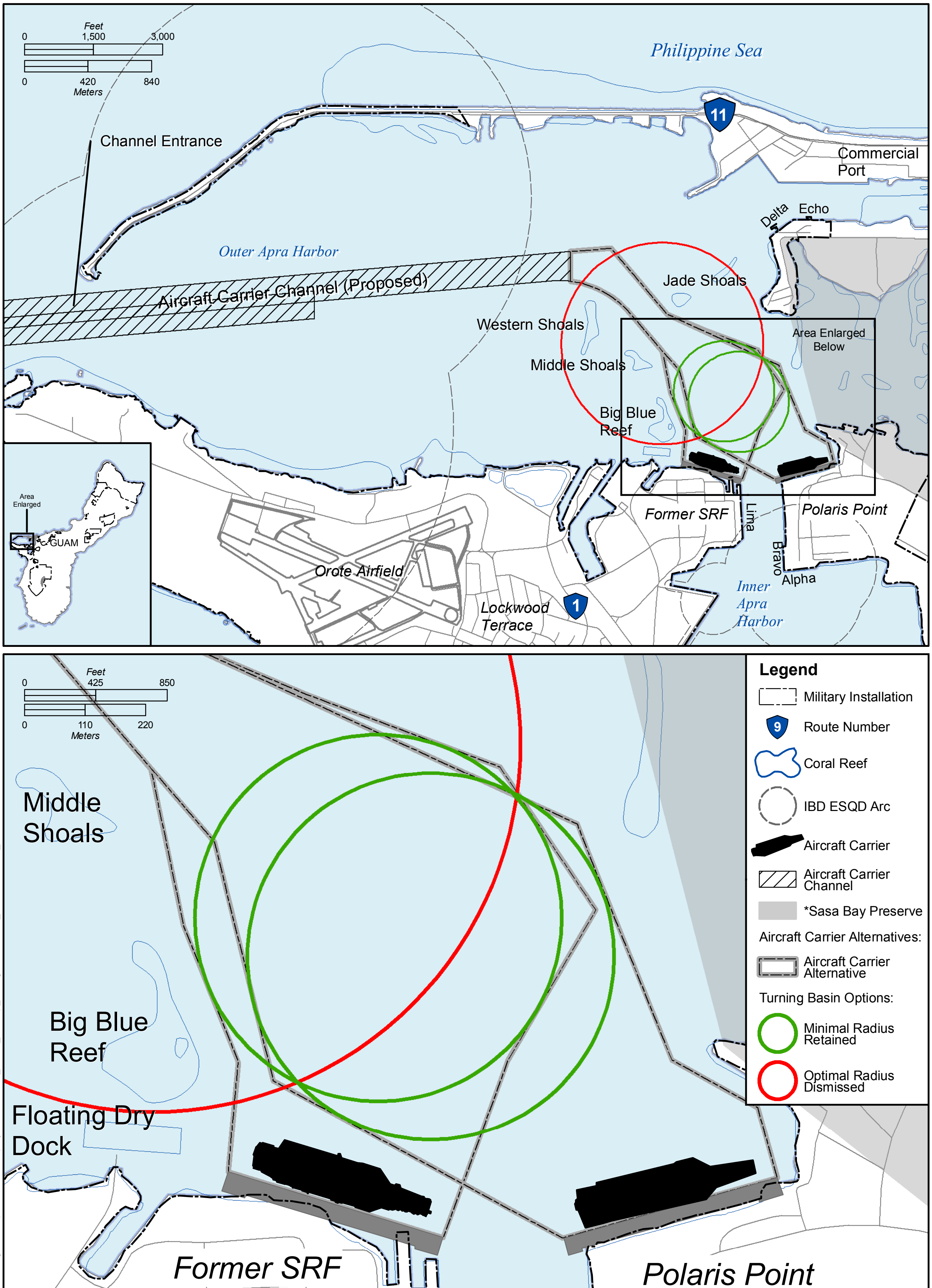

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Figure 2.3-6
Aircraft Carrier Berthing Channel & Turning Basin

*Sasa Bay Marine Preserve is a GovGuam designation over U.S. submerged lands. Legitimacy of the designation is in dispute.

N W E S

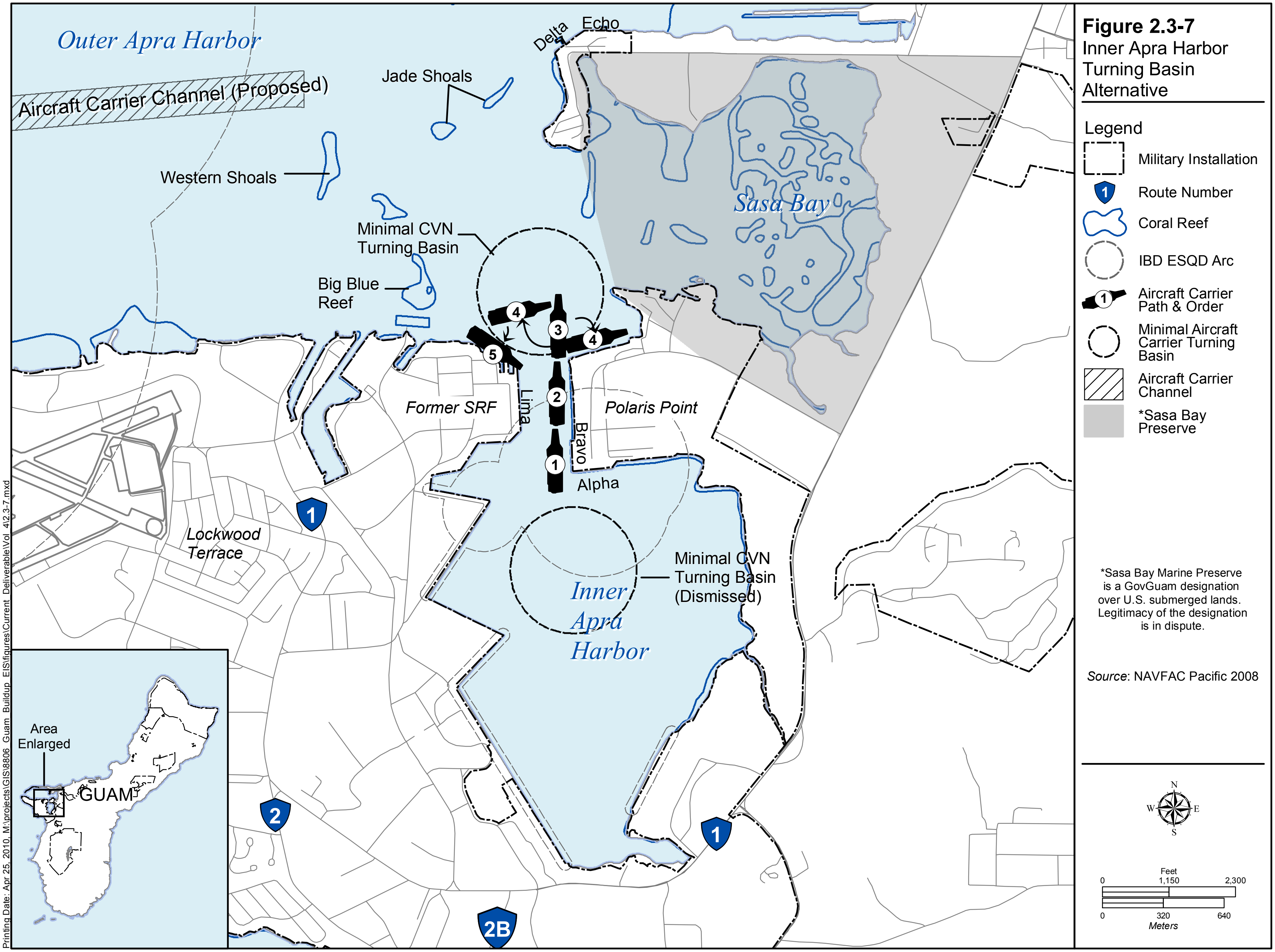

Figure 2.3-7
Inner Apra Harbor Turning Basin Alternative

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The following turning basin options were also considered but dismissed:

- *Relocate the turning basin to deeper water in Outer Apra Harbor and move the carrier in reverse when leaving the berth.* All ships are more difficult to control (speed and direction) in reverse and the risks increase with the length of the ship. An aircraft carrier may need to leave the berth under emergency conditions and reversing the ship in a hurry would be difficult. This option does not meet the criteria for practicability (including requirements for security/force protection and operational/navigational characteristics).
- Relocate the turning basin to Inner Apra Harbor, while maintaining one of the proposed Outer Apra Harbor berths (Polaris Point or Former SRF). As a replacement for an Outer Apra Harbor turning basin, an Inner Apra Harbor turning basin would reduce the volume of direct impact to coral. However, the Inner Apra Harbor turning basin would not eliminate the need for an Outer Apra Harbor turning basin. After making the 180 degree turn in Inner Apra Harbor, the ship bow would be facing north as it exits the channel. Once it clears the channel, it must be pivoted 90 degrees before being guided into either Polaris Point or the Former SRF berths. A full 360 degree turning basin is required for safe navigation. This option is dismissed because of practicability (operational/navigational) and environmental criteria.
- Use of Dry Dock Island as an aircraft carrier berth location instead of Polaris Point or the Former SRF to eliminate the need for a turning basin. Reasons for dismissal of Dry Dock Island from full impact analysis have been previously described. Two options were proposed for Dry Dock Island: the current configuration and a reconfigured land mass that relocates the western shoreline to the northeast. The second option would require dredging and fill within the Sasa Bay Preserve, but it would provide a larger area for aircraft carrier movement. The second option was subsequently dismissed. The Dry Dock Island options were also dismissed because they do not eliminate the need for a turning basin, would not avoid or minimize coral loss, and there is insufficient area to negotiate the sharp turns (Figure 2.3-8).

2.3.4 Structural Design

In order to accommodate the proposed sites' topographical and environmental conditions in the most economical manner, the report *CVN-Capable Berthing Study* (NAVFAC Pacific 2008) evaluated various wharf structural design options for general site compatibility, constructability, costs, and seismic performance. Structural design alternatives included:

1. Vertical-pile-supported wharf on armored sloped embankment
2. Tied-back steel sheet pile bulkhead
3. Concrete caissons

While both the sheet pile bulkhead and concrete caissons are used in Apra Harbor, the study found that a pile supported wharf on armored sloped embankment for this proposed action is preferable based on previous studies conducted in the mid-1990s to determine the optimal retaining structures for the Pier 400 Landfill project in the Port of Los Angeles. This design option provides for superior seismic performance and economic costs for berths approximately 50-ft (15 m) in depth. It is noted that virtually all new berth construction along the seismically active continental U.S. West Cost is of this type.

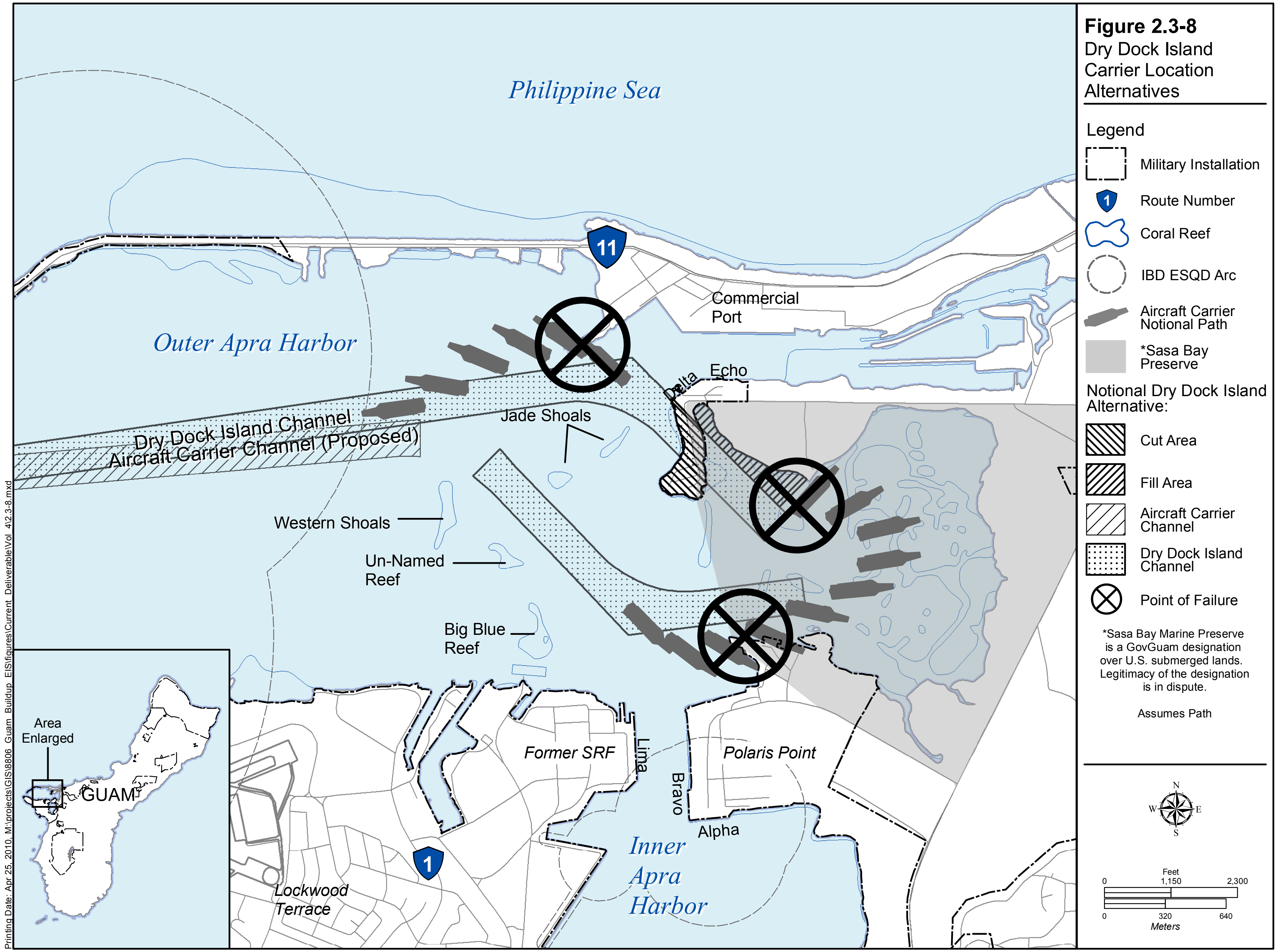

Figure 2.3-8
Dry Dock Island Carrier Location Alternatives
Legend
Military Installation
Route Number
Coral Reef
IBD ESQD Arc
Aircraft Carrier Notional Path
*Sasa Bay Preserve
Notional Dry Dock Island Alternative:
Cut Area
Fill Area
Aircraft Carrier Channel
Dry Dock Island Channel
Point of Failure
*Sasa Bay Marine Preserve is a GovGuam designation over U.S. submerged lands. Legitimacy of the designation is in dispute.
Assumes Path
N
E
S
W
Feet
0
1,150
2,300
0
320
640
Meters
Philippine Sea
Outer Apra Harbor
11
Commercial Port
Delta
Echo
Jade Shoals
Dry Dock Island Channel
Aircraft Carrier Channel (Proposed)
Western Shoals
Un-Named Reef
Big Blue Reef
Former SRF
Lima
Bravo
Polaris Point
Alpha
Inner Apra Harbor
1
Lockwood Terrace
Area Enlarged
GUAM
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However, the report also notes that Apra Harbor is subjected to typhoon induced storm waves which can damage the pier supported wharf if special precautions and designs are not implemented These precautions are not usually required for the other two structural design types. Thus, while the all-vertical pile supported wharf is preferred for seismic reasons, the caisson and sheet pile bulkhead concept are more inherently resistive to wave impact, and thus preferred in locations exposed to extreme wave events.

Any of the three structural design options is possible for the two berthing site alternatives, although there are practical limitations as indicated. For the remainder of this EIS, it is presumed that the all-vertical pile supported wharf is the preferred alternative, based on perceived benefits, risks, costs and environmental impacts. Although all design options would disturb the same area, the selection of this preferred alternative would enable further assessment of the potential impacts associated with noise from pile driving construction activities upon marine resources and species protected under the Endangered Species Act.

Final design, using refined data, analyses, and costs, may indicate that one of the other design alternatives, especially the concrete caissons, is better suited. All design options would disturb approximately the same area. A brief summary of each design option is presented below.

2.3.4.1 Steel Pile Supported Wharf

This structural design alternative would result in a concrete deck superstructure 90 ft (27 m) wide by up to 1,325 ft (404 m) long, supported by all vertical piling. When all piles are installed vertically, the deck and piles resist lateral loads as a ductile moment resisting frame. This allows the wharf to flex slightly during an earthquake without serious damage. Piling is driven through the superficial soil and into underlying rock.

Both pre-stressed concrete piling and steel piling were considered for the structure. Generally, pre-stressed concrete piles are preferred in a marine environment due to their inherent corrosion resistance capacity. These piles can be installed at sites with sands and bay mud, and even very dense sands with the aid of jetting. However, at sites with limestone, rock, or similar materials, concrete piles require difficult and expensive pre-drilling to penetrate the rock. Steel piles were selected due to the highly variable soil strata expected at the site. Given that either type of pile would be imported into Guam, steel lends itself better to on-site lengthening/shortening to match the variability in the bearing depth and embedment. During final design, and after additional site subsurface investigations have determined the actual bearing elevations, the steel versus concrete issue would be revisited. Concrete could then be selected if cost savings are apparent. With modern coatings and suitably maintained protection systems, steel piles can easily obtain a 50-year or more life.

A flat plate concrete deck structure was recommended in the *CVN-Capable Berthing Study* (NAVFAC Pacific 2008). In addition to excellent seismic performance, the concrete flat slab is very durable in the marine environment and can support a variety of loads.

The underlying embankment slopes upward from -49.5 ft (-15 m) MLLW to +7 ft (+2 m) MLLW. Placement of quarry stone and riprap stone for a marine revetment for shoreline protection would be necessary along the slope of the shoreline beneath where the wharf would be constructed. Some dressing of the existing slope would be required to prepare the slope for the rock. The slope would be protected with large armor rock over a filter course of quarry run. Approximately 42,000 cy (32,111 m^3) of quarry stone would be placed as fill and 19,815 cy (15,150 m^3) of riprap stone placed as fill. The surface area that would be affected along the slope of the shoreline is approximately 3.6 ac (1.5 ha).

The sloped embankment and armor rock would also provide lateral support for the piling against seismic, mooring, and berthing forces. The rock and sloped embankment would be an integral part of the entire structure. A similar structure was constructed for the two aircraft carrier berths at North Island, San Diego. As the seismic conditions for San Diego and Guam are very similar, and that structure meets current aircraft carrier requirements, it has been used for planning purposes at this site with modifications to reflect the needs of this project and advances in seismic engineering since the construction of the San Diego wharves.

2.3.4.2 Sheet Pile Bulkhead

Sheet pile bulkhead construction has long been considered economical in many ports and military harbors due to its simplicity, ease and speed of construction, available U.S. suppliers, and costs, when considered for non-seismic berths to 30 or 35 ft (9 or 11 m) depth. Unfortunately, many times these systems were installed without adequate protection (coatings and/or cathodic protection) and thus earned a bad reputation for durability. However, with proper modern coatings and periodically maintained cathodic protection systems, the expected life is 50 years or more.

For berths greater than 30 ft (9 m) water depth and in seismic areas, such as this project, the advantages of sheet pile bulkheads quickly disappear. Sheet pile bulkheads have performed poorly in severe seismic events, such as the 7.7 Mercalli Guam earthquake that occurred in 1993. Most of the wharves experienced some degree of structural damage, ground cracking and settlement, liquefaction, and lateral spreading. Underground utility lines and structures located within the affected areas were damaged, and significant settlement of trench backfill occurred. The worst damage occurred along portions of the Victor, Uniform, Sierra, and X-Ray Wharves, with Sierra Wharf experiencing lateral displacements of 4 to 6 ft (1.2 to 1.8 m). The primary cause was liquefaction of loose material placed behind the bulkhead during construction and the subsequent failure of the tie back system.

While the bulkheads and backfill can be designed for these seismic events, the need to use very large and heavy sheet pile sections negates the cost effectiveness they once enjoyed. They also tend to fail in a non-yielding manner that causes abrupt and not-easily-repaired failures. The deeper berths require more retained fill and hence larger soil retaining stresses. Furthermore, these heavy sections are only produced by one or two foreign mills and require long lead times for large quantities. To resist the lateral forces caused by a seismic event, the tie back system should be pile supported; however, that introduces more cost inefficiencies. Liquefaction of the backlands still remains a problem unless soil improvement techniques (surcharging, stone columns, and dynamic deep compaction being the most common) are incorporated.

2.3.4.3 Concrete Caissons

Reinforced concrete caissons are widely used for the construction of vertical breakwaters and gravity quay walls. Concrete caissons are particularly useful in areas of large tidal fluctuations. A caisson structure was used in the construction of Kilo Wharf in Apra Harbor. This type of construction is also employed where extreme waves are known to occur that could uplift and destroy a pile supported wharf. This is the primary reason that caissons were utilized in both the original construction and the planned extension (Military Construction P-502) of Kilo Wharf.

The caisson is constructed dry in a fabrication facility (typically a graving yard or dry dock), launched or lifted out, floated into place and sunk onto a dredged and prepared gravel foundation placed on the sea floor. The cells of the caisson are then filled with soil and Portland Cement Concrete paving is placed on top to provide the working surface. Because caissons are stand-alone units, they can be used in offshore

DoD lands by themselves (as is the case in a portion of the Kilo Wharf facility) or backfilled to provide a contiguous area with the backlands.

Similar to the sheet pile bulkhead, the caisson has a history of poor seismic performance, the primary example being Kobe Port in Kobe, Japan during the Hyogoken Nanbu 6.8 Mercalli event of 1995. In that case, the primary mode of failure was lateral movement (up to 25 ft [8 m]) and rotation of the top of the caissons (tipping) due to foundation failure. Both were due to liquefaction of the retaining and supporting materials during the earthquake.

This design option would require additional dredging/excavation to cut out and level the area behind the selected berth face. Alternatively, the caisson could be placed further offshore in deeper water, but that could require placing a gravel pad to raise the elevation of the foundation to an appropriate level. The environmental impacts associated with the caisson-based design of the Kilo Wharf Extension are presented in the Kilo Wharf Extension Final EIS (COMNAV Marianas 2007). In addition to the cost for concrete, dry construction, launching, and towage to the site, the added costs of foundation preparation and dredging/excavation makes caissons the most expensive option of the three. Previously, caisson fabrication on Guam was thought to be problematic. There is essentially only one facility capable of fabricating and launching the caissons in a timely manner: the floating dry dock (AFDB-8), that is currently the property of the Guam Shipyard, and may not be available for use in construction of the caissons. However, foreign fabricators may be able to provide caissons in a cost effective manner, even though transportation costs may be high. Inherent strengths of precast prestressed concrete components are consistent quality and control and resistance to reinforcing corrosion. Components can be barged from the source direct to the construction site and reduce the need for laydown costs. The modularity of precast components may allow more efficient erection over water, minimizing construction costs. There may be other options such as partial construction on land, launching into a nearby shallow waterway, and finishing construction in deeper water. The use of caissons at Kilo Wharf and its recent extension (MCOM P-502) revealed no unusual problems in construction. With the rougher wave environment, modular construction of caissons may be of benefit.

2.3.5 Dredging

2.3.5.1 Methodology

The NEPA approach for addressing aircraft carrier-related dredging methods is the same as described in Volume 2 for Sierra Wharf dredging (Volume 2, Chapter 2). There are two general types of dredging operations that could be implemented: mechanical dredging and hydraulic dredging. The operations vary by the method used to loosen the material from its in situ state and transport the material from the seafloor to the water surface. The type of dredging equipment that is used would affect the characteristics of the dredged material. Differences in dredged material characteristics resulting from dredging methods as well as logistical considerations relevant to the use of mechanical and hydraulic dredges are described in Appendix D in Volume 9 of this EIS. The distinctions between the two dredging methods are described as follows:

<u>Mechanical Dredges</u>

- Excavates dredge sediments using an open or enclosed bucket that may vary in size from 1.5 cy to 25 cy (1 to 19 m^3); typically barge mounted.
- Placement of dredged material into open scows that hold the material for transport to an offloading site. The offloading site can be upland or open water with proper permits. Details

regarding the offloading locations for the individual upland dewatering sites is presented in the Final Report, Upland Placement Study (NAVFAC Pacific 2008a).

- Operates best in hard-packed consolidated sediments and is not well suited for hard rock environments; loose or fine materials tend to be released into the water column during withdrawal from the dredge floor to the surface and back.
- Water content of the dredged material is typically in the range of 10%.

Hydraulic Dredges

- Excavates dredged sediment in place using a system of pipes and centrifugal pumps; typically a self-propelled unit.
- Placement of dredged material into upland placement site where dewatering occurs with return flow discharge into receiving water body; loose or fine material is not released into the water column during transfer of dredged material.
- Able to operate in a wide range of sediment types including some hard surface environments when a cutterhead can be used to grind or claw away hardened materials.
- Water content of the slurry containing the dredged material is approximately 80% requiring more management of the upland placement area than mechanical dredges. Freeboard of slurry from the top of the bermed storage area must be maintained and weir structures are typically needed to control effluent to meet water quality standards.

Mechanical or hydraulic dredging or a combination of both could be used for the project. Volume 9, Appendix D describes the general characteristics of the methods. Historically, mechanical dredging has been used in Apra Harbor, and would likely be the preferred method. Hydraulic dredges utilize a series of interconnected pipes that transport water and solids mixture to the dewatering site. One disadvantage to the hydraulic dredge is that these pipes are typically floating on the surface and can be a hazard to navigation in high traffic areas and thus could potentially adversely affect naval operations. They require an extensive array of support equipment besides the pipeline including work and crew boats, and support barges. Also, the majority of the dredged materials as noted in Chapter 4, Volume 4 was found to be coarse, gravelly sand. Coarse materials require more pumping power and can result in increased wear and damage to the pumps and pipes that transfer the dredged material. Additional information regarding mechanical and hydraulic dredges is presented in Volume 9, Appendix D.

Mechanical dredging is assessed as the maximum adverse environmental effect method of dredging in the EIS because it has the greater combined potential for environmental impacts from direct and indirect impacts to coral reefs due to sediment redistribution. Specific potential impacts to water quality from mechanical dredging are addressed in Chapter 4 of this Volume. Specific potential impacts to marine biological resources are addressed in Chapter 11 of this Volume.

The standard best management practices associated with in-water work (including dredging), such as silt curtains, would be implemented (see Volume 4, Chapter 4 and Chapter 11, and Volume 7).

Dredged Material Disposal

This EIS assumes five scenarios for the placement of dredged material: 100% disposal in a proposed ocean dredged material disposal site (ODMDS), 100% disposal upland, 100% beneficial reuse, 20-25% beneficial reuse/75-80% ocean disposal and 50% beneficial reuse/50% ocean disposal. These five scenarios are explained further below. The 100% ODMDS and 100% upland disposal options are analyzed as the environmentally most adverse scenarios, because placing all dredged material in either location would limit the capacity of either the ODMDS or upland site(s) and does not account for some of the sediment being used for a beneficial purpose. Further discussion of each potential disposal option, including the sediment testing and sampling that has been conducted, is provided below.

Sediment Sampling/Testing

Sediment samples near the proposed dredging areas were analyzed according to testing criteria (40 Code of Federal Regulations [CFR] Parts 225 and 227). If the sediment meets the criteria, it can be beneficially reused, placed on land, or disposed of in an ODMDS. If the material does not meet the criteria for ocean disposal, it would not be placed in the ODMDS but potentially can still be beneficially reused, placed on land in an upland placement site or a confined disposal facility for treatment or remediation. Preliminary sediment characterization data suggest most of the material from Outer Apra Harbor and Inner Apra Harbor would meet the testing criteria and be suitable for disposal/dewatering on land or ODMDS disposal (NAVFAC Pacific 2006). Test results for samples taken in the vicinity of Sierra and Romeo Wharves in Inner Apra Harbor indicate that dredged material from these areas may not be suitable for ocean disposal (NAVFAC Pacific 2007). However, the indication for the Sierra Wharf dredge sediments not being likely suitable for ocean disposal was based upon only one amphipod test where the toxicity levels were only slightly elevated. The overall low contaminant concentrations and tissue concentrations below published effects levels may allow for ocean disposal of these materials for Sierra Wharf (NAVFAC Pacific 2007). Additional analysis of the sediments in the vicinity of Romeo Wharf would be required to determine ocean disposal suitability of those materials. The results of the 2007 dredge sediments study are available in Volume 9, Appendix K.

Previous testing for Alpha/Bravo wharf construction and maintenance dredging of Inner Apra Harbor and the approach to the inner harbor has indicated minimal contamination in the nearshore substrate. Sediment quality investigations in Inner and Outer Apra Harbor were conducted at three locations in 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 west of the Inner Apra Harbor Channel in Outer Apra Harbor; and 3) Sierra Wharf on the western edge of Inner Apra Harbor (NAVFAC Pacific 2006). The term Charlie Wharf is a term used in the NAVFAC Pacific 2006 report to describe the northern shoreline area of Polaris Point adjacent to Bravo Wharf even though there is no wharf presently at that location. The 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 concern within the materials to be dredged from these potential wharf sites.

Sediment core samples were selected from multiple locations within the dredging footprints for the three dredge areas (Figure 2.3-9). The number of samples and the compositing of samples were consistent with common practice for U.S. Army Corps of Engineers (USACE) dredging permit applications for Hawaii and Guam dredging projects. Within nine geographic areas, the core samples were composited and analyzed. Composite 1 (six sample locations) and Composite 2 (three sample locations) were representative of the proposed dredging for the turning basin and aircraft carrier berthing at the Former SRF location. Composite 1 and Composite 3 (five sample locations) were representative of the area to be dredged for the proposed turning basin and berthing at Polaris Point (see Figure 2.3-9).

The results of the physical testing indicated that, with the exception of the Composite 3 area adjacent to Charlie Wharf, the sediments were coarse-grained and comprised predominantly of gravelly sand.

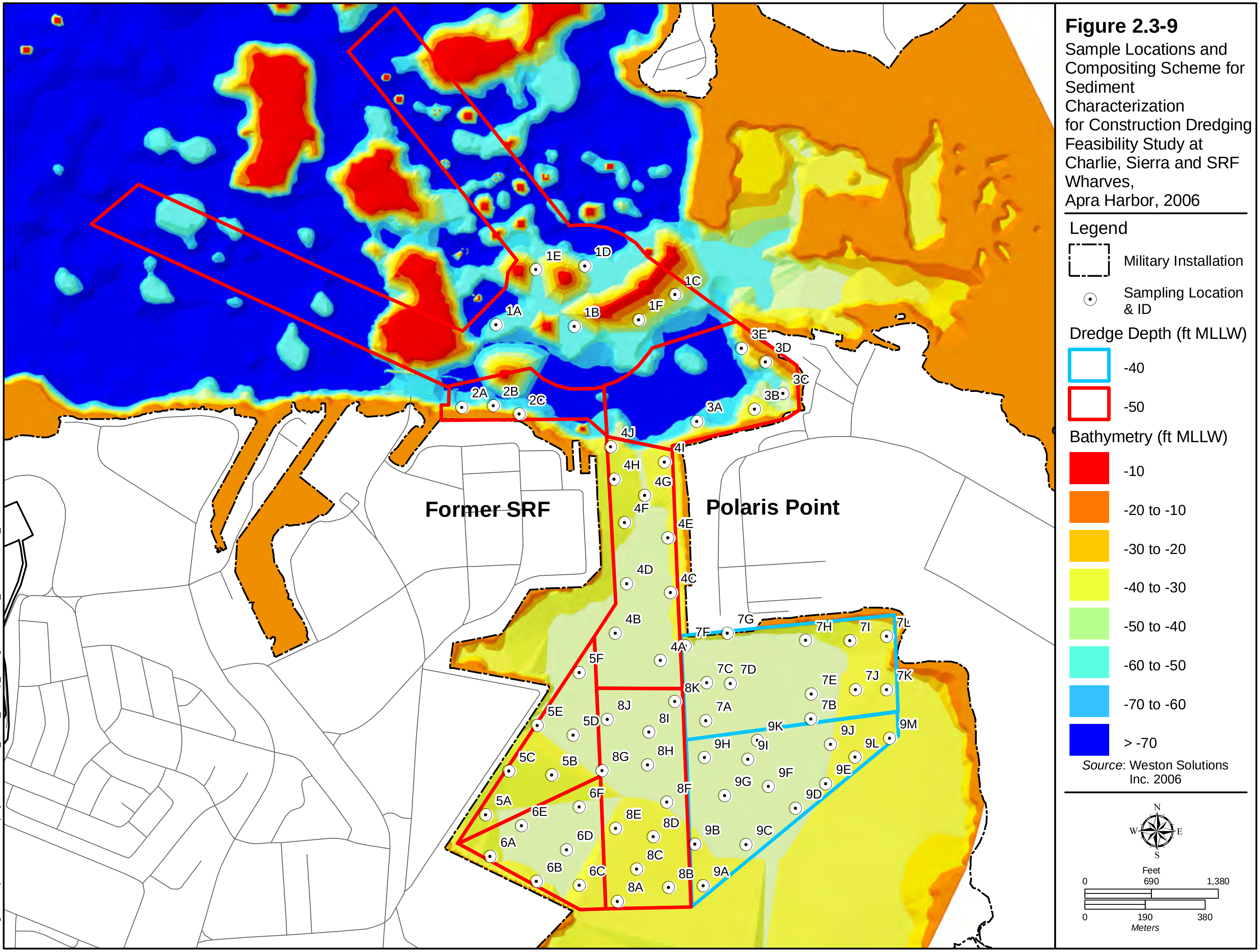

Figure 2.3-9
Sample Locations and Compositing Scheme for Sediment Characterization for Construction Dredging Feasibility Study at Charlie, Sierra and SRF Wharves, Apra Harbor, 2006

In the Composite 3 area and all of the Inner Apra Harbor areas, the sediment samples were predominantly 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. Study areas in which many chemicals exceed the ER-M values and exceed them by a large margin would be considered more contaminated than those in which none of the sediment quality guidelines were exceeded. With respect to chemical analyses and as noted in detail in Chapter 4, Volume 2, in general, sediment contaminant concentrations were low throughout all the areas sampled. This included results for total organic carbon, heavy metals, ammonia, sulfides, total petroleum aromatic hydrocarbons, PCBs, chlorinated pesticides, organotins, and phthalates.

Additional core samples from the potential dredging areas in the outer harbor were obtained for radioactivity analysis. Thirty sediment samples from eighteen cores were analyzed. One sample was taken from every 2 ft (0.6 m) of depth in the sediment cores. The number of samples per core ranged from one to three. With respect to radioactivity analyses and as noted in detail in Chapter 4, Volume 2, no radioactivity associated with nuclear-powered ships was detected. Non-naturally occurring nuclides typical of worldwide fallout from past nuclear weapons testing was detected at very low levels. The results from this sampling demonstrate that the materials to be dredged would not require special handling and would be suitable for upland placement for beneficial reuse or ocean disposal with respect to radioactivity.

Of all the composite sample chemical test results, only one result in Composite 3 (Polaris Point area) exceeded the ER-L concentration and that was for nickel (NAVFAC Pacific 2006). The ER-L concentration is 20.9 and the test result was slightly higher than the ER-L with a value of 21.50. The results from this study would suggest that the materials to be dredged from Outer Apra Harbor would not require special handling and would be suitable for upland placement for beneficial reuse or ocean disposal, although the ocean disposal permitting process would require separate analysis and toxicity testing.

Additional sediment sampling and analyses in Outer Apra Harbor were conducted in March 2010 to delineate the distribution and magnitude of chemicals of potential concern within the dredge footprint of the two potential CVN berthing sites; Polaris Point and the Former SRF wharf. Material from the proposed CVN turning basin was also evaluated (NAVFAC Pacific 2010a). The full report of this study is contained in Volume 9 Appendix K. Figure 2.3-10 provides the location of the sediment samples for the March 2010 testing. Sediment samples were attempted at 20 different locations in outer Apra Harbor; 18 of those were successfully sampled. Consistent with previous sediment sampling efforts conducted in these locations, sediment samples were analyzed for physical and chemical parameters, including general chemistry, metals, semi-volatile organic compounds (polynuclear aromatic hydrocarbons [PAHs], phenols, and phthalates), organochlorine pesticides, polychlorinated biphenyls (PCBs), and organotins and the results compared to ER-L and ER-M sediment quality guidelines, as established. The 2010 analysis concluded that low chemical concentrations found in the most recently collected sediment samples from Polaris Point, the Former SRF Wharf, and the Turning Basin were consistent with other previous Tier III dredged material evaluations conducted in the same areas of Apra Harbor in the NAVFAC Pacific 2006 study where the material was deemed suitable for ocean disposal. Details of this additional testing and results are presented in Chapter 4 of this Volume 4. The entire 2010 study is provided in Volume 9, Appendix K.

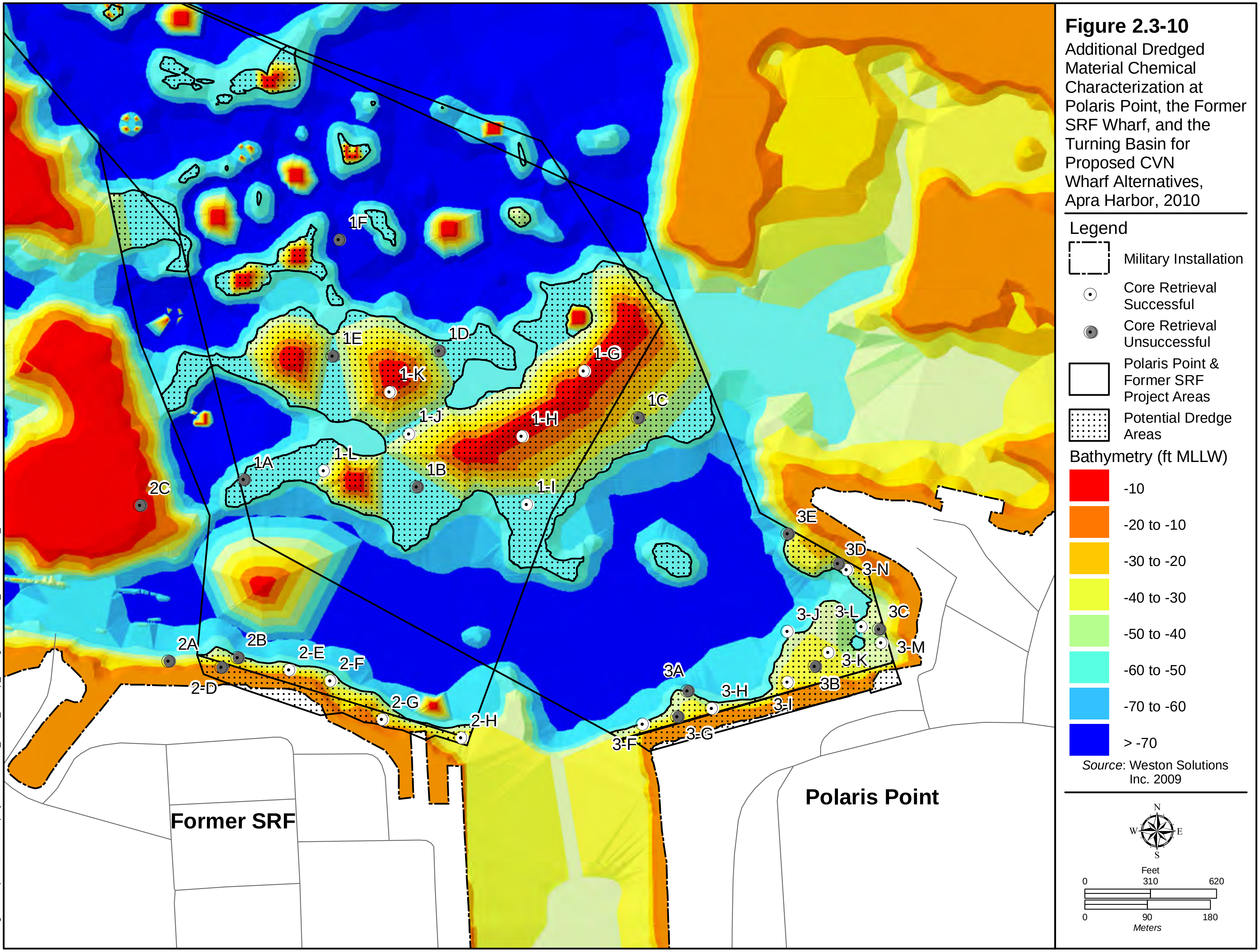

Figure 2.3-10
Additional Dredged Material Chemical Characterization at Polaris Point, the Former SRF Wharf, and the Turning Basin for Proposed CVN Wharf Alternatives, Apra Harbor, 2010

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Regarding the potential for unexploded ordnance, there is a low probability of encountering unexploded ordnance in the sediment as the area has been dredged recently. There are no known unexploded ordnance sites within the dredge areas. There have been no Navy dredging projects on Guam that have required designation of an upland site for the treatment or remediation of sediment. None is anticipated for this project.

Upland Disposal

The placement of dredged material in upland sites is often referred to as upland disposal even though the primary purpose is to first allow the dredged material to dry out (or "dewater") so it can more easily and cost-effectively be handled for relocation elsewhere once a beneficial reuse has been identified. Existing upland disposal sites are typically managed so that new wet dredged material is kept separate, if possible, from the dry material so that if there is a need for the dry material it easily can be removed from the site. Although sediment can be dewatered in a separate site, for the purposes of the proposed action in this EIS, sediment would be "dewatered" and stored within the same areas.

There are existing and feasible new proposed sites for upland placement on Naval Base Guam. The feasible sites noted in the Draft EIS were Fields 3, 4, 5, former Public Works Center (PWC) and Polaris Point as discussed in Volume 2. It was noted in the Draft EIS in Volume 2 and in detail in Volume 9, Appendix D, that there is sufficient capacity, with berm modification, in the Polaris Point, PWC, and Field 5 sites individually to contain 100% of the total volume of the dredged material from either alternative. This information was based upon a 2008 upland placement study (NAVFAC PAC 2008). Some of the upland placement sites are described under previous NEPA documents (Fields 3 and 5 and Polaris Point) for historical dredging projects. Recent preliminary information from the upland placement study supplemental review currently in progress has indicated that there may be substantially less upland capacity available on the five confined disposal facilities on Navy lands. Due to land use changes, Field 4, the PWC Compound, and the Polaris Point confined upland sites may not be available for upland placement. Capacity may be reduced in Field 5 due to cell construction to separate different types of materials. Field 3 remains a suitable option for upland placement. The environmental impacts of using the disposal sites for aircraft carrier wharf dredged material are the same as those described in Volume 2 for the Sierra Wharf dredging, based on preliminary sediment characterization.

Beneficial Reuse

Between 1 and 1.1 million cy (764,555 to 841,010 m^3) of dredged material would be excavated from the Inner and Outer Apra Harbor for the proposed Navy and Marine Corps actions which does not include future maintenance dredging. The dredged material is expected to consist of a mixture of sediments including sand from the outer harbor and silts/clays from the inner harbor. Additionally, there would be coral fragments and other submerged rubble that would be included in the volume of dredged material. Beneficial use of portions of this total volume could be possible and several potential local projects are identified below. In addition, other potential beneficial reuses could include landfill cover, material for roadway construction, aggregate mixture for cement operations, stockpiling for future uses, or beach renourishment. However, no specific potential projects of this type have been identified at this time other than what is indicated in the following list.

- Support shoreline stabilization below Aircraft Carrier Wharf: As part of the construction process, some fill could be used with the riprap stone that would be placed along the shoreline if the steel pile supported wharf design is used. Approximately 40,000 cy (30,582 m^3) of quarry stone in addition to an estimated 20,000 cy (15,292 m^3) of riprap stone is envisioned for this stabilization purpose. It is possible that some of the rubble or some other suitable material from the dredged material could be used and mixed in below the quarry stone layer. Therefore, it is estimated that approximately 50% of the quarry stone amount or 20,000 cy (15,292 m^3) of the dredged material could be used.

- Fill of berms and backstops at proposed military firing ranges on Guam: There are a number of berms and backstops that would be constructed as part of the development of new military firing ranges on Guam. The berms range in length from 35 to 255 ft (11 to 78 m); 7 to 56 ft (2 to 17 m) in width; and 3 to 7 ft (0.9 to 2 m) in height. Fill could be used to create these earthen mound structures. The volume within these berms and backstops has been calculated and equals an estimated 160,000 cy (122,329 m^3).
- Port Authority of Guam (PAG) expansion program: The PAG has prepared a Master Plan that includes a proposed eighteen acre area for expansion of fast land to support new commercial port cargo handling in Apra Harbor. The potential in-water expansion project is an ambitious endeavor that may be confronted with cost, feasibility and ecological concerns and also requires full environmental documentation by the USACE and subsequent permit approval before implementation. Up to 1.5 million cy (1.1 million m^3) of artificial fill would be needed to create this new land if this PAG expansion program comes to fruition. The Navy has a memorandum of agreement with PAG to provide fill from proposed dredging projects should the material be deemed suitable and the timing and logistics of both projects work out.

Given the potential availability of these upland beneficial use projects on Guam, the following five scenarios are possible for the disposal or placement of the proposed dredging projects in the Inner and Outer Apra Harbor:

1. 100 % beneficial use with all dredged material being used as artificial fill for the PAG expansion program (either direct waterfront placement or following placement at PAG upland placement site)
2. 20-25% beneficial use of dredged material in berm construction and under wharf for shore and pile stabilization (assumes no PAG need and/or logistics/approval problems for use of fill) and 75 to 80% ODMDS placement;
3. 100% upland placement on existing Navy confined disposal facilities on base on Apra Harbor; and
4. 100% placement in the Guam ODMDS.
5. 50% placement in the Guam ODMDS and 50% beneficial reuse.

The percentage of beneficial re-use could exceed the 20-25% scenario depending on the individual potential projects noted above or a combination of them or other re-use options such as landfill cover or road base material use. The Navy is in the process of developing a detailed dredged material management plan that will incorporate the disposal options, specific plans for beneficial reuse to the extent possible, and include specific monitoring efforts required for each disposal option.

ODMDS

The U.S. Environmental Protection Agency (USEPA) is pursuing the designation of an ODMDS approximately 11 to 14 nm (20 to 26 km) from the west coast of Apra Harbor. The designation is anticipated in 2010 and an ODMDS EIS was prepared concurrent with this EIS. Ocean disposal is regulated under Title 1 of the Marine Protection, Research, and Sanctuaries Act (33 USC 1401 et seq.) Formal designation of an ODMDS does not constitute approval of dredged material for ocean disposal.

Results from additional analysis and testing would be required to develop a dredged material management plan and the USACE Section 404/10/103 permit application. Ocean disposal is only allowed when USEPA and USACE determine that the project dredged material: 1) is environmentally suitable according to testing criteria, as determined from the results of physical, chemical, and bioassay/ bioaccumulation testing that is briefly described in Section 2.7 (USEPA and USACE 1991); 2) does not have a viable beneficial reuse; and 3) there are no practical land placement options available. Should dredged material be deemed unsuitable for ocean disposal, it would have to be disposed of in an upland placement site on land.

2.3.6 Alternatives Considered and Dismissed Summary

The sections above provided a detailed discussion of the reasons why certain alternatives were not carried forward for analysis in the EIS. In summary, the following table, Table 2.3-1, provides the range of alternatives that were considered, dismissed, and retained for the proposed berth of the aircraft carrier in Apra Harbor, Guam.

Table 2.3-1. Alternative Analysis Summary

Component	*Alternatives **(Key to Figure 2.3-2)***	*Dismiss/Retain in EIS Impact Analysis*	*Reasons for Dismissal or Retention*
Wharf Location			
New Wharf	Polaris Point (northern coast) **(1a)**	Retain	Meets all practicability criteria
	Former Ship Repair Facility (SRF) (northern coast) **(2a)**	Retain	Meets all practicability criteria
	*Commercial Port **(3)***	*Dismiss*	*Security/Force Protection and Operationally/Navigationally not practicable*
	*Glass Breakwater **(4)***	*Dismiss*	*Security/Force Protection and Operationally/Navigationally not practicable*
	*Dry Dock Island **(5)** and **(6)***	*Dismiss*	*Operational/Navigational and Environmental impact*
	*Bravo Wharf –North **(7a)** and South **(7b)***	*Dismiss*	*Security/Force Protection and Operationally/Navigationally not practicable*
Existing Wharf	*Delta/Echo Wharf **(8)***	*Dismiss*	*Security/Force Protection and Operationally/Navigationally not practicable*
	*Sierra Wharf (or other Inner Harbor Wharves) **(9)***	*Dismiss*	*Security/Force Protection*
	*Kilo Wharf **(10)***	*Dismiss*	*Operationally/Navigationally not practicable*
	*Lima Wharf **(11)***	*Dismiss*	*Security/Force Protection and Operationally/Navigationally not practicable*
	*Bravo Wharf **(12)***	*Dismiss*	*Security/Force Protection and Operationally/Navigationally not practicable*
Wharf Alignment			
Polaris Point	*Parallel to coast, full 600 ft clearance **(1a)***	*Dismiss*	*Environmental impact*

Table 2.3-1. Alternative Analysis Summary

Component	*Alternatives **(Key to Figure 2.3-2)***	*Dismiss/Retain in EIS Impact Analysis*	*Reasons for Dismissal or Retention*
	Parallel to coast, reduced clearance at east end (not shown)	Retain	**Avoids environmental impact of full clearance alternative**
	*Diagonal **(1b)***	*Dismiss*	*Environmental impact Cost and technology for structural support due to wave impacts*
Former SRF	*Parallel to shore at coastline **(2b)***	*Dismiss*	*Environmental & Dry Dock operation impacts*
	*Parallel to shore & recessed **(2c)***	*Dismiss*	*Environmental impact of excavation*
	Parallel to coast but angled through finger piers **(2a)**	Retain	**Minimizes environmental impacts**
Turning Basin			
	Optimal radius	*Dismiss*	*Environmental impact*
	Minimal radius	Retain	**Minimizes environmental impact**
Channel Alternatives			
	Optimal-straight	*Dismiss*	*Environmental impact*
	Slight bend	*Dismiss*	*Environmental impact*
	54 degree bend	Retain	**Minimizes environmental impacts**
Wharf Structural Design (subject to modification on final design)			
	Vertical steel or concrete pile	Retain	Cost effectiveness based on oceanographic conditions
	Steel sheet pile bulkhead	*Dismiss*	*Poor performance, historically, in seismic events*
	Concrete caisson	*Dismiss*	*Environmental impact associated with cut and fill and poor performance during seismic events*
Dredging Methods (subject to modification on final design)			
	Mechanical	Retain	EIS analysis is conservatively based on this dredge method alternative with greater potential environmental impact
	Hydraulic	*Dismiss*	*Potentially less environmental impact than mechanical*
Dredged Material Disposal (likely a combination of all three alternatives)			
	ODMDS	Retain	Viable option
	Upland placement	Retain	Viable option
	Beneficial reuse	Dismiss (viable option; but reuse project-specific details are not available for impact analysis)	Viable option; but reuse project-specific details are not available for impact analysis

Legend: **BOLD text =** proposed mitigation
BOLD numbering corresponds to wharf location/alignments presented in Figure 2.3-2.

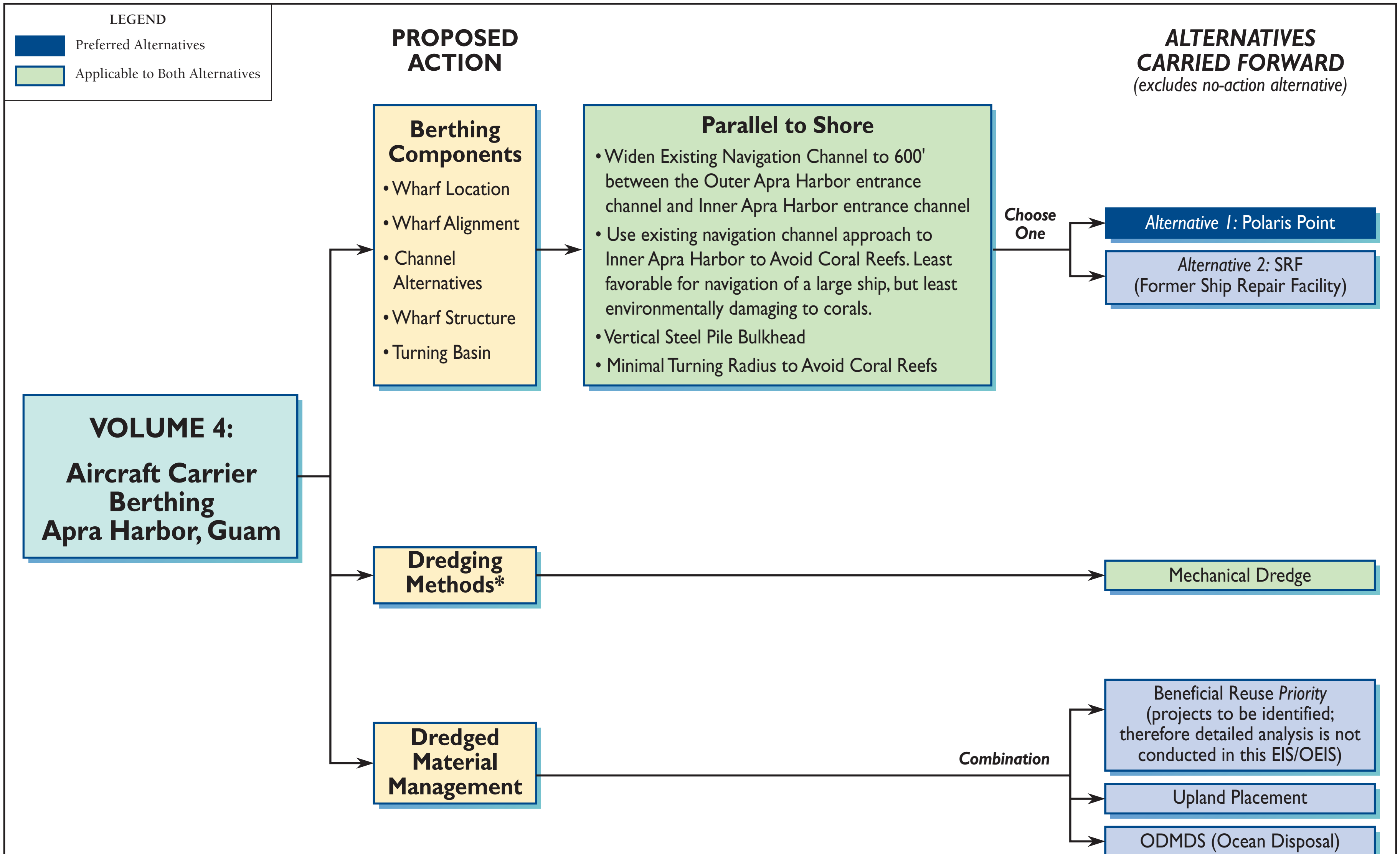
2.4 ALTERNATIVES CARRIED FORWARD FOR ANALYSIS

The lead agency's primary decision relative to the visiting aircraft carrier is whether to construct a new deep-draft wharf along the northern coastline of Polaris Point or the Former SRF, or to take no action. The proposed operation and required facilities would be the same at both sites; however, there would be site-specific differences in construction required to meet the operational requirements. The two wharf location alternatives have the same navigation channel alignment that follows the existing ship navigation route between the Outer Apra Harbor entrance channel and the Inner Apra Harbor entrance channel. The turning basins are slightly different but both turning basin radii are the minimum allowable within Navy navigational and operational constraints. For planning purposes, a steel pile supported wharf was retained as the wharf structural design; however, the design could be refined during the final design and construction phase. Mechanical or hydraulic dredging or a combination of both could be used for the project; however, mechanical dredging has been retained for analysis in this EIS because it is considered the environmentally maximum adverse impact. A combination of beneficial reuse, upland disposal, and ocean disposal would be used for dredged material management. A range of potential beneficial reuse projects are presented in the EIS but are not analyzed in detail.

The alternatives in this EIS were evaluated to ensure they met the purpose and need as outlined in Chapter 1. Subsequent sections (Sections 2.5 and 2.6) describe in detail the two alternative wharf locations carried forward for analysis: Alternative 1 , Polaris Point (preferred alternative), and Alternative 2, Former SRF. Figure 2.4-1 provides an overview of the alternatives that are considered for analysis in this EIS.

2.4.1 Least Environmentally Damaging Practicable Alternative (LEDPA)

Chapter 4 of this Volume contains an analysis of the least environmentally damaging practicable alternative (LEDPA), which is required under the Section 404(b)(1) guidelines of the Clean Water Act (CWA). Specifically, Section 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 (LEDPA) 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 implemented after taking into consideration cost, existing technology, and logistics in light of overall project purposes. The Section 404 (b)(1) guidelines are applicable to the proposed aircraft carrier berthing activities analyzed in this Volume and are discussed in detail in Chapter 4.



*Note: Analysis assumed dredging by mechanical means as an environmental maximum potential adverse affect method and is the method historically used at Apra Harbor. Hydraulic dredge may be used in final design and permitting.

Figure 2.4-1
Summary of Proposed Action and Alternatives Carried Forward for the Navy Aircraft Carrier Berthing, Guam

2.5 ALTERNATIVE 1 POLARIS POINT (PREFERRED ALTERNATIVE)

2.5.1 Operation

Figure 2.5-1 shows the Alternative 1Polaris Point (referred to as Alternative 1) project area, including a 3-dimensional rendering. As described in the alternatives considered and dismissed section, the navigation channel would be widened to 600 ft (183 m) and the alignment would follow the existing navigation channel fairway with a sharp bend between Jade and Western Shoals. The most likely route of the aircraft carrier through the harbor and to the wharf is depicted by ship icons in Figure 2.5-1. The carrier would be pivoted within the minimum radius turning basin to be aligned starboard side to the wharf and the bow would be facing east. On departure, the aircraft carrier would follow the same route with assistance by tugboats. When a carrier is not present, other ships would be able to use the wharf at the discretion of Port Operations. These ships would be significantly shorter and easier to maneuver into the wharf than an aircraft carrier.

Access to the site on land is from the traffic signaled intersection at Marine Drive and existing Polaris Point Road through the Polaris Point manned security gate and manned security gates at the aircraft carrier compound. Because of the distance from the wharf to Naval Base Guam, there likely would be limited increased pedestrian traffic between the wharf and Naval Base Guam.

2.5.1.1 Radiological Material Operation

Nuclear-powered aircraft carriers already visit Guam. No changes to current in-port operations would be expected because of the anticipated longer visit times (21 days compared to 7 days). Minor regularly scheduled maintenance, or small emergent repairs, may occur while in port just as might happen today. If required, a routine transfer of radioactive waste packaged per Department of Transportation requirements would be conducted. Existing radiological response capability stationed at the Polaris Point Alpha and Bravo wharf area supporting the homeported submarine squadron would to be available to support the aircraft carrier if needed, as occurs under existing conditions.

2.5.2 Facilities

2.5.2.1 Shoreside Structures

Staging Area and Access

Alternative 1 provides for approximately 5.8 ac (2.3 ha) of staging area adjacent to the back of the wharf (Figure 2.5-2 and Figure 2.5-3.) The staging area would be sloped landward at 1%, the same as the wharf. The entire area would be paved with asphalt and concrete over a crushed aggregate base. All underground utilities and storm drains as well as building and light standard foundations would be installed prior to paving.

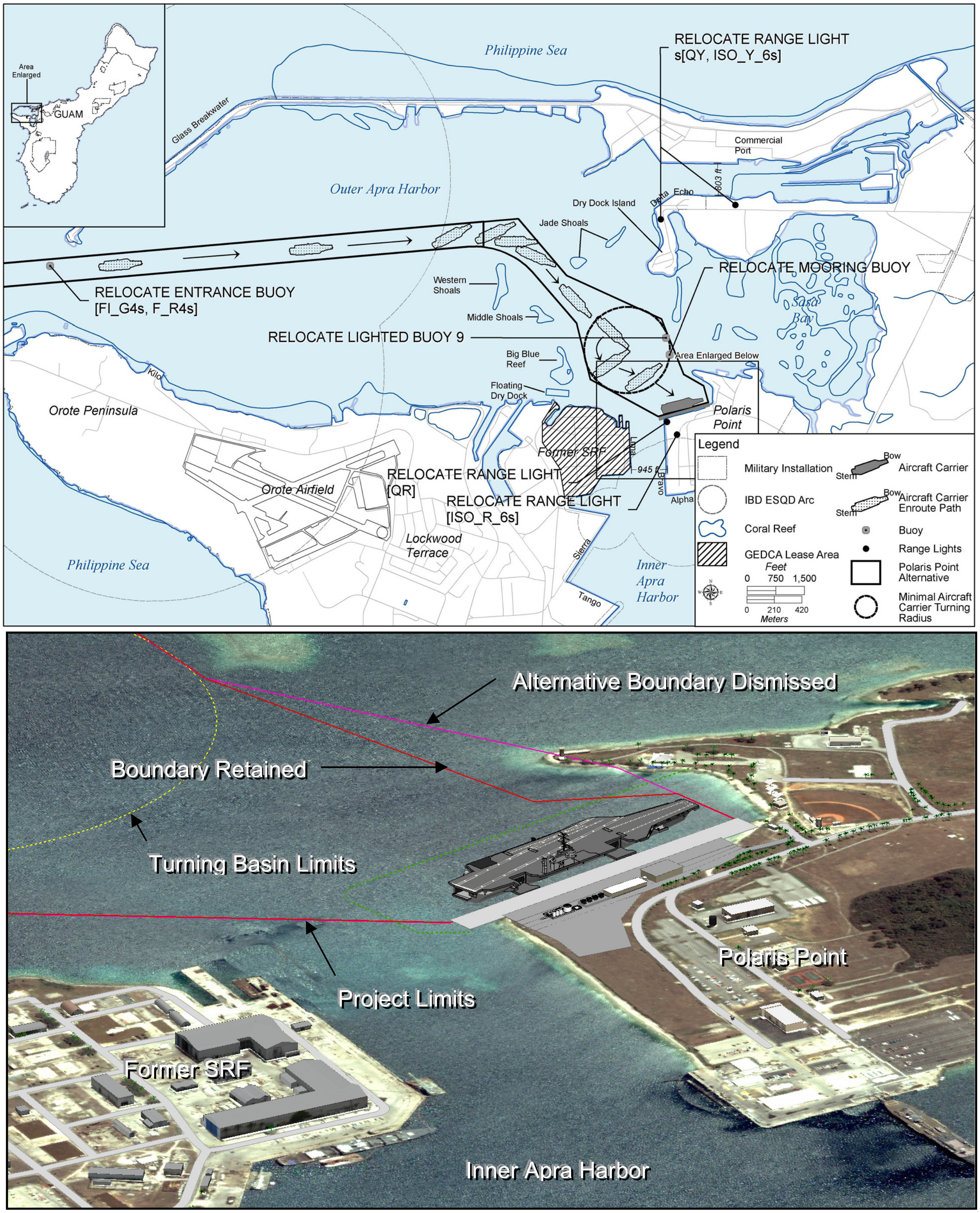
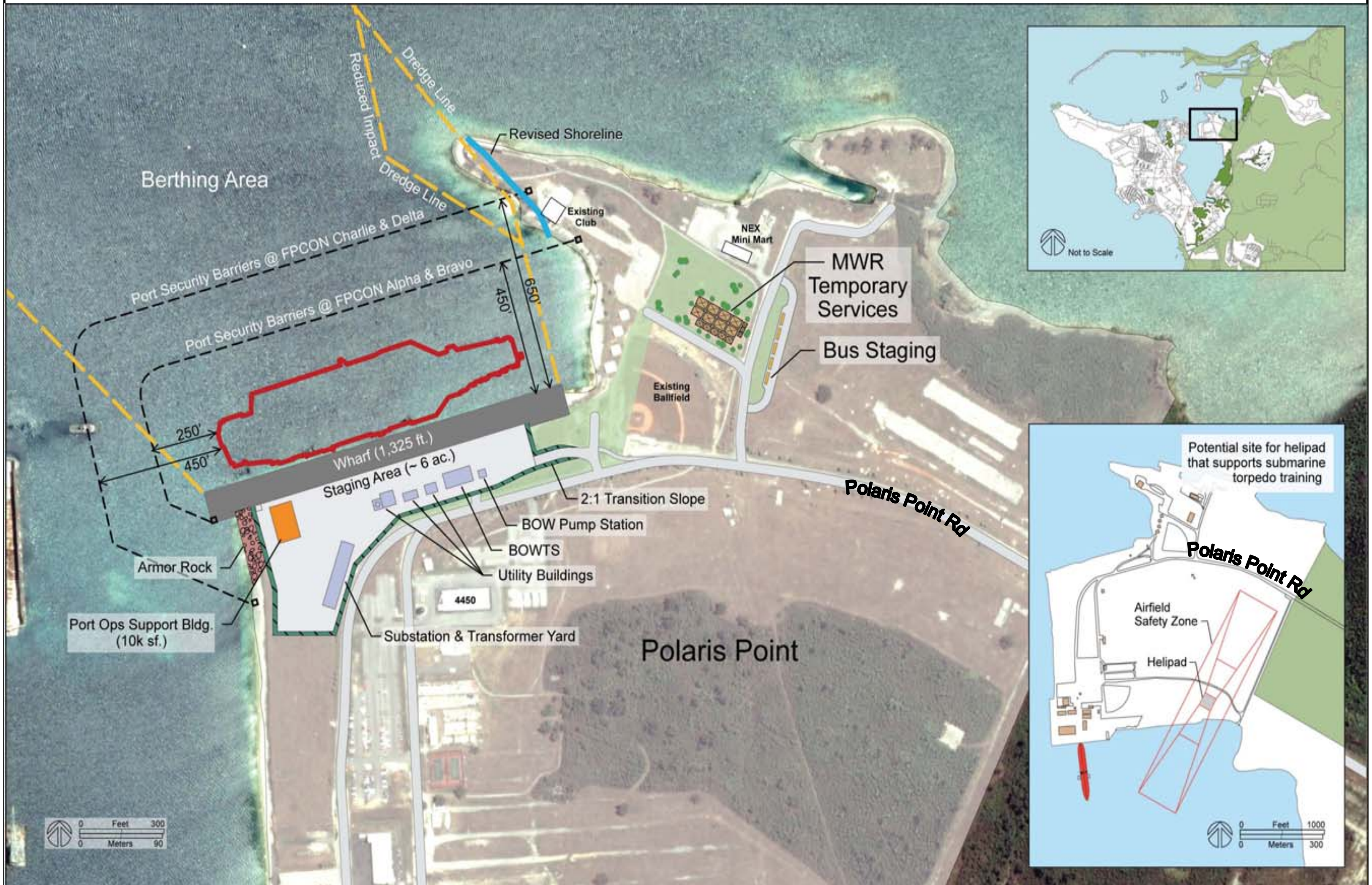


Figure 2.5-1
Alternative 1 – Polaris Point

Source: NAVFAC Pacific 2008

Figure 2.5-2 Polaris Point Alternative Site Plan



Source: NAVFAC Pacific 2008

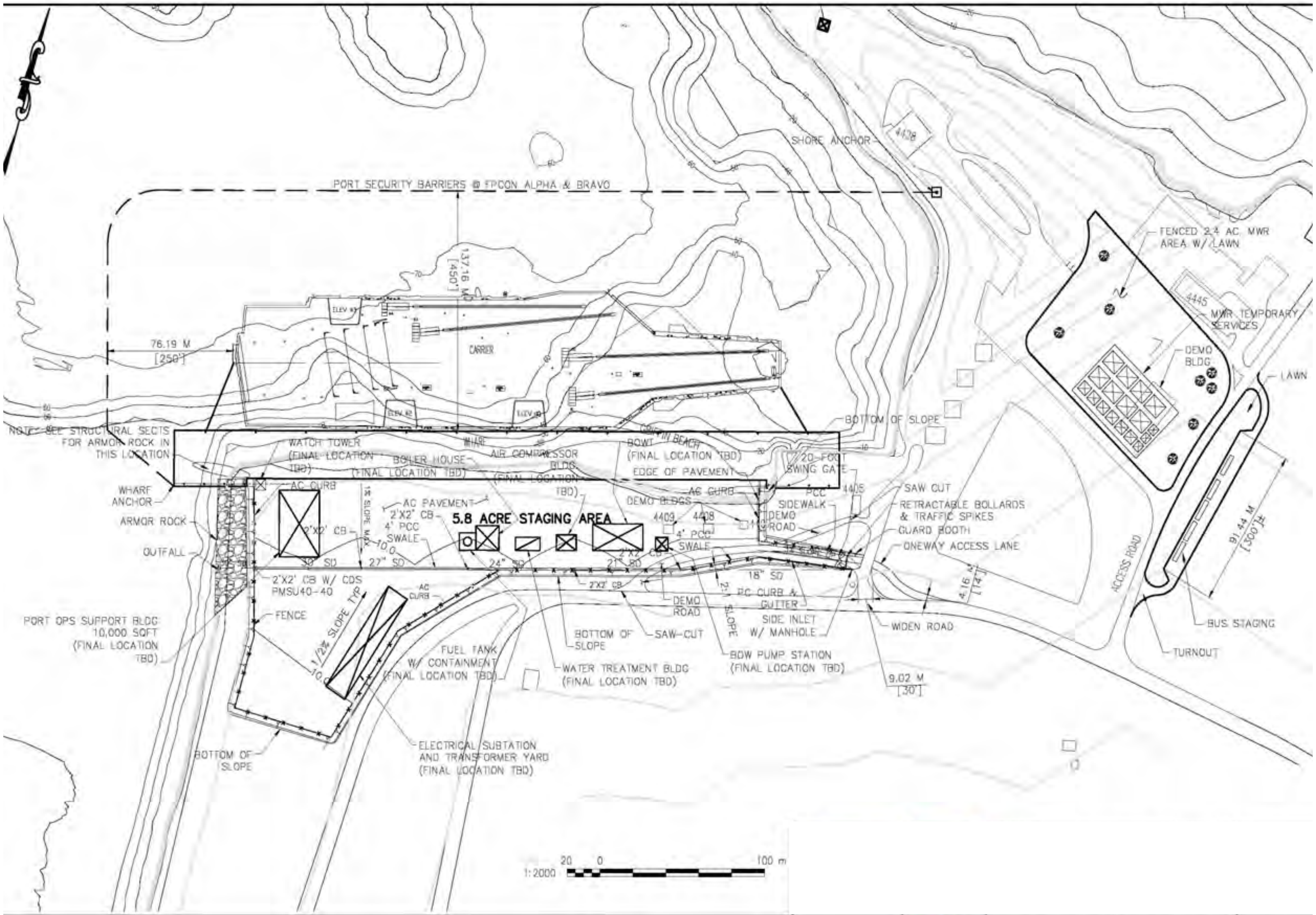


Figure 2.5-3
Polaris Point Improvements

Source: NAVFAC Pacific 2008

The proposed staging area for the aircraft carrier services is configured and sized to provide unimpeded access to the wharf, with a reasonable amount of area for operation, staging, and support. In addition, adequate areas to accommodate the various buildings listed in the previous section and associated parking would be provided. Demolition of nearby buildings and roadways would be kept to a minimum.

A new 10,000 ft^2 (929 m^2) Port Operations Support Building with restrooms would be used for storage of material and equipment that support the aircraft carrier visits, including floating security barriers and replacement parts shipped to Guam pending aircraft carrier arrival. The building would be uninhabited with no planned office space. The building would be constructed of concrete and designed to meet typhoon winds, seismic forces, anti-terrorism/force protection (AT/FP) requirements, sustainability objectives and other applicable codes. It would be located at the western end of the staging area and west of the proposed utility buildings.

The site plan provides access from Polaris Point Road with a short one-way access lane cut through the apex of the existing softball field lot. This would provide queuing for about 12 vehicles without obstructing Polaris Point Road or the right hand turn-off to the softball diamond. Vehicles denied entry would have room to back up onto the turn-off road and return back down Polaris Point Road. The driveway entrance/exit is quite a bit longer than that for the Former SRF site but the slope is not as steep (NAVFAC Pacific 2008).

Security/Biosecurity

Security

Landside and waterside security requirements were established from UFC 4-025-01 (*Waterfront Security Design*). The perimeters of staging areas are designed to protect against vehicle intrusion with hardened security fencing (security fencing supported on concrete vehicle barriers). In areas inaccessible to vehicles, such as rock revetments and beach shorelines, only security fencing would be used to prevent pedestrian intrusion. The wharf access control point, via the staging area or directly from an approach ramp, would be at a guard booth controlling active vehicle barriers (hydraulic bollards and traffic spikes) for the inspection of vehicles.

Watch towers are required for the berth. UFC specifications require that they be at least 30 to 50 ft (9 to 15 m) above the wharf, positioned to monitor the waterfront, spaced at approximately 1,000 ft (305 m) intervals, and that they be hardened and secured by fencing. The towers would be sized to support two personnel with Heating, Ventilation, and Air Conditioning (HVAC), water, sewage, telephone, fire alarm, security power circuits, etc., but designed to be operated by a single person. Due to the orientation of the wharf and the dredging required at the end of the point, the existing guard tower would have to be demolished. A replacement tower would be constructed at the southern side of the east end of the wharf.

Floating port security barriers are required to surround an aircraft carrier while it is at berth. The recommended minimum barrier standoff requirement for force protection condition Alpha and Bravo (the lowest threat level) is 250 ft (76 m) from the aircraft carrier hull. In the event that force protection conditions Charlie and Delta (higher threat level) are declared, the port security barriers would have to be relocated 200 ft (61 m) beyond the barriers for force protection condition Alpha and Bravo. The proposed locations are shown on Figure 2.5-2.

Shoreside security would be enhanced by a combined single entrance and exit ramp to the surrounding grade. Access to the facility would be controlled by a guard building at the entrance and protected by hydraulic bollards and traffic spikes. Traffic queuing would be afforded to various degrees in each alternative layout.

Each layout is designed so that rejected vehicles can turn around without being boxed in from behind. This eliminates the possibility that a vehicle would have to drive past the check point and make a U-turn and leave. For additional protection, the entrance ramps also would be situated a reasonable distance from the asset. An enclave gate and concrete sidewalk along the entrance side of the ramp also would be provided for pedestrians. Pedestrian access would be controlled by the same guard booth as the vehicles. Appropriate electronic surveillance would be installed.

Biosecurity

A Micronesia Biosecurity Plan (MBP) is being developed to address potential invasive species impacts associated with this EIS as well as to provide a plan for a comprehensive regional approach. The MBP will include risk assessments for invasive species throughout Micronesia and procedures to avoid, minimize, and mitigate these risks. It is being developed in conjunction with experts within other Federal agencies including the National Invasive Species Council (NISC), U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS), the US. Geological Survey (USGS), and the Smithsonian Environmental Research Center (SERC). The plan is intended to be a comprehensive evaluation of risks in the region, including all Marine Corps and Navy actions on Guam and Tinian and specifically those being proposed in this EIS. It will include brown treesnake (BTS) control measures to prevent BTS movement off Guam and management within Guam. The Navy will implement applicable DoD portions of the plan and would collaborate with other government agencies and groups on full implementation of the plan throughout the region. Because some actions proposed in this EIS will occur prior to finalizing the MBP, interim measures are also proposed in this EIS to address invasive species that will supplement existing practices. For additional information on the MBP and existing and interim measures for invasive species control, please refer to Volume 2, Chapter 10, Section 10.2.2.6.

MWR

The Navy MWR area for supporting aircraft carrier activities would be situated on a 2.4 ac (0.97 ha) lot north of the existing baseball field on Polaris Point (see Figure 2.5-2 and Figure 2.5-3). The MWR area would be located about 500 ft (152 m) north of the access control point for the staging area. There is a 7,200 ft^2 (669 m^2) building pad that would have to be razed before that area could be graded and landscaped for lawn and trees. The lawn may be supported by a permanent irrigation system. A 3-in (7.6 cm) thick asphalt lot about 0.5 ac (0.2 ha) in size would be constructed for locating temporary facilities such as food and beverage booths, seating areas, parking and lighting.

The MWR area would require utility connections. The area would be enclosed by a 1,300 ft (396 m) long chain-link fence and would have multiple locking swing gate entry points. One of the gates would have a permanent turnstile and guard shack. A loop road would be constructed off of the east side of the Polaris Point access road. The loop road would have a 10 ft (3 m) wide by 300 ft (91 m) long turnout on the west side to park five buses. Bicycles would be made available at the MWR area.

Aids to Navigation

To accommodate the widened channel, turning basin, and approaches to both wharf location alternatives, the existing aids to navigation would require modification. The existing Inner Apra Harbor Channel is marked at the entrance in Outer Apra Harbor with two lighted buoys designated as: "FI G 4s" and "FI R 4s." The centerline of this channel is defined for navigation by the entrance range lights designated "QY" and "Iso Y 6s." Because the proposed realignment and widening of this channel is not identical with the current centerline, relocation of entrance lighted buoy "FI R 4s" and both range lights "QY" and "Iso Y 6s" would be required.

The existing Approach Channel to Inner Apra Harbor would be widened and slightly realigned as a result of the modifications aids to navigation. Figure 2.5-1 illustrates the buoys and range lights that would have to be relocated or removed to avoid obstructing the channel. The alignment of this channel is currently designated by range lights "Q R" and "Iso R 6s." Additionally, the channel limits are marked with lighted buoys to warn pilots of the shoals on either side of the navigation path. It is recommended that both range lights "Q R" and "Iso R 6s" be relocated to redefine the channel centerline. For Alternative 1, the range lights at Polaris Point would have to be relocated and raised so that the lights are high enough to be seen by other ships when the carrier passes in front of the lights. The proposed enlargement of the turning basin would also require relocation or removal of two other buoys. One is a mooring buoy located at the eastern edge of the proposed basin and the other is lighted buoy "9" just north of the mooring buoy.

2.5.2.2 Utilities

Although the utility requirements for the CVN 68 (Nimitz Class) and CVN 78 (Ford Class) are similar, there are some differences, as shown in Table 2.5-1. The differences are highlighted in bold typeface. The requirements were compiled from Navy technical guidance and specifications (NAVFAC Pacific 2008). These requirements are significantly greater than for other Navy vessels and would meet the requirements of the vessels in the CSG that may temporarily berth at one of the alternative locations. The *CVN-Capable Berthing Study* (NAVFAC Pacific 2008) contains detailed information on utility requirements. Table 2.5-2 indicates which utilities require new facilities or improvements to existing facilities based upon alternative locations. Volume 6 includes the waterfront demand on utilities and addresses alternatives to large scale utility demands as a result of the proposed nuclear aircraft carrier berthing, relocation of the Marine Corps, and Army Air and Missile Defense Task Force to Guam. The Volume 4 discussion of utilities is specific to utility improvements to support the aircraft carrier requirements.

Table 2.5-1. Aircraft Carrier Utility Requirements

System	*Criteria*	*Requirement*		*Source*
		CVN 68 (Nimitz Class)	*CVN 78 (Ford Class)*	
Bilge Oily Waste	Peak Quantity	80,000 gpd	**82,000 gpd**	UFC 4-150-02;
	Average Quantity	35,000 gpd	**38,000 gpd**	
	Design Rate	90 gpm	90 - **180 gpm**	
Wastewater	Average Daily Flow	550,000 gpd	550,000 gpd	UFC 3-240-2N
Potable Water	Average Demand	185,000 gpd	**235,000 gpd**	UFC 4-150-02; UFC 2150-02
	Design Rate	1,000 gpm	1,000 gpm	
	Minimum Pressure	40 psi	40 psi	
Steam	Constant	7,500 lb/h	**Not required**	UFC 4-150-02; UFC 3-430-08N; UFC-3-430-09N
	Intermittent	7,200 lb/h	**Not required**	
Compressed Air	Design Rate	2,400 scfm	**Not required**	UFC 3-150-02; UFC 4-213-10; UFC-3-430-09N
Pure Water	Peak Rate	150 gpm	**100 gpm**	Draft CVN 78 facilities planning criteria
	Design Rate	20,000 gpd	20,000 gpd	
Shore Power	Peak Demand	21 MW 4,160 V	**30 MW @ 13,800V**	UFC 4-150-02; UFC 2150-02
Information Systems	Capacity	200 pair copper; 48-strand fiber optic cable; provision for CATV connection	Assume same as CVN 68	UFC 4-150-02; UFC 2150-02; and NCTS discussions

Legend: **BOLD** text indicates that requirements differ for CVN 78 compared to CVN 68
CATV = cable television, gpd = gallons per day, gpm = gallons per minute, lb/h = pounds per hour, MW = megawatts, psi = pounds per square inch, scfm = cubic feet per minute at standard conditions, V = volts.
Source: NAVFAC Pacific 2008.

Table 2.5-2. Aircraft Carrier Utility Type of Construction

System	*Alternative 1 Polaris Point*	*Alternative 2 Former SRF*
Bilge Oily Wastewater	New	New
Wastewater	Improve existing and supplement	Improve existing and supplement
Potable Water	Improvement (extend line)	Improvement (extend line)
Steam	New	New
Compressed Air	New	New
Pure Water	New	New
Shore Power	New and improvements	New and improvements
Information Systems	Improvement (extend line)	New extend from Building 3169

Steam, Compressed Air, and Pure Water

Steam, compressed air, and pure water utilities do not exist at either alternative site.

Saturated steam (150 pounds per square inch gauge [psig]) is used by CVN 68 vessels to supply shipboard laundry and galley facilities, in addition to any supplementary heating requirements. The steam demand is what is required by the berthed vessel crew complement with an embarked air wing. Steam is not required for CVN 78 vessels. The constant load for the CVN 68 is 7,500 pounds/hour. System redundancy and capacity is described in UFC 3-430-08N. Two marine oil-fired boilers would be installed in a new boiler house with condensate collection systems. Two distribution pipes would be installed underground between the boiler house and the wharf.

A compressed air system is required for CVN 68 class vessels at all active berths, but CVN 78 does not have a compressed air requirement. Under emergency conditions, the vessel's compressed air system would be used to fill any additional compressed air demand. Typically, the vessel requirement for 125 psig compressed air should be at a minimum commercial quality. However, it is presumed that the air may also be used for emergency response equipment and thus shall meet the requirements of Class D breathing air as described by American National Standards Institute G-7.1-1989. Both the steam and compressed air requirements and conditions are defined by Military Handbook (MIL-HDBK) 1025/2, and UFC Manual 2150-02. A new 2,400 standard cubic foot per minute (68 m^2) system would be built with underground piping along the wharf.

Pure water is required to support the nuclear powered capabilities of the aircraft carrier. The requirement is 20,000 gallons per day (gpd) (75,708 liters per day [lpd]). Existing potable water infrastructure would be used and water would be treated to Grade A quality. A structure would house the equipment, and underground pipes would extend to the wharf. The possibility of using temporary portable equipment was evaluated and determined not feasible due to procurement costs, maintenance, and storage when not in use; and labor for set-up, tearing down, and certification.

2.5.2.3 Bilge and Oily Wastewater Treatment System (BOWTS)

A BOWTS separates oil, grease, and oily waste found in bilge and oily water. A BOWTS has the capability to lower the contaminant levels to less than the permissible limits for discharge to publicly owned treatment works. The new BOWTS would be sized to accommodate the ultimate requirements of the CVN 78: i.e., a pumping rate of 90 gallons per minute (gpm) (341 liters per minute [lpm]) with an average flow rate of 38,000 gpd (143,845 lpd) and a peak flow rate of 82,000 gpd, (310,403 lpd).

The existing BOWTS at Apra Harbor Naval Complex are inadequate to handle the requirements of either a CVN 68 or CVN 78 for a 21 day duration visit. Therefore, a permanent BOWTS is proposed near the wharf and would include a combined gravity and force main collection system as well as a bilge oily wastewater (BOW) pump station. Separated water would be sent to the DoD water treatment facility at Apra Harbor. Reclaimed oil would be handled in accordance with existing base oil management procedures and used for power generation or recycled/re-refined for other purposes. BOW operations are carried out according to a Naval Base Guam Facilities Response Plan prepared under the Oil Pollution Act of 1990 (OPA 90) regulations and guidelines.

Wastewater

The existing wastewater treatment plant and collection system at Apra Harbor Naval Complex is inadequate to handle the volume of wastewater of either a CVN 68 or CVN 78 for a duration of 21 days. Depending on the selected berthing location, upgrades would be required for various portions of the landside wastewater collection system.

Proposed improvements to the Apra Harbor Wastewater Treatment Plant (AHWWTP) are being executed under other military construction projects (MCON P-262 and P-534). This particular plant currently operates at a secondary wastewater treatment plant level. The AHWWTP is being rehabilitated and upgraded to restore its designed capacity of 4.36 million gallons per day (mgd) (16.5 million liters per day [mld]). The Navy is upgrading the plant disinfection system to reduce the discharged coliform level, implementing/monitoring pre-treatment programs, and removing wastewater treatment plant (WWTP) sludge from the sewer to reduce metals to the plant. The composition of the wastewater from the aircraft carrier is primarily domestic waste but in a more concentrated form. The projected aircraft carrier wastewater inflows would increase wastewater flows to AHWWTP by approximately 550,000 gpd (2.1 mld). Currently AHWWTP has an average flow of 2.9 mgd (11 mld). Even with the additional proposed flow, the wastewater plant would be operating within its design parameters and permitted capacity. However, in addition to completion of the programmed projects, other improvements to the wastewater system would be required to support the aircraft carrier berthing.

Upgrades to the existing Sewage Pump Station (SPS) Number 9 at Polaris Point, associated force main, and trunkline “B” would be necessary to accommodate the additional flows from an aircraft carrier. Specific improvements would include the construction of a new submersible type SPS, a new dry pit/wet well-type pump station to replace the aging SPS 9, and 14,800 linear ft (4,511 m) of associated force mains. In addition to the pressurized systems, approximately 4,940 linear ft (1,506 m) of new gravity sewer lines would be required, including 4,420 linear ft (1,347 m) of 8, 12, 15, and 21 in (0.2, 0.3, 0.38, 0.53 m, respectively) lines. These upgrades would follow existing rights of way and utility lines that currently parallel Route 29 and Marine Corps Drive. Standard construction practices would be utilized to ensure that existing lines are not disrupted.

A standard ship to shore sewage hose capable of handling pressurized sewage would connect the vessel’s discharge fitting to the shore receiving station also known as a riser. The riser consists of a hose connector, plug valve, and a check valve. The manifold piping system transfers wastewater to the shore piping system and to the lift station. This control network ensures that the wastewater exits the ship and arrives into the lift station avoiding the possibility of uncontrolled release of the wastewater.

Potable Water

The potable water supply would be connected to the southern Navy water system, which receives its surface water supply from Fena Reservoir. Potable water demand for the aircraft carrier would have no impact on the Northern Guam Lens Aquifer(NGLA). According to and following the applicable UFC documents and guidance provided in the review draft Navy Facility Planning Criteria for aircraft carriers, the daily average potable water requirements, with air wing or troops aboard, for a CVN 68 is 185,000 gpd (700,300 lpd) and for a CVN 78 is 235,000 gpd (889,569 lpd). Therefore, the existing potable water system requirements are based on the necessity to supply a minimum flow rate at the berthing location of 1,000 gpm (3,785 lpm) at 40 psi and satisfy an average daily demand of 235,000 gpd (889,569 lpd). During periods of low rainfall, the flow rate requirement may have a localized impact on the existing water distribution system, including water provided to Guam Water Authority (GWA) to supply water to southern Guam. In accordance with existing DoD directives and existing agreements with GWA, every effort would be made during periods of low rainfall and drought to ensure appropriate water conservation measures are implemented for on base demand at Naval Base Guam, including transient carrier demand.

Potable water is supplied to Polaris Point from the Tupo Tank system. In addition to Polaris Point, the Tupo Tank supplies water to areas outside of the Apra Harbor Naval Complex and north to Barrigada (Navy), including GovGuam and Navy areas between those two locations. Based on the water demands of the service area and the maximum fire flow requirements, the storage capacity of the tank was evaluated based on criteria provided in UFC 3-230-19N (*Water Supply Systems*). The storage capacity required for all users served by the Tupo Tank, including the proposed water demand of a CVN 78, was calculated to be 4.2 million gallons (mg) (15.9 million liters [ml]). The Tupo Tank has a capacity of 5.0 mg (18.9 ml). Therefore, no improvements are required at the Tupo Tank for the berthing of either a CVN 68 or CVN 78 at Polaris Point.

Military Construction (MCON) Project P-431 (Alpha/Bravo Wharf Improvements) improved the water distribution lines within Polaris Point. Approximately 5,000 linear ft (1,524 m) of 8 and 12-in (0.2 m and 0.3 m) water lines supplying water to Polaris Point were replaced with a 16-in (0.4 m) main. The 6-in (0.15 m) water lines along the wharf were replaced with 8-in (0.2 m) lines. A new fire pump house was constructed under this project. These improvements were incorporated in the water system model used to evaluate the capacity of the existing potable water system. The results of the model indicate that more than 1,000 gpm (3,785 lpm) can be provided at pressures exceeding 40 psi to the berthing site at Polaris Point. Therefore, no major water system improvements would be required for this option. Water system improvements would be limited to the construction of a new 8-in (0.2 m) service lateral to the berthing site and the associated pier side water outlets.

The potable water system would be used for any fire fighting requirements at the berth.

Electrical Power Distribution and Communications System

The electrical infrastructure at Polaris Point is capable of supporting planned projects such as MCON P-465, Consolidated Submarine Learning Center Training & Commander Submarine Squadron 15 Headquarters Facility, and P-528, Construct Torpedo Exercise Support Building.

As discussed in section 2.2.1, it is anticipated that a transient aircraft carrier and its escort ships would rely on shoreside utility infrastructure for water, wastewater, and solid waste after 2015. Electric power would be provided in accordance with customer service agreements between Guam Power Authority (GPA) and the U.S. Navy. Any GPA commitments for additional power to support the aircraft carrier and its escort ships will be determined by future CSA modifications. Any changes in the shoreside power requirements for the aircraft carrier and its escort ships may require additional NEPA review.

The electrical infrastructure at Polaris Point is incapable of accommodating the aircraft carrier Polaris Point berth without major improvements and additions as follows:

- A new 34.5 kilovolts (kV) circuit breaker and underground feeder circuit in GPA Piti 34.5 kV Switching Station (by GPA)
- A new aircraft carrier berth substation
- Operational and security lighting using high-mast steel poles with metal-halide luminaries

Stormwater

Alternative 1 provides for approximately 5.8 ac (2.3 ha) of staging area adjacent to the back of the wharf. The maximum surface area of the pier would be approximately 2.7 ac (1.1 ha). Additionally, the MWR area would be situated on a 2.4 ac (0.97 ha) lot adjacent to the pier. Surface flow would be directed toward the west and south perimeters of the staging area and would be intercepted by a concrete swale. The layout of the staging area intercepts surface flow from the southeast. Therefore, a catch basin is planned to intercept this flow (however, more refined topographical and planimetric information may demonstrate that this catch basin may be eliminated and the total design flow reduced accordingly). The storm drain path would be along the same alignment as the swale, southward and then westward. A cyclonic separator would be located in the southwest corner of the staging area and the outfall located on the east end of the channel between the Apra Inner and Outer Harbors. Armor rock would be installed from the back of the wharf to about 250 ft (76 m) southward along the channel. However, additional rock cover is planned on the east side of the staging area at the west end of Griffin Beach, to protect the concrete cut-off wall return from undercutting action by waves. Chapter 4 of this Volume contains more information on potential impacts from stormwater.

Solid and Hazardous Waste

Typically, solid waste storage bins would be provided in the aircraft carrier compound and near the MWR activity area, as needed. Solid waste would be handled and managed in accordance with Navy standard operating procedures and would be disposed of at the Navy landfill as long as it meets all criteria for disposal in the landfill.

A ship-board hazardous regulated waste receptacle is typically designated at the wharf. The hazardous waste would be managed in accordance with Navy standard operating procedures and the Navy Resource Conservation and Recovery Act (RCRA) permit would be modified to consider the additional volumes of waste. Additionally, the increase in hazardous materials would be handled and disposed of per applicable best management practices as described in Volume 7. Volume 4, Chapter 17 contains a description of the types and quantities of hazardous waste that would be generated from the proposed action.

2.5.3 Construction

2.5.3.1 Polaris Point-Specific

The wharf plan for Alternative 1 (Polaris Point) is shown on Figure 2.5-4. Site preparation would require the grubbing and removal of all ground cover for construction of the staging area. The site area is estimated at 250,000 ft^2 (23,225 m^2). Site preparation would include demolition and replacement in-kind of three minor buildings (4407, 4408, 4409) (totaling approximately 940 ft^2 [87 m^2]).

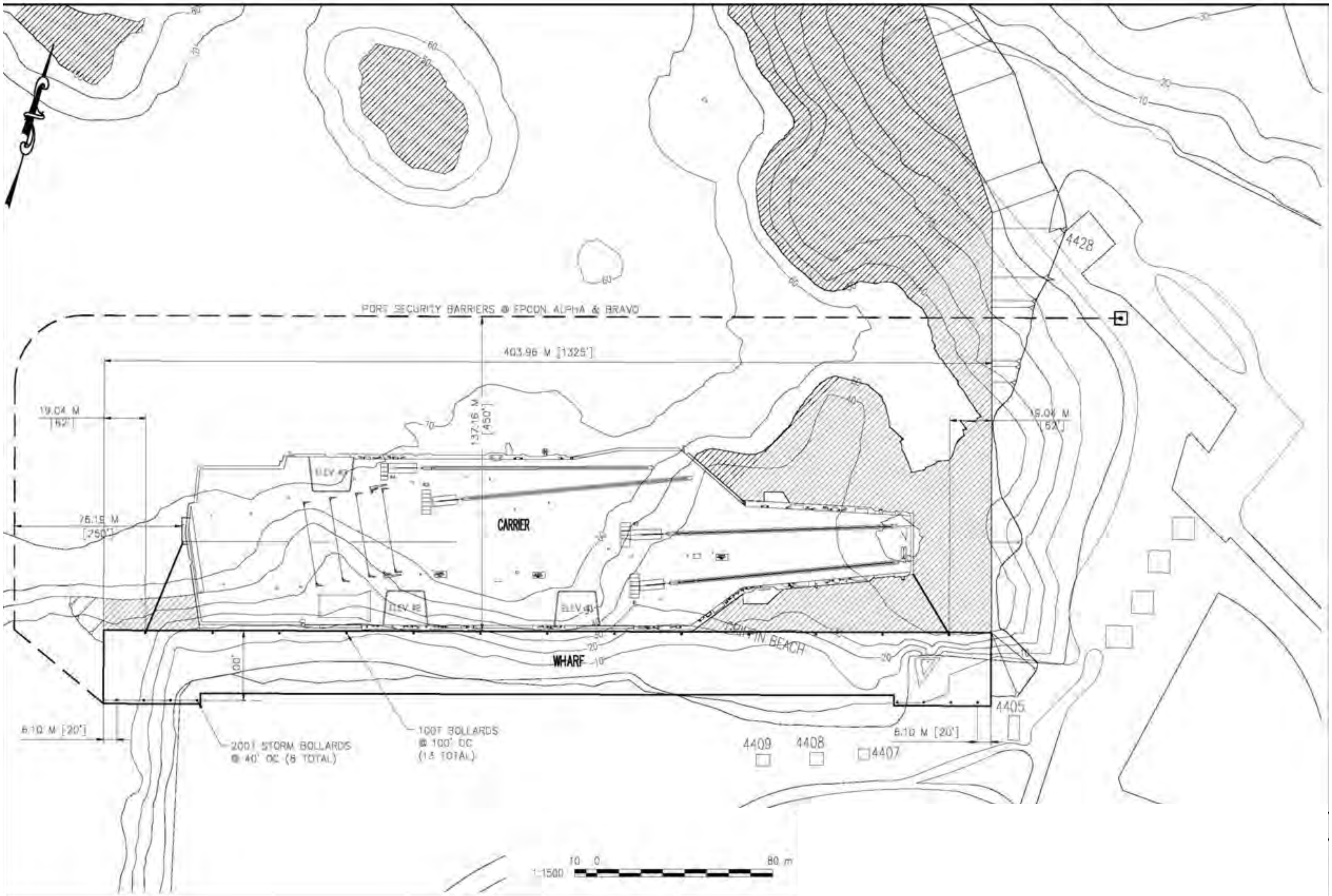


Figure 2.5-4 Polaris Point Wharf-Plan View

Source: NAVFAC Pacific 2008

Surveys of these buildings have been conducted for asbestos-containing material, lead-based paint, and PCB-containing electrical equipment (NAVFAC Pacific 1998). Demolition and recovery of these types of materials, if present, would be conducted in accordance with Navy procedures and applicable laws.

There would be required some minor roadway and remnant pavement removal and possibly re-alignment of utility lines along this portion of roadway. The soil would be scarified and re-compacted before the fill material is placed to prevent differential settlement. No tree removal would be required. Landscaping, including trees and grass, is proposed in the MWR area. Subgrade work would be required for installation of utility ducts and storm water facilities. Fill would be required behind the riprap slope underneath the wharf. Vertical sheet pile would be driven into the slope (Figure 2.5-5).

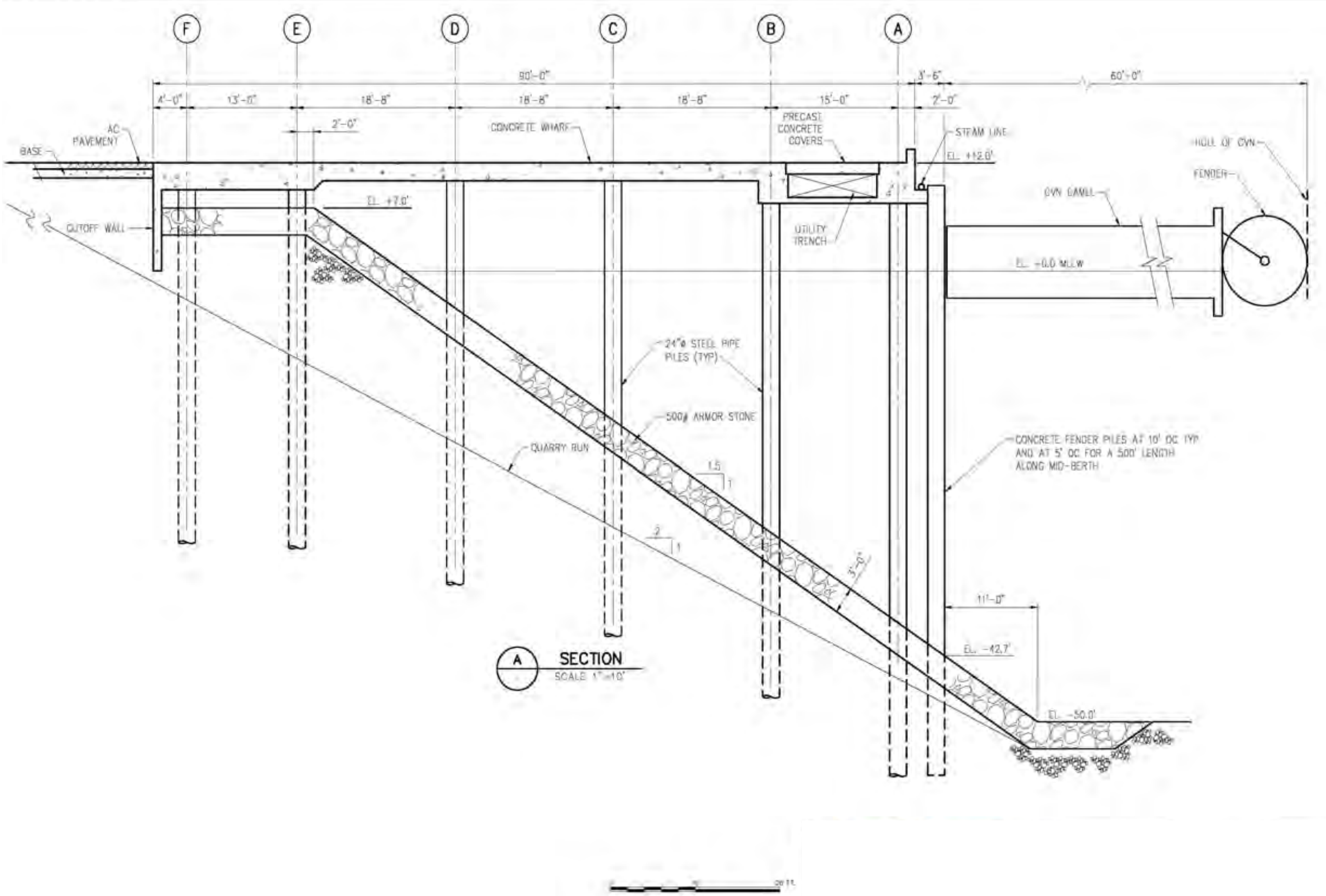
The project dredging would be limited to an area near the channel bend, portions of the turning basin and areas under the wharf structure. Figure 2.5-6 shows the outer limits of dredging and specific areas that would require dredging because they are currently less than -49.5 ft [-15 m] MLLW. The minimum turning basin radius is shown on Figure 2.5-1. Approximately 608,000 cy [464,850 m^3] of dredged material including 2 ft (0.6 m) for overdredge would be generated.

2.5.3.2 Construction Common to Both Action Alternatives

Dredging

Standard dredge design has been modified through continuing engineering studies to find the least environmentally damaging alternative for Polaris Point (see *CVN-Capable Berthing Study* [NAVFAC Pacific 2008]). Figure 2.5.6 illustrates the smallest dredge footprint for this alternative. The dredge methods and dredged material disposal options would be the same as those described to support the Marine Corps Sierra Wharf dredging in Volume 2, Section 2.5. Dredging operations have been modeled as a 24 hours per day operation for a duration of 6 to 9 months, but depending upon dredging efficiency, could last from 8 to 18 months. Continuing consultation between the Navy and regulatory agencies would determine the actual operational parameters and duration. The total dredge volume would be approximately 608,000 cy (464,850 m^3), including a 2 ft (0.6 m) overdredge. The total dredge area would be approximately 53 ac (21.4 ha). Approximately 30% of the dredged material would be generated at the shoreline area of Polaris Point to provide an appropriate slope for the wharf structure. The anticipated dredging production rate is 75 cy/hour (57 m^3/hour) based on recent mechanical dredging of similar substrate (Volume 9, Appendix E). At this rate, total production would be approximately 1,800 cy (1,376 m^3) per day.

Figure 2.5-5
Wharf Profile
View-Steel Piles



Source: NAVFAC Pacific 2008

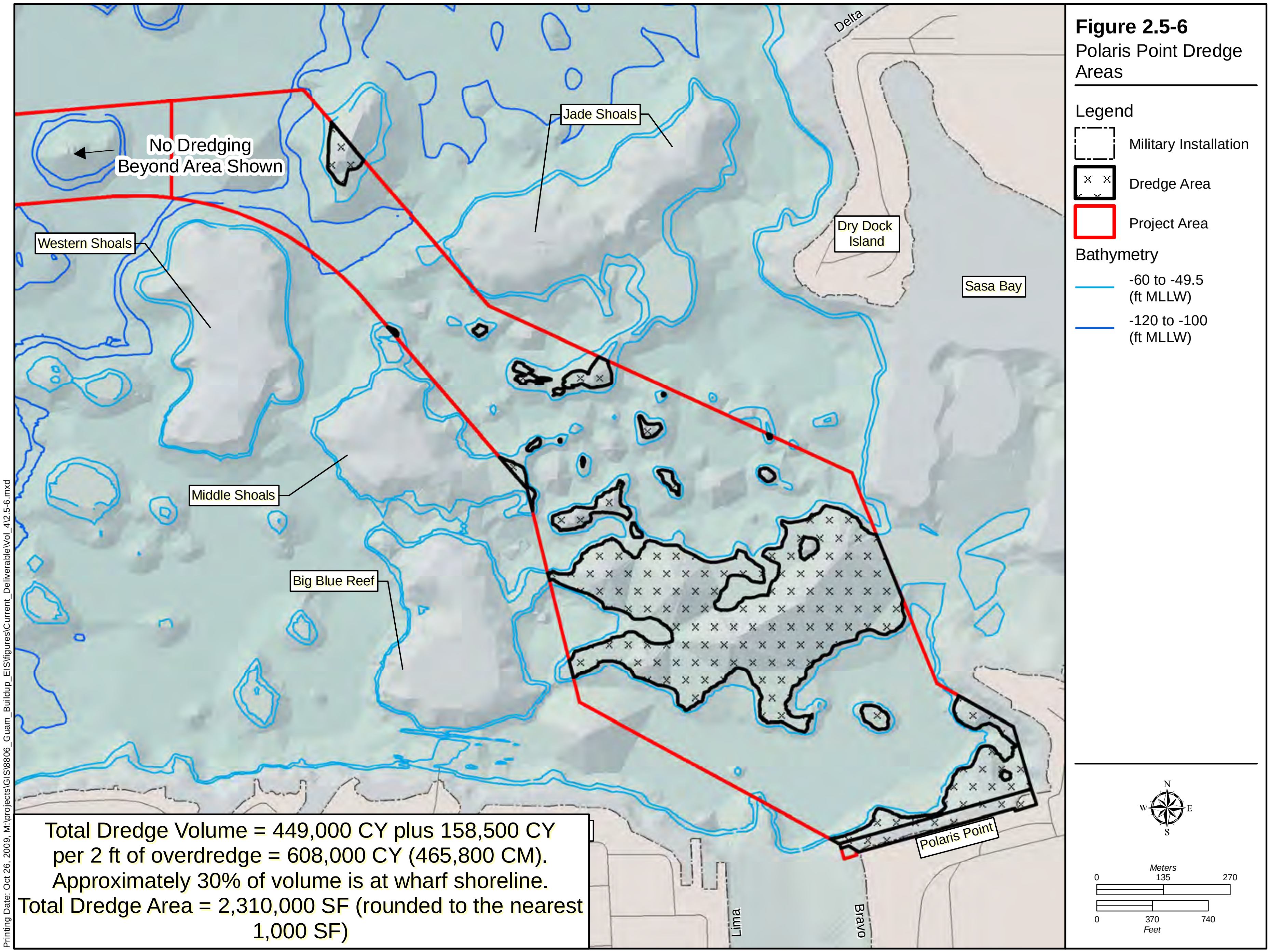


Figure 2.5-6
Polaris Point Dredge Areas
Legend
Military Installation
Dredge Area
Project Area
Bathymetry
-60 to -49.5 (ft MLLW)
-120 to -100 (ft MLLW)
No Dredging Beyond Area Shown
Jade Shoals
Western Shoals
Dry Dock Island
Sasa Bay
Middle Shoals
Big Blue Reef
Polaris Point
Delta
Lima
Bravo
Meters
0
135
270
370
740
Feet
N
S
E
W
Total Dredge Volume = 449,000 CY plus 158,500 CY per 2 ft of overdredge = 608,000 CY (465,800 CM). Approximately 30% of volume is at wharf shoreline. Total Dredge Area = 2,310,000 SF (rounded to the nearest 1,000 SF)
Printing Date: Oct 26, 2009, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_4\2.5-6.mxd

The thickness of the substrate to be dredged (from existing water depths to proposed water depths) is only 1.6 to 3.3 ft (0.5 to 1 m) throughout most of the project area. Dredging would therefore pass rapidly from site to site; a 75.5 by 75.5 ft (23 m by 23 m) grid area would require only a half day of dredging. The wharf area would require a longer dredging duration because there would be a greater volume of dredged material. Assuming two 4,000 cy (3,058 m^3) scows, there would be one to two barge trips per day to the ODMDS or an Inner Apra Harbor wharf for loading trucks and hauling to an upland placement site.

The required measures that are not project-specific are described in Volume 7. BMPs to avoid or minimize indirect impacts to nearby reefs would likely include installation and maintenance of silt curtains to contain the re-suspended material within the dredge area. The substrate may require chiseling to roughen the surface prior to dredging to allow the clamshell to grab hold of the material. No blasting would be required.

2.5.3.3 Equipment and Materials

The project would utilize specialized heavy equipment including a dredger and a large floating crane barge with pile driving equipment (if piles are specified in final design). Smaller equipment would include smaller cranes, concrete pumps, small barges, tugboats, and excavation equipment that is available locally. Smaller dredgers have been used historically in Apra Harbor, but the magnitude of this project would likely require imported equipment.

This project would utilize imported materials, including steel pipe piles and steel shapes, concrete forms, miscellaneous metals, fenders, bollards, steel reinforcing and cement for concrete, asphalt, and mechanical equipment and piping for steam, compressed air, and pure water. Some assembly of these items on Guam would be required. Local aggregates for concrete, road base, asphalt paving, and possibly armor rock may be used. All imported materials would come through either the local commercial port or be specially shipped by barge.

2.6 ALTERNATIVE 2: FORMER SRF

2.6.1 Operation

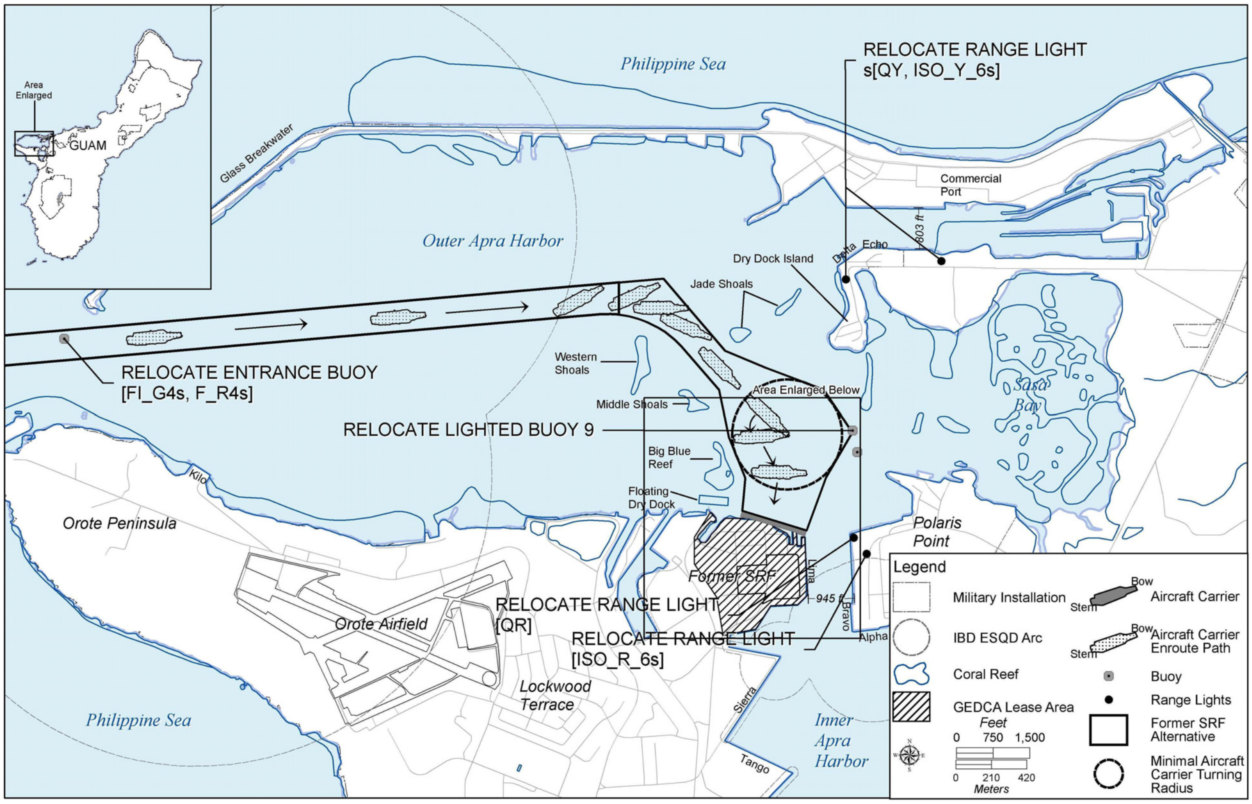
The Alternative 2 Former SRF (referred to as Alternative 2) project area and a 3-dimensional rendering are shown in Figure 2.6-1. The site plan is shown as Figure 2.6-2. As described in the alternatives considered and dismissed section, the channel would be 600 ft (183 m) in width and the alignment would follow the existing navigation channel fairway with a sharp bend between Jade and Western Shoals. The proposed route of the aircraft carrier through the harbor and to the wharf is depicted by ship icons in Figure 2.6-1. The carrier would be pivoted within the minimum radius turning basin to be aligned starboard side to the wharf and the bow would be facing east. Unlike at Alternative 1 (Polaris Point), the full 600 ft (183 m) approach distance in front of the wharf would be available. On departure, the aircraft carrier would follow the same route with assistance by tugboats. Operation would be as described for Alternative 1, except for the specifics identified in this section.

Access to the site is from existing primary (Marine Drive and Sumay Drive) and secondary roads (4th Street and Main Street) through Naval Base Guam and into the GEDCA lease area. The lease to GEDCA expires on October 1, 2012 and is currently being renewed by the Navy. No decision has been made at the present time in connection with the future reuse of the Former SRF lands to include a new lease for commercial ship repair facility purposes beyond the current 2012 lease expiration date. The proposed project construction would occur after the existing lease term expires. The lease area could be reduced and the proposed project area could be excluded from any new lease.

There would be some disruption of shipyard activities during wharf construction and aircraft carrier visits. Disruption from construction would be temporary and would be mitigated through scheduling of construction and ship repair visits. Disruption of shipyard activities during aircraft carrier visits would be minimized through scheduling with the shipyard and potentially mitigated through compensation for delays or lost work. When an aircraft carrier is in port, the dry dock (AFDB-8, Big Blue) could not be used for docking or undocking. Further, force protection requirements, including deployment of the floating port security barriers, would conflict with continued use of the dry dock at its present location. The effects of these limitations would be a restriction on commercial business opportunities at the commercial ship repair facility. Figure 2.6-1 and Figure 2.6-2 show the location of the dry dock.

2.6.1.1 Radiological Material Operation

Nuclear-powered aircraft carriers already visit Guam. No changes to current in-port operation are expected because of the anticipated longer visit times (21 days compared to 7 days). Minor regularly scheduled maintenance, or small emergent repairs, may occur while in port just as might happen today. If required, a routine transfer of radioactive waste packaged per Department of Transportation requirements would be conducted. Existing radiological response capability stationed at the Polaris Point Alpha and Bravo wharf area to support the homeported submarine squadron would continue to be available to support the aircraft carrier if needed, as occurs under existing conditions.



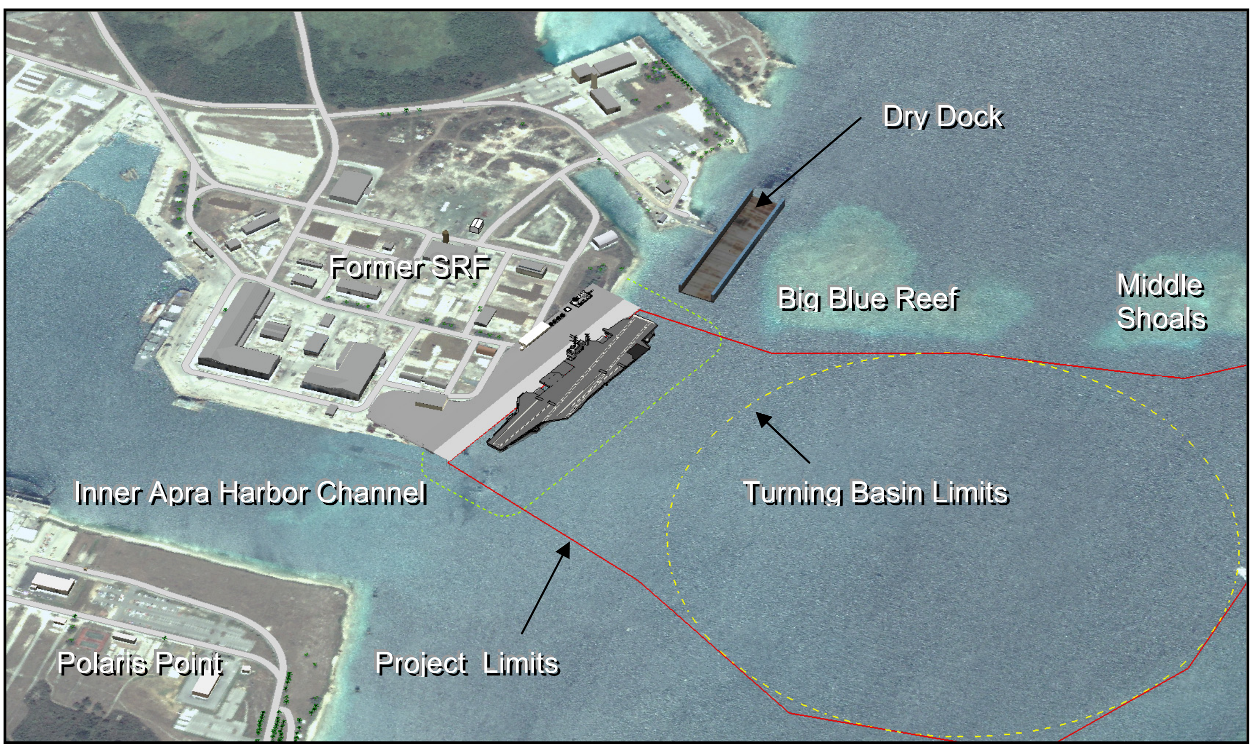


Figure 2.6-1
Alternative 2 – Former SRF

Source: NAVFAC Pacific 2008

Figure 2.6-2 Former SRF Alternative Site Plan

Source: NAVFAC Pacific 2008

2.6.2 Shoreside Structures

2.6.2.1 Design Standards

Design standards would be the same as described for Alternative 1 (Section 2.5).

2.6.2.2 Staging Area and Access

The Alternative 2 location would provide an approximate 6 ac (2.4 ha) staging area adjacent to the back of the wharf (see Figure 2.6-2). The staging area would be sloped landward at 1%, the same as the wharf deck. The entire area would be paved with asphalt concrete over a crushed aggregate base. All underground utilities and storm drains, building, and light standard foundations would be installed prior to paving. The Port Operations Support Building would be at the eastern end of the wharf near Lima Wharf.

Security/Biosecurity

Security

Security measures would be similar to that of Alternative 1, Polaris Point, , in that the location is within an active military base with the full complement of protective measures. Site specific requirements would be similar to Polaris Point. Watch towers would be located just behind and at either end of the wharf.

Biosecurity

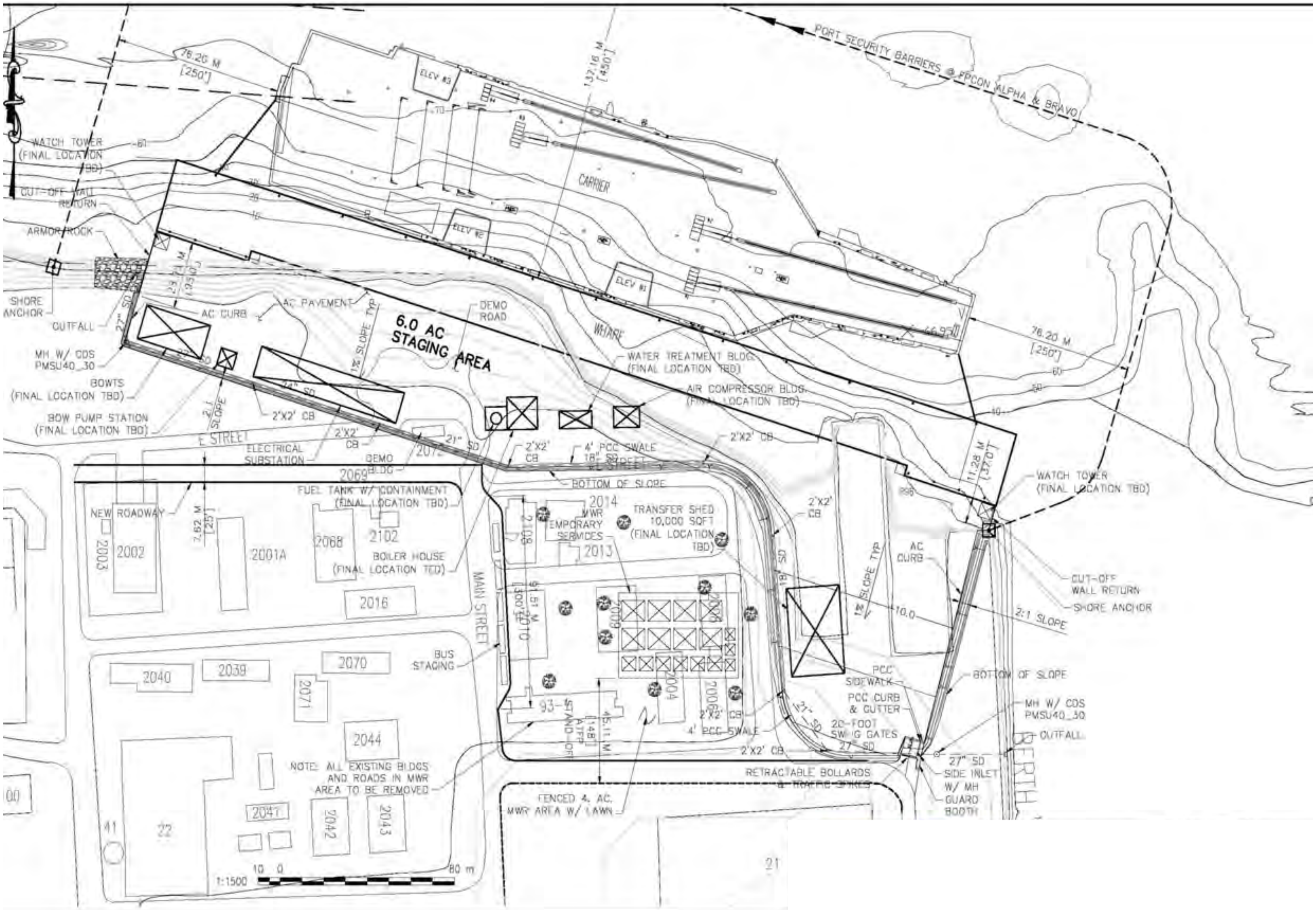
A MBP is being developed to address potential invasive species impacts associated with this EIS as well as to provide a plan for a comprehensive regional approach. The MBP will include risk assessments for invasive species throughout Micronesia and procedures to avoid, minimize, and mitigate these risks. It is being developed in conjunction with experts within other Federal agencies including the National Invasive Species Council (NISC), U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS), the US. Geological Survey (USGS), and the Smithsonian Environmental Research Center (SERC). The plan is intended to be a comprehensive evaluation of risks in the region, including all Marine Corps and Navy actions on Guam and Tinian and specifically those being proposed in this EIS. It will include brown treesnake (BTS) control measures to prevent BTS movement off Guam and management within Guam. The Navy will implement applicable DoD portions of the plan and would collaborate with other government agencies and groups on full implementation of the plan throughout the region. Because some actions proposed in this EIS will occur prior to finalizing the MBP, interim measures are also proposed in this EIS to address invasive species that will supplement existing practices. For additional information on the MBP and existing and interim measures for invasive species control, please refer to Volume 2, Chapter 10, Section 10.2.2.6.

Biosecurity requirements would be the same as those described for Alternative 1, but because the area is a previously developed industrial area and does not contain forest or secondary growth, the habitat is less favorable for snakes or other non-native species.

MWR

The Navy MWR area for supporting aircraft carrier activities would be situated on a 4 ac (1.6 ha) lot to the west of the access control point for the staging area (Figure 2.6-2 and Figure 2.6-3). There are nine existing structures totaling about 36,500 ft^2 (3,391 m^2) that would have to be razed and about 43,900 ft^2 (4,078 m^2) of roadway servicing the buildings removed. Relocation of existing shipyard capabilities at these locations would be required. Subsequently, the area would be graded and landscaped for lawn and trees. The lawn may be supported by a permanent irrigation system. A 3-in (7.6 cm) thick asphalt lot

Figure 2.6-3 Former SRF Improvements



Source: NAVFAC Pacific 2008

about 0.5 ac (0.2 ha) in size would be constructed for locating temporary facilities such as food and beverage booths, seating areas, parking and lighting.

The MWR area would require utility connections. The area would be enclosed by a 900-ft long (274-m long) chain link fence, and would have multiple locking swing gate entry points. One of the gates would have a permanent turnstile and guard shack. Additional parking for five buses would be provided in a 10-ft wide by 300-ft long (3-m wide by 91-m long) turnout on the east side of Main Street. Bicycles would be made available at the MWR area.

Aids to Navigation

Aids to navigation modifications would be as described for Alternative 1, with the exception that range lights at Polaris Point, while requiring relocation, would not have to be raised, and the mooring buoy would not have to be relocated (see Figure 2.6-1).

2.6.2.3 Utilities

Refer to the engineering drawings included in the *CVN-Capable Berthing Study* (NAVFAC Pacific 2008) for details on existing conditions. Table 2.5-1 and Table 2.5-2 summarize the utility requirements.

Steam, Compressed Air and Pure Water

Although there is a possibility of re-using the existing steam plant at the Former SRF, the cost for a new system and the upgrades are comparable. Therefore, a new system as proposed for Polaris Point is proposed for Alternative 2.

There would be no differences in terms of the pure water systems between this alternative and Alternative 1, with the exception of pipe lengths from the wharf structure and water source to the pure water production plants, compressed air production plants, and steam production plant.

BOWTS

The new BOWTS would be sized to accommodate the ultimate requirements of the CVN 78, i.e., a pumping rate of 90 gpm (341 lpm) with an average flow rate of 38,000 gpd (143,845 lpd) and a peak flow rate of 82,000 gpd (310,403 lpd).

The existing BOWTS at Apra Harbor Naval Complex is inadequate to handle the aircraft carrier BOWTS requirements of either a CVN 68 or CVN 78 for a 21 day duration visit. There is no BOWTS at the Former SRF. Mobile BOWTS units are available at the Former SFR; however, these units are typically small and would not be able to process the amount of BOW generated by a carrier. Therefore, a new BOW collection and treatment system would be constructed near the location of the proposed berth. The BOWTS would consist of a combined gravity and force main collection system, a BOW pump station, and a treatment system.

Wastewater

For the proposed berthing at the Alternative 2 location, a separate and dedicated wastewater collection system sized to handle only the aircraft carrier loadings would be required because this alternative provides for the wharf to be located adjacent to a commercial industrial area and segregation of wastewater would be necessary. This dedicated system would be designed and constructed solely within military property and would include the construction of three new submersible type sewage pump stations and 6,700 linear ft (2,042 m) of associated force mains. In addition to the pressurized systems, approximately 4,420 linear ft (1,347 m) of new gravity sewers are required; of that, 2,720 linear ft (829 m) of 15-in, 18-in, and 24-in (0.38 m, 0.46 m, 0.61 m, respectively) relief sewer lines are proposed along

Marine Corps Drive to increase the capacity of the existing sewer trunkline "A" for the aircraft carrier berthing. As with Alternative 1, the sewage line would terminate at the military AHWWTP, and improvements as described for Alternative 1 would be required. Regarding the makeup of the wastewater generated from the aircraft carrier for Alternative 2, the composition of the wastewater is primarily domestic but in a more concentrated form than residential wastewater. The transfer of the wastewater from the aircraft carrier to the landside lift station would occur as described for Alternative 1 in Section 2.5. These upgrades would follow existing rights of way and utility lines that currently parallel Marine Corps Drive. Standard construction practices would be utilized to ensure that existing lines are not disrupted.

Potable Water

The potable water supply would be connected to the southern Navy water system, which receives its surface water supply from Fena Reservoir. Potable water demand for the aircraft carrier would have no impact on the NGLA.

Potable water is supplied to the Alternative 2 site from the Apra Heights Tank system. In addition to the Alternative 2 site, the Apra Heights Tank supplies water to most of the Apra Harbor Naval Complex. Based on the water demands of the service area and the maximum fire flow requirements, the storage capacity of the tank was evaluated based on criteria provided in UFC 3-230-19N (*Water Supply Systems*). The storage capacity required for all users served by the Apra Heights Tank, including the proposed water demand of a CVN 78, was calculated to be 2.6 mg (9.8 ml). The Apra Heights Tank has a capacity of 5.0 mg (18.9 ml). Therefore, no improvements are required for the Apra Heights Tank for the berthing of either a CVN 68 or CVN 78 at the Alternative 2 site.

Approximately 1,200 linear ft (366 m) of 10-in (0.25 m) water line along the entrance road to the Alternative 2 site would be replaced with a 12-in (0.30 m) water line under project P-494 (an Environmental Assessment [EA] and Finding of No Significant Impact [FONSI] have been completed). In addition to this project, approximately 2,200 linear ft (671 m) of 16-in (0.41 m) water line along Sumay Drive is currently being replaced with an 18-in (0.46 m) main. These improvements were incorporated in the water system model used to evaluate the capacity of the existing potable water system. The results of the model indicate that more than 1,000 gpm (3,785 lpm) can be provided at pressures exceeding 40 psi to the berthing site at the Alternative 2 site. Therefore, no major water system improvements would be required for this option. Water system improvements would be limited to the construction of a new 8-in (0.20 m) service lateral to the berthing site and the associated pier side water outlets.

The potable water system improvements required to support the aircraft carrier would be located along and adjacent to the proposed berthing location. The pier side water lines and outlets would be constructed concurrently with the wharf site work. Construction scheduling of the supply lateral to the wharf would be coordinated with other adjacent site improvements. The potable water system would be used for and has sufficient capacity for fire fighting.

Electrical Power Distribution and Communications System

A programmed construction project (P-494) would construct a new SRF Substation to support planned waterfront upgrades for Sierra, Romeo, and Uniform Wharves and existing SRF loads. The SRF Substation would be fed from the new Orote Substation with two 34.5 kV circuits, each with conductors capable of roughly 25 mega volt amperes (MVA), but with duct capacity that would enable doubling the capacity of each circuit.

The scope of P-494 does not include providing the capacity to accommodate the aircraft carrier without additional circuits and 34.5 kV switchgear additions. As discussed in section 2.2.1, it is anticipated that a transient aircraft carrier and its escort ships would rely on shoreside utility infrastructure for water, wastewater, and solid waste after 2015. Electric power would be provided in accordance with customer service agreements between Guam Power Authority (GPA) and the U.S. Navy. Any GPA commitments for additional power to support the aircraft carrier and its escort ships will be determined by future CSA modifications. Any changes in the shoreside power requirements for the aircraft carrier and its escort ships may require additional NEPA review.

Proposed improvements under Alternative 2 include:

- Provide a new circuit breaker in the GPA Piti 34.5 kV Switching Station (by GPA)
- Upgrade existing GPA 34.5 kV Overhead Feeder Circuit X20 between Piti 34.5 kV Switching Station and Orote
- Provide a new underground, concrete encased, 34.5 kV feeder circuit from the GPA Piti 34.5 kV Switching Station to Orote Substation
- Provide additions to the Orote Substation 34.5 kV switchgear
- Provide a new aircraft carrier berth substation
- Provide one underground, concrete-encased, 34.5 kV express feeder circuit from the SRF Substation to the aircraft carrier SRF berth substation
- Provide wharf operational and security lighting using high-mast steel poles with metal-halide luminaries

<u>Stormwater</u>

Initial designs indicate that a concrete swale to collect surface flow would run east to west along the perimeter of the pad on the east side and would subdivide the pad on the west side. Flows captured in catch basins would be conveyed through two separate concrete storm drain pipe systems. Following the last catch basin and before discharge, the stormwater would be treated in each system by inline cyclonic separators to remove oil, grease, and trash. The separators would collect and retain the undesirable material for the first 0.5 in (12.7 mm) of rainfall that occurs. Greater flows would bypass the separator. Discharge from the separators would be to an outfall to Outer Apra Harbor and at the channel connecting the Outer and Inner Harbors. Volume 4, Chapter 4 contains more information on potential impacts from stormwater.

<u>Solid and Hazardous Waste</u>

As described for Polaris Point, solid waste storage bins are typically provided in the aircraft carrier compound and near the MWR activity area, as needed. Solid waste would be handled and managed in accordance with Navy standard operating procedures and would be disposed of at the Navy landfill as long as it meets all criteria for disposal in the landfill.

A ship-board hazardous regulated waste holding area is typically designated at the wharf. The hazardous waste would be managed in accordance with Navy standard operating procedures and the Navy RCRA permit would be modified to accommodate the increased volumes of waste. Volume 4, Chapter 17 contains a description of the types and quantities of hazardous waste that would be generated from the proposed action.

2.6.3 Construction

2.6.3.1 Alternative 2 - Specific

The wharf plan for Alternative 2 is shown on Figure 2.6-4. Site preparation would require the grubbing and removal of all ground cover for construction of the staging area. This would include the demolition and removal of a minor building (approximately 700 ft^2 [65 m^2]) and the removal of about 3,400 ft^2 (316 m^2) of the end of the inner finger pier.

Surveys of these buildings have been conducted for asbestos-containing material, lead-based paint, and PCB-containing electrical equipment. Demolition and recovery of these types of materials, if present, would be conducted in accordance with Navy procedures and applicable laws.

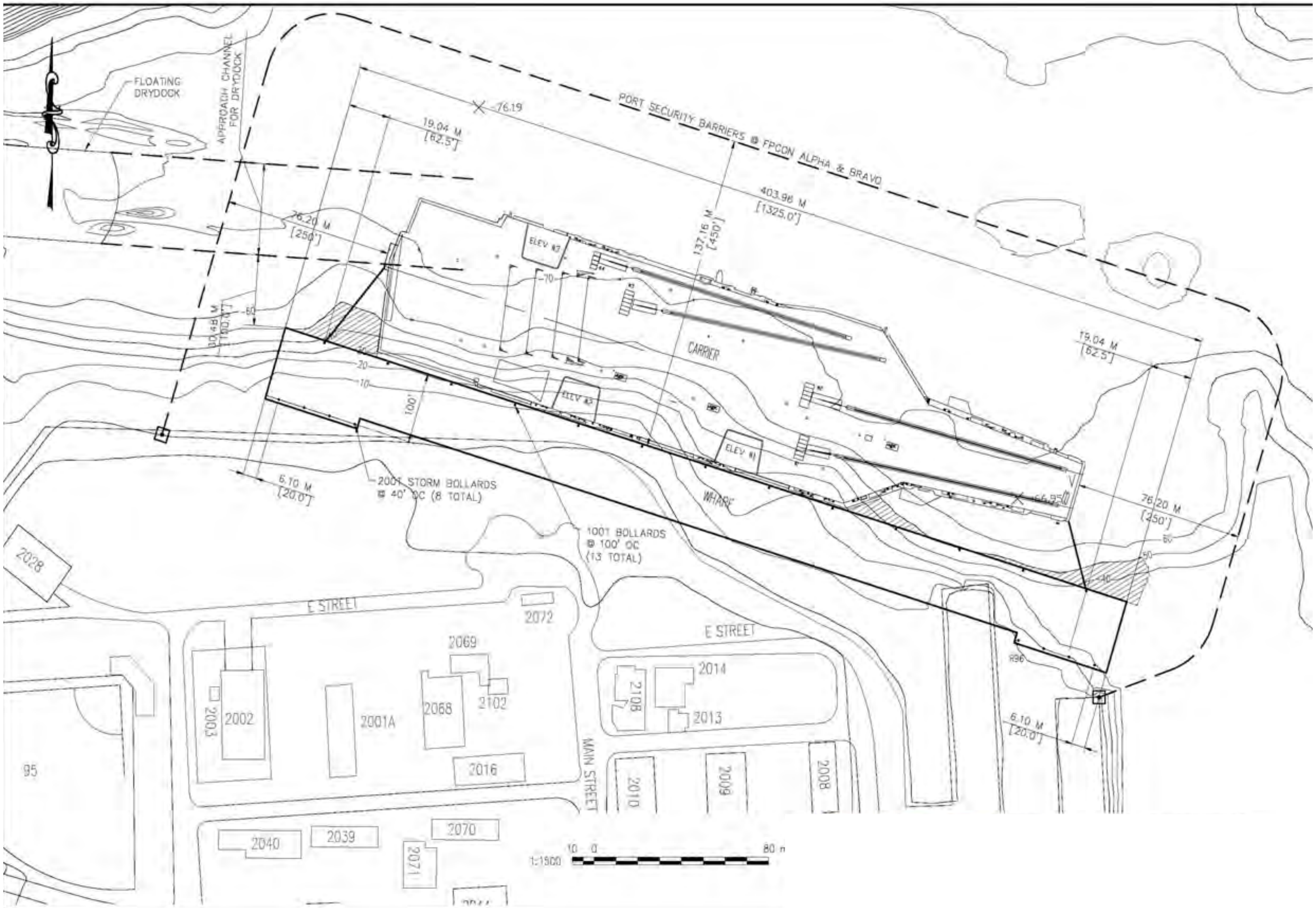
There would be some minor roadway removal around the demolished building and re-alignment of some utility lines along E Street near the demolished building location. The pavement over the finger piers would be pulverized and left in place. The soil in the other areas would be scarified and re-compacted to prevent differential settlement before the fill material is placed. The water areas between the slips would be filled and the entire site would be raised to the required grade using reclaimed dredged materials. Soil improvement methods may need to be utilized to consolidate the various soil fills to prevent liquefaction.

The project dredging would be limited to an area near the channel bend, portions of the turning basin and areas under the wharf structure. Figure 2.6-5 shows the specific areas that would require dredging (areas less than -49.5 ft [-15 m] MLLW) within the project area, that represent the outer limits of the proposed dredging activity. The minimum turning basin radius to allow the aircraft carrier to be safely maneuvered within Navy operational and navigational constraints is shown on Figure 2.6-1. The total dredge volume would be 479,000 cy (366,222 m^3) including 2 ft (0.6 m) overdredge and approximately 30% of that would be generated at the shoreline area of Alternative 2 to provide an appropriate slope for the wharf structure. The anticipated dredging production rate is as described for Alternative 1: 75 cy/hour (57 m^3/hour) based on recent mechanical dredging of similar substrate. The total dredge area would be approximately 44.3 ac (17.9 ha). At this rate total production per day would be approximately 1,800 cy (1,376 m^3). Throughout most of the project area the depth to be dredged is less than 1 ft (0.3 m) and the dredging would proceed quickly at an estimated rate of 22,777 ft^2 (2,116 m^2) per day in the turning basin and the channel. The wharf area would require a longer dredging duration because there would be greater depths of dredging (excavation) required, creating a higher volume of dredged material.

2.6.3.2 Construction Common to Both Action Alternatives

The dredging equipment and materials required for Alternative 2 would be the same as those described for Alternative 1 (refer to Section 2.5.3.2).

Figure 2.6-4
Former SRF Wharf-Plan View



Source: NAVFAC Pacific 2008

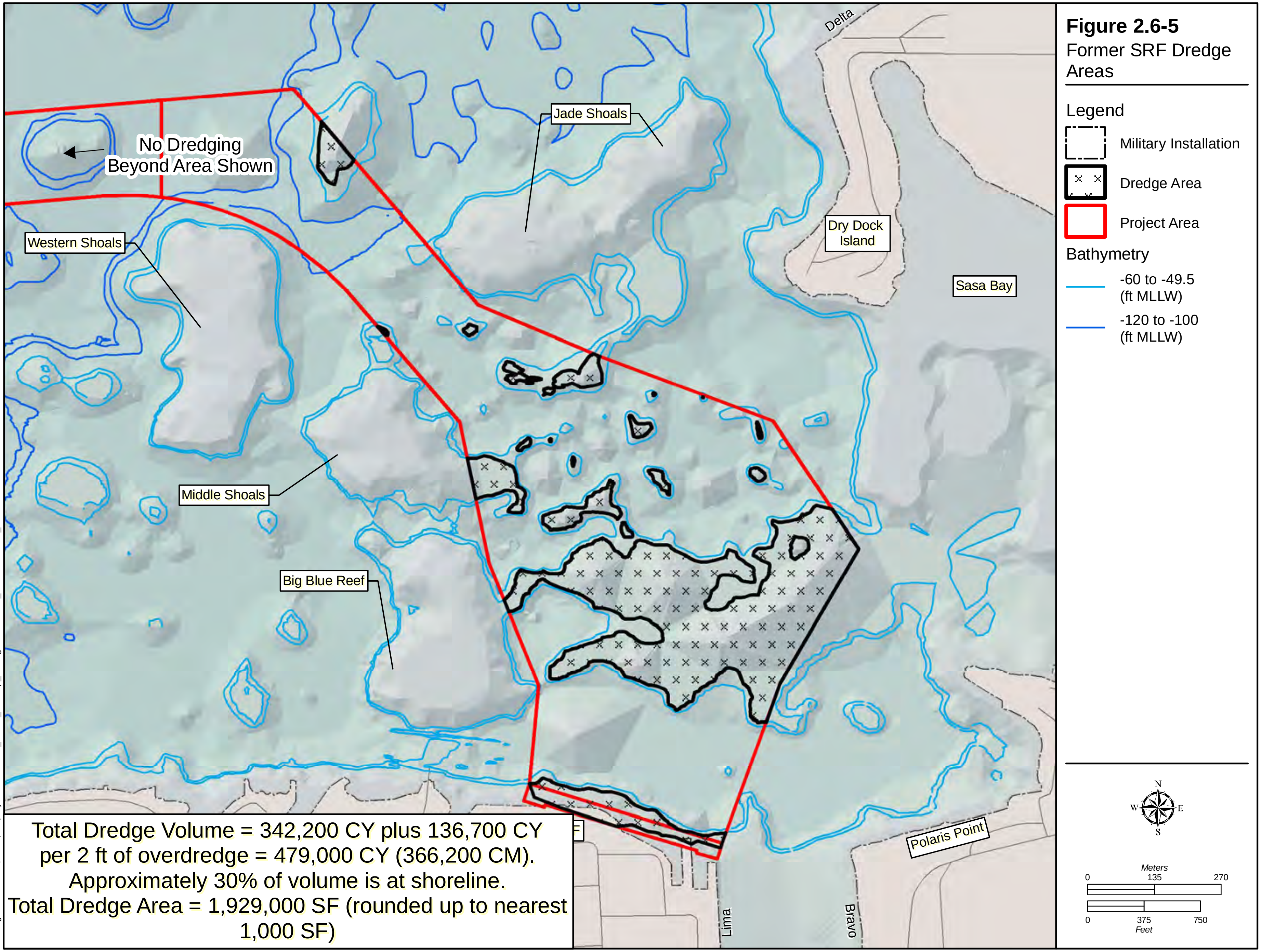


Figure 2.6-5
Former SRF Dredge Areas

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2.7 NO-ACTION ALTERNATIVE

Under the no-action alternative there would be no wharf, deep water channel access or associated facility construction to support the aircraft carrier extended visits in Apra Harbor. No dredging would be required.

Under the no-action alternative the transient aircraft carrier visits could not be accommodated and the projected level of port visits for ammunition ships would be reduced due to increased ammunitions ship operations.

The no-action alternative would not meet the purpose of and need for the proposed action. It would not support the QDR goal of an increased aircraft carrier presence in the Western Pacific. Although this alternative is not considered a feasible alternative, it is carried forward for analysis in the EIS to serve as a baseline comparison to the two action alternatives.

Chapter 2:

CHAPTER 3.
GEOLOGICAL AND SOIL RESOURCES

3.1 INTRODUCTION

This chapter describes the potential environmental consequences to geological and soil resources associated with implementation of the alternatives within the region of influence (ROI), i.e., areas that could be affected by construction or operation of facilities associated with transient berthing of an aircraft carrier. For a description of the affected environment for all resources, refer to the respective chapters of Volume 2 (Marine Corps Relocation – Guam). The locations described in that Volume include the ROI for the aircraft carrier berthing component of the proposed action and the chapters are presented in the same order as in this Volume.

3.2 ENVIRONMENTAL CONSEQUENCES

3.2.1 Approach to Analysis

3.2.1.1 Methodology

The methodology for identifying, evaluating, and mitigating impacts to geology and soil resources was established through review of reports of relevant geologic and soils studies, federal laws and regulations, local building codes and grading ordinances, and Navy guidance documents. The impact analyses in this chapter are presented by alternative and geographic area as described in the affected environment sections in Volume 2. Geology and soils conditions may also constrain the placement of a facility or location of a land use; where such constraints occur, they are discussed below.

Analysis of topography, soil, and vegetation was completed during site characterization using LIDAR Contour Data, geotechnical reports, and site visits to ensure minimal impacts to geologic and soil resources.

Activities associated with construction and operation of facilities for the transient aircraft carrier berthing, their potential effects on geologic and soils resources, and potential constraints to facilities siting resulting from geologic or soils conditions are as follows:

Construction

- Cut and fill activities leading to soil erosion
- Removal of vegetation, landscaping and/or existing facilities leading to soil erosion
- Use of heavy equipment resulting in soil compaction
- Creation of impervious surfaces resulting in increased runoff and soil erosion

Operation

- Vehicle movements on unpaved surfaces resulting in increased soil erosion and compaction
- Potential damage from soil liquefaction, landslides, or tsunamis, which constrain facilities siting

The potential effects of these activities or constraints and their significance within the ROI under the alternatives are described below. The analysis of potential impacts to geology and soils identifies direct and indirect impacts. Direct impacts are those that may occur during the construction phase of the project and result in physical soil disturbance. Such disturbance may cause increased erosion, compaction, and loss of productive soil. Potential direct impacts of construction include stormwater discharges that contain elevated sediment concentrations that may increase pollutant loading into surface waters.

Indirect impacts are those that result from the completed project, such as the leaching of contaminants into soils. For non-training activities, indirect impacts include stormwater discharges that contain elevated sediment concentrations that may increase pollutant loading into surface waters. Potential soil contamination issues are addressed in Chapter 17, Hazardous Materials and Waste.

Indirect groundwater impacts associated with construction and operational activities include contamination of groundwater resources through percolation of surface runoff. Direct spills and leaks as well as stormwater runoff can contribute to groundwater contamination. Increased soil erosion also may indirectly impact water quality and aquatic ecosystems. Potential impacts to these resources are described in Chapter 4, Water Resources; Chapter 10, Terrestrial Biological Resources; and Chapter 11, Marine Biological Resources.

Applicable Regulatory Standards

The U.S. Environmental Protection Agency (USEPA) Region 9 grants the Guam Environmental Protection Agency (GEPA) the authority to enforce portions of federal statutes via a Memorandum of Agreement. Under this agreement, the Safe Drinking Water Program, Water Resources Management Program, and the Water Pollution Control Program (WPCP) are administered by GEPA. The GEPA WPCP is responsible for protecting Guam's resources from point and non-point source pollution, including administration of the National Pollutant Discharge Elimination System (NPDES) program. NPDES permits are required for large and small construction activities. Requirements include a Notice of Intent, a Notice of Termination and a construction site Storm Water Pollution Prevention Plan (SWPPP). Permits are required for projects that disturb greater than 1 acre (ac) (0.4 hectares [ha]) of soil, including lay-down, ingress and egress areas. Phase I regulates construction activities disturbing 5 ac (2 ha) or more of total land area and Phase II regulates small construction activities disturbing between 1 and 5 ac (0.4 and 2 ha) of total land area.

An Environmental Protection Plan (EPP) is required for all projects at the discretion of the GEPA Administrator. EPPs are specifically identified in 22 Guam Annotated Regulations, Division II, Chapter 10, Section 10103.C.5(d). EPPs shall include nonpoint source control measures including erosion and sedimentation control; vegetation, wildlife and coral/marine resource protection measures; fugitive dust control; solid and hazardous waste management and disposal procedures; nutrient management plan; integrated pest management strategy/plan; confined animal facilities management plan; irrigation water management plan; personnel safety procedures; work site maintenance and typhoon contingency plans; as necessary, depending on the work, project, activity and facility function.

Seismic, liquefaction, and ground shaking are reduced by following Unified Facility Code (UFC) 3-31-04, that provides the Department of Defense (DoD) requirements for:

- Earthquake-resistant design for new buildings
- Evaluating and rehabilitating existing buildings for earthquake resistance
- Guidance on applying seismic design principles to specialized structural and non-structural elements

The new UFC adopts the seismic design provisions of the 2003 *International Building Code* for use in DoD building design.

3.2.1.2 Determination of Significance

For geology and soils, the significance of impacts is determined by subjective criteria, as well as by regulatory standards. A significant impact may result from any of the following:

- Increased rate of erosion and soil loss from physical disturbance including removal of vegetation
- Reduced amounts of productive soils
- Alteration of surrounding landscape and effect on important geologic features (including soil or rock removal and filling of sinkholes that would adversely affect site drainage)
- Diminished slope stability
- Increased vulnerability to a geologic hazard (e.g., seismic activity, tsunami, liquefaction), and the probability that such an event could result in injury

3.2.1.3 Issues Identified during Public Scoping Process

The following analysis focuses on potential effects to geology and soils that would arise from the proposed action. As part of the analysis, concerns relating to geology and soils that were identified during scoping meetings by the public, including regulatory stakeholders, were addressed. These included:

- Implementing erosion control measures for construction and post-construction phases
- Ensuring that proper permitting and local government clearances are sought where applicable

3.2.2 Alternative 1 Polaris Point (Preferred Alternative)

3.2.2.1 Onshore

Onshore activities associated with Alternative 1, Polaris Point (referred to as Alternative 1) include construction of a wharf and staging area with ground disturbance of approximately 5.8 ac (2.3 ha), a Morale, Welfare, and Recreation (MWR) area of 2.4 ac (1.0 ha), security structures including a 50 ft (15.2 m) watch tower and fencing, and various buildings including a Port Operations Support Building, substation, water treatment facility, and a pump station. As part of the project, four existing structures (Buildings 4407, 4408, 4409, and an existing guard tower) would be demolished. A 300 ft (91 m) roadway would be demolished and replaced with a new access road to connect Polaris Point Drive to the staging area. Underground utilities would be constructed in existing utility corridors except in the vicinity of the wharf where extensions from nearby utility systems would be constructed.

There would be the potential for an increased rate of erosion, compaction, and soil loss from the physical disturbance of construction activities. Soil erosion is primarily a concern for discharge into surface or nearshore waters. The erosion potential of soil types found in the proposed action is found in Table 3.2-1.

Table 3.2-1. Erosion Potential at Apra Harbor

Soil Type	*Location*	*Erosion Potential*
Ritidian Rock Outcrop at 3-15% slope	Orote	slight
Urban Land Coastal Fill at 0% slope	Orote	slight

Source: Young 1988.

The construction Standard Operating Procedures (SOPs) would include requirements for stormwater compliance with stormwater best management practices (BMPs), including a SWPPP to ensure that all aspects of project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7. Implementation of these measures such as silt fences and hay bales would prevent erosion and limit sediment runoff in stormwater; thus, there would be minimal impacts from soil erosion and stormwater runoff. A more detailed explanation of regulatory permitting requirements is available in Volume 8.

Soil types potentially lost are not agriculturally productive. Topography or landscape features would not be changed substantially by the proposed action.

Apra Harbor is located in a potentially active seismic zone. Hazards associated with earthquakes, fault rupture, and slope instability would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The developments proposed as Alternative 1 would be located on a relatively flat area that would not be subject to slope instability. The underlying fill at Apra Harbor is vulnerable to liquefaction. Alternative 1 would result in less than significant impacts associated with geologic hazards.

<u>Construction</u>

Apra Harbor

Alternative 1 would disturb soil during construction at Apra Harbor. There is a risk of an increased rate of erosion, compaction, and soil loss from the physical disturbance caused by construction activity. Erosion potential for soils found at Apra Harbor is shown in Table 3.2-1.

To reduce the potential for significant impacts during construction of Alternative 1, the following soil conservation and management procedures would be followed:

- Soil piles and exposed slopes would be covered during times of inclement weather.
- Revegetation would occur as soon as possible after any ground disturbance or grading.
- Construction and grading would be minimized during times of inclement weather.

The construction SOP would include requirements for stormwater compliance, with BMPs to ensure that all aspects of project construction would be performed in a manner to minimize soil loss impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7. Implementation of measures such as silt fences and hay bales would prevent erosion; thus, there would be minimal impacts from soil erosion. A more detailed explanation of regulatory permitting requirements is available in Volume 8. Indirect impacts to geological resources, water resources, and marine biological resources from soil erosion would be prevented by implementation of BMPs.

As stated in Volume 2, there are no sinkholes in the project vicinity. Therefore, Alternative 1 would result in less than significant impacts to a unique geologic resource.

Apra Harbor is located in a potentially active seismic zone. Hazards associated with earthquakes, fault rupture, and liquefaction would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The developments proposed as Alternative 1 would be located on a relatively flat area that would not be subject to slope instability. The high risk of liquefaction at Apra Harbor requires a geotechnical survey prior to construction. Wherever possible, liquefiable soils would be replaced with properly compacted fill soils as recommended in the site-specific geotechnical report. UFC 3-310-04 Seismic Design for Buildings (USACE 2007) would be followed to minimize structural hazards associated with ground shaking.

Alternative 1 would result in less than significant impacts associated with geologic hazards.

Naval Base Guam

The feasible upland placement sites for dredged materials and resulting potential geological impacts are described for the Inner Apra Harbor dredging in Volume 2, Chapter 3 of this EIS. The upland placement sites are considered temporary (3 to 4 years). The sites are all vacant lands and would be developed with bermed perimeters approximately 16 to 30 ft (5 to 9 m) in height. When the material is dry it can be reused by the receiver, resulting in a beneficial impact to geological and soil resources, or stockpiled.

Soil types disturbed would not be agriculturally productive. Construction SOPs and a SWPPP (required by the NPDES permit) would be followed to minimize soil erosion. Therefore, Alternative 1 would result in less than significant impacts to unique geologic resources and would not result in significant soil erosion, compaction, or loss of agriculturally productive soil.

The construction SOPs would include requirements for stormwater compliance and BMPs to ensure that all aspects of project construction would be performed in a manner to minimize impacts during construction activity. A description of the standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7. Implementation of these measures would prevent erosion; thus, there would be minimal impacts from soil erosion. A more detailed explanation of regulatory permitting requirements may also be available in Volume 8. Indirect impacts to geological resources, water resources, and marine biological resources from soil erosion would be prevented by implementation of BMPs.

There are no known sinkholes in the vicinity of any of the proposed projects. Therefore, Alternative 1 would result in less than significant impacts to a unique geologic resource.

Naval Base Guam is located in a potentially active seismic zone. Hazards associated with earthquakes, fault rupture, and liquefaction would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The developments proposed as Alternative 1 would be located on a relatively flat area that would not be subject to slope instability. The underlying fill at Naval Base Guam is vulnerable to liquefaction. The high risk of liquefaction at Naval Base Guam requires a geotechnical survey prior to construction. Wherever possible, liquefiable soils would be replaced with properly compacted fill soils as recommended in the site-specific geotechnical report. UFC 3-310-04 Seismic Design for Buildings (USACE 2007) would be followed to minimize structural hazards associated with ground shaking. Alternative 1 would result in less than significant impacts associated with geologic hazards.

<u>Operation</u>

Apra Harbor

Operations under Alternative 1 would result in less than significant impacts to unique geologic resources and would not result in significant soil erosion or compaction or loss of agriculturally productive soil.

In addition to SOPs to account for the high potential for liquefaction, appropriate construction planning measures to address geological constraints to land use and facilities siting as discussed above would be implemented. Because Apra Harbor is located in a potentially active seismic zone, potential structural damage or injuries during operations from seismic ground shaking and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The developments proposed as Alternative 1 would be located on a relatively flat area that would not be subject to slope instability. Indirect impacts to geological resources, water resources, and marine biological resources from soil erosion would be prevented by implementation of BMPs. Alternative 1 would result in less than significant impacts associated with geologic hazards.

Naval Base Guam

Operations under Alternative 1 would result in less than significant impacts to unique geologic resources and would not result in significant soil erosion, compaction, or loss of agriculturally productive soil.

Because Naval Base Guam is located in a potentially active seismic zone, potential structural damage or injuries during operations from seismic ground shaking and fault rupture would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The Alternative 1 proposed developments would be located on a relatively flat area that would not be subject to slope instability. Indirect impacts to geological resources, water resources, and marine biological resources from soil erosion would be prevented by implementation of BMPs. Alternative 1 would result in less than significant impacts associated with geologic hazards.

3.2.2.2 Offshore

Construction

Offshore construction activities associated with Alternative 1 include dredging of the berthing area, the turning basin, and the channel bend; construction of a wharf at Polaris Point; and the operations associated with berthing of the aircraft carrier. Approximately 30% of the dredged volume would be removed from the shoreline area, as excavation would be required to achieve the appropriate slope for wharf construction. Dredged materials would be stored at upland sites whenever possible and reused as fill for Guam Military Relocation projects or other beneficial reuse purposes. Direct impacts to benthic habitats and their organisms would result from the proposed dredging activities, as discussed in Chapter 11, Marine Biological Resources. The underwater topography would change because dredging of coral within the turning basin area would remove underwater structural relief. Areas that are dredged would change from coral cover to sand, with the exception of the area near the shoreline of Polaris Point, which is mostly silty clay. Chapter 11, Marine Biological Resources, describes impacts from these disturbances to marine flora and fauna in greater detail.

The conditions of the applicable U.S. Army Corps of Engineers (USACE) dredging permits would include measures to minimize effects of dredging, including the use of silt curtains. Dredging activities are a concern for water resources and are addressed under Chapter 4, Water Resources, in this Volume.

Dredged material is required by the USEPA to first be considered for beneficial reuse. Whenever possible, dredged material would be reused (see Chapter 2 of this Volume for a description of potential beneficial reuse projects). In the event that some or all of the dredged material is not fit for reuse, the proposed USEPA Ocean Dredged Material Disposal Site (ODMDS) was evaluated for geological impacts as described in the project–specific ODMDS EIS (USEPA 2010). Briefly summarized, the impact assessment analysis concluded that the geological impacts would be significant if the disposal of dredged material would: 1) alter the regional and site-specific bathymetry, 2) interfere with or change sediment transport processes, or 3) alter the existing characteristics of the seafloor (e.g., change the substrate from predominantly silty sand to gravel). The analysis was based on sediment analysis and sediment transport modeling; the conclusion was that impacts to regional geology would be minor. Indirect impacts to geological resources, water resources, and marine biological resources from soil erosion would be prevented by implementation of BMPs.

Offshore construction activities would have minimal impacts to geologic and soil resources.

Operation

Offshore operations associated with the transit and berthing of the aircraft carrier and related ship movements (tugs) under Alternative 1 would not disturb or change geology or soils, thus there would be no impact to resources.

3.2.2.3 Summary of Alternative 1 Impacts

Table 3.2-2 summarizes construction and operation impacts from Alternative 1.

Table 3.2-2. Summary of Alternative 1 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	• Alternative 1 would result in minimal impacts to topography by changing the landscape at Apra Harbor. • Soil disturbances and loss of vegetation could cause increased rates of erosion and soil loss from physical disturbance in all proposed construction areas under Alternative 1. Minimal impacts would occur with the use of BMPs. • Soil types impacted would not be agriculturally productive; thus, minimal impacts to soil resources would occur. • Adherence to UFC 3-310-04 Seismic Design for Buildings would reduce risk of damage to structures from seismic hazards.
	Operation	Adherence to UFC 3-310-04 Seismic Design for Buildings during construction would reduce risk of damage to structures and subsequent injuries from seismic hazards that could potentially impact operation. Minimal impacts would occur due to geologic hazards.
Offshore	Construction	Alternative 1 would result in minimal impacts to geological resources.
	Operation	Alternative 1 would result in minimal impacts to geological resources.

3.2.2.4 Alternative 1 Proposed Mitigation Measures

No mitigation measures are required or recommended under Alternative 1.

3.2.3 Alternative 2 Former Ship Repair Facility (SRF)

3.2.3.1 Onshore

Construction

Under Alternative 2 would be the project area. Although sited in a different location, the geology of and soil types found at the Former SRF are similar to those described under Alternative 1; thus, the level of impacts would not differ from those of Alternative 1.

Operation

Under Alternative 2 would be the project area. Although sited in a different location, the geology of and soil types found at the Former SRF are similar to those described under Alternative 1; thus, the level of impacts would not differ from those of Alternative 1.

3.2.3.2 Offshore

Construction

The level of impacts would not differ from those of Alternative 1.

Operation

The level of impacts would not differ from those of Alternative 1.

3.2.3.3 Summary of Alternative 2 Impacts

Table 3.2-3 summarizes construction and operation impacts from Alternative 2.

Table 3.2-3. Summary of Alternative 2 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	• Alternative 2 would result in minimal impacts to topography by changing the landscape at Apra Harbor. • Soil disturbances and loss of vegetation could cause increased rates of erosion and soil loss from physical disturbance at all proposed construction areas under Alternative 2. Minimal impacts would occur with the use of BMPs. • Soil types impacted would not be agriculturally productive; thus, minimal impacts to soil resources would occur. • Adherence to UFC 3-310-04 Seismic Design for Buildings would reduce risk of damage to structures from seismic hazards.
	Operation	• Adherence to UFC 3-310-04 Seismic Design for Buildings during construction would reduce risk of damage to structures and subsequent injuries from seismic hazards that could potentially impact operation. Minimal impacts would occur due to geologic hazards.
Offshore	Construction	• Alternative 2 would result in minimal impacts to geological resources.
	Operation	• Alternative 2 would result in minimal impacts to geological resources.

3.2.3.4 Alternative 2 Proposed Mitigation Measures

Proposed mitigation measures would not differ from those of Alternative 1 and no mitigation measures are required for Alternative 2.

3.2.4 No-Action Alternative

Under the no-action alternative, no construction, dredging, or operation associated with the aircraft carrier berthing would occur. Existing operations at Polaris Point, as a military training and recreational facility, and at the Former SRF, as a commercial ship repair facility, would continue. Therefore, the no-action alternative would not have impacts to geology or soils.

3.2.5 Summary of Impacts

Table 3.2-4 summarizes the potential impacts of each action alternative and the no-action alternative. A text summary is provided below.

Table 3.2-4. Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
Topography		
LSI • Alternative 1 would result in minimal impacts to topography by changing the landscape at Apra Harbor.	LSI • Alternative 2 would result in minimal impacts to topography by changing the landscape at Apra Harbor.	NI • No impacts to geological and soil resources.
Geology		
NI • No impacts to geological resources.	NI • No impacts to geological resources.	NI • No impacts to geological and soil resources.
Soil		
LSI • Soil disturbances and loss of vegetation could cause increased rates of erosion and soil loss from physical disturbance at all proposed construction areas under Alternative 1. Minimal impacts would occur with the use of BMPs. • Soil types impacted would not be agriculturally productive; thus, minimal impacts to soil resources would occur. BI • Dredged material can be beneficially reused by receiver.	LSI • Soil disturbances and loss of vegetation could cause increased rates of erosion and soil loss from physical disturbance at all proposed construction areas under Alternative 2. Minimal impacts would occur with the use of BMPs. • Soil types impacted would not be agriculturally productive; thus, minimal impacts to soil resources would occur. BI • Dredged material can be beneficially reused by receiver.	NI • No impacts to geological and soil resources.
Geological Hazards		
LSI • Adherence to UFC 3-310-04 Seismic Design for Buildings would reduce risk of damage to structures from seismic, liquefaction and ground shaking hazards.	LSI • Adherence to UFC 3-310-04 Seismic Design for Buildings would reduce risk of damage to structures from seismic liquefaction, and ground shaking hazards.	NI • No impacts to geological and soil resources.

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

Soil types disturbed would not be agriculturally productive. Construction SOPs and a SWPPP (required by the NPDES permit) would be followed to prevent soil erosion. Therefore, the proposed action would result in less than significant soil erosion, compaction, or loss of agriculturally productive soil. The construction SOPs would include requirements for stormwater compliance and BMPs to ensure that all aspects of project construction would be performed in a manner to minimize impacts during construction activity. A description of standard BMPs and resource protection measures required by regulatory mandates can be found in Volume 7. Implementations of measures such as silt fences and hay bales would prevent erosion, thus there would be minimal impacts from soil erosion. A more detailed explanation of regulatory permitting requirements is available in Volume 8. Indirect impacts to geological resources, water resources, and marine biological resources from soil erosion would be prevented by implementation of BMPs.

There are no known sinkholes in the vicinity of any of the proposed projects; therefore, no sinkholes would be affected.

Apra Harbor and Naval Base Guam are located in a potentially active seismic zone. Hazards associated with earthquakes, fault rupture, and liquefaction would be minimized by adherence to UFC 3-310-04 Seismic Design for Buildings (USACE 2007). The proposed developments would be located on a relatively flat area that would not be subject to slope instability. Neither Alternative 1 nor Alternative 2 would result in significant impacts associated with geologic hazards.

3.2.6 Summary of Proposed Mitigation Measures

As previously described, there would be no significant impacts to geological and soil resources from the proposed action; therefore, no mitigations have been identified or would be required.

Volume 7, Chapter 2 describes two additional mitigation measures; force flow reduction and adaptive program management of construction. Implementing either of these mitigation measures could further reduce impacts to geologic and soil resources by lowering peak population levels during construction.

CHAPTER 4.
WATER RESOURCES

4.1 INTRODUCTION

Water resources as defined in this Environmental Impact Statement (EIS) are sources of water available for use by humans, flora, or fauna, including surface and groundwater, nearshore waters, and wetlands. Surface water resources, including but not limited to 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 for human consumption. Consistent with the definition contained in 22 Guam Administrative Rule 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 1,000 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.

This chapter contains the discussion of the potential environmental consequences associated with implementation of the alternatives within the region of influence (ROI) for water resources. For a description of the affected environment, refer to the respective chapter of Volume 2 (Marine Corps Relocation – Guam). The locations described in that Volume include the ROI for the aircraft carrier berthing component of the proposed action (Apra Harbor), and the chapters are presented in the same order as the resource areas contained in this Volume.

4.2 ENVIRONMENTAL CONSEQUENCES

4.2.1 Approach to Analysis

4.2.1.1 Methodology

This section contains a discussion of potential environmental consequences associated with implementation of the alternatives within the ROI for water resources. The environmental consequences of each action alternative and the no-action alternative are presented in this section. The methodology for identifying, evaluating, and mitigating impacts to water resources has been established based on federal and local laws and regulations as described in Volume 2, Chapter 4, Section 4.1.

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, issues of public concern, and significance criteria to determine the magnitude of potential impacts to water resources.

The proposed action analysis is separated into two main activities: construction and operation. Each of these activities has potential effects with associated 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 operation following completion of construction. Indirect impacts are those that may occur as a result of the completed project or those that may occur during operation 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 Department of Defense (DoD) entities are required to reduce demand for indoor water by as much as 20% and outdoor water use by 50% in the coming years. 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
- Rainwater Harvesting - investigate harvesting, storage and distribution systems

Provisions of the existing Unified Facility Code (UFC) Low Impact Development (LID) Manual 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, National Pollutant Discharge Elimination System (NPDES) permitting requirements, LEED goals, and recent laws 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. Following is a brief discussion of the approach to impact analysis for water resources, including surface water/stormwater, groundwater, nearshore water, and wetlands, for construction and operation. Subsequent sections of the chapter provide a detailed description of the potential impacts to these resources.

Construction

Surface Water/Stormwater

Surface water issues include:

- Water quality
- Flooding
- Flow path alterations

Surface water quality impacts were 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 was 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 were 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 that may contain elevated sediment concentrations, 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 increased contamination by sedimentation or chemical constituents.

Groundwater

Groundwater impact concerns include water quality and water quantity. Groundwater quality was 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 enters the groundwater. Water availability is addressed in Volume 6, Chapter 3, Section 3.1, Potable Water.

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

Nearshore Water

The nearshore water impact analysis focused on water quality. Recreational nearshore issues are addressed in Chapter 9, 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 were 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 and an increase in stormwater discharge that may increase non-point source pollution.

Wetlands

Impacts to wetlands were evaluated to determine if there would be any impacts from:

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 wetland 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. Wetland functionality refers to the ability of the wetland to trap sediments 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 operation 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.

Operation

Surface Water/Stormwater

For non-training operation activities, potential causes of impacts to surface waters include stormwater discharges which may increase the volume of sediment loading to the surface water as well as increased contaminants from sources such as vehicle maintenance, household discharges, 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 may result in potential damage from flooding. The storage of hazardous materials and fuels pose a continued risk of contamination of surface water from leaks or spills.

Groundwater

Effects to groundwater from non-training operation activities may result from increases in impervious surfaces, waste generating activities, and storage of potential contaminants. The direct impacts may 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 (see Volume 6, Chapter 3). The indirect impacts may include decreases in groundwater recharge from increased impervious areas and saltwater intrusion from increased aquifer pumping.

Effects to groundwater from operational activities may result from increases of impervious areas, waste-generating activities, and storage of potential contaminants. The direct impacts may include an increase in polluted stormwater runoff and contamination from leaks or spills of hazardous or regulated materials. These activities can pose both short-term and long-term effects.

Nearshore Water

Nearshore waters may be impacted by non-point source runoff containing chemical pollutants, nutrients, and/or sediments from upland support sites. In addition, ship operations, most notably docking activity, can stir up sediments, resulting in temporary suspended sediment plumes and associated localized increases in turbidity in nearshore waters.

The CWA prohibits the discharge of oil and hazardous substances in such quantities as may be harmful into or upon the navigable waters of the U.S., including the contiguous zone, exclusive economic zone and adjoining shorelines. Under the CWA, the USEPA published oil pollution prevention regulations in 1973 (amended in 1974, 1976, 2002 and 2004). These regulations include requirements for both oil spill prevention and response. The Navy has developed operations manuals and spill contingency plans, provides personnel training, and conducts testing of transfer equipment to comply with these regulations. OPVAVINST 5090.1C Environmental Readiness Manual Section 22-2.2.7.1 requires all hands to receive environmental training. This training includes oil and hazardous substance management, handling, minimization, and spill response. Chapter 22 also requires ships to strictly comply with fuel transfer and ballasting procedures to ensure ballast water does not become contaminated with oil or any other waste. Ships using self-compensating fuel tanks are required to ensure adequate margin is preserved to prevent inadvertent discharges of oil with the compensating water. OPNAVINST 5090.1C also directs the Navy to prevent the introduction of non-native organisms into natural ecosystems. Section 19-10, Ship Ballast Water and Anchor System Sediment Control provides measures to prevent such aquatic introductions, as mandated by the National Invasive Species Act of 1996 (P.L. 104-332). This law mandates the establishment of an Armed Forces Ballast Water Management Program to prevent such introductions.

As described in the EIS, the proposed action would be implemented in accordance with these aforementioned regulations.

Wetlands

Wetlands were assessed for the potential to be impacted by potential spills and leaks of hazardous materials that may be stored in close proximity. Indirect impacts to existing wetlands could 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.

4.2.1.2 Determination of Significance

The following factors were considered in evaluating potential impacts to groundwater and surface waters:

- Long-term increased inundation, sedimentation, and/or damage to water resources in the ROI caused by project activities, including impervious surfacing that increases and/or diverts rainfall runoff and/or affects its collection and conveyance and implementation of mitigation measures
- Depletion, recharge, or contamination of a usable groundwater aquifer for municipal, private, or agricultural purposes
- Increases in soil settlement or ground swelling that damages structures, utilities, or other facilities caused by inundation and/or changes in groundwater levels
- Creating noncompliance with any applicable law or regulation
- Increasing risk of environmental hazards to human health
- Decreasing existing and/or future beneficial use
- Reducing the amount of water or wetlands available for human use or ecological services
- Reducing availability or accessibility of water resources

If an activity was determined to have a potential impact, the impact was then evaluated to determine its significance. For significant impacts, a determination was made as to whether the impact can be mitigated to less than significance.

4.2.1.3 Issues Identified during Public Scoping Process

The following analysis focuses on the effects to water resources: surface water, groundwater, nearshore water, and wetlands that could be impacted by the proposed action. As part of the analysis, concerns relating to water resources that were identified by the public, including regulatory stakeholders, during the scoping meetings were addressed. These include:

- Describe water quality with respect to public health requirements, drinking water regulations, and applicable water quality standards
- Estimate quality and quantity of stormwater runoff to be generated by increased impervious surfaces, methods of contaminant removal, methods of runoff redirection to recharge the aquifer, and effects to 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 operation

- Construction and bulldozing of the jungles that could potentially cause runoff, pollute the beaches, and destroy marine life
- Effects of training and dredging on sedimentation stress for the coral reefs and other marine life
- Identify ways to monitor and mitigate indirect impacts from sediments on coral reefs

4.2.2 Alternative 1 Polaris Point (Preferred Alternative)

4.2.2.1 Onshore

This discussion of potential impacts to onshore water resources focuses on potential impacts to surface water resources, groundwater resources, and wetland areas for Alternative 1, Polaris Point (referred to as Alternative 1). For a discussion of potential impacts to nearshore waters, see the Offshore section below.

Construction

Surface Water/Stormwater

Proposed construction activities under Alternative 1 would be located more than 1,500 ft (457 m) from any of the streams around Apra Harbor. Due to the distance from these streams, the proposed action is not anticipated to have any direct impacts to these streams. However, there is a potential to increase the amount of sediment in the runoff that could eventually flow into area streams, resulting in an indirect impact. The sediment can transport other constituents such as nutrients, heavy metals, organic and inorganic compounds, and detrimental microorganisms. To minimize these potential temporary increases in stormwater runoff, erosion, and sedimentation, a Construction General Permit (CGP) would be obtained and followed and a SWPPP would be prepared and implemented. The SWPPP would identify construction-specific Best Management Practices (BMPs) (Volume 2, Chapter 4, Table 4.2-1) that would be implemented as part of Alternative 1 to reduce the potential for erosion, runoff, sedimentation, and subsequent water quality impacts. Project and site-specific BMPs would retain silt laden stormwater before it reaches a sensitive surface water resource. Further, stormwater runoff would be diverted away from water bodies to protect waters of the U.S. A Spill Prevention Control and Counter-measures (SPCC) Plan would be implemented to reduce the potential for leaks and spills of petroleum, oil, and lubricants (POLs) and other hazardous or other contaminants from equipment. The facilities associated with the Polaris Point wharf would be constructed within the 100-year flood zone. Thus, all structures within this area would be designed and constructed to elevate the structure out of the flood zone and reduce potential impacts from flooding.

Under Alternative 1, dredged material would potentially be placed in an upland placement facility. 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 4.2-2 in Volume 2, Chapter 4). Only the Polaris Point upland placement facility would be located in the 100-year flood zone. Upland placement facilities would consist of a fully bermed disposal area, thereby isolating the dredged material from the surrounding environment. Following placement of dredged material, the sediments would be allowed to consolidate, settle, and dewater. Water would evaporate or percolate into the ground. The exterior slope of the upland placement facility berms would be seeded with grass to minimize erosion.

Water generated from mechanically dredged material (i.e., effluent) placed in an upland placement facility would not discharge into sensitive surface waters because infiltration rates of the foundation soils at the upland placement sites are greater than any potential effluent discharge (NAVFAC Pacific 2005). In addition, runoff generated from rainfall would not be expected to exit the upland placement site due to high infiltration rates. Because dredged material placed in an upland placement facility would be finer and therefore, have lower infiltration rates than foundation soils, trenches would be constructed to allow water to reach foundation soils and facilitate rapid infiltration of runoff. 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 would result in less than significant impacts to surface water.

Groundwater

Under Alternative 1, proposed construction and dredged material upland placement activities would be in compliance with the water protection measures identified in the surface water section above, which would therefore also protect local groundwater quality. The dredged material upland placement sites would be located over aquifers. However, those aquifers are not used for supplying drinking water; thus, any effluent that might percolate into the aquifer would not affect regional groundwater drinking quality or quantities. Based upon recent and historical sediment sampling that has been conducted in association with Outer and Inner Apra Harbor Navy dredge projects, it is anticipated that the dredged material would be within effects range-low (ER-L) thresholds for National Oceanic and Atmospheric Administration (NOAA) sediment quality guidelines as the majority of the sediments tested contain no or low concentrations of contaminants of concern. Based on these sampling efforts, a limited area of sediment in the vicinity of Sierra and Romeo wharves in Inner Apra Harbor was identified that may be unsuitable for ocean disposal due to effects range-medium (ER-M) thresholds and amphipod toxicity and would be placed in an upland placement site (NAVFAC Pacific 2007a). The indication for the Sierra Wharf dredge sediments not being likely suitable for ocean disposal was based upon only one amphipod test where the toxicity levels were only slightly elevated. The overall low contaminant concentrations and tissue concentrations below published effects levels may allow for ocean disposal of these materials for Sierra Wharf (NAVFAC Pacific 2007a). Additional analysis of the sediments in the vicinity of Romeo Wharf would be required to determine ocean disposal suitability of those materials. The results of the 2007 dredge sediments study are available in Volume 9, Appendix K. The location of these samples for Area P-436B is presented in Volume 2, Chapter 2.4,Water Resources. Material unsuitable for ocean disposal would be placed upland. No impacts to groundwater from upland placement of these sediments are expected. Leachate analysis to groundwater is discussed below.

The upland placement sites would be enclosed by earthen berms of 16 to 30 ft (5-9 m) in height. As the dredge dewatering effluent has the potential to impact the quality of the local, non-potable groundwater beneath the upland placement sites, a leachate pathway analysis was conducted for dredged material placement at the Field 5 upland placement site as part of the Environmental Assessment (EA) for Alpha and Bravo Wharves. No contaminants of concern were discovered in the leachate that would exceed the Guam Environmental Protection Agency (GEPA) water quality standards for groundwater, and no engineering controls at the upland placement site were required (NAVFAC Pacific 2005). Because the dredged material to be generated in this action would be similar to that evaluated for the Alpha and Bravo Wharf EA, the impacts to groundwater are expected to be similar. In addition, a dewatering plan would be submitted to the GEPA prior to placing the dredged material in an upland placement site. Therefore, construction activities associated with Alternative 1 would result in less than significant impacts to groundwater.

Wetlands

The dredging activities proposed under Alternative 1 would occur in Outer Apra Harbor, away from the wetlands located in Inner Apra Harbor and Sasa Bay. The nearest wetland to the proposed dredging activity would be Wetland Area T, located approximately 2,500 ft (762 m) east of the nearest extent of proposed dredging (Figure 4.2-1). Other wetland areas (W, V2, U, S, X, and SV-O) would be located even further away from the proposed dredging areas. To the west, Wetland Areas A and B are located over 3,000 ft (914 m) from the nearest extent of proposed dredging (Figure 4.2-1). Due to the distance and implementation of BMPs such as the use of silt curtains in nearshore waters and operational controls, there would be no impacts to wetlands.

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) would minimize impacts.

Operation

Surface Water/Stormwater

The operational phase of Alternative 1 would increase the area of impervious surface, resulting in an associated relatively minor increase in stormwater discharge intensities and volume. However, existing stormwater infrastructure or new stormwater infrastructure improvements included as part of the proposed action would incorporate LID Integrated Management Practice (IMP) measures and BMPs to ensure stormwater retention would be consistent with local and federal requirements and thus minimize potential impacts to surface water quality. These IMP and BMP measures would provide stormwater pre-treatment 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 federal, Government of Guam (GovGuam), and military orders, laws, and regulations, including the preparation and implementation of a Stormwater Pollution Prevention Plan (SWPPP), Stormwater Management Plan (SWMP), and SPCC Plan that would control runoff and minimize potential leaks and spills. In addition, Alternative 1 would include the implementation of BMPs and LID measures. All nonpoint and point source discharges would be monitored pursuant to Clean Water Act (CWA) permits. Implementation of these protective measures would minimize potential effects of runoff, spills, and leaks, and would minimize potential effects to surface water resources by retaining and treating stormwater prior to discharge to surface waters and by responding to oil and hazardous waste spills and preventing their discharge to surface waters. Therefore, operations associated with Alternative 1 would result in less than significant impacts to surface water.

Groundwater

The project area is located over 4 miles (mi) (6.4 kilometers [km]) west of the Northern Guam Lens Aquifer (NGLA). The BMPs and follow-on measures and plans identified under the surface water discussion would also serve to protect groundwater quality in the project area by reducing the potential for spills and leaks from POLs or hazardous materials. Therefore, operations associated with Alternative 1 would result in less than significant impacts to groundwater.

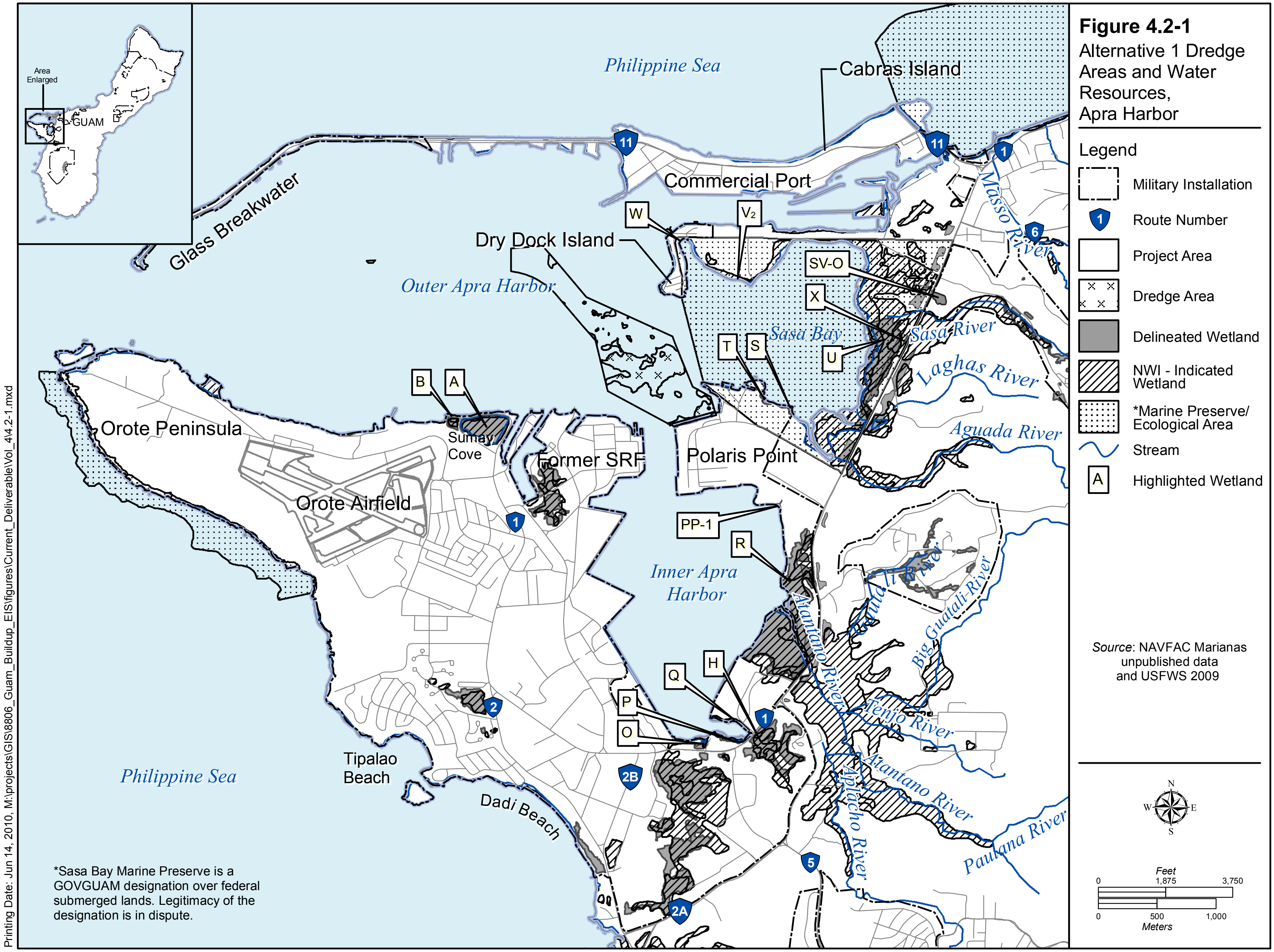
Figure 4.2-1
Alternative 1 Dredge Areas and Water Resources, Apra Harbor
Legend
Military Installation
Route Number
Project Area
Dredge Area
Delineated Wetland
NWI - Indicated Wetland
*Marine Preserve/ Ecological Area
Stream
Highlighted Wetland
Source: NAVFAC Marianas unpublished data and USFWS 2009
Feet
0
1,875
3,750
0
500
1,000
Meters
Area Enlarged
GUAM
Philippine Sea
Cabras Island
Commercial Port
Glass Breakwater
Dry Dock Island
Outer Apra Harbor
Sasa Bay
Sasa River
Laghas River
Aguada River
Masso River
Orote Peninsula
Orote Airfield
Sumay Cove
Former SRF
Polaris Point
Inner Apra Harbor
Atantano River
Tenjo River
Aplacho River
Paulana River
Big Guatali River
Tipalao Beach
Dadi Beach
W
V2
SV-O
X
T
S
U
B
A
PP-1
R
Q
H
P
O
*Sasa Bay Marine Preserve is a GOVGUAM designation over federal submerged lands. Legitimacy of the designation is in dispute.
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Wetlands

No wetland areas would be directly or indirectly affected by operational activities associated with Alternative 1 as no delineated wetland areas are located near the proposed operational areas. Proposed BMPs, LID measures, and wastewater treatment plant (WWTP) improvements would collectively reduce the potential for pollutants to impact wetland areas. Therefore, operations associated with Alternative 1 would not impact wetlands.

4.2.2.2 Offshore

Construction

Nearshore Waters

As a consequence of construction, approximately 3.6 acres (ac) (1.5 hectares [ha]) of intertidal area and open water would be filled. The 3.6 ac of fill corresponds to the wharf area as depicted on Figures 2.5-2 and 2.5-5. As shown on Figure 2.5-6, this fill area is within the dredging footprint and it would backfill the riprap that would be placed on the dredged area beneath the wharf. The area of fill would consist of a riprapped slope from the Mean High Water line at the shoreline to the outer edge of the wharf. Wharf pilings would be installed first and then the riprap protection slope under the full width and length of the wharf deck would be added. The aggregate impacts to water resources under the preferred alternative are summarized in Table 4.2-1.

Table 4.2-1. Summary of Aggregate Effects to Jurisdictional Waters of the U.S. and Wetlands

Component Action	*Jurisdictional*		*Type and Area (ac/ha) of Impact*				*Impacted Feature*
	Waters[1]	*Wetlands*	*Direct*	*Indirect*	*Temp.*	*Perm.*	
Dredging	●			ND	●		Outer Apra Harbor
Pilings and riprap	●		3.6ac/ 1.5 ha			●	Outer Apra Harbor

[1] "Waters" refers to jurisdictional waters of the U. S. as defined by the Clean Water Act

During construction operations under Alternative 1, contaminated runoff or spills and leaks could potentially be transported to, or directly released to nearshore waters. However, implementation of the Naval Base Guam SPCC Plan would reduce the potential for spills and leaks of POLs and hazardous materials. Additionally, in-water BMPs such as silt curtains in the nearshore areas and water quality monitoring would be implemented in accordance with USACE Section 404/10 and GEPA WQC which would also serve to reduce potential impacts to nearshore waters from construction activities.

Under Alternative 1, wharf construction activities would result in localized temporary impacts to nearshore water quality from resuspended sediment; however, these localized temporary impacts would be minimized by implementing in-water BMPs such as silt curtains in nearshore areas, water quality monitoring, and other construction BMP measures. In-water BMPs and water quality monitoring would contain turbidity within the immediate area. 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 Water Quality Certification (WQC). Conditions and measures imposed by those certifications and permits would be followed to ensure protection of nearshore waters. Upon completion of construction, water quality would be expected to return to pre-construction conditions.

Under Alternative 1, the total dredged material volume anticipated for Polaris Point would be approximately 608,000 cubic yards (cy) (464,850 cubic meters [m^3]), including the overdredge.

Approximately 30% of the dredged material would be generated at the shoreline area of Polaris Point to provide an appropriate slope for the wharf structure. As discussed previously in Chapter 2 of this Volume, there are five possible disposal scenarios for dredged material: 100% disposal in the ODMDS, 100% disposal upland, 100% beneficial reuse, 50% beneficial reuse/50% ocean disposal and 20-25% beneficial reuse/75-80% ocean disposal. Several beneficial use projects have been identified as described in Chapter 2. However, for the purposes of impact analysis, the EIS conservatively assumes that all dredged sediments would be placed at one or more of five potential upland sites at Naval Base Guam (refer to Figure 4.2-2 in Volume 2, Chapter 4) for dewatering and reuse, or placed in a U.S. Environmental Protection Agency (USEPA) approved Ocean Dredged Material Disposal Site (ODMDS) for Guam. The more likely outcome would be a combination of the three approaches (i.e., ocean disposal, upland placement, and beneficial reuse). The Navy is in the process of developing a detailed dredged material management plan that will incorporate the disposal options, specific plans for beneficial reuse to the extent possible, and include specific monitoring efforts required for each disposal option.

The following sections present an analysis of the potential impacts to nearshore waters from the proposed dredging activity.

Physical Impacts to Nearshore Waters from Dredging

During dredging activities, nearshore water quality would be temporarily impacted by turbidity and sediment generated during the dredging process. Dredging is scheduled to last between 8 and 18 months, depending upon the dredging schedule chosen. Although the project would occur over a period of 8-18 months, dredging activity would be transient in nature and would not occur at any one location for the entire duration of the project. Therefore, impacts to any specific area would be temporary and limited to that specific location. Dredged materials would be transported to existing upland disposal sites for upland placement or disposed of at an offshore site, if available. Prior to disposal of dredge materials, a sampling and analysis plan would be submitted to the GEPA.

Mechanical dredging was used for analysis because it represents the maximum potential adverse environmental effect to water quality. The primary physical impact from mechanical dredging involves a disturbance to the marine environment that generally leads to re-suspension of sediments and increased turbidity that could adversely affect marine corals and filter-feeding invertebrates. Selection and operation of the type of dredge equipment, 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 that occurs during dredging 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 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 varies significantly from site to site (SAIC 2001).

Even under ideal conditions, substantial losses of loose and fine sediments will usually occur. Sediment loss during a typical mechanical 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).

Given the coarse nature of Outer Apra Harbor sediments, it is likely that the majority of the suspended sediment would settle out rapidly, resulting in a much shorter turbidity plume than otherwise would be the case. Maximum concentrations of suspended solids in the surface plume should be less than 0.5 parts per thousand (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 less than 0.1 ppt. The near-bottom plume would probably have higher solids concentrations, indicating that re-suspension of bottom material near the bucket impact point is probably the primary source of turbidity in the lower water column. In typical dredging projects, the visible near-surface plume normally dissipates rapidly within an hour or two after the operation ceases (SAIC 2001). Given the course nature of the samples, the time period for dissipation is anticipated to be similar. It is assumed that because of the proximity of coral reefs to the project area, no barge overflow would be a condition of the WQC. This likely permit certificate condition would help reduce the potential for impacts to nearshore waters by preventing the release of silt laden water during barge loading and transport.

A primary influence on the sediment 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 indicate that sediments in the area of the navigation channel and proposed turning basin consist primarily of sand and rubble with silty sediments being found along the proposed berthing areas (NAVFAC Pacific 2006). The coarse grain size of the material to be dredged indicates that the majority of the resuspended sediment would settle out of the water column rapidly. Dispersion modeling of suspended sediment from dredging activities in Apra Harbor was conducted in March 2009 as part of the *Habitat Equivalency Analysis and Supporting Studies* with a detailed summary included in Appendix E 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. Due to the similarities in site conditions and subsequent anticipation of similar silt curtain effectiveness, 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. As dredging for the proposed project would be conducted continuously, the maximum daily rate of 24 hours was used in the model. Under the maximum potential adverse effect scenario model run, the dredge plume had a maximum length of 328 ft (100 m). The plumes rapidly dissipated following dredging.

Historically, water quality monitoring, silt curtains in the nearshore areas, and other in-water BMPs have been implemented during dredging operations in Outer Apra Harbor in order to protect corals and filter-feeding invertebrates; similar BMPs would be used under Alternative 1. Silt curtains are physical barriers to sediment transport that extend from the water surface to a specified water depth. Silt curtains are designed to contain or deflect suspended sediments or turbidity in the water column and, when properly deployed and maintained, can effectively control the flow of turbid water. Sediment containment within a limited area is intended to provide residence time to allow soil particles to settle out of suspension and reduce flow to other areas where negative impacts could occur. Silt curtains may also be used to protect specific areas (e.g., sensitive habitats, water intakes, or recreational areas) from suspended sediment and particle-associated contamination. The use of silt curtains near sensitive resources in addition to around the dredging area might further reduce the potential impacts from sediments that may be released (see also Chapter 11 of this Volume for a discussion on sediment plume modeling). A number of protective measures would be taken to minimize the distribution of the turbidity plume that would unavoidably be generated by the proposed dredging operations. Silt curtains are one example of these types of protective measures. Silt curtains are commonly utilized to contain sediment plumes near the point of dredging in the nearshore environment. Standard turbidity curtains are approximately 20-30 ft (6-9 m) in length and have a weighted bottom to maintain the effectiveness of the curtain against the movement of currents within the water body. Since the dredge equipment is not stationary for the entire period of dredging, it is impractical to have a silt curtain extending to and being anchored to the bottom of the harbor. The length of time the silt curtains would be in place would be determined through agency coordination and permitting; however, in general terms the curtains would potentially be in place during and after dredging operations until monitoring indicates turbidity levels have returned to pre-dredging concentrations. In the event of silt curtain failure, dredging activity would cease until repairs to the curtain are completed. As the material is being excavated by the mechanical dredge, the heaviest materials fall rapidly to the bottom of the water body with the lighter and more buoyant fraction floating in the upper levels and surface of the water where the curtains are most effective. The majority of the sediment (e.g., >50%) is comprised of larger grained material and, therefore is generally referred to as being “coarse” and would settle quicker than silty materials. The area proposed for dredging is designated as M-2 or area of “Good” water quality. Prior to starting the dredging activity, a water quality monitoring plan would be submitted to the GEPA. Water quality control measures could consist of using silt curtains, water quality monitoring, and other BMP measures to prevent suspended sediments from exceeding GEPA water quality standards, and performing frequent monitoring during construction to ensure the effectiveness of suspended sediment containment. Should exceedances of water quality standards occur, construction activities would be interrupted until turbidity levels returned to acceptable levels. The sedimentation controls would reduce impacts to aquatic communities and water quality outside of the project area.

Chemical Impacts to Nearshore Waters from Dredging

Resuspended sediment plumes may result in a decrease in dissolved oxygen (DO) in the water column by increasing the biological oxygen demand, affecting marine organisms both on the seabed and in the water column. In addition, because 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). Under Alternative 1, it is not anticipated that there would be releases of organic (silty) sediment except close to shore, where there is a higher percentage of organic sediment. 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 total organic carbon (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., polyaromatic hydrocarbons), 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 indicate that sediments in the area of the navigation channel and proposed turning basin consist primarily of coarse grained materials with low amounts of TOC (≤ 0.17% dry weight) (NAVFAC Pacific 2006). The coarse grain size of the material to be dredged coupled with the low TOC and contaminant concentrations indicate that dredging would only result in short term and localized impacts to water quality. These impacts would be further reduced by deployment of silt curtains and operational control measures which historically have been implemented during dredging operations in Apra Harbor.

Sediment quality investigations in Outer Apra Harbor were conducted in 2006. Sediment core samples were taken to the proposed dredged depth needed to accommodate visiting aircraft carriers. The proposed dredge footprint was geographically covered by the sediment sampling regime that included a total of fourteen discrete sampling sites. The areas included the proposed turning basin in the Outer Harbor and the berthing areas of Alternative 1 and Alternative 2 (NAVFAC Pacific 2006). The outer entrance channel was not sampled as the sediment in that area is sand and predominately clean. The 2006 reconnaissance level effort was performed consistent with guidance outlined in the Ocean Testing Manual (United States Environmental Protection Agency [USEPA] and United States Army Corps of Engineers [USACE] 1991). The purpose of the investigation was to delineate the distribution and magnitude of chemicals of potential concern within the material to be dredged from these two potential wharf sites and common turning basin area. The 14 sediment sampling sites were evenly distributed around the two alternative wharf locations and within the proposed turning basin area. Sediment samples were taken at depths up to -52 ft MLLW, which translates into sediment core lengths of up to 43 ft, and covers the range of anticipated dredge depths. On average sediment cores were approximately 11 ft long. Sediment sampling cores were not taken in coral areas to avoid impacts to this sensitive habitat. Refer to Figure 2.3-9 in Chapter 2 of this Volume for sediment sample locations.

Water depths in the area of Alternative 1 range from -20 to -80 ft (-6 to -24 m) mean lower low water (MLLW). The Alternative 2 site has water depths that 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. Within the logical geographic areas associated with each wharf alternative location and the turning basin, the core samples were composited and the composited samples were analyzed. Composites 1 (six sample locations) and 3 (five sample locations) are representative of the areas to be dredged for the aircraft carrier turning basin and berthing at Alternative 1. Composites 1 (six sample locations) and 2 (three sample locations) were representative of the areas to be dredged for the aircraft carrier turning basin and berthing at Alternative 2.

The results of the sediment quality analysis indicate that, with the exception of Area 3 adjacent to the proposed Alternative 1 site, sediments in Outer Apra Harbor (Areas 1 and 2) were coarser-grained and comprised predominantly of a gravelly sand. In Area 3 (immediately offshore Polaris Point), 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 (TTLC) values. The results are summarized in Table 4-2.2. 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 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 10th percentile of observed effects concentration and ER-M represents the 50th 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., TOC, ammonia, sulfides, oil and grease and total recoverable petroleum hydrocarbons) do not have ER or TTLC values.

Table 4.2-2. Sediment Sampling Summary Table

Analyte	*ER-L/ER-M*	*Composite*		
		Outer Apra Harbor		
		1	*2*	*3*
TOC (%)		0.13	0.17	0.5
Arsenic	8.2/70	3.76	3.76	7.55
Cadmium	1.2/9.6	0.27	0.15	0.10
Chromium	81.0/370	11.50	13.30	53.90
Copper	34.0/270	4.85	23.60	17.90
Lead	46.7/218	4.08	18.60	8.71
Mercury	0.15/0.71	0.04	0.12	0.05
Nickel	20.9/51.6	4.91	5.41	**21.50**
Silver	1.0/3.7	<0.025	<0.025	<0.025
Zinc	150/410	6.96	24.80	26.80
Tributyltin	Not established	<1	<1	<1
Total PAH	4022/44792	34.00	1115.10	129.30
Arochlor 1260	-	<10	22.2	<10

In general, sediment contamination was low throughout all the areas sampled in Outer Apra Harbor. 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. Composites 1 and 2 did not exceed any of the ER-L values. There were minor exceedences of the ER-L value for one metal (nickel) for Composite 3. Nickel occurs naturally in the environment and this exceedance is 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. All other analytes, e.g., PCBs (aroclor and individual congeners), chlorinated pesticides, organotins, phenols, phthalates were either not detected or reported at less than the laboratory detection limits. Composite 3 had the lowest ammonia level. 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 Outer 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 sampling and analyses were conducted in March 2010 to delineate the distribution and magnitude of chemicals of potential concern within the dredge footprint of the two potential CVN berthing sites; Polaris Point and the Former SRF wharf. Material from the proposed CVN turning basin was also evaluated (NAVFAC Pacific 2010a). Refer to Figure 2.3-10 in Chapter 2 of this Volume for sediment sample locations for the March 2010 report. The full report of this study is contained in Volume 9 Appendix K.

Consistent with previous sediment sampling efforts conducted in these locations, sediment samples were analyzed for physical and chemical parameters, including general chemistry, metals, semi-volatile organic compounds (polynuclear aromatic hydrocarbons [PAHs], phenols, and phthalates), organochlorine pesticides, polychlorinated biphenyls (PCBs), and organotins and the results compared to effects range-low (ER-L) and effects range-median (ER-M) sediment quality guidelines, as established. ER-M values were also used to calculate a mean ER-M quotient (ER-Mq). The concentration of each constituent was divided by its ER-M value to produce a quotient, or proportion of the ER-M equivalent to the magnitude by which the ER-M value is exceeded or not. ER-Mq values were calculated for the 2006 Tier II sampling event and compared to the 2010 ER-Mq values as a predictive analysis of sediment suitability for open water disposal.

For the majority of analytes, concentrations in the 2010 samples were either not detected or lower than ER-L values. ER-L exceedances were observed in three metals, two PAH compounds, four organochlorine pesticides and total detectable PCBs. Only two occurrences of a single analyte exceeding the ER-M value occurred (4,4'-DDT).

The results of the ER-Mq analysis determined that all of the ER-Mq's are well below the value of one, suggesting the sediment quality (i.e., contaminant concentrations) is not likely impairing benthic communities. Generally speaking, ER-Mq's for each group of analytes within a given area were similar between the two study years with the exception of PCB ER-Mq's. In 2006, the ER-Mq for PCBs in Area 1 was 0.003; whereas, in 2009, the ER-Mq was 0.123. This difference was due to the fact that in 2006, PCBs were not detected in the Area 3 composite sample; however, in 2009, one of the eight samples had PCB congener detections. The mean ER-Mq for each area was consistent between the 2006 and 2009 investigations (Table 4.2-3).

The 2010 analysis concluded that low chemical concentrations found in the most recently collected sediment samples from Polaris Point, the Former SRF Wharf, and the Turning Basin were consistent with other previous Tier III dredged material evaluations conducted in the same areas of Apra Harbor in the NAVFAC Pacific 2007) study where the material was deemed suitable for ocean disposal. Also similar to the results of this most recent sediment analysis in 2010, sediments from the previous Tier III study had chemical concentrations that were generally low, but some analytes exceeded comparable ER-M values.

Based on these similarities, it is likely if the 2010 sediments from the proposed Polaris Point or SRF Wharf dredge footprints were further evaluated according to guidance outlined in the Ocean Testing Manual (USEPA and USACE 1991) and/or Inland Testing Manual (USEPA and USACE 1998) they would be deemed suitable for ocean disposal or upland placement.

Table 4.2-3. Comparison of ER-Mq's for Each Analyte Group per Area Between Study Years

	2006			*2009*		
	Turning Basin	*SRF Wharf*	*Polaris Point*	*Turning Basin*	*SRF Wharf*	*Polaris Point*
Metals	0.030	0.056	0.086	0.040	0.078	0.079
PAHs	0.000	0.014	0.002	0.001	0.012	0.007
Pesticides	0.044	0.044	0.044	0.017	0.035	0.056
PCBs	0.003*	0.182	0.003*	0.005	0.166	0.123
Mean Overall ER-M Q	0.020	0.074	0.034	0.016	0.073	0.066

* ER-Mq recalculated from 2006 raw data. 2006 study summed all non-detect congeners using 1/2 detection limit resulting in an overestimation of ER-Mq. This study used the total PCB congener value reported by the laboratory

Physical Impacts from Ocean Disposal

A detailed discussion of water quality impacts at the proposed Guam ODMDS is presented in the EIS for the ODMDS designation (USEPA 2010).

In general, 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 dredge disposal, 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 dredge disposal 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.

As modeled in the ODMDS EIS, the footprint of material deposited on the seafloor would be elongated toward the northeast having a width of 6.5 nautical miles (12.0 kilometers [km]) and a length of 8.1 nm (15.0 km). This would be most evident in the dispersion 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 (in) (1 millimeter [mm]) would be 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 (2,195 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 (DAMOS) 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 the DAMOS 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 concentrations 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, any chemical effects of hopper discharge are expected to dissipate rapidly with the ambient conditions returning 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 including 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 may 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.

Numerical modeling may be conducted using chemical concentrations in proposed dredged materials to determine the diluted concentrations 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 2010). 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. The analysis used time series plots of dredge plume concentrations developed for the Master Plan for Deep-Draft Wharf and Fill Improvements at Apra Harbor EIS (July 2007). This analysis shows that during both average and maximum potential adverse effect loading scenarios, the dredge plumes dissipate rapidly, usually 2-3 hours after dredging has stopped. The dilution time of four hours was determined by the USEPA's Green Book (USEPA and USACE 1991). The Green Book specifies two criteria related to dilution of dredged material: Criterion I – the maximum concentration of a constituent outside the disposal site boundary at any time after discharge must satisfy applicable water quality standards and Criterion II – the maximum concentration of a constituent within the disposal site four hours after discharge must satisfy the water quality standards. The final concentration of a conservative constituent after mixing is expressed as the initial concentration divided by the dilution factor, assuming an ambient concentration of the constituent of zero.

As noted above, preliminary chemical testing results revealed low concentrations of contaminants in Outer Apra Harbor, indicating the material is likely suitable for ocean disposal. Pursuant to Section 103 Marine Protection, Research, and Sanctuaries Act (MPRSA), 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).

Impacts of Upland Site Placement to Nearshore Waters

The dredged material would be placed in scows, then into sealed end dump trucks for transfer to the upland placement sites. During most rainfall events, stormwater runoff from within the upland placement facilities is not expected except in the rare case such as a typhoon.

The dredged material would be dewatered in accordance with USACE and Guam permitting requirements. Therefore, with the implementation of BMPs as identified in Volume 2, Chapter 4, Table 4.2-1, construction activities associated with Alternative 1 would result in less than significant impacts to nearshore waters.

Radiological Impacts from Dredging

The Navy has conducted radiological environmental monitoring in Apra Harbor for nearly 50 years. The results of this monitoring are discussed in detail in Volume 4, section 18.2.2.6. Trace concentrations of cobalt-60 in Apra Harbor sediment have been detected as a result of historical U.S. Navy nuclear-powered ship operations. This amount of radioactivity is very small when compared to the amount of naturally occurring radioactivity already in the sediment. Cobalt-60 was last detected in 1990 in one Apra Harbor sediment sample at a concentration of 0.015 pCi/g. This concentration would have decayed to about 0.005 pCi/g by 2010, or about a tenth of a percent of the natural concentration of potassium-40 radioactivity in a banana. No cobalt-60 has been detected in any subsequent samples. The routine Navy environmental monitoring samples are taken from the surface layer of sediment.

Sediment cores from Apra Harbor have been analyzed for radioactivity on two occasions. Prior to dredging associated with Alpha and Bravo wharves' improvements in the inner harbor, core samples from the proposed dredge area were obtained for sensitive analyses using gamma-ray spectroscopy and, in some cases, chemical separation followed by alpha spectroscopy (COMNAV Marianas 2006). Six sediment core composites and 50 sediment samples were analyzed. No cobalt 60 was detected. However, very low levels of non-naturally occurring radioactivity were identified in some samples, documented in Table 4.2-4. Low levels of cesium, plutonium, and americium are detectable throughout the world due to fallout from historical atmospheric weapons testing.

Table 4.2-4. Radiological Test Results for Alpha/Bravo Wharves

Radionuclide	*Range of Specific Activity Low – High (pCi/g)*	*IAEA de minimis Concentration (pCi/g)*
Cesium 137	0.004 – 0.031	33.4
Plutonium 239/240	0.023 – 0.183	96.5
Americium 241	0.028 – 0.049	117.5
Cobalt 60	<0.003 - <0.012	4.5

This trace amount of radioactivity in the sediment is far below the concentration established by the International Atomic Energy Agency for determining whether dredged sediments can be regarded as non-radioactive or de minimis under the Convention on Prevention of Marine Pollution by Dumping of Wastes and Other Matter, London Convention, 1972 (IAEA 2003).

In December 2009, additional sediment cores were obtained from the potential dredging areas in Outer Apra Harbor. Thirty sediment samples from eighteen cores were analyzed. One sample was taken from every two feet of depth in the sediment cores. The number of samples per core ranged from one to three. The results were essentially identical to the results of the inner harbor core samples discussed above. No cobalt 60 was detected. However, very low levels of non-naturally occurring radioactivity were identified in some samples, documented in Table 4.2-5. Low levels of cesium, plutonium, and americium are detectable throughout the world due to fallout from historical atmospheric weapons testing.

Table 4.2-5. Radiological Test Results for Outer Apra Harbor

Radionuclide	*Range of Specific Activity Low – High (pCi/g)*	*IAEA de minimis Concentration (pCi/g)*
Cesium 137	0.009 – 0.013	33.4
Plutonium 239/240	0.007 – 0.026	96.5
Americium 241	0.005 – 0.017	117.5
Cobalt 60	<0.003 - <0.005	4.5

The results of these two sets of core samples indicate that there is no concern for elevated radioactivity concentrations in deeper layers of sediment, either from nuclear-powered ships or operations associated with past nuclear weapons testing, in either the Inner Apra Harbor or Outer Apra Harbor. In accordance with the IAEA guidance, any dredged sediment from Apra Harbor may be disposed of without any need for special considerations regarding radioactivity.

<u>Operation</u>

Nearshore Waters

Currently, sediment plumes occur as a result of propeller wash from tugboats and aircraft carriers while docking and getting underway. Under the proposed action, transient aircraft carriers would dock in Apra Harbor for a cumulative total of up to 63 visit days per year, with an anticipated length of 21 days or less per visit. Similar to dredging operations, the extent of the turbidity plume generated from propellers would be a function of bottom current velocities and sediment grain size as well as propeller jet flow velocities. Ambient water conditions would return shortly after ship movement ceases in the harbor. The proposed dredging would increase the distance between propellers and the sea floor, which is expected to reduce but not eliminate sediment resuspension by ship propellers. This reduction would have a beneficial impact on water quality as there would be fewer incidents of sediment resuspension from propeller wash with less sediment being resuspended. Should sediment resuspension occur, any potential impact to the nearby high quality coral resources of Big Blue Reef would be lessened because of the distance between that reef and Alternative 1.

Leachate from hull coatings commonly discharges into surrounding seawater from vessels, including Navy aircraft carriers. Vessel hulls that are continuously exposed to seawater are typically coated with a base anti-corrosive coating covered by an anti-fouling coating. This coating system prevents corrosion of the underwater hull structure and through leaching action releases antifouling compounds. These compounds inhibit the adhesion of marine organisms to the hull surface. The coatings on most Navy vessels are copper based ablative paints. Tributyl tin-based paints have been phased out by the Navy (Booz Allen 1999). The increase in proposed aircraft carrier visits to Apra Harbor would not be expected to increase substantially the amount of hull coating leachate. Aircraft carriers and other Navy vessels routinely visit Apra Harbor. Results of sediment sampling in Outer Apra Harbor indicate that levels of copper range from 4.85 to 23.60 parts per million, below the NOAA sediment quality environmental risk levels of 34 parts per million for copper in marine sediment (NAVFAC Pacific 2006). Adding 47 visit days per year is not anticipated to increase the amount of hull coating leachate sufficiently to present an increase in environmental risk in coastal waters and/or marine sediments.

With implementation of the proposed upgrades, the existing wastewater collection system at Apra Harbor Naval Complex would be sufficient to handle the wastewater requirements of either a CVN 68 (Nimitz Class) or CVN 78 (Ford Class) aircraft carrier for a duration of 21 days. Proposed improvements to the wastewater system at Naval Base Guam, which have been previously discussed, would result in a minor beneficial impact to the treatment of wastewater and thus nearshore receiving waters.

Nearshore waters may also be affected by point-source discharges resulting from accidental spills. The CWA prohibits the discharge of oil and hazardous substances in such quantities as may be harmful into or upon the navigable waters of the United States, including the contiguous zone, exclusive economic zone and adjoining shorelines. Under the CWA, EPA published oil pollution prevention regulations in 1973 (amended in 1974, 1976, 2002 and 2004). These regulations include requirements for both oil spill prevention and response. The Navy has developed operations manuals and spill contingency plans, provides personnel training, and conducts testing of transfer equipment to comply with these regulations. OPVAVINST 5090.1C Environmental Readiness Manual Section 22-2.2.7.1 requires all hands to receive environmental training. This training includes oil and hazardous substance management, handling, minimization, and spill response. Chapter 22 also requires ships to strictly comply with fuel transfer and ballasting procedures to ensure ballast water does not become contaminated with oil or any other waste. Ships using self-compensating fuel tanks are required to ensure adequate margin is preserved to prevent inadvertent discharges of oil with the compensating water. Compliance with the aforementioned laws and procedures would ensure that no significant impact to nearshore water would occur from point-source discharges under the proposed action.

Therefore, operations associated with Alternative 1 would result in less than significant impacts to nearshore waters.

4.2.2.3 Summary of Alternative 1 Impacts

Table 4.2-6 summarizes the potential construction and operational impacts associated with implementation of Alternative 1.

Table 4.2-6. Summary of Alternative 1 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	• SW: temporary increase in stormwater runoff, erosion, and sedimentation; potential for water to accumulate in the upland placement sites • GW: increased potential for local groundwater contamination • WL: no impacts due to distance from proposed action site
	Operation	• SW: increase in stormwater volume and intensity • GW: increased potential for local groundwater contamination • WL: no impacts due to distance from proposed action site
Offshore	Construction	• NW: minor increase in runoff volume and pollutant loading potential; minor increase in wharf-construction related suspended sediment and floating debris; 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 the water column
	Operation	• NW: minor increase in runoff volume and pollutant loading potential; minor, temporary turbidity plumes; beneficial reduction in wastewater-related pollutants

Legend: SW = surface water/stormwater, GW = groundwater, NW = nearshore waters, WL = wetlands, ac = acre, ha = hectare, DO = dissolved oxygen

With the implementation of dredging-related BMPs and any project-specific mitigation measures identified during the USACE permitting process for the dredging of Apra Harbor, there would be no reduction in the amount of wetlands on Guam; there would be less than significant reductions in the availability or accessibility of water resources and. impacts to water quality resulting from dredging would be mitigated to less than significant. No impacts to usable groundwater would occur as no groundwater aquifers used for production are located in the project area. Increases in stormwater would be managed by stormwater infrastructure. Through the development and implementation of site-specific BMPs (Volume 2, Chapter 4, Table 4.2-1) and LID measures, and facility-specific plans and procedures, there would be no increased risk from environmental hazards to human health. Furthermore, all actions associated with Alternative 1 would be implemented in accordance with all applicable federal, GovGuam, and Navy environmental guidance (hazardous materials and oil spill management), laws, and regulations (Table 3.1-1, Volume 8). Therefore, Alternative 1 would result in less than significant impacts to water resources.

4.2.2.4 Alternative 1 Proposed Mitigation Measures

Dredging of Apra Harbor and subsequent handling of the dredged materials and fill of jurisdictional waters of the U.S. 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.

The practice of no barge overflow during dredging and disposal operations would help maintain water quality both near the point of dredging and en route to the disposal site.

Where practicable, additional silt curtains may be installed in deep water portions of the harbor during channel and/or harbor dredging operations to maintain water quality and protect sensitive aquatic resources by shielding sensitive resources from the sediment plume and/or directing the plume away from areas containing sensitive aquatic resources.

Water quality monitoring during pile driving or dredging activities would be conducted. If a visible plume is observed over sensitive coral habitat outside the silt curtains, the construction activity would stop, be evaluated, and corrective measures taken. Construction would not resume until the water quality returned to ambient conditions.

A detailed description of resource protection measures, including BMPs, potentially required by regulatory mandates is in Volume 7 and Volume 2, Chapter 4 Table 4.2-1 of. A more detailed explanation of potential regulatory permitting requirements is available in Volume 8 (refer to Table 3.1-1).

4.2.3 Alternative 2 Former Ship Repair Facility (SRF)

4.2.3.1 Onshore

Construction

Surface Water/Stormwater

Proposed activities under Alternative 2, Former SRF (referred to as Alternative 2), are the same as those described under Alternative 1, except that the Former SRF would be the project area. Thus, potential construction impacts to surface water resulting from implementation of Alternative 2 are similar to the potential impacts discussed under Alternative 1. Please refer to Section 4.2.2.1.

Potential dredging impacts to surface water resulting from implementation of Alternative 2 would be less than the potential impacts discussed under Alternative 1 as the volume of dredged material would approximately 27 % (129,000 cy [98,628 m^3]) less under Alternative 2. Please refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 would result in less than significant impacts to surface water.

Groundwater

Proposed activities under Alternative 2 are the same as those described under Alternative 1, except that the Former SRF would be the project area. Thus, potential construction impacts to groundwater resulting from implementation of Alternative 2 are similar to the potential impacts discussed under Alternative 1. Please refer to Section 4.2.2.1. Therefore, construction activities associated with Alternative 2 would result in less than significant impacts to groundwater.

Wetlands

Proposed activities under Alternative 2 are the same as those described under Alternative 1, except that the Former SRF would be the project area. Under Alternative 2, construction and dredging activities would occur at about the same distance from the identified wetland areas to the east of the dredging area associated with Alternative 1 (at least 2,000 ft [610 m]) (Figure 4.2-2). With the dredging in front of the SRF, Wetland Areas A and B would be approximately 2,600 ft (792 m) west of the nearest extent of dredging operations, slightly closer than under Alternative 1 (Figure 4.2-2). While dredge operations would be slightly closer, the dredge volume under Alternative 2 would be approximately 27% less than under Alternative 1, resulting in a slightly smaller potential suspended sediment volume in the water column. Thus, potential construction impacts to nearshore waters resulting from implementation of Alternative 2 would be slightly less than the potential impacts discussed under Alternative 1.

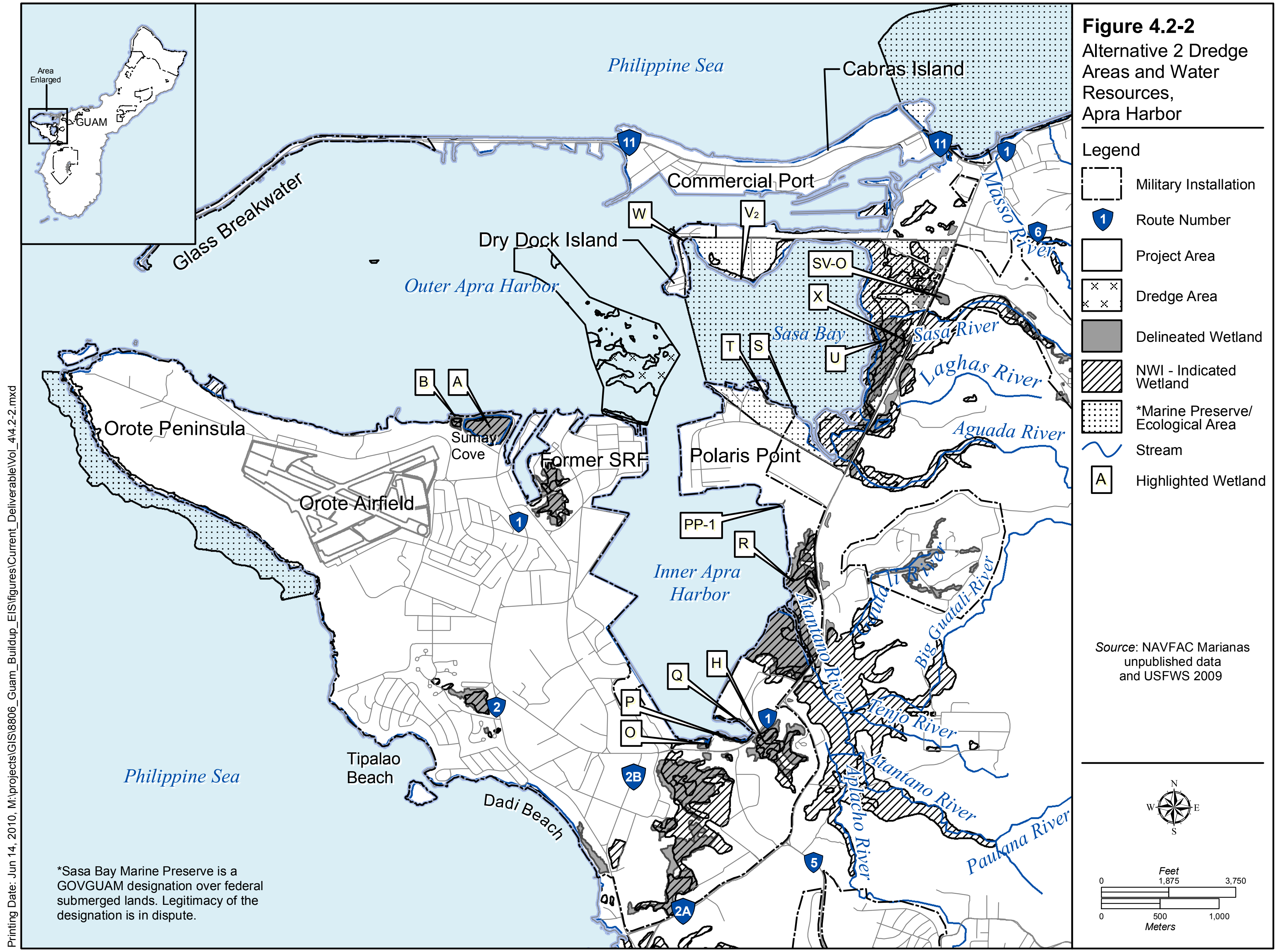

Figure 4.2-2
Alternative 2 Dredge Areas and Water Resources, Apra Harbor

Water quality monitoring, silt curtains and other BMPs would be used, consistent with past dredging operations in Apra Harbor, in order to protect sensitive areas including wetlands. BMPs and any proposed mitigation measures identified during the permitting process, 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) would minimize impacts. Therefore, construction activities associated with Alternative 2 would not affect wetlands.

Operation

Surface Water/Stormwater

Potential operational impacts to surface water resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Please refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 would result in less than significant impacts to groundwater.

Groundwater

Potential operational impacts to groundwater resulting from implementation of Alternative 2 would be the same as the potential impacts discussed under Alternative 1. Please refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 would result in less than significant impacts to groundwater.

Wetlands

Potential operational impacts to wetlands resulting from implementation of Alternative 2 are similar to the potential impacts discussed under Alternative 1. Please refer to Section 4.2.2.1. Therefore, operations associated with Alternative 2 would not affect wetlands.

4.2.3.2 Offshore

Construction

Nearshore Waters

Potential impacts of construction to nearshore waters resulting from implementation of Alternative 2 would be similar to those discussed under Alternative 1; however, due to the proximity of Alternative 2 to Big Blue Reef, effects would be greater to this high quality coral reef habitat and its associated Endangered Species Act (ESA)-listed species (see Chapter 11 of this Volume for additional details).

Under Alternative 2, the total dredged volume anticipated for the SRF would be approximately 479,000 cy (366,222 m^3), including the overdredge; approximately 27% (129,000 cy [98,628 m^3]) less than Alternative 1. As is also the case under Alternative 1, under Alternative 2, the dredged sediments would be placed upland at Naval Base Guam (refer to Figure 4.2-2 in Volume 2, Chapter 4) for dewatering and reuse, disposed of in a USEPA-approved ODMDS for Guam, or disposed of via a combination of these approaches (i.e., ocean disposal, upland placement, and beneficial reuse).

Three sediment samples collected along the SRF wharf during the 2006 characterization effort indicated that sediments in that area were predominantly coarse grained consisting mostly of sand and gravel (85%) and had low TOC (0.17%). Although sediments in that area contained the highest concentrations of total polyaromatic hydrocarbons, lead, and mercury when compared to the other composite samples, none of the analytes exceeded their respective ER-L values. The coarse grain size of the material to be dredged coupled with the low TOC and contaminant concentrations indicate that dredging and disposal would not have significant impacts on water quality and impacts would be similar to those described under Alternative 1. Thus, potential dredging impacts to nearshore waters resulting from implementation of Alternative 2 are similar to the potential impacts discussed under Alternative 1. An additional amount of fill would also be needed for Alternative 2 for the water areas between the slips of the finger piers that would be incorporated into the construction of the wharf area. The additional amount of clean fill required for the finger piers for Alternative 2 would be approximately 20,000 cy (15,291 m^3). Please refer to Section 4.2.2.2 for discussion of potential impacts of dredging and fill similar to both alternatives. With the implementation of BMPs identified in Volume 2, Chapter 4, Table 4.2-1 and any proposed mitigation measures identified during the permitting process, construction activities associated with Alternative 2 would result in less than significant impacts to nearshore waters.

Operation

Nearshore Waters

Potential operational impacts to nearshore waters resulting from implementation of Alternative 2 would be similar to those discussed under Alternative 1; however, due to the proximity of Alternative 2 to Big Blue Reef, effects of resuspended sediments would result in greater long-term impacts (see Chapter 11 of this Volume for additional details).

4.2.3.3 Summary of Alternative 2 Impacts

Table 4.2-7 summarizes the potential construction and operational impacts associated with implementation of Alternative 2.

Table 4.2-7. Summary of Alternative 2 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	• SW: temporary increase in stormwater runoff, erosion, and sedimentation; potential for water to accumulate in the upland placement sites • GW: increased potential for local groundwater contamination • WL: no impacts due to distance from wetlands
	Operation	• SW: increase in stormwater volume and intensity • GW: increased potential for local groundwater contamination • WL: no impacts due to distance from wetlands
Offshore	Construction	• NW: minor increase in runoff volume and pollutant loading potential; minor increase in wharf construction-related suspended sediment and floating debris; 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 the water column
	Operation	• NW: minor increase in runoff volume and pollutant loading potential; minor, temporary turbidity plumes; beneficial reduction in wastewater-related pollutants

Legend: SW = surface water/stormwater, GW = groundwater, NW = nearshore waters, WL = wetlands, ac = acre, ha = hectare, DO = dissolved oxygen

With the implementation of dredge-related BMPs and any project-specific mitigation measures identified during the USACE permitting process for the dredging of Apra Harbor, there would be no reduction in the amount of wetlands on Guam, and there would be less than significant reductions in the availability or accessibility of water resources. No impacts to usable groundwater would occur as no groundwater aquifers used for production are located in the project area. Increases in stormwater would be managed by stormwater infrastructure. Through the development and implementation of site-specific BMPs (Volume 2, Chapter 4, Table 4.2.1) and LID measures, and facility-specific plans and procedures, there would no increased risk from environmental hazards to human health. Furthermore, all actions associated with Alternative 2 would be implemented in accordance with all applicable federal, GovGuam, and Navy environmental guidance (hazardous materials and oil spill management), laws, and regulations. Therefore, Alternative 2 would result in less than significant impacts to water resources.

4.2.3.4 Alternative 2 Proposed Mitigation Measures

Under Alternative 2, the same proposed mitigation measures as described under Alternative 1 would be implemented (see Section 4.2.2.4).

4.2.4 No-Action Alternative

4.2.4.1 Surface Water/Stormwater

Under the no-action alternative, no construction, dredging, or operations associated with the aircraft carrier berthing would occur. Existing operations at Polaris Point, as a military training and recreational facility, and the Former SRF, as a commercial ship repair facility, would continue; therefore, existing surface water conditions would remain.

There are limited surface water resources flowing into or adjacent to Apra Harbor. Threats to surface water adjacent to Apra Harbor 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 berthing the carrier in Apra Harbor would not change the on-going 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.

4.2.4.2 Groundwater

Under the no-action alternative, no construction, dredging, or operations associated with the aircraft carrier berthing would occur. Existing operations at Polaris Point, as a military training and recreational facility, and the Former SRF, as a commercial ship repair facility, would continue; therefore, existing groundwater conditions would remain.

There are no local usable groundwater resources in or adjacent to Apra Harbor. However, regional 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 berthing the carrier in Apra Harbor 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. Therefore, implementation of the no-action alternative would result in no impacts to groundwater.

4.2.4.3 Nearshore Waters

Under the no-action alternative, no construction, dredging, or operations associated with the aircraft carrier berthing would occur. Existing operations at Polaris Point, as a military training and recreational facility, and the Former SRF, as a commercial ship repair facility, would continue; therefore, existing nearshore conditions would remain.

The identified nearshore water quality concerns for the marine waters of Apra Harbor (copper, aluminum, nickel, *enterococci* bacteria, total residual chlorine, biochemical oxygen demand and total suspended solids) would 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 (e.g., the former Orote Landfill) are identified and removed or otherwise managed. As a result, a reduction in pollution loading to nearshore waters from upland sources would occur. Not berthing the carrier in Apra Harbor would not change the on-going nearshore water quality concerns or the protection actions for Guam nearshore waters; these conditions and actions would persist. Therefore, implementation of the no-action alternative would result in no impacts to nearshore waters.

4.2.4.4 Wetlands

Under the no-action alternative, no construction, dredging, or operations associated with the aircraft carrier berthing would occur. Existing operations at Polaris Point, as a military training and recreational facility, and the Former SRF, as a commercial ship repair facility, would continue; therefore, existing wetland conditions would remain.

The identified primary threats to wetlands in and adjacent to Apra Harbor (human disturbance, non-native plants species, sedimentation, and erosion) would persist. These threats to wetland area and function are of concern and are therefore monitored by federal and Guam agencies to protect wetland areas. The absence of berthing the carrier in Apra Harbor would not change the on-going threats or protection actions for wetlands on Guam; these conditions and actions would continue. Therefore, implementation of the no-action alternative would result in no impacts to wetlands.

4.2.5 Summary of Impacts

Table 4.2-5 summarizes the potential impacts of each action alternative and the no-action alternative. A text summary is provided below.

Implementation of either Alternative 1 or Alternative 2 would have the potential to impact the quality and quantity of stormwater runoff during both the construction and operational phases of the project. Construction activities would have the potential to cause erosion and sedimentation which could degrade surface water quality. However, the development and implementation of BMPs (Volume 2, Chapter 4, Table 4.2.1), site-specific BMPs, LID IMP measure, and facility-specific plans and procedures, would minimize impacts to water resources. An SPCC Plan would be implemented under the action alternatives to reduce the potential for leaks and spills from contaminants. In addition, roadway-specific BMPs would be included in the planning, design, and construction of all roadways. Increases in stormwater would be managed by stormwater infrastructure. Proposed construction activities within the 100-year flood zone would incorporate flood protection measures.

Under Alternatives 1 and 2, the dredged material upland placement sites would be located several miles/kilometers from the NGLA; any effluent that percolates into the underlying soils would not affect groundwater drinking quality or quantities. Nearshore water quality would be temporarily degraded by turbidity and suspended sediments. However, with implementation of dredging-related BMPs and any project-specific mitigation measures identified during the USACE permitting process (see Section 4.2.2.4) for the dredging of Apra Harbor, there would be less than significant impacts to nearshore waters from dredging or ocean disposal. There would be no impacts to wetlands under either alternative.

Alternatives 1 and 2 would be implemented in compliance with all federal, local, and Navy environmental guidance (hazardous materials and oil spill management), laws, and regulations (Volume 8, Table 3.1-1), and would include the implementation of BMPs, LID measures, and monitoring. Implementation of Alternative 1 would result in less than significant impacts to water resources. Similarly, implementation of Alternative 2 would also result in less than significant impacts to water resources. Existing conditions would remain the same under the no-action alternative; therefore, there would be no impacts to water resources under the no-action alternative.

Table 4.2-5. Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
Construction Impacts		
SW: LSI • temporary increase in stormwater runoff and sedimentation; temporary discharge of ponded rainwater GW: LSI • increased potential for local groundwater contamination NW: SI-M • minor increase in runoff volume and pollutant loading potential; minor increase in wharf-construction related suspended sediment and floating debris; 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 the water column WL: NI • no impact due to distance from wetlands	SW: LSI • temporary increase in stormwater runoff and sedimentation; temporary discharge of ponded rainwater GW: LSI • increased potential for local groundwater contamination NW: SI-M • minor increase in runoff volume and pollutant loading potential; minor increase in wharf-construction related suspended sediment and floating debris; 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 the water column WL: NI • no impact due to distance from wetlands	Water Resources: NI
Operation Impacts		
SW: LSI • increase in stormwater volume and intensity GW: LSI • increased potential for local groundwater contamination NW: LSI • minor increase in runoff volume and pollutant loading potential; minor, temporary turbidity plumes; beneficial reduction in wastewater-related pollutants WL: NI • no impact due to distance from wetlands	SW: LSI • increase in stormwater volume and intensity GW: LSI • increased potential for local groundwater contamination NW: LSI • minor increase in runoff volume and pollutant loading potential; minor, temporary turbidity plumes; beneficial reduction in wastewater-related pollutants WL: NI • no impact due to distance from wetlands	Water Resources: NI

Legend: SI = Significant impact, SI-M = Significant impact mitigable to less than significant, LSI = Less than significant impact, NI = No impact, ,SW = surface water/stormwater, GW = groundwater, NW = nearshore waters, WL = wetlands, DO = dissolved oxygen

4.2.6 Summary of Proposed Mitigation Measures

Table 4.2-6 summarizes the proposed mitigation measures.

Table 4.2-6. Summary of Proposed Mitigation Measures

Alternative 1	*Alternative 2*
Construction	
• Physical Barriers: Deep water silt curtains • No barge overflow during dredging operations • Water quality monitoring	• Same as Alternative 1
Operation	
• None identified	• None identified

4.3 LEAST ENVIRONMENTALLY DAMAGING PRACTICABLE ALTERNATIVE (LEDPA)

This section focuses on compliance with the Section 404(b)(1) guidelines of the CWA. In addition to being the preferred alternative, Alternative 1, as the proposed aircraft carrier berth project is currently defined, is considered the *least environmentally damaging practicable alternative* (LEDPA). Specifically, Section 404(b)(1) of the CWA stipulates that no discharge of dredged or fill material into waters of the United States, 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 could be implemented after taking into consideration cost, existing technology, and logistics in light of overall project purposes. Section 404 permitting is applicable to the proposed new berthing of the aircraft carrier at Guam for the proposed work within Apra Harbor. Permitting decisions are based on guidelines ("404(b)(1) Guidelines") developed jointly with the USEPA that are now part of the Code of Federal Regulations (40 CFR 230). 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 has identified the LEDPA consistent with the Section 404(b)(1) guidelines. As part of the regulatory review process, the USACE will prepare the final findings of fact and factual determinations pursuant to Section 404(b)(1) of the CWA which support selection of the LEDPA.

The Section 404(b)(1) analysis below follows the legal guidelines with regard to content and format; thus, the various subparts and section headings can readily be cross referenced with the regulations. The list of subparts that are discussed include:

- Subpart A: General
- Subpart B: Compliance with the 404(b) Guidelines
- Subpart C: Potential Impacts on Physical and Chemical Characteristics of the Aquatic Ecosystem
- Subpart D: Potential Impacts on Biological Characteristics of the Aquatic Ecosystem
- Subpart E: Potential Impacts on Special Aquatic Sites
- Subpart F: Potential Effects on Human Use Characteristics
- Subpart G: Evaluation and Testing
- Subpart H: Actions Taken to Minimize Adverse Effects

This section ends with a brief comparative summary of the two alternatives carried forward for analysis in this EIS and highlights the reasons why Alternative 1 is considered the LEDPA. Table 4.3-1 at the end of this discussion identifies the corresponding sections within the Section 404(b)(1) guidelines analysis that follows.

Throughout this analysis, other Chapters (particularly Chapters 4 and 11) within the Volume are referenced to minimize redundancy. While the intent of this analysis is to provide sufficient data to show that Polaris Point is the LEDPA, it is not the intent to be all inclusive. Therefore, as noted in the text throughout this section, other Chapters should be reviewed for additional details.

SECTION 404(B)(1) GUIDELINES ANALYSIS

Subpart A. GENERAL:

Location. Outer Apra Harbor, Guam (See Figure 2.3-1, Volume 4).

Project Purpose.

The proposed project is the construction and operation of a new deep-draft wharf with outer harbor and shoreside infrastructure improvements, creating the capability to support a transient nuclear powered aircraft carrier in Apra Harbor, Guam.

General Description.

Two wharf locations Alternative 1 (preferred) and Alternative 2 are carried forward for analysis (see the following section for more information on alternatives considered and dismissed).

Under the proposed action with a transient-capable port, the new aircraft carrier berth would support a cumulative total of up to 63 visit days per year, with an anticipated length of 21 days or less per visit. This capability is required to support increased aircraft carrier operational requirements in the Western Pacific. The longer transient visits would interfere with existing munitions operations and therefore require a new deep-draft wharf that can accommodate the transient aircraft carrier. Additionally, due to the length of a transient visit, shoreside infrastructure for utilities (i.e., power, wastewater management, potable water supply) must be improved to minimize or eliminate reliance on shipboard systems while in port.

The primary project components include wharf construction and dredging. Although final designs are not available, impact analysis for wharf construction is based on steel pile construction. Final design, using refined data, analyses, and costs, may indicate that one of the other design alternatives, especially the concrete caissons, is better suited. Dredging is required within the area near the channel bend, portions of the turning basin, and areas alongside the proposed wharf structure to accommodate the aircraft carrier at either wharf location. Dredging is required to deepen these areas to the required -49.5 ft (-15 m) plus 2 ft (0.6 m) of overdredge. Approximately 608,000 cy (464,850 m^3) of dredged material would be removed for Alternative 1 and approximately 479,000 cy (366,222 m^3) would be removed for Alternative 2. Approximately 30% of the dredged material would be generated at the shoreline area of either alternative to provide an appropriate slope for the wharf structure. The dredge footprint area for Alternative 1 is 53 ac (21.4 ha) and 44 ac (17.8 ha) for Alternative 2.

The dredging method historically used in Guam is mechanical dredging with a barge-mounted crane with attached clamshell buckets to retrieve the sediment and deposit it on a scow (barge). Mechanical dredging using a traditional clamshell bucket is assumed for this EIS analysis because it represents the maximum adverse environmental impact in terms of short-term water quality impacts. It is likely that this method would be used for the proposed dredging; however, the decision for the type of dredge to be used would not be made until final design. Further discussion of dredging methodologies is located in Chapter 2 of this Volume and Volume 9, Appendix D.

Alternatives Considered, Dismissed, and Carried Forward. As previously discussed in Section 2.3.1, Chapter 2, the analysis and selection of reasonable alternatives and options for: 1) wharf location, 2) wharf alignment, 3) navigation channel, and 4) turning basin options for transient carrier visits were based on consideration of the following criteria:

- Practicability (with sub-criteria)
  - Meets security/force protection requirements
  - Meets operational/navigational characteristics
  - Meets cost, technology, and logistics requirements
- Avoids and/or minimizes environmental impacts to the extent practicable

Although the criteria are not specifically weighted, it is imperative that security/force protection or operational requirements not be compromised. Therefore, these two criteria represented the first level of screening for the alternatives analysis and any alternative that did not meet these basis requirements were automatically dismissed.

Section 2.3 of Volume 4 provides a detailed overview of the reasons why numerous options including 10 individual wharf locations, 4 wharf alignments, 2 navigation channel alignments, 1 turning basin option, and 2 structural wharf design options were dismissed from further study in this EIS. A short summary is provided below.

Wharf Location. Ten individual wharf locations were considered (see Table 2.3-1, Section 2.3.6 of this Volume). Following is the list of locations in italics considered and dismissed and the criteria why they were dismissed. Section 2.3 contains a detailed discussion of this elimination process.

Guam Commercial Port – security/force protection and operational/navigational

Glass Breakwater – security/force protection and operational/navigational

Dry Dock Island – operational/navigational and environmental

Bravo Wharf/pier – security/force protection, operational/navigational

Lima Wharf – security/force protection, operational/navigational

Delta and Echo Wharves – security/force protection, operational/navigational

Sierra Wharf (and all Inner Apra Harbor Wharves) – security/force protection

Kilo Wharf – operational/navigational

Polaris Point – retained (Alternative 1)

Former SRF – retained (Alternative 2)

As discussed previously in Section 2.3.1 of this Volume, during the public comment period on the Draft EIS, the public provided a new site location between Kilo Wharf and Sumay Cove, in an area adjacent to San Luis beach and design alternatives for Delta/Echo pier. These alternatives were evaluated and dismissed from further analysis in the EIS.

Alternative 1 (preferred) and Alternative 2 are the only two sites that meet the screening criteria and are therefore carried forward for analysis in this EIS. See Section 2.3 of this Volume for a detailed analysis.

Wharf Alignment. Section 2.3 of this Volume describes in detail the various wharf alignments that were considered and dismissed. Two wharf alignments were assessed for Polaris Point: parallel to shore (east-west) and a diagonal alignment from Polaris Point across the bay (southwest to northeast). For the parallel to shore (east-west) alignment, two options for aircraft carrier approach were considered, one with a full clearance area and one with a reduced clearance area. The diagonal alignment was dismissed because of the potential direct impacts to coral, it would be most exposed to storm waves, and it would require additional cost to implement. The full clearance, parallel to shore alignment was also dismissed because a land outcrop north of Polaris Point would have to be removed, which would also result in greater direct coral impacts than the reduced clearance option under consideration. A reduced clearance was approved by port operations, harbor pilots and Commander, U.S. Pacific Fleet to ensure that the reduction was acceptable from a navigation and operations perspective. Therefore, the parallel to shore (east-west), reduced clearance is carried forward for analysis in the EIS.

Three wharf alignments were considered for the Former SRF, all of which were parallel to shore. Two options were dismissed, one of which would permanently block access to the dry dock, even when the aircraft carrier is not present and the second of which would require significant amounts of excavation of existing land area. The wharf alignment alternative retained for further consideration in this EIS at the Former SRF follows the current shoreline as it extends from the end of the finger pier at Lima Wharf in a north-northwesterly direction toward the current location of the floating dry dock.

Navigation Channel. Three navigation channel options were considered, including a channel with a sharp bend (54 degrees), a straight channel, and slight bend option. As discussed in Section 2.3 of Volume 4, the straight channel and slight bend option were dismissed because of their direct impacts to high quality coral. The sharp bend option, which has been retained for analysis in this EIS, is the least favorable for navigation but the least environmentally damaging because it minimizes direct impacts to coral in the vicinity of Jade and Western Shoals and requires less dredging than the other two options.

Turning Basin. The minimum radius turning basin option was retained for analysis in this EIS because it met the minimum radius needed to safely maneuver the aircraft carrier while minimizing dredging and impacts to corals. See Section 2.3 of this Volume for additional details.

Wharf Design. Structural design options include vertical steel pile supported wharf on armored slope embankment, tied-back steel sheet pile bulkhead (including solid fill), and concrete caissons. All design options would disturb the same area, but there are structural and environmental impact advantages (alters but retains open water and intertidal habitat under the wharf) to a steel pile supported wharf, as described in Section 2.3. Also, due to the need to have a level foundation for the full width of the caisson alternative, additional dredging would be needed for the caisson design alternative increasing its potential environmental impacts as well as cost. Final design is not available for inclusion in this EIS. The impact analysis is based on steel pile construction.

Subpart B. COMPLIANCE WITH THE 404(b) GUIDELINES

230.10. <u>Restrictions on Discharge</u>

<u>Description of the Proposed Discharge Site(s)</u>. Discharge sites regulated by Section 404(b)(1) associated with the proposed action would be located at the site of construction for the new wharf. As discussed in

Section 2.3, this EIS assumes that steel pile construction would be used; however, final design is not yet available. A typical steel pile wharf design is shown on Figure 2.5-5 of this Volume. Fill would be in the form of a sloped marine revetment that would be placed under the wharf and along the shoreline to support the vertical steel piles and stabilize the shoreline. In comparison to other wharf construction methods, steel pile construction would require less fill than sheet pile bulkhead wharves and less dredging than caisson-based wharves.

Because the proposed dredging is also an integral part of this project, a discussion of dredged material disposal is included here. The EIS assumes five disposal scenarios: 100% ODMDS (ocean) disposal, 100% upland placement, 100% beneficial reuse, 20-25% beneficial reuse/75-80% ocean disposal, and 50% beneficial reuse/ 50% ocean disposal.

Under the 100% upland placement scenario, five upland placement sites on Navy land were initially identified in the Draft EIS 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 detail in Appendix D of Volume 9. Fields 3 and 5 and Polaris Point have been proposed for other dredging projects and have already been addressed in a NEPA document. Field 4 and PWC Compound sites are addressed in this EIS in Volume 2 and Volume 9, Appendix D. Polaris Point, Field 5, and PWC Compound sites were noted in the Draft EIS to each individually have sufficient capacity to accommodate all of the anticipated dredged material from either alternative action. Recent preliminary information from the upland placement study supplemental review has indicated that there may be substantially less upland capacity available on the five confined disposal facilities on Navy lands. Due to land use changes, Field 4, the PWC Compound, and the Polaris Point CDFs may not be available for upland placement. Capacity may be reduced in Field 5 due to cell construction to separate different types of materials. Field 3 remains a suitable option for upland placement. Used in combination with the ODMDS and beneficial reuse, only a portion of the candidate sites would be required to accommodate the dredged material. Upland dewatering, which occurs through evaporation and infiltration 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.

As noted above, the Navy is in the process of developing a detailed dredged material management plan as a supplement to the Navy's 2008 upland placement study that will incorporate the disposal options, specific plans for beneficial reuse to the extent possible, and include specific monitoring efforts required for each disposal option.

As noted in Section 2.3, USEPA is pursuing the final designation of an ODMDS approximately 11 to 14 nm (20 to 26 km) from the west coast of Apra Harbor. The designation is anticipated in 2010 and the ODMDS EIS has been prepared concurrent with this EIS. Volume 9, Appendix D provides the details regarding the dimensions, dike heights, and volume capacities of the five upland placement sites noted above. The upland placement sites are enclosed by earthen berms of 16 to 30 ft (5-9 m) in height. The dredged material would always be at or below the berm height. The berms would have an exterior horizontal to vertical slope of 2:1. No soil or fill would be brought to the site for construction. Vegetation would be cleared and soil compacted. Non-hazardous dredged material water would be allowed to evaporate or percolate through the ground. However, during extended periods of intense rain such as would occur with a typhoon, infiltration rates may be exceeded and, although unlikely, temporary discharge of stormwater may occur. All of the sites considered for dewatering are uplands and no wetland impacts would occur from their use. Only the Polaris Point upland placement facility would be located in the 100-year flood zone.

Types of discharge sites. Open water and upland disposal.

i) Type(s) of Habitat. The proposed wharf construction in-water area is designated as M-2 or an area of "Good" water quality. The existing upland sites contain previously disturbed upland vegetation and for Field 5 previously dredged materials; the proposed ODMDS open-water sites are deep water bottom and are being addressed in a separate EIS (NAVFAC 2009).

ii) Timing and duration of discharge. Wharf construction would take approximately three and one half years to complete, which includes the time needed for dredging. The dredging project is expected to take approximately eight to eighteen months to complete. Further refinement of the dredging timeframe would occur during the permitting process.

Description of discharge. Pile driving equipment would be used for wharf construction. Impacts to marine resources from pile driving are discussed in Chapter 11 of this Volume. Placement of the quarry stone and riprap stone for the marine revetment for shoreline protection would involve the use of clamshell loaders or similar bucket loaders to place the rock along the slope of the shoreline beneath where the wharf would be constructed for either alternative. The overall area of the concrete deck for both alternatives is 90 ft (27 m) wide by up to approximately 1,325 ft (404 m) long except where the storm bollards are installed where the width would be approximately 115 ft (35 m). For Alternative 1, the marine revetment would be placed under the deck on the existing surface at a slope of 1 vertical to 1.5 horizontal to a depth of 3 ft (1 m). Approximately 42,000 cy (32,111 m^3) of quarry stone would be placed as fill and 19,815 cy (15,150 m^3) of riprap stone placed as fill. The affected surface area would be approximately 3.6 ac (1.5 ha) that would represent a loss of open water/intertidal habitat. For Alternative 2 an additional amount of fill would be needed for the water areas between the slips of the finger piers that would be incorporated into that structure. The additional amount of clean fill required for the finger piers for Alternative 2 would be approximately 20,000 cy (15,291 m^3). Alternative 1 does not have this additional fill requirement. As part of the construction of the pile supported structure, there would be temporary resuspension and redistribution of sediments in the construction area. For purposes of the EIS, it has been assumed that the material would be removed using a mechanical (bucket) dredge with placement of the dredged material into scows for disposal.

230.11. Factual Determinations

A. Physical Substrate Determination. Dredging is required within the area near the channel bend, portions of the turning basin, and areas alongside the proposed wharf structure to accommodate the aircraft carrier at either wharf location. Dredging is required to deepen these areas to the required -49.5 ft (-15 m) plus 2 ft (0.6 m) of overdredge. Approximately 608,000 cy (464,850 m^3) of dredged material would be removed for Alternative 1 and approximately 479,000 cy (366,222 m^3) would be removed for Alternative 2. Approximately 30% of the dredged material would be generated at the shoreline area of either alternative to provide an appropriate slope for the wharf structure. The dredge footprint area for Alternative 1 is 53 ac (21.4 ha) and 44 ac (17.8 ha) for Alternative 2.

The proposed dredging activities under either alternative would significantly impact coral and coral reefs, including live/hard bottom "live rock" communities. For a discussion of corals, see Section 230.44 coral reefs below. Potential impacts to non-coral benthic organisms include direct impacts to those organisms residing in the immediate dredge areas. Organisms residing in the area adjacent to and outside the dredged impact area could experience indirect impacts due to increased sedimentation from dredging activities. The impacts to non-coral substrate would be temporary and localized, however significant due to the quantity removed. Sessile (permanently attached or immobile) organisms such as marine floral communities (macroalgae) have been found to be the predominant benthic community at 40% (almost twice the overall coral cover [22%]) within the area to be dredged. Approximately 46 acres [22 ha] of non- coral substrate and approximately 10 acres of algae bed habitat would be removed. Due to the intensity of the impact (large area removed), and cumulative impacts associated with dredging of a variety of habitats (refer to Section 11.2.1.2, in this volume) a "more than minimal" significant effect on marine flora and sessile invertebrate habitat was determined, however effects are temporary as described below.

Under Alternatives 1 and 2, dredging activities would have direct, semi-permanent impacts to non-coral benthic organisms, particularly to sessile organisms. Although mortality would occur to marine flora and sessile invertebrates, new recruits would replenish these populations. The rate of re-colonization and the type and abundance of benthic invertebrates re-colonizing the bottom would depend on both abiotic and biotic factors. Abiotic factors include physical substrate conditions, water temperature, DO content, and salinity. Biotic factors include succession, recruitment, competition, and biogeography.

It is anticipated that the communities may return within a year of being dredged. Therefore, early dredge zones would recover as the staggered 18 month dredging process moves through the harbor channel. Considering, maintenance dredging would take place approximately every 10 years, the fast-growing, non-coral benthic community would have time to recover and provide those ecological services temporarily lost. Therefore, no long-term adverse impacts on the benthic marine flora and invertebrate community in Apra Harbor are expected. Impacts to non-coral benthic organisms would be less than significant as a result of implementing the offshore dredging component of Alternatives 1 and 2. See Volume 4, Chapter 2 and 11 for full impact analysis.

Actions have been taken to avoid and minimize adverse impacts to coral by the selection of alternatives that reduce the direct potential impacts to coral utilizing the sharp bend alternative for access to the proposed turning basin for each alternative. The potential impacts to corals have been further reduced by minimizing the turning basin radii for each alternative under consideration. The potential impacts to coral of Alternative 1 were minimized by dismissal of the full clearance, parallel to shore alignment because under that alignment a land outcrop north of Polaris Point would have to be removed, which would also result in greater direct coral impacts.

Considering that both of the alternative areas have been previously dredged and that dynamic physical conditions dominate the areas, pre-construction conditions would return relatively quickly except where changed by the presence of pilings and riprap beneath the wharf or where slow-growing corals have repopulated the area since the last dredging event 60 years ago. Those structures associated with wharf construction are likely to provide additional benthic settlement areas for sessile organisms as well as refuge for Apra Harbor fish species.

A suite of proposed mitigation options are being proposed to offset the loss of corals (see Section 230.44).

B. <u>Water Circulation, Fluctuation and Salinity Determination.</u> No significant change to water circulation, fluctuation, or salinity is expected to occur.

C. <u>Suspended Particulate/Turbidity Determinations.</u> During dredging and construction of the proposed wharf for either alternative, nearshore water quality would be temporarily impacted by turbidity and suspended sediment generated during the dredging process and construction activities as described in Section 4.2 of this Volume. Dispersion modeling of suspended sediment from dredging activities in Apra Harbor was conducted in March 2009 as part of the *Habitat Equivalency Analysis and Supporting Studies* with a detailed summary is included in Appendix E 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. Due to the similarities in site conditions and subsequent anticipation of similar silt curtain effectiveness, 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. As dredging for the proposed project would be conducted continuously, the maximum daily rate of 24 hours was used in the model. Under the maximum potential adverse effect scenario model run, the dredge plume had a maximum length of 328 ft (100 m). The plumes rapidly dissipated following dredging.

Given the coarse nature of the majority of Outer Apra Harbor sediments, it is likely that the suspended sediment would settle out rapidly, resulting in a much shorter turbidity plume than fine grained sediments in Inner Apra Harbor. Turbidity control measures such as the installation of silt curtains would be implemented to prevent suspended sediments from exceeding water quality standards outside the work area, and frequent monitoring during construction to ensure the effectiveness of suspended sediment containment would be performed. Dredging operations would be halted if the turbidity plume is visible outside the silt curtain (see Volume 7).

D. <u>Contaminant Determinations.</u> Sediment quality investigations in 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, including the vicinity of Alternatives 1 and 2. Figure 2.3-9 in Chapter 2 of this Volume provides the location of the sediment samples for the 2006 testing. Sediment contamination was low throughout all the areas sampled.

Additional sediment sampling and analyses in Outer Apra Harbor were conducted in March 2010 to delineate the distribution and magnitude of chemicals of potential concern within the dredge footprint of the two potential aircraft carrier berthing sites; Polaris Point and the Former SRF wharf. Material from the proposed aircraft carrier turning basin was also evaluated (NAVFAC Pacific 2010a). Figure 2.3-10 in Chapter 2 of this Volume provides the location of the sediment samples for the March 2010 testing. The full report of this study is contained in Volume 9 Appendix K.

Consistent with previous sediment sampling efforts conducted in these locations, sediment samples were analyzed for physical and chemical parameters, including general chemistry, metals, semi-volatile organic compounds (polynuclear aromatic hydrocarbons [PAHs], phenols, and phthalates), organochlorine pesticides, polychlorinated biphenyls (PCBs), and organotins and the results compared to effects range-low (ER-L) and effects range-median (ER-M) sediment quality guidelines, as established. The 2010 analysis concluded that low chemical concentrations found in the most recently collected sediment samples from Polaris Point, the Former SRF Wharf, and the Turning Basin were consistent with other previous Tier III dredged material evaluations conducted in the same areas of Apra Harbor in the NAVFAC Pacific 2006 study where the material was deemed suitable for ocean disposal. Details of this additional testing and results are presented in Chapter 4 of this Volume 4.

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.

E. <u>Aquatic Ecosystem and Organism Determination.</u> As described in Volume 4, Section 11.2, the proposed dredging activities under either alternative would have a long-term, significant impact on essential fish habitat (EFH), specifically coral reefs and some live/hard bottom communities. Proposed compensatory mitigation, as described in Section 230.44, would be required. The proposed construction of the aircraft carrier wharf would change the bottom habitat for either alternative location. Under Alternatives 1 and 2, dredging activities would have direct and semi-permanent impacts to non-coral benthic organisms particularly to sessile (non-mobile) organisms. Some mortality would occur to marine flora and sessile invertebrates, other such organisms are anticipated to quickly colonize the area once project activities cease, as described further in Chapter 11 of this Volume. Unavoidable, short-term adverse direct impacts to marine flora, non-coral invertebrates and associated EFH (i.e. submerged aquatic vegetation [SAS]) from physical removal would occur within the dredged footprint. Although, these organisms are anticipated to reestablish themselves from adjacent areas after construction, considering the size of the impact area and due to the context and intensity, and cumulative effects (see Section 11.2.1.2), these impacts would be "more than minimal", therefore significant, but temporary in nature. So, the implementing the offshore dredging component of Alternatives 1 and 2 may adversely affect EFH.

Those mobile organisms in the region of influence that are not directly subjected to removal or fill activities could sustain impacts as a result of transport, suspension and deposition of dredging-generated sediments. Removal of soft bottom substrate overlying hard substrate would provide additional potential habitat for coral and non-coral benthic organisms.

Two additional special-status species known to occur in the region include the bumphead parrotfish (NMFS candidate species and EFH management unit species [MUS]) and the spinner dolphin (protected under the Marine Mammal Protection Act [MMPA]). The bumphead parrotfish is reported nearby within Piti Bomb Holes Reserve (NOAA 2005); however, it has not been observed in Apra Harbor. Spinner dolphins are rarely reported in Outer Apra Harbor. There would be no significant impacts to or no adverse effects on special-status species (i.e., the action would not "jeopardize" or result in a "take" of an ESA-listed species or a species listed under the MMPA).

F. Proposed Disposal Site Determinations. Under the 100% upland placement scenario, five upland placement sites on Navy land were identified in the Draft EIS 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 detail in Appendix D of Volume 9. Three of the alternative upland placement sites, Polaris Point, Field 5, and the PWC Compound sites were noted in the Draft EIS to each individually have sufficient capacity to accommodate all of the anticipated dredged material from either alternative action. Recent preliminary information from the upland placement study supplemental review has indicated that there may be substantially less upland capacity available on the five confined disposal facilities on Navy lands. Due to land use changes, Field 4, the PWC Compound, and the Polaris Point CDFs may not be available for upland placement. Capacity may be reduced in Field 5 due to cell construction to separate different types of materials. Field 3 remains a suitable option for upland placement. For the upland placement site(s) used, there would be no discharge of effluent associated with the upland placement at any of the possible upland sites and therefore no mixing zones are necessary for this disposal option.

G. Determination of Cumulative Effects on the Aquatic Ecosystem. The proposed action is not expected to have significant cumulative adverse impacts. Dredging and disposal of dredged material has and would continue to cause temporary increases in turbidity in dredged areas. Ongoing and future dredging projects in Apra Harbor would have additive impacts with the dredging proposed under either alternative. The majority of these impacts would be temporary in nature and/or would be minimized through the implementation of mitigation measures and BMPs.

Potential cumulative anthropogenic impacts on non-coral benthic organisms include potential releases of chemicals attached to suspended sediment into the ocean; introduction of debris into the water column and onto the seafloor; and mortality and injury of marine organisms near the areas of impact. Implementation of the proposed action, when considered cumulatively with the past, present and future projects, would have no significant long-term effects or changes to species abundance or diversity; or result in significant loss or degradation of sensitive habitats. The majority of these impacts would be temporary in nature and/or would be minimized through the implementation of BMPs None of the potential impacts would affect the sustainability of resources, the regional ecosystem, or the human community. Therefore, cumulative impacts to non-coral benthic organisms on Guam would be less than significant.

Regarding threatened or endangered species, green and hawksbill turtles are known to utilize Apra Harbor, but there are few records documenting use of beaches for nesting in the proposed project area. It is anticipated that implementation of Alternative 1 and 2 may affect, but is not likely to adversely affect the ESA-listed green sea turtles with regards to dredging associated forage habitat loss, nesting and physical injury. The pile driving components of Alternative 1 and 2, although not likely to take sea turtles, due to limited visibility from elevated turbidity of waters in the action area, may potentially expose sea turtles to noise levels that exceed the NOAA's criterion for Level B Take, and therefore may affect, and likely to adversely affect the green sea turtle and the hawksbill sea turtle. As a result, the Navy will be requesting an Incidental Take Permit for the pile driving action associated with the CVN MILCON. Therefore, Alternative 1 and 2 would result in significant impacts on special-status species.

Increased vessel movements associated with the aircraft carrier and MEU embarkation operation and commercial shipping traffic have the potential for increased sea turtle disturbances and strikes in route to and from Sasa Bay (a high turtle concentration area) within Apra Harbor. However this increase (approximately 3 extra trips per year) is considered negligible in regards to impacts on the sea turtle population.

Potential cumulative impacts to essential fish habitat (EFH), when considered cumulatively with the past, present and future projects would include potential release of pollutants into the nearshore environment; introduction of debris into the water column; mortality and injury of marine organisms (including coral reef ecosystems) near the dredging impact areas; physical and noise impacts from increased vessel activity, and indirect impacts from recreational activities and WWTP loading directly related to increased on-island population growth. Direct and indirect impacts have been documented to marine biological resources, including EFH and ESA-listed species from past projects.

The cumulative impacts to nearshore waters from the various aspects of the proposed action include temporary increases in suspended sediments and turbidity in Apra Harbor and at the existing ODMDS from dredging and disposal activities; potential changes in hydrodynamics from deepening the harbor; increases in stormwater runoff from upland development in the south; and increased sedimentation from construction-related ground disturbance. The majority of these impacts would be temporary in nature and/or would be minimized through the implementation of BMPs, LID measures, permit requirements, sustainability measures, and compliance with federal and local regulations. Cumulative impacts on coral and coral reef MUS present in the EFH of Apra Harbor would be long-term and significant. This significant impact to corals would be mitigated by DoD through the implementation of an approved

Compensatory Mitigation Plan. The compensatory mitigation plan would meet the requirements of the compensatory mitigation rule and include a suite of mitigation projects. Both watershed management and artificial reef projects are being considered. Final determination may not be made until after the ROD on this EIS and during the USACE regulatory process. It is possible that a combination of the mitigation efforts would be appropriate. The various options are listed by categories below and described in detail in Volume 4, Chapter 11, Section 11.2.3).

- Category 1: Watershed Restoration and Management
- Category 2: Coastal Water Resource Management
- Category 3: Apra Harbor Water Resource Management
- Category 4: In-Lieu Fee or Mitigation Banking Program

H. Determination of Secondary Effects on the Aquatic Ecosystem. The proposed action is not expected to have significant secondary effect on the aquatic ecosystem. Implementation of BMPs, monitoring during construction activities, permit compliance, and proposed mitigation of unavoidable impacts would reduce the secondary impacts of the proposed action to a less than significant impact.

230.12. Findings of compliance or non-compliance with the restrictions on discharge.

A. No significant adaptation of the guidelines was made relative to this evaluation.

B. There is no practicable alternative to the proposed action that does not involve the discharge of fill material into waters of the United States.

C. The discharges of fill materials would not cause or contribute to violations of any federal or Guam EPA water quality standard with the implementation of BMPs to control turbidity and giving consideration to the low concentrations of contaminants found in sediment samples for the project area in previous site characterizations.

D. The placement of fill materials would not result in significant adverse impacts to human health and welfare, including municipal and private water supplies, recreational and commercial fisheries, or special aquatic sites. Significant impacts to coral reefs would occur but this impact would be compensated by appropriate mitigation.

E. The upland placement scenario would not result in the discharge of effluent or suspended sediments from the upland site(s) which would require a specified mixing zone or restriction on their discharge.

The proposed action is therefore found to be in compliance with the 404(b)(1) Guidelines.

Subpart C. POTENTIAL IMPACTS ON PHYSICAL AND CHEMICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

230.20. Physical Substrate. As described in Volume 4, Section 11.2, the proposed dredging activities under either alternative would significantly impact coral reefs, live/hard bottom, and submerged aquatic vegetation EFH MUS. For a discussion on corals, see Section 230.44 coral reefs below. The impacts to non-coral substrate would be short-term and localized, however significant. Potential impacts to non-coral benthic organisms include direct impacts to those organisms residing in the immediate dredge areas. Organisms residing in the area adjacent to and outside the dredged impact area could experience indirect impacts due to increased sedimentation from dredging activities. Sessile (permanently attached or immobile) organisms such as marine floral communities (macroalgae) have been found to be the predominant benthic community at 40% (almost twice the overall coral cover [22%]) within the area to be dredged. Under Alternatives 1 and 2, dredging activities would have direct and permanent impacts to non-coral benthic organisms particularly to sessile organisms. Although some mortality would occur to marine flora and sessile invertebrates (specifically live/hard bottom and SAS), other such organisms are anticipated to quickly reestablish once project activities cease, as described further in Chapter 11 of this Volume (NOAA Benthic Habitat Mapping 2007; DOER 2005; Atlantic States Marine Fisheries Commission 2002; and U.S. Army Corps of Engineers Coastal Engineering Research Center 1982). Although, these organisms are anticipated to reestablish themselves (temporary effect) from adjacent areas after construction, considering the size of the impact area and due to the context and intensity, and cumulative effects (see Section 11.2.1.2), these impacts would be "more than minimal", therefore significant. Removal of soft bottom substrate overlying hard substrate would provide additional potential habitat for coral and non-coral benthic organisms. Therefore, impacts to non-coral benthic organisms would be less than significant as a result of implementing the offshore dredging component of Alternatives 1 and 2.

230.21. Suspended Particulate/Turbidity. During dredging and construction of the proposed wharf for either alternative, nearshore water quality would be temporarily impacted by turbidity and suspended sediment generated during the dredging process and construction activities as described in Section 4.2 of this Volume. Given the coarse nature of the majority of Outer Apra Harbor sediments, it is likely that the suspended sediment would settle out rapidly, resulting in a much shorter turbidity plume than fine grained sediments in Inner Apra Harbor (see Chapter 4 of this Volume). Maximum concentrations of suspended solids in the surface plume should be less than 0.5 parts per thousand (ppt) in the immediate vicinity of the operation and decrease rapidly with distance from the operation due to settling and dilution of the material. Turbidity control measures such as the installation of silt curtains would be implemented to prevent suspended sediments from exceeding water quality standards, and frequent monitoring during construction to ensure the effectiveness of suspended sediment containment would be performed. The Navy would monitor for any exceedances of water quality standards. If any exceedances occur, construction activities would be interrupted until turbidity levels returned to acceptable levels. The sedimentation controls would prevent significant impacts to aquatic communities and water quality outside of the project area. According to the modeling results noted in Section 230.60, the turbidity plumes rapidly dissipated following dredging resulting in less than significant impacts.

230.22. Water. Ambient conditions in the project area are designated as M-2 or an area of "Good" water quality as described in Volume 2, Section 2.4, Least Environmentally Damaging Practicable Alternative for Waterfront Functions, and Section 4.2 of this Volume, which addresses water quality impacts from the proposed dredging and construction activities under both alternatives. There would be temporary minor increases in the resuspension of sequestered contaminants (attached to sediments), decreased light transmittance, and minor transient chemistry alterations in the water column during dredging and wharf construction.

230.23. Current Patterns and Circulation. Circulation patterns within the area are controlled by astronomical tides, winds, and to a lesser degree, freshwater discharge from upland water resources. The proposed dredging project and wharf construction would have no effect on circulation patterns, current velocities, or water stratification in Outer Apra Harbor.

230.24. Normal Water Fluctuation. No change in water fluctuation consisting of daily, seasonal, annual tidal and flood fluctuations in water level would occur as a result of the proposed dredging and wharf construction.

230.25. Salinity Gradients. Salinity gradients in Outer Apra Harbor are not expected to change from either alternative.

Subpart D. POTENTIAL IMPACTS ON BIOLOGICAL CHARACTERISTICS OF THE AQUATIC ECOSYSTEM

230.30 Threatened and endangered species. Special-Status Species in the project area include sea turtles. Green and hawksbill turtles are known to utilize Apra Harbor, but there are only historic records documenting use of beaches for nesting near the project area. Noise impacts from in-water construction activities would be the main focus for sea turtles. As identified in Volume 2, Chapter 11, the available data on sea turtle hearing suggests a hearing in the moderately low frequency range, and a relatively low sensitivity within the range they are capable of hearing (Bartol et al. 1999; Ketten and Bartol 2006). Green turtles are most sensitive to sounds between 200 and 700 Hz, with peak sensitivity at 300 to 400 Hz (Ridgway et al. 1969). Sensitivity even within the optimal hearing range is apparently low—threshold detection levels in water are relatively high at 160 to 200 dB with a reference pressure of one dB re 1 μPa-m (Lenhardt 1994).

The ability of sea turtles to detect noise and slow moving vessels via auditory and /or visual cues would be expected based on knowledge of their sensory biology (Navy 2009a). Noise from dredging activities (87.3 dB at 50 ft [15 m]) and pile driving (average 165 dB at 30 ft [9 m] would occur. Sound levels would decline to ambient levels (120 dB) within approximately 150 ft (45.8 m) from in-water construction activities (NMFS 2008c). It is anticipated that NMFS-trained monitors would perform visual surveys prior to and during in-water construction work as part of the USACE permit conditions. If sea turtles are detected (within a designated auditory protective distance), in-water construction activities would be postponed until the animals voluntarily leave the area (see detailed mitigation listings in Volume 7).

The Navy recognizes that there are many on-going and recent past studies on the subject of potential exposures to sea turtles and other marine species from pile driving actions. Further research and validation of these studies are necessary prior to being able to determine the applicability of the methodologies and results to the proposed action within this EIS. The Navy would continue to research these studies and where appropriate, incorporate and apply methodologies, analysis, and results to the on-going impact analysis to sea turtles from the proposed action. Applicability of these studies would also be coordinated through consultations with the National Marine Fisheries Service.

To further protect sea turtles, the contractor performing work in Apra Harbor would be directed to stop work when there is a positive visual sighting of a turtle anywhere near the project. The contractor can resume work fifteen minutes after the turtle submerges and is no longer seen. This instruction is the same for turtles within or outside of the silt curtains.

Additionally, the Navy would comply with USACE permit conditions, which include resource agency recommended BMPs for sea turtle avoidance and minimization measures and protocols during in-water construction activities (dredging and pile driving) and vessel operations. These measures may include look outs, stop work policies when turtles approach the area, and "ramping up" on pile driving activities, and others, are described in detail in the Mitigation Measures section, Volume 7. Formal consultation with NOAA in the context of Section 7 consultation includes these species. Informal consultations between the Navy and these agencies have been ongoing since June 2007 concerning the activities associated with the proposed action.

Potential indirect impacts from construction and operation include noise and activity, which would be less than significant for the reasons discussed in Chapter 10, Terrestrial Biological Resources and Chapter 11, Marine Biological Resources. Direct impacts from incidental boat strikes would be very uncommon and less than significant. Spills, should they occur, could significantly impact the sea turtle nesting area at Sumay Cove and possibly others. However, with implementation of BMPs, SPCC Plans, and with adequate spill equipment and response capabilities, impacts would be less than significant. BMPs and Mitigations are listed in Volume 7.

Three additional special-status species known to occur in the region include the Napoleon wrasse and bumphead parrotfish (a NMFS species of concern and candidate species, respectively), and spinner dolphin (protected under the MMPA). The bumphead parrotfish is reported nearby within Piti Bomb Holes Reserve, approximately 4 mi (6.4 km) from the Outer Apra Harbor Entrance Channel (NOAA 2005), but has not been observed in Apra Harbor. Spinner dolphins are rarely reported in Outer Apra Harbor. When they are sighted, it is only near the outer entrance channel several times a year for short durations. The location of these sightings range from 7,500 - 11,250 ft (2,286 – 3429 m) away from the proposed area of dredging depending upon the stage of dredging. Therefore, a no effects determination for spinner dolphins and bumphead parrotfish are applicable. Effects on the Napoleon wrasse are expected to be short-term and localized, and therefore there would be no adverse affects to this species.

In summary, it is anticipated that implementation of Alternative 1 and 2 may affect, but is not likely to adversely affect the ESA-listed green sea turtles with regards to dredging associated forage habitat loss, nesting and physical injury. The pile driving components of Alternative 1 and 2, although not likely to take sea turtles, due to limited visibility from elevated turbidity of waters in the action area, may potentially expose sea turtles to noise levels that exceed the NOAA’s criterion for Level B Take, and therefore may affect, and likely to adversely affect the green sea turtle and the hawksbill sea turtle. As a result, the Navy will be requesting an Incidental Take Permit for the pile driving action associated with the CVN MILCON. Therefore, Alternative 1 and 2 would result in significant impacts on special-status species.

Increased vessel movements associated with the aircraft carrier and MEU embarkation operation and commercial shipping traffic have the potential for increased sea turtle disturbances and strikes in route to and from Sasa Bay (a high turtle concentration area) within Apra Harbor. However this increase (approximately 3 extra trips per year) is considered negligible in regards to impacts on the sea turtle population.

230.31 <u>Fish, crustaceans, mollusks, and other aquatic organisms in the food web.</u> As described in Volume 4, Section 11.2, under Marine Flora, Invertebrates, and Associated EFH, those mobile organisms in the region of influence that are not directly subjected to removal or fill activities could sustain impacts as a result of transport, suspension, and deposition of dredging-generated sediments. Mobile finfish and some invertebrates would likely vacate the area due to the increased disturbance. Under Alternatives 1 and 2, dredging and construction activities would have direct and permanent impacts to non-coral benthic organisms, particularly to sessile organisms, and some site attached reef fish and mobile macro-invertebrates. Although some mortality would occur to marine flora and sessile invertebrates (i.e. live/hard bottom and SAS), other such organisms are anticipated to quickly recolonize the area once project activities cease. Although there would be no loss of unique species (Dollar 2009), and these organisms are anticipated to reestablish themselves from adjacent areas after construction, considering the size of the impact area, and due to the context and intensity, and cumulative effects (see Section 11.2.1.2), these impacts would be “more than minimal”, therefore significant. Impacts to marine flora, invertebrates, and associated EFH would significant as a result of implementing either Alternative 1 or 2, and therefore may adversely affect associated EFH.

<u>Essential Fish Habitat</u>

As discussed in Volume 2, Chapter 11, all of Apra Harbor is considered EFH and Jade Shoals is a Habitat Area of Particular Concern. Four sensitive MUS associated with EFH include Napoleon or humphead wrasse (NMFS species of concern and EFH-Currently Harvested Coral Reef Taxa [CHCRT]); bigeye scad (EFH-CHCRT); scalloped hammerhead shark (EFH-Potentially Harvested Coral Reef Taxa [PHCRT]); and sessile MUS (EFH-PHCRT), including stony corals (NMFS candidate species present) , soft corals, sponges, algae, etc.

The proposed construction of the aircraft carrier wharf would change the bottom habitat of both alternative locations. Considering that both of the alternative areas have been previously dredged and the dynamic physical conditions that dominate the area, pre-construction conditions would return relatively quickly, except in the area changed by the presence of pilings and riprap beneath the wharf. Those structures associated with wharf construction likely would provide additional benthic settlement areas for sessile organisms (albeit probably non-native species) as well as refuge and forage for Apra Harbor fish species.

Dredging impacts to EFH would be greatest for all life stages of coral and sessile reef species, and some crustacean MUS. Site-attached reef fish and pelagic egg/larval stages of bottomfish and pelagic MUS may also be adversely affected. Coral reef habitat would be permanently lost and would be mitigated through the preparation and implementation of an approved compensatory mitigation plan. Dredging activities would cause turbidity plumes and underwater noise that would temporarily disturb EFH MUS. Indirect impacts to EFH would include initial adverse effects within 40 ft. (20 m) of the dredge site due to cumulative exceedance of 6 mm sedimentation to less than significant effects from the temporary degradation of water quality as a result of suspended solids, reduction of light penetration and interference with filter-feeding benthic organisms out to approximately 144 ft (44 m). The increase in turbidity would be short-term and localized.

BMPs such as the use of silt curtains and proposed mitigation measures as identified in Volume 7 would minimize impacts to this EFH resource through a reduction in sedimentation associated with dredging activities.

230.32 <u>Other wildlife (migratory birds for this analysis).</u> The indigenous grey-tailed tattler and Pacific reef heron utilize food resources within Apra Harbor shoreline areas. A small amount of shoreline habitat that is not currently developed would be removed at the proposed aircraft carrier project area. The amount removed would be very small in relation to the total amount available. Similar areas of habitat are common in the area and any individuals affected would move to these other areas so that there would be less than significant impacts to populations of these shorebirds from removal of habitat.

Potential indirect impacts include noise and activity, pollutants, and dredging sedimentation. Only common migratory bird species widespread on Guam are known within the Polaris Point and Former SRF terrestrial area. Noise and activity from construction could force them to move temporarily but there are other areas of suitable habitat nearby. Existing commercial and Navy activity in Apra Harbor generates substantial background noise and lighting; however, migratory birds still frequent the area. Any noise associated with the temporary construction and dredging would not contribute substantially to the overall background noise and light levels nor significantly impact migratory birds.

Fueling of project-related construction or operation vehicles, watercraft, and equipment could result in accidental releases of petroleum products that would migrate within Apra Harbor. The Sasa Bay mangrove area is over 4,000 ft (1,219 m) from the aircraft carrier dredging location. Required BMPs during construction would make it unlikely for a major spill to occur. There would be a containment boom around the dredging operation to guard against fuel spills. Additionally, Navy oil response units would be present nearby. Pursuant to Navy response plans, small spills would be quickly contained and unlikely to reach environmentally sensitive areas. Potential impacts would be less than significant.

Proposed dredging and construction of the proposed wharf for either alternative location would result in suspension of sediments that could be mitigated. However, resuspended plume modeling results show that sediments would largely be contained within silt curtains employed for the dredging; any sediment plume would not migrate into Sasa Bay or only a very short distance into the bay under all scenarios modeled (Ericksen 2009). Use of silt curtains is part of standard procedures to minimize suspended sediment migration. The two alternatives are located within the confines of Outer Apra Harbor, well away from high wind and wave action, thus increasing the effectiveness of the silt curtains. Impacts would be less than significant.

Subpart E. POTENTIAL IMPACTS ON SPECIAL AQUATIC SITES

230.40 Sanctuaries and refuges. Dredging and construction activities would not significantly affect any of the fish and wildlife resources that are designated for preservation or refuges on Guam.

230.41 Wetlands. The onshore impacts to wetlands are discussed in Volume 4, Section 4.2 for both Alternatives 1 and 2. There would be no direct filling or dredging of wetlands with either alternative. Indirect impacts to coastal wetlands as a result of the release of sediment into the water column is unlikely to reach any wetlands. As noted in Section 4.2, for Alternative 1, the nearest wetland to the proposed dredging activity would be Wetland Area T, located approximately 2,500 ft (762 m) east of the nearest extent of proposed dredging (Figure 4.2-1). Other wetland areas (W, V2, U, S, X, and SV-O would be located even further away from the proposed dredging areas. To the west, Wetland Areas A and B would be located over 3,000 ft (914 m) from the nearest extent of proposed dredging (Figure 4.2-1). For Alternative 2, Section 4.2 notes that the closest wetland area is the same distance from the identified wetland areas to the east of the dredging area associated with Alternative 1 (at least 2,000 ft [610 m]) (Figure 4.2-2). With the dredging in front of the SRF, Wetland Areas A and B would be approximately 2,600 ft (792 m) west of the nearest extent of dredging operations. Potential impacts would be unlikely due to the implementation of dredging BMPs, 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 Alternative 1 or 2 would not impact wetlands.

230. 42 Mudflats. No effect.

230.43 Vegetated shallows. No effect.

230.44 Coral reefs. The interaction of sediment removal and resuspended sediment with benthic communities, particularly corals, is of considerable importance in estimating the effects of the proposed dredging and wharf construction activities. Section 11.1, Volume 4, addresses non-coral benthic organisms. Section 11.2 addresses the impacts of Alternatives 1 and 2 to corals. Under Alternatives 1 and 2, dredging activities would have significant direct, permanent impacts to coral reefs. The coral reef habitat is an important component of the EFH within Apra Harbor, providing habitat necessary to fish for spawning, breeding, feeding, or growth to maturity. In addition to the significance determination described in Section 11.2, the following Habitat Equivalency Analysis (HEA)-related approach was utilized in assessing potential impacts (Navy 2009a). Under the 2008 USACE compensatory mitigation rule, permit applicants are required to mitigate to no net loss of ecological services and function. HEA is a modeling tool that has been used in a variety of legal and technical contexts to quantify impacts to natural resources and the services/functions they provide, and quantify the amount of restoration/mitigation required to offset documented losses. A HEA model was conducted for both aircraft carrier alternatives and a report entitled *Habitat Equivalency Analysis (HEA) Mitigation of Coral Habitat Losses* was prepared. It is included in Volume 9, Appendix E, Section F of this EIS.

The HEA addresses direct and indirect impacts to coral habitat arising from dredging to support aircraft carrier berthing and maneuvering in Outer Apra Harbor. The basic HEA steps include:

1. Loss calculation: Document and estimate the duration and extent of injury from the time of injury until the resource recovers to baseline, or possibly to a maximum level below baseline.
2. Restoration calculation: a) Document and estimate the services provided by the compensatory project over the full life of the habitat, and b) Calculate the size of the replacement project for which the total increase in services provided by the replacement project equals the total interim loss of services due to the injury.

The HEA analysis focuses on the coral habitat expected to be either permanently lost due to direct dredging, initial adverse indirect effects, or temporarily affected by sedimentation. Much of the habitat within the dredge footprint is previously dredged and unconsolidated soft sediment with no coral cover (Smith 2007; Dollar et al. 2009). Due to the short-term and localized impacts associated with dredging on soft bottoms and the anticipated quick recolonization of the benthic community, those habitats were not included in the HEA model.

The total area of removal by dredging (two dimensional view) of habitat with some coral coverage is approximately 25 ac (10.1 ha) for the Alternative 1, and approximately 24 ac (9.7 ha) for the Alternative 2. These acreages represent approximately 1% of the coral habitat of Apra Harbor. When looking within the 200 m study area , each alternative has approximately the same amount of potential coral impact of approximately 71 ac (29 ha). The total area (three dimensional view) of habitat with some coral coverage is approximately 33 ac (13 ha) for Alternative 1 and approximately 32 ac (13 ha) for Alternative 2.

In addition, an estimate was made of the discounted service acre-years expected to be lost due to aircraft carrier dredging-related activities. The “acre-year” metric allows the analysis to consider not only the number of ac lost, but also injury severity and recovery over time. A loss of one acre-year equates to a complete loss of ecological function provided by the identified habitat for one year. Such a loss could be arrived at in numerous ways (e.g., 50% degradation of two ac of habitat for one year, 10% degradation of five ac of habitat for two years, 5% degradation of one acre of habitat for 20 years, etc.).

The simplified examples above do not take into account the effects of discounting, which is applied in the HEA methodology to convert losses occurring in different years into a single, common year. A 3% annual discount rate is applied to the calculations, which is the most common discount rate used in HEA applications and one that research indicates reasonably reflects society’s general preference for current use and enjoyment of resources, compared to future resource use and enjoyment (NOAA 1999, Freeman 1993). The sum of these discounted losses across years represents the present value acre-years of ecological services lost.

Alternative 1 would require the dredging of approximately 608,000 cy (464,850 m^3) of dredged material to obtain the desired -49.5 ft (15 m) MLLW plus 2 ft (0.6 m) water depth to accommodate the aircraft carrier. The total dredge footprint for Alternative 1, with coral, is estimated at 53 ac (21.5 ha). Alternative 2 would require the dredging of approximately 479,000 cy (366,222 m^3) of dredged material. Approximately 30% of the dredged material would be generated at the shoreline area of either alternative to provide an appropriate slope for the wharf structure. The total dredge area for Alternative 2, with coral, is estimated at 44 ac (17.9 ha). Table 11.2-19 summarizes the direct and indirect impacts of dredging to corals based on coral coverage category with the implementation of Alternatives 1 and 2. Areas with the greatest coral abundance (>70 to ≤ 90%) would comprise the smallest portion (10%) of the total coral coverage category that would be lost due to proposed dredging. Areas with the least amount of coral coverage (0 – ≤10%) would comprise the largest portion (approximately 36%) of the total coral coverage category that would be lost due to proposed dredging. About two thirds (62%) of the area proposed for dredging contains corals with a coverage of less than 30%. Approximately 3% of the total area proposed for dredging contains corals in the 70-90%, coverage category and 10% for the 50-90% range of coverage.

In general, approximately 35% of the proposed dredge area contains some coral coverage and virtually all of the area consists of reefs that were dredged 60 years ago during the creation of Inner Apra Harbor, Polaris Point, and Dry Dock Island. Therefore, there would be unavoidable permanent significant impacts to coral reefs from a dredging of approximately 25 ac (10.1 ha) of live coral (all classes [>0% to ≤90%]) and an initial indirect adverse effects due to cumulative sedimentation of greater than 6 mm out to 40 ft (12 m) beyond the dredge footprint.

Chapter 11 of Volume 4 summarizes the data used in the HEA calculations to estimate aircraft carrier-related coral habitat impacts and the resulting loss estimates. As shown in these tables, Alternative 1 is expected to result in a loss of approximately 1,048 discounted service acre-years (DSAYs) of coral habitat (across all coral habitat categories), approximately 996 DSAYs due to direct impacts and 52 DSAYs due to indirect impacts. Alternative 2 is expected to result in a loss of approximately 1,023 DSAYs (969 DSAYs due to direct impacts and 54 DSAYs due to indirect impacts).

The HEA was used to develop an estimate of the DSAYs gained per acre of artificial reef, discounted in the same manner as HEA loss calculations. Given a total expected loss of 1,048 DSAYS, a total of approximately 123 ac (49.8 ha) of artificial reef would be required to compensate for coral habitat impacts expected due to the Alternative 1. Results indicate that each acre of artificial reef would provide approximately 22.1 DSAYs. Approximately 121 ac (49.0 ha) of artificial reef would be required for proposed mitigation of impacts due to Alternative 2.

The Navy is considering a suite of options for compensatory mitigation for the loss of ecological service provided by corals being adversely impacted in Outer Apra Harbor as shown below. The Council for Environmental Quality (CEQ) has provided a number of potential Mitigation Projects to be considered that are included in the list below and discussed in detail in section 11.2.2.4. Specific projects are discussed in the compensatory mitigation impact analysis section 11.2.2.7 in Chapter 11 of this volume.

Compensatory mitigation for unavoidable coral community impacts includes the following options:

Category 1: Watershed Restoration and Management

- Afforestation
- Stream bank stabilization
- Riparian restoration
- Road stormwater BMPs
- Erosion control
- Wetland enhancement
- Land/submerged land acquisition/easement for conservation

- Education

Category 2: Coastal Water Resource Management

- Road stormwater control at a range of sites on Guam
- Shallow water reef enhancement within non-DoD federal property (e.g. National Parks)
    - Land acquisition
    - Erosion control
    - Wetland restoration
    - Artificial reefs
    - Coral transplanting
    - Boundary marking & enforcement
    - Monitoring
    - Education

Aquaculture (e.g. fish hatchery) for native herbivorous species

Support for enhanced enforcement of fishing and recreational diving regulations

Protection and conservation actions

- Marine debris removal
- Nuisance algae removal
- Installation of recreational mooring buoys

- Establishment of marine protected area(s) (MPAs)
- Upgrades/Improvements Wastewater Management Systems

Category 3: Apra Harbor Water Resource Management

- Erosion control
- Stormwater management (roads, wharves, industrial facilities)
    - Artificial reefs
    - Coral transplantation
    - Glass breakwater modifications
    - Wetland enhancement
    - Revise Navy management plans
    - Support for enhanced enforcement of fishing and recreational diving regulations
    - Education
- Protection and Conservation Actions
    - Marine debris removal
    - Nuisance algae removal
    - Installation of recreational mooring buoys

Category 4: In-Lieu Fee or Mitigation Banking Program

The final conceptual determination would not be made until the Record of Decision on this EIS. More detailed identification of mitigation would be done during the USACE permit process. Both artificial reefs and watershed management projects would be considered as potential compensatory mitigation, and it is possible that a combination of those mitigation efforts that are listed below would be appropriate. The Navy has not advanced a proposal at this time and specific mitigation measures would be subject to the permitting action/mitigation decision of the USACE.

The effectiveness of either upland watershed management or artificial reefs schemes to replace coral loss have been studied and conclusions concerning success differ. Section A of the *HEA and Supporting Studies* report (Volume 9, Appendix E, Section A) summarizes key points of discussion that were raised during review of the draft HEA, including relative merits (pros and counterpoints/cons) of artificial reefs and watershed management projects (HEA Section A, 3.3.4, Table 2 and 3, respectively). Compensatory mitigation for unavoidable coral community impacts includes the following options.

Category 1: Watershed Restoration and Management

Watershed restoration and management is a collective term to describe a variety of projects that would remove or diminish anthropogenic stresses on receiving coastal waters in order to improve water quality, resulting in recolonization or improved growth of existing coral in those coastal waters. Restoration of a watershed returns the ecosystem to as close an approximation as possible of its state prior to a specific incident or period of deterioration and restores the ability of the ecosystem to function. Watershed restoration can be complicated because an ecosystem has a myriad of interactions. These include interactions between the watershed's inhabitants, water level and flow, nutrient cycling, and the inevitable, natural changes that occur over time that change ecosystem dynamics (e.g., soil erosion and replacement). When deterioration of a watershed occurs gradually, restoration can require rigorous scientific protocols and involve lengthy, complicated, and costly investigations.

The approach to watershed restoration/conservation is to address reef degradation from discharge of eroded sediments from upland sources. Restoring vegetation to barren areas to reduce soil runoff and subsequent discharge into coastal waters is a major step in watershed restoration and improvement of coastal waters. Most potential watershed restoration projects would involve planting native seedlings in grasslands and badland areas as well as in fertile valley areas of watersheds. Other important elements of a successful watershed restoration project include but are not limited to animal control, monitoring and continuous watershed management.

EPA looks at the watershed restoration process as consisting of the following major steps: (1) build partnerships, (2) characterize the watershed to identify problems, (3) set goals and identify solutions, (4) design an implementation program, (5) implement the watershed plan, (6) measure progress and make adjustments (GEPA 2008)

The following projects could be used separately or in conjunction to develop a conceptual mitigation plan for watershed restoration:

Afforestation. *Coastal marine waters and associated rivers and watersheds on Guam have been recommended by resource agencies for potential compensatory mitigation for coral reef impacts. The approach to restoration/conservation of sites rather than a detailed assessment is described to address on-going problems of reef degradation from discharge of eroded sediments from upland sources.*

The Navy has held several conversations with federal and Guam resource agencies on coral impact assessment and compensatory mitigation methods associated with the Guam Military Relocation EIS. Resource agencies have recommended coastal marine waters and associated rivers and watersheds as restoration candidates for potential compensatory mitigation for coral reef impacts. USFWS has recently provided the following potential sites for a watershed aforestation coral reef restoration option (USFWS 2009). The information below is also supplemented by information from GEPA (2008).

- Achugao Subwatershed – Coastal waters and beach south of Achugao Point located in the southwestern portion of Guam. This beach is the discharge point for *Agaga River* associated with the Cetti Watershed.
- Fouha Subwatershed – Coastal waters at the head of Fouha Bay, located south of Cetti Bay, in the southwestern portion of Guam. Fouha Bay is the discharge point for the *La Sa Fua River* associated with Umatac Watershed in the southwestern portion of Guam.
- Geus Watershed – Coastal waters and marine bay (5 mi^2 [13 km^2]) associated with Cocos Lagoon located at the southern tip of Guam. The *Geus River,* associated with the Geus Watershed, discharges into the Cocos Lagoon.
- Ajayan Subwatershed – Coastal waters and intermittent beach at Ajayan Bay located east of Cocos Lagoon. The *Ajayan River,* associated with the Manell Watershed, discharges into Ajayan Bay.

The recommended watersheds have not been fully evaluated to determine their suitability, but are being considered by the Navy as options for mitigation. These watersheds are associated with reefs that are degraded by sedimentation, but were healthy a few decades ago (USFWS 2009).

Additional restoration/enhancement projects as recommended in Guam Bureau of Statistics and Plans (BSP) (2009) include the following Project Locations: Apra, Tumon, Tamuning, Piti, Asan, Fonte, Southern Agat, Togcha, Ylig, Pago, and Ugum. Project objectives would be to improve water quality and forest habitat restoration in these watersheds as they flow into waters that host marine preserves and other valuable marine resource areas. Most of the potential restoration projects would involve the planting of native seedlings in grasslands and badland areas as well as in fertile valley areas of watersheds. Other important elements of a successful watershed restoration project include but are not limited to animal control, monitoring and continuous watershed management.

Guam BSP (2009) provided figures delineating the boundary of the watershed area in which the listed projects would occur (refer to Figures 11.2-5 through 11.2-8 in Chapter 11 of this Volume). The watershed area on the figures is approximately 4,694,980 ac (1,900,000 ha) along the southwestern coast of Guam, extending from south of Naval Base Guam to the southern point of Guam and Cocos Island. The watershed area was selected because there is evidence that coral communities have previously existed in the receiving coastal waters. Under improved water quality conditions, these coral communities could be restored.

The Talofofo watershed associated with the Main Cantonment is located on Navy-owned land. The watershed currently suffers from soil erosion which manifests itself in sediment transfer to various streams that feed into Talofolo Bay. The Main Cantonment Watershed of savanna grassland vegetation would be restored and protected within the northeastern portion to address an on-going problem of reef degradation in Talofofo Bay from the transport of eroded sediments.

The potential for watershed restoration on privately owned lands would be limited as these types of projects require full control of the land and its uses to be successful. A Sella Bay watershed restoration project was proposed as compensatory mitigation for coral loss at Kilo Wharf. Because land use was not totally controlled and management agreements could not be concluded, the project had to be moved to Cetti Bay. It may be possible, however, to have a combination of reforestation/aforestation on some smaller scale when done in conjunction with watershed restoration project on Navy-owned or GovGuam lands, artificial reef installation within Apra Harbor or other areas, and/or riparian enhancement that would benefit fish, corals, and other marine organisms.

A direct and predictable relationship between a specific watershed project(s) and replacement of coral function is difficult to determine. Therefore, it would be difficult to predict how many watershed projects and of what type would be required to restore the productivity lost due to dredging. On the other hand, the effectiveness of artificial reefs would be more readily quantified as to its success in replacing lost coral function and value. However, all mitigation options are under consideration at this time.

Stream bank stabilization. This option would involve stabilization of stream banks within watersheds that would involve the placement of vegetative and/or mechanical rip rap revetment on banks of rivers and streams to minimize erosion and sediment laden run-off from entering sensitive riverine systems. The design would include major factors including: a) capability of conveying peak runoff flows produced by major storms and b) maintenance crew accessibility to structural BMPs for vegetation maintenance (i.e., through cutting vs. spraying) and rip rap/revetment repair.

Riparian restoration. This option would include mangrove and/or wetlands enhancement associated with the Philippine Sea. This may be based on Guam BSPs developed system of reference wetlands as a baseline for future classification and to establish a basis for ecological function when formulating the scope and extent of potential compensatory mitigation.

Category 2: Coastal Water Resources Management

Coastal water resource management is a collective term to describe a variety of projects that would improve the quality or diminish anthropogenic stresses on nearshore coastal waters in order to improve management efforts and water quality, resulting in recolonization or improved growth of existing coral in those coastal waters. Addressing upland watershed issues (Option 1) prior to coastal efforts is important process.

The following projects could be used separately or in conjunction to develop a conceptual mitigation plan for coastal water resources management:

Shallow Water Reef Enhancement – coral transplanting within non-DoD federal property (e.g. National Parks). This option would include the transplanting of a significant quantity of coral that would be removed by the proposed dredging project. The objective of shallow water reef enhancement is to minimize coral colony mortality by transplanting coral to several new sites on Navy submerged lands. Transplantation site selection criteria would include physical, chemical, and biological factors. Studies have shown that larger intact colonies survive transplanting much better than small or fragmented colonies. Larger colonies also have far greater reproductive potential than small ones. Therefore, these types of projects often focus on transplanting large specimens. A detailed transplantation plan would be prepared which would include methods for moving large colonies, techniques for stabilizing the colonies at the transplant site, and monitoring protocols.

Wetland/mangrove restoration. This option would include mangrove and/or wetlands enhancement in the *Philippine Sea coastal areas*. This may be based on Guam BSPs developed system of reference wetlands as a baseline for future classification and to establish a basis for ecological function when formulating the scope and extent of potential compensatory mitigation.

Establishment of Marine Protected Areas. This option would include the addition of special conservation areas associated with federally-owned submerged lands in and around Guam and the possibility of land swaps between GovGuam to keep these areas contiguous. This option may also include the expansion of existing ERA Marine or Terrestrial Units of Navy-owned submerged lands around Guam, including the beaches and limestone forest area inland from the Marine Unit. The expanded Marine Unit would include shallow water benthic habitat that contains both hard and soft corals. The management plans for these ERAs would be modified to prohibit fishing and other types of consumptive activities that could potentially adversely affect EFH.

Additional information would be provided in the compensatory mitigation plan prior to issuance of the DA permit.

Upgrades/Improvements Wastewater Management Systems. This option would involve upgrading Guam treatment plants and ocean outfalls to have refurbished primary and/or upgraded to secondary treated effluent to improve coastal water quality that would in turn enhance coral health in the coastal zone of Guam. This option is an alternative for the Northern District Wastewater Treatment Plant under consideration within this EIS.

Category 3: Apra Harbor Water Resource Management

This option includes a variety of projects that would improve the overall quality or diminish anthropogenic stresses on Apra Harbor in order to improve water quality and result in improved conditions and growth for the coral reef ecosystems present.

The following projects could be used separately or in conjunction to develop a conceptual mitigation plan for Apra Harbor water resources management:

Artificial reefs.

An artificial reef is a man-made, underwater structure, typically built for the purpose of promoting marine life in areas of generally featureless bottom. Artificial reefs can be created by a number of different methods. Many reefs “are built” by deploying existing materials in order to create a reef (e.g., sinking oilrigs, scuttling ships, or by deploying rubble, or construction debris). Other artificial reefs are purpose built (e.g., the reef balls) from PVC and/or concrete. Regardless of construction method, artificial reefs are generally designed to provide hard, 3-dimmentional surfaces to which algae and invertebrates attach, which in turn attracts fish species providing food habitat for fish assemblages. Car and Hixon (1997) “identified that methods used to evaluate the performance of an artificial reef will vary according to the purpose for which the reef was built. They found that artificial reefs with structural complexity and other abiotic and biotic features similar to those of natural reefs would best mitigate in-kind losses of reef fish populations and assemblages from natural reefs – specifically they compared colonization and subsequent assemblage structure of reef fishes on coral and artificial (concrete block) reefs where reef size, age, and isolation were standardized. Although species richness and fish abundance (all species combined) were greater on natural reefs vs. artificial structures, substantial differences in species composition were not detected.”

This option would be a direct application of a HEA derived artificial reef project in Apra Harbor. The Navy would install an artificial reef in approximately 80+ ft (24.4 + m) of water (to ensure its survival even in a super-typhoon) using one or more agreed upon artificial reef concepts. Reef alternatives may include “Z blocks” (used in Hawaii), Biorock, and Reefballs. Suggestions of other artificial reef options would be welcomed. Placement would be on the harbor floor and would not affect hard substrate. A mitigation site would be located within the ESQD arc of Kilo Wharf (to prevent the reef from being used as a Fish Aggregation Device that would invite recreational or commercial fishing or diving activities). As part of the artificial reef proposal, the HEA restoration project would include the potential use of transplanted coral as part of its compensation strategy.

Success criteria would be based on a replacement of benthic structure and one percent coral cover, as a proxy to ecosystem function. Long-term monitoring would be implemented to measure success. Potential Guam INRMP projects associated with the artificial reef could include assessment of functions these structures provide. Artificial reefs, though quantitatively easier to scale for a ratio between replacement and function lost than watersheds, have been criticized as being primarily fish aggregating devices that do not increase coral community productivity. In other words, the replacement of structure does not necessarily equate to a restoration of coral community function.

Shallow water reef enhancement – coral transplanting. This option may include transplantation of a significant quantity of coral that would be impacted by the propose dredging action. The objective of shallow water reef enhancement for Option 3 is to minimize coral colony mortality by transplanting coral to several new sites on Navy submerged lands within Apra Harbor. Transplantation site selection criteria would include physical, chemical, and biological factors.

Wetland/Mangrove enhancement. This option would include mangrove and/or wetlands enhancement in Apra Harbor. This may be based on Guam BSPs developed system of reference wetlands as a baseline for future classification and to establish a basis for ecological function when formulating the scope and extent of potential compensatory mitigation.

Category 4: In-Lieu Fee or Mitigation Banking Program

Within the HEA Administrative Working Group, DoD, and the Military Civilian Task Force on Guam, there is support for the use of In-Lieu Fee or mitigation banking programs to manage, implement and monitor the success of natural resource compensatory mitigation projects on Guam. Revised regulations by the USACE and EPA in March 2008 govern compensatory mitigation for authorized impacts to waters of the U.S. under Section 404 of the CWA. In-lieu fee mitigation and mitigation banks would be included in this 2008 compensatory mitigation rule as endorsed federal programs. These programs have not yet been established on Guam.

Under mitigation banks, units of restored, created, enhanced, or preserved resources are expressed as "credits" which may subsequently be withdrawn to offset "debits" incurred at a project development site. Ideally, mitigation banks are constructed and functioning in advance of development impacts, and are seen as a way of reducing uncertainty in the USACE Regulatory program by having established compensatory mitigation credit available to an applicant.

In-Lieu-Fee mitigation occurs in circumstances where a permittee provides funds to an In-Lieu-Fee sponsor instead of either completing project-specific mitigation or purchasing credits from an approved mitigation bank. The program sponsor periodically funds a consolidated mitigation project from the proceeds of the accumulated In-Lieu-Fees. A Memorandum of Understanding would be executed among DoD, regulators and stakeholders that establishes an In-Lieu-Fee Mitigation Sponsor (typically a non-government organization) and a Review Team to determine how the bank would work.

The In-Lieu-Fee amount is based upon the compensation costs that would be necessary to restore, enhance, create or preserve coral ecosystems or other habitats with similar functions or values to the one affected. The fee is banked in an investment account until a project is approved for implementation. The In-Lieu-Fee mitigation bank would be managed by the In-Lieu-Fee Mitigation Sponsor (Sponsor) that uses the accumulated funds to implement projects that restore, enhance, or preserve ecosystems with similar functions and values that are located within the same biophysical region as the permitted disturbance. Key stakeholders, including regulatory agencies, DoD and the Sponsor, form an advisory committee that determines the projects that would be implemented. The Sponsor is responsible for implementing the project according to an approved work plan.

Development of Compensatory Mitigation Plan

The preparation and implementation of an approved Compensatory Mitigation Plan is the Navy's mitigation for adverse impacts to coral. A USACE permit would be required for the construction of the aircraft carrier wharf due to alteration of navigable waters and discharge of fill materials into the water. This permit would be the vehicle through which compensatory mitigation would be implemented. The project would be designed to avoid coral reef impacts and to minimize any unavoidable impacts. Unavoidable impacts would be mitigated through implementation and/or funding of mitigating measures to compensate for the resulting loss of ecological functions and/or services. Selection, scaling, and implementation of appropriate compensatory mitigation actions are being carried out in consultation with USACE, NOAA, USFWS, USEPA and GovGuam resource agencies. The HEA presented is a tool designed to equate impact habitat services to mitigation habitat services. The financial aspect does not come into consideration until after the mitigation project has been selected (e.g., execution costs of the mitigation project). As more information is gathered on the likely impacts and costs of the compensatory mitigation projects under consideration, a more detailed mitigation plan would be developed to comply with requirements of the USACE-EPA 2008 Compensatory Mitigation Rule.

230.45 Riffle and pool complexes. Not applicable.

Subpart F. POTENTIAL EFFECTS ON HUMAN USE CHARACTERISTICS

230.50 Municipal and private water supplies. No effect.

230.51 Recreational and commercial fisheries. No effect on commercial fisheries. There may be temporary effects on recreational fisheries as a result of construction and operation. The impact would not be significant on recreational fisheries but would temporarily displace recreational fishing to other areas. See Section 11.1.4.2 in this Volume

230.52 Water-related recreation. The effects on water related recreation by both alternatives would be the same as described in Volume 4, Section 9.2. for Alternatives 1 and 2. This impact would not be significant and would involve the temporary displacement of recreational divers from the Western Shoals dive sites but these divers could relocate and utilize other dive sites for recreational purposes and return once the dredging and wharf construction were completed. Other users that could be affected include recreational users such as jet skiers, tour operators, and commercial tour submarines. Impacts would be temporary and less than significant.

230.53 Aesthetics. The aesthetic environment would be altered by the construction of the site and presence of the aircraft carrier when it visits. Additionally, there would be temporary impacts to the visual environment as a result of the physical presence of heavy equipment during construction causing a temporary degradation of the aesthetic environment.

230.54 Parks, national and historical monuments, national seashores, wilderness areas, research sites, and similar preserves. No effect. See Chapter 9, Volume 4.

Subpart G. EVALUATION AND TESTING

230.60 General evaluation of dredged or fill material. Section 4.2., Volume 4, discussed the dispersion modeling of turbidity from dredging activities in Apra Harbor in March 2009 as part of the *Habitat Equivalency Analysis and Supporting Studies* with a detailed summary included in Appendix K of

Volume 9 (Ericksen 2009). 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. According to the modeling results, the plumes rapidly dissipated following dredging resulting in less than significant impacts. See also 230.61 below.

230.61 <u>Chemical, biological and physical evaluation and testing.</u>

Section 4.1, Volume 2 and Volume 4, discuss historical testing of sediments including their chemical, biological, and physical evaluations. Sediment quality investigations in 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, including the vicinity of Alternatives 1 and 2. The three sites were: 1) former Charlie Wharf located at Polaris Point 2) the Former SRF site, and 3) the turning basin common to each in Outer Apra Harbor. Fourteen discrete samples of sediment to the proposed dredge depth were taken. The area samples were combined into three composites. Composite 1 (six sample locations) was of the turning basin; Composite 2 (three sample locations) was of the area in front of the Former SRF site; and Composite 3 (five sample locations) was representative of the area to be dredged for Polaris Point. 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 from Outer Apra Harbor would meet the testing requirements for ocean disposal.

Additional sediment sampling and analyses were conducted in March 2010 to delineate the distribution and magnitude of chemicals of potential concern within the dredge footprint of the two potential CVN berthing sites; Polaris Point and the Former SRF wharf. Material from the proposed CVN turning basin was also evaluated (NAVFAC Pacific 2010a). The 2010 analysis concluded that low chemical concentrations found in the most recently collected sediment samples from Polaris Point, the Former SRF Wharf, and the Turning Basin were consistent with other previous Tier III dredged material evaluations conducted in the same areas of Apra Harbor in the NAVFAC Pacific 2006 study where the material was deemed suitable for ocean disposal. Also similar to the results of this most recent sediment analysis in 2010, sediments from the previous Tier III study had chemical concentrations that were generally low, but some analytes exceeded comparable ER-M values. Based on these similarities, it is likely if the 2010 sediments from the proposed Polaris Point or SRF Wharf dredge footprints were further evaluated according to guidance outlined in the Ocean Testing Manual (USEPA and USACE 1991) and/or Inland Testing Manual (USEPA and USACE 1998) they would be deemed suitable for ocean disposal or upland

As noted above, preliminary chemical testing results indicate the low concentrations of contaminants, indicating the material is likely suitable for ocean disposal. Pursuant to Section 103 MPRSA, 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). Testing would be accomplished within three years of the start of the proposed construction dredging.

Subpart H. ACTIONS TAKEN TO MINIMIZE ADVERSE EFFECTS

230.70 <u>Actions concerning the location of the discharge.</u> The effects of the discharge of the dredged material would be minimized by locating and confining the upland placement sites with no return effluent discharge. Impacts would be further reduced by utilizing previously used upland placement sites so that the substrate would be composed of similar material to that of the dredged material. With the high probability that a mechanical dredge would be used, the upland placement sites would not have large areas of standing bodies of water that could potentially drain into adjoining areas. Silt curtains and other

BMPs and mitigation measures, as described in Volume 7, would be used to control silt plumes at the construction and dredging sites.

230.71 <u>Actions concerning the material to be dredged.</u> Information provided in Section 230.21 noted that the materials to be dredged from Outer Apra Harbor are predominantly coarse materials and sand. Sediments of this type are less likely to contain high concentrations of contaminants versus sediments composed of fine materials such as silts. As noted in Section 4.1 of Volume 2, no special treatment of these dredged materials is expected.

230.72 <u>Actions concerning the material after discharge.</u> Selection of diked upland placement sites would minimize the potential impacts of the material after discharge. The materials would be isolated from the surrounding areas by the dikes which would be maintained using grassed slopes to prevent erosion as noted in Appendix D of Volume 9. As the dredged materials have not been found with limited testing to be contaminated and the historical test results as noted in Section 4.1, Volume 2 provided similar results regarding a lack of high concentrations of contaminants, no special measures such as liners or special treatment of the materials after discharge would have to be utilized.

230.73 <u>Actions concerning the method of dispersion.</u> The environmental effects of the material to be dredged would be minimized as the proposed dredging would include the use of silt curtains and other protective measures to minimize the distribution of suspended sediment in the water column during dredging. The dredged materials would be placed in scows and not be allowed to overflow into the water minimizing potential turbidity impacts. There would be no return effluent from the upland placement site into Apra Harbor.

230.74 <u>Actions related to technology.</u> Section 4.2 of Volume 4 presents possible equipment and machinery that can be used to minimize the impacts during dredging and disposal/dewatering activities. Section 4.2 of Volume 2 and Appendix D of Volume 9 present operational controls of the dredging equipment that can be employed to minimize impacts to the environment. Silt curtains and similar devices can also be placed around areas of specific concern such as coral to provide them with additional measures of protection.

230.75 <u>Actions affecting plant and animal populations</u>. As noted in Section 2.3 in Volume 4, the channel option carried forward was the option that reduced dredging impact to corals to the greatest extent possible versus the other two channel options considered and dismissed. Selection of existing upland sites would further reduce potential impacts to plant and animal populations. As noted in Section 11.2, Volume 4, mitigation measures including restrictions on dredging during stony coral spawning periods which occur in Apra Harbor during the full moon phases in June, July, and August would be considered.

230.76 <u>Actions affecting human use.</u> As described in Chapter 9 of this volume, there would be some impacts to recreational users from both alternatives. To assist the public in planning its offshore recreational activities near the project area, public notice of dredging activities would be provided. Dredging would proceed as rapidly as practicable to minimize the impact.

Although the impacts to the existing on-base recreational resources would be short-term, recreational resource users—existing and new—would experience crowding and increased competition for the available recreational resources. To mitigate the potentially significant impacts to the existing recreational resources at Polaris Point, the Navy would consider providing additional shuttle bus services and taxis to be made available on-base to offer transportation services for the Sailors to the most popular sites on the island including Tumon/Tamuning villages, which offer recreational, shopping, and entertainment resources. Comparable and alternate marine activities, such as diving (snorkeling, SCUBA, free diving), boating, kayaking, marine tours (dolphin watching, cruise, catamaran rides), and beachcombing are some of the recreational resources popular in these regions.

230.77 **Other actions.** As noted above, there is no proposed return flow effluent from the upland placement site as part of the dredging cycle.

The total area of removal by dredging (two dimensional view) of habitat with some coral coverage is approximately 25 ac (10.1 ha) for the Alternative 1, and approximately 24 ac (9.7 ha) for the Alternative 2. Cumulative impacts on coral and coral reef MUS present in the EFH of Apra Harbor would be significant. This significant impact would be compensated following the implementation of an approved compensatory mitigation plan. The total area (three dimensional view) of habitat with some coral coverage is approximately 33 ac (13 ha) for Alternative 1 and approximately 32 ac (13 ha) for Alternative 2. A discussion of compensatory mitigation proposals to offset the above impacts to coral reefs is presented in Volume 4, Section 11.2.2.7.

ALTERNATIVES COMPARISON SUMMARY AND LEDPA DETERMINATION

There are several reasons why Alternative 1 is considered both the Navy preferred alternative and the LEDPA. Under the LEDPA analysis, it is assumed that both alternatives are practicable and are therefore differentiated by which alternative is the least environmentally damaging. These reasons are highlighted below and identified in Table 4.3-1.

Alternative 1 (Preferred, LEDPA)

As discussed throughout Chapter 2 of this Volume, Alternative 1 is considered the Navy preferred alternative wharf location for the aircraft carrier. Both alternatives are located within the same general area of the base, but Polaris Point has several advantages. Radionuclear response times can be met at either alternative, but the proximity to the existing radionuclear response facilities and personnel at Polaris Point reduces the challenge of meeting response times at Former SRF. The Former SRF is located approximately 3.2 mi (5.1 km) away from the radionuclear response facilities. It is more efficient to consolidate the radionuclear facilities at one location. From a land use planning perspective, it is preferred to co-locate nuclear powered vessels and the nuclear powered submarines that are berthed at adjacent wharves on Polaris Point.

Another benefit of Alternative 1 is that this alternative would not impact dry dock operations and would not require a reduction in the Guam Shipyard lease area that would be required under Alternative 2. Further discussion may be found in Chapter 2, Section 2.5 of this Volume. Although the Navy would compensate for work days lost, Alternative 2 would impact Guam’s dry dock operations. The Guam Shipyard lease area would have to be renegotiated to reduce the footprint and provide room for the aircraft carrier. The lease is scheduled for renegotiation, but the aircraft carrier wharf would impact the lease area. Security and force protection requirements can be met at the Former SRF; however, the proximity of the civilian Guam Shipyard personnel adds an additional security consideration requiring greater perimeter setbacks. Further discussion may be found in Chapter 2, Section 2.5.

The Polaris Point site borders recreational areas and is less industrial than the Former SRF. There is more space for recreational activities near the wharf for military personnel while the carrier is at the transient port. Recreational and retail opportunities are within walking distance of the Former SRF, but there are no facilities near the wharf for the military personnel on the carrier while at the transient port. Further discussion may be found in Chapter 9, Recreational Resources and Chapter 13, Visual Resources in this Volume.

An advantage of Alternative 1 is that access to Polaris Point does not require transit through the Main Gate to Naval Base Guam. Short-term aircraft carrier visit traffic is characterized as predominantly to off-base destinations. This Alternative would minimize the traffic impacts on the Main Base, specifically the Main Gate, representing a benefit to permanent personnel at the base. There would be some increase in traffic on base but most of the traffic would be outside the Main Base. Commercial vendor supply trucks also could make deliveries to Polaris Point without Main Base access. Traffic impacts are assessed in Volume 6.

Alternative 1 would have higher costs for wastewater upgrades, but costs would be offset by the added benefit of improved reliability for other Polaris Point facilities. The power and communications costs for Alternative 1 would be lower than for Alternative 2.

Environmental Factors Contributing to Polaris Point Being the LEDPA

Dredging and Fill. Alternative 1 requires a greater volume of dredged material than Alternative 2 to accommodate the aircraft carrier. Alternative 1 would require a dredge volume of 608,000 cy (464,850 m3) while Alternative 2 would require a dredge volume of 479,000 cy (366,222 m3). However, even though the total dredged material volume is higher, the difference is due to coastal excavation compared to open water dredging, where coral habitat is located. There is some coral located at the shoreline at Polaris Point, but the large majority of material is fill material and not coral. Because of the wharf alignment needed to accommodate the aircraft carrier, Alternative 1 would require less fill than Alternative 2. Both alternatives would result in approximately 3.6 ac (1.5 ha) of fill below the wharf structure, with an additional amount of fill required at Alternative 2 for the water areas between the slips of the finger piers that would be incorporated into that structure (approximately 20,000 cy [15,291 m3]). Alternative 1 does not have this additional fill requirement.

Sensitive Resources. As shown in Table 2.8-1, the impacts to coral under both alternatives are comparable. The advantage of Alternative 1 is that although there would be greater short-term impacts to coral from dredging, over the long term there would be fewer impacts to sensitive resources from operations, especially to areas containing high quality coral such as Big Blue Reef, because Alternative 1 is located further away from Big Blue Reef than Alternative 2.

A substantial percentage of the coral at all depth contours off Polaris Point was growing on metallic and/or concrete debris, was of marginal quality, and showed the greatest signs of stress (Smith 2007). This stress appeared to be due in part to high levels of total suspended solids (TSS) coming from Inner Apra Harbor. Some colonies with hemispherical growth forms (e.g., *P. lobata*) at survey sites within the dredge footprint (Polaris Point, Fairway, and Turning Basin) were observed secreting copious amounts of mucus. As these areas are within the active ship transit lanes, the mucous secretion may be a sediment rejection response related to increased sediment resuspension from current ship activities (Smith 2007).

Additional coral and coral reef community survey data by Smith are provided in detail in Chapter 11 of this volume (Smith 2007). In general, coral development varies dramatically between sites and at different depths, with some locations supporting well developed complex coral reefs and other areas supporting only small patch reefs or sparsely scattered corals. Seventeen coral families were observed throughout the study area. Only one site (Big Blue Reef east) contained all of the observed coral families which is closest to Alternative 2.

When reef survey zones were ranked according to variables that included coral coverage, diversity, rugosity, health, and size-frequency distribution, the areas within the proposed dredge footprint (Turning Basin, shoal areas and Polaris Point) ranked lowest on the scale, and were ranked consistently lower than the sites that are outside the project footprint. The highest ranking was given to Big Blue Reef west, owing to protection from exposure to poor water quality factors associated with Inner Apra Harbor and ship-induced sediment resuspension.

The Polaris Point area, turning basin, Big Blue Reef east, navigation channel and Delta/Echo Wharves areas do not meet any of the Habitat Areas of Particular Concern criteria (see Volume 2, Section 11.1). However, Big Blue Reef west provides significant ecological function and is sensitive to human induced environmental degradation, thereby meeting two of the four criteria for HAPC designation.

The turning basin for Alternative 1 is further from Big Blue Reef and this distance may decrease the risk of construction and operation sediment resuspension impact on this valued coral community and threatened and endangered species such as sea turtles; Big Blue Reef is a resting and foraging area for sea turtles. Pile driving activities associated with Alternatives 1 and 2 may affect, and are likely to adversely affect ESA-listed sea turtles, hence the Navy will be requesting an Incidental Take Permit for these activities associated with the CVN MILCON.

The northwest limits of the channel widener for the turning basin for Alternative 1 is further east of the Middle Shoals Reef coral system than Alternative 2. Figures 11.1-10 and 11.1-11 in Chapter 11, Volume 4 show that Alternative 1 would impact less coral than Alternative 2 in the Middle Shoals due to the location of this widener.

Further discussion of impacts to water quality and marine resources may be found in Chapter 4, Water Resources and Chapter 11, Marine Biological Resources of this Volume.

Based on the above discussion, Alternative 1 is considered the NEPA preferred alternative and the LEDPA. Impacts to the aquatic ecosystem would be avoided or minimized to the greatest extent possible. Implementation of Alternative 1 would have less high quality coral removed by a percentage comparison (42% for Alternative 1 and 46% for Alternative 2); its construction and operational phases are further away from Big Blue reef having both short-term and long-term environmental protection advantages when compared to Alternative 2; and fewer impacts to threatened and endangered species are anticipated due to increased distance to resting and foraging areas. BMPs and compensatory mitigation would be provided as described in Volume 7 and at the end of each chapter in Volume 4. Once final impacts through complete design are identified, a final mitigation plan would be prepared.

. Table 4.3-1. Comparison of Alternative 1 and Alternative 2s

LEDPA Analysis Reference	*Characteristic*	*Alternative 1 (NEPA Preferred and LEDPA)*	*Alternative 2*
Subpart A	Navigation channel: Generally follows existing channel to minimize dredging	Same	Same
Subpart A	Wharf design – steel pile	Same	Same
Subpart A	Dredge method - mechanical	Same	Same
Subpart B (230.10)	Dredged Material Disposal: Beneficial Reuse/ODMDS/Upland Combination	Same	Same
Subpart A	Turning Basin Radius	Same	Same

. Table 4.3-1. Comparison of Alternative 1 and Alternative 2s

LEDPA Analysis Reference	*Characteristic*	*Alternative 1 (NEPA Preferred and LEDPA)*	*Alternative 2*
Subpart A	Turning Basin Location	**Further away from Big Blue Reef (high quality coral and coral reef habitat)**	Closer to Big Blue Reef
Subpart E (230.44)	Coral Reef Impacts (2 Dimensional) Coral Impact (Direct) Coral Impact (Indirect - 200 m buffer around dredged area) Coral Reef Impacts (total) Coral Reef Impacts (3 Dimensional)	 25 ac (10.1 ha) 46 ac (18.6 ha) 71 ac (29 ha) 33 ac (13 ha)	 24 ac (9.7 ha) 47 ac (19.0 ha) 71 ac (29 ha) 32 ac (13 ha)
Subpart E (230.44)	Coral Reef Removal	**Less high quality coral removed by percentage (see Table 11.1-3 in Chapter 11 of this Volume)**	More high quality coral removed by percentage (see Table 11.1-3 in Chapter 11 of this Volume)
	Proximity to Big Blue Reef (nearest named reef)	**Greater distance to Big Blue Reef-less likely to impact the reef and threatened and endangered species from dredging and regular operations**	Adjacent to Big Blue Reef
Subpart D (230.30)	Threatened and Endangered Species Significant impacts from pile driving	**Fewer impacts to threatened and endangered species due to increased distance from foraging and resting areas**	Greater potential impacts to threatened and endangered species
Subpart D (230.31)	EFH (May adversely affect EFH)	Same	Same
Subpart C (230.21, 230.22, 230.23, 230.24, 230.25)	Water Quality Increased turbidity during dredging; would be minimized by silt curtains and other proposed mitigation measures.	Same	Same
Subpart E (230.41)	Wetlands: No dredge/fill of wetlands.	Same	Same
Subpart A	Dredge Volume (including 2 ft overdredge)	608,000 cy (464,850 m^3) (difference due to coastal excavation not open water dredging)	479,000 cy (366,222 m^3)
Subpart A	Dredge Footprint Area Fill	53 ac (21.5 ha) 3.6 ac (1.5 ha)	44 ac (17.8 ha) 3.6 ac (1.5 ha) plus additional for finger piers
NA	Impact by Vessel Operation (i.e. resuspension of sediments associated with berthing movements)	**Greater distance to sensitive habitat**	Closer to sensitive habitat

CHAPTER 5.
AIR QUALITY

5.1 INTRODUCTION

This chapter contains the discussion of the potential environmental consequences associated with implementation of the alternatives for aircraft carrier berthing within the region of influence (ROI) – Apra Harbor – for air quality. A description of the air quality resources in the Apra Harbor ROI is provided in Section 5.1 of Volume 2 (Marine Corps Relocation – Guam), inclusive of a regulatory overview, stationary sources, mobile sources, ambient air quality modeling, climate, and greenhouse gas (GHG) emissions. GHGs are discussed cumulatively as carbon dioxide (CO_2) equivalent emissions at the global scale in Volume 7, Section 4.4, as the change in climate conditions caused by the burning of fossil fuels is a global effect, requiring that the air quality impact analysis be assessed on a global or regional scale, not at the local scale such as for an island.

5.2 ENVIRONMENTAL CONSEQUENCES

5.2.1 Approach to Analysis

5.2.1.1 Methodology

This section describes the analysis approach used to address potential impacts from the proposed increase in aircraft carrier berthing and construction of a wharf and associated shoreside facilities at Apra Harbor. Since some of the effects from this action would contribute to the aggregate effects in this ROI, the analysis results presented in this section are also considered in the aggregate impact analysis on Guam discussed in Volume 7 that combines the impacts from all applicable actions.

As described in Chapter 2, two alternative locations are being considered for a new wharf to provide aircraft carrier berthing capabilities for extended port calls, one at Alternative 1 and Alternative 2. The alternatives are largely equivalent based on the requirements for supporting an aircraft carrier, and the location of both alternatives would be on either side of the entrance to Inner Apra Harbor with similar wharf alignment. The differences between the two alternatives are mainly limited to the location-specific elements relative to each wharf alternative. The major components of the proposed project include shoreside structures, utilities, a new wharf, and dredging. Due to the general similarity of the alternatives as related to air quality and the associated construction and operation activities, they are not analyzed separately in this chapter. The assumptions made in developing the list of major construction items, the equipment necessary to complete construction, and construction productivity are presented in Volume 9, Appendix I, Section 3.4 Construction Activity Emissions.

Construction

Construction activities including the operation of construction equipment, trucks, and workers' commuting vehicles may have short-term air quality impacts. Although the emissions from construction workers' commuting vehicles are considered part of the overall construction emissions, it is anticipated that the majority of construction workers would be living in limited areas with appropriate consolidated transportation support. As such, the emission component from commuting vehicles is relatively small (see Chapter 7 in Volume 6 for details).

In estimating construction-related criteria pollutants and CO_2 emissions, the usage of equipment, the likely duration of each activity, and manpower estimates for the construction were based on the information provided in Chapter 2 for the future project-associated construction activities under each alternative.

Estimates of construction crew and equipment requirements and productivity were based on the data contained in 2003 *RSMeans Facilities Construction Cost Data* (RSMeans 2003) and 2006 *RSMeans Heavy Construction Cost Data* (RSMeans 2006). It is assumed for emissions estimate purposes that most construction activities would occur between 2011 through 2014 and then dredging would occur from 2014 to 2015.

Estimates of construction equipment operational emissions were based on estimated hours of equipment use and the emission factors for each type of equipment, as provided by the United States (U.S.) Environmental Protection Agency's (USEPA) NONROAD emission factor model and the national default model inputs for NONROAD engines, equipment, and vehicles of interest provided with the model (USEPA 2008). The average equipment horsepower values and equipment power load factors are also provided in association with the NONROAD emission factor model. Since the operational activity data presented in RSMeans' cost data books are generated based on the overall length of time equipment is present on site, an equipment actual running time factor (i.e., actual usage factor) was further employed to determine actual equipment usage hours for the purpose of estimating equipment emissions. The usage factor for each equipment type was obtained from Federal Highway Administration's (FHWA) Roadway Construction Noise Model User's Guide (FHWA 2006). Emission factors related to construction-associated delivery trucks were estimated using USEPA Mobile6 emission factor model (USEPA 2003), because it provides a specific emission factor database for various truck classifications. The workers' commuting vehicle emissions were also estimated using the Mobile6 model and assumed workers would travel approximately an average of 10 miles (mi) (16.1 kilometers [km]) per day to the site using shuttle buses or vans.

A maximum sulfur content of 0.5% was conservatively used to predict SO_2 and PM emissions for diesel-powered equipment and vehicles based on USEPA's Heavy-Duty Standards/Diesel Fuel Regulatory Impact Analysis (RIA) (USEPA 2000). Based on the RIA, data observed in 1992 shows that No. 2 diesel fuel imports actually had sulfur content ranging from 0.39% to 0.5%. Therefore, using the actual highest sulfur content observed in 1992 (0.5%) for vehicles in this analysis is considered appropriate and conservative and is also coincident with the highest sulfur content fuel input available in available both in the NONROAD and Mobile6 models. It should also be noted that with the introduction of the Heavy-Duty Engine and Vehicle Standards and Highway Diesel Fuel Sulfur Control Requirements (40 CFR Parts 69, 80, and 86) in 2006, refiners were required to start producing diesel fuel for use in highway vehicles with a sulfur content of no more than 15 ppm. Therefore, the sulfur content of fuels since 1992 has decreased in general although Guam has been granted an exemption from using low sulfur fuel (see Volume 6, Section 7.2). DoD is currently examining the potential use of ultra low sulfur fuel for construction activities and highway diesel vehicles on Guam, so that the actual sulfur content used may be far lower than the results provided here. The detailed methodology used to calculate these emissions is presented in Volume 9, Appendix I, Section 3.4 Construction Activity Emission.

Operation

Operational activities are common to both of the alternatives. The operational elements that have potential to have air quality impact during aircraft carrier berthing include:

- Aircraft carrier on-board diesel generator operations

- Aircraft carrier routine maintenance
- Transient aircraft
- Escort vessels
- Tugboats that assist in navigating the aircraft carrier through the harbor
- On-road vehicles transporting the aircraft carrier crew
- On-road trucks for transporting materials to and from aircraft carriers.

In 1999, the Navy published a Final Environmental Impact Statement (EIS) for *Developing Home Port Facilities for Three Nimitz Class Aircraft Carriers in Support of the U.S. Pacific Fleet* (Navy 1999). In the FINAL EIS, an emissions inventory for one aircraft carrier homeporting for half a year was developed. This inventory was used to prorate the aircraft carrier emissions based on an increase in aircraft carrier berthing days at Apra Harbor of 47 days.

The emissions from aircraft taking off from the aircraft carrier, parking at Andersen Air Force Base (AFB), and ultimately flying back were estimated using the methods, emission factors, and numbers of new sorties obtained from the following references:

- The Procedures of Emission Inventory Preparation, Volume IV: Mobile Sources (USEPA 1992)
- Aircraft engine emission factors developed by the Navy's Aircraft Environmental Support Office (AESO 1999a, 1999b, 1999c; 2000a, 2000b, 2001)
- The Aircraft Noise Study for Guam Joint Military Master Plan at Andersen AFB (Wyle 2008).

Accompanying vessel and tugboat emissions during each air carrier escort were not considered in the analysis because the number of aircraft carrier visits on an annual basis would not increase although the number of berthing days would increase. The operations of vessels and tugboats are expected to increase during the training when the aircraft carrier stays longer at the Apra Harbor and such training-related increased activities from vessels and tugboats are considered in Volume 2.

As described in Chapter 2, the radioactive material operation on Guam would be limited to minor emergency unscheduled repairs and emergency response, and no radioactive waste would be brought ashore. Scheduled maintenance and repair of the Naval Nuclear Propulsion Program (NNPP) would be conducted at the ship's homeport; therefore, there would be no radioactive air emissions from the proposed action.

The aircraft carrier berthing-related vehicle operation would be increased due to an increase in berthing days. However, since air emissions resulting from an increase in on-road vehicular trips are considered in the traffic-related air quality impact analysis contained in Volume 6, vehicular emissions are not discussed in this Volume.

5.2.1.2 Determination of Significance

Under the Clean Air Act (CAA), ships, motor vehicles, and construction equipment are exempt from air permitting requirements. Since the emissions from these sources associated with the proposed project would occur in areas that are in attainment of the National Ambient Air Quality Standards (NAAQS) for all criteria pollutants except sulfur dioxide (SO_2), the General Conformity Rule (GCR) is not applicable. Nonetheless, the National Environmental Policy Act (NEPA) and its implementing regulations require analysis of the significance of air quality impacts from these sources as well as non-major stationary sources. However, neither NEPA nor its implementing regulations have established criteria for determining the significance of air quality impacts from such sources in CAA attainment areas.

In the GCR applicable to nonattainment areas, USEPA uses the "major stationary source" definition under the New Source Review program as the *de minimis* levels to separate presumably exempt actions from those requiring a positive conformity determination. Since the proposed action and alternatives would occur mostly in areas that have always been in attainment, this Environmental Impact Statement (EIS) selected the "major stationary source" definition (250 tons per year [TPY] or more of any air pollutant subject to regulations under the CAA) from the Prevention of Significant Deterioration (PSD) program. The PSD source threshold is used as the threshold for locations that are in attainment for determining the potential significance of air quality impacts from these sources. CO_2 is not a criteria pollutant and the 250 TPY significance threshold is not applicable to it. The potential effects of CO_2 and other greenhouse gas emissions are by nature global and are based on cumulative impacts. Individual sources are not large enough to have an appreciable effect on climate change. Hence, the impact of proposed CO_2 and other greenhouse gas emissions is discussed in the context of cumulative impacts in Volume 7 in terms of CO_2 equivalency.

As noted above, neither the PSD permitting program nor the GCR are applicable to these mobile sources and non-major stationary sources in attainment areas. Therefore, the analysis of construction and operational incremental emissions from these sources in attainment areas and the significance criteria selected (250 TPY) are solely for the purpose of informing the public and decision makers about the relative air quality impacts from the proposed action and other alternatives under NEPA requirements.

Parts of Apra Harbor, including the area proposed for the aircraft carrier berthing, are within a SO_2 nonattainment area due to emissions associated with the operation of the Piti Power Plant (see Figure 5.1-1 of Volume 2). Under the GCR, emissions associated with all operational and construction activities from a proposed federal action, both direct and indirect, must be quantified and compared to annual *de minimis* (threshold) levels for pollutants that occur within the applicable nonattainment area. Direct emissions are emissions of a criteria pollutant or its precursors that are caused or initiated by a federal action and occur at the same time and place as the action. Indirect emissions are emissions occurring later in time and/or further removed in distance from the action itself. Indirect emissions must be included in the determination, if both of the following apply:

- The federal agency proposing the action can practicably control the emissions and has continuing program responsibility to maintain control.
- The emissions caused by the federal action are reasonably foreseeable.

Both of these situations apply and therefore indirect emissions were included in the determination. The SO_2 emissions estimated for the activities associated with the proposed aircraft carrier berthing from both stationary and mobile sources are compared with the 100 TPY *de minimis* level to determine the impact significance of the increase in SO_2 emissions. The overall air quality impacts, including the general conformity applicability requirements, are discussed for Alternative 1 in Volume 7, which addresses the combined effects from all project components under the proposed action and presents an overall aggregate effect.

5.2.1.3 Issues Identified during Public Scoping Process

The following analyses focus on addressing potential air quality impacts onshore and offshore from implementation of the proposed action. As part of the analysis, concerns relating to air quality effects that were raised by the public, including regulatory stakeholders, during scoping meetings were addressed, if sufficient project data and available impact criteria were available. These include:

- Increases in vehicle and vessel emissions and disclosure of available information of health risks associated with vehicle emissions and mobile source air toxics.
- Increases in construction-related emissions and impacts including emissions estimates of criteria pollutants and diesel particulate matter (PM) from construction of alternatives.
- Compliance with the GCR in siting project facilities.

5.2.2 Alternative 1 Polaris Point (Preferred Alternative)

5.2.2.1 Onshore

Construction

Under Alternative 1 the Navy proposes to construct a new deep-draft wharf along the northern coastline of Polaris Point, which is the preferred location for a new aircraft carrier wharf. The design and construction of a new wharf at Polaris Point supports the Navy's need to berth transient aircraft carriers for extended port calls and durations increasing from 16 to 63 days annually; an increase of 47 days. The proposed Polaris Point wharf would be aligned parallel to the coast with reduced clearance on the eastern edge.

Estimates on construction activities were calculated to identify equipment, material, and manpower requirements for the construction associated with the proposed aircraft carrier berthing project at Polaris Point. Assumptions were made to develop a list of major construction items, necessary equipment, and productivity levels necessary for the completed construction of Polaris Point including, but not limited to: shoreside structure prototypes, a bermed fuel tank, an electric substation, stormwater management, the Morale, Welfare and Recreation (MWR) area, a sewer pump station, a Bilge and Oily Wastewater Treatment System (BOWTS) pump station, a BOWTS pump station prototype, and the wharf and related dredging activities.

The emissions produced from potential construction, vehicle and paving activities that would occur from 2011 to 2014 form the basis from which the total air pollutant emissions in TPY were calculated. The calculated total emissions are summarized in Table 5.2-1 and detailed in Volume 9, Appendix I, Section 3.4.3 Construction Emissions: Marine Corps Relocation – Aircraft Carrier Berthing. Estimates of the emissions associated with dredging activities and dredged material disposal were conducted for both 100% disposal in the Ocean Dredged Material Disposal Site (ODMDS) and 100% disposal at the upland site(s) (Table 5.2-1). Logistics and air quality impacts for beneficial reuse of dredged material were covered as part of estimates of movements of aggregates for construction projects, which is discussed in Volume 6.

Table 5.2-1. Total Increased Annual Emissions - Alternatives 1 and 2

Activity	*Pollutant (TPY)*						
	SO_2	*CO*	*PM_{10}*	*$PM_{2.5}$*	*NO_x*	*VOC*	*CO_2*
Construction (2011 – 2014)	0.4	1.4	0.1	0.1	0.7	0.2	118.9
Dredging and Disposal, ODMDS Option (2014 – 2015)	0.1	8.0	1.0	0.3	0.4	9.9	540.3
Dredging and Disposal, Upland Site Option (2014 – 2015)	0.2	4.1	0.5	0.1	0.4	5.0	307.0
Operation (2015 and after)							
Aircraft Carrier	0.1	0.2	0.1	NA	1.1	1.3	NA
Transient Aircraft	0.4	91.1	4.6	8.4	26.2	0.4	NA
Total Operation	0.5	91.3	4.7	8.4	27.3	1.7	NA

Legend: VOC = volatile organic compound

Operation

The operational emissions from the extended aircraft carrier berthing were predicted based on Navy-provided aircraft carrier emission inventory data for half-year berthing (U.S. Navy 1999). The increase in emissions from the additional 47 days per year aircraft carrier berthing schedule was prorated using the emissions inventory established by the Navy (U.S. Navy 1999).

Given the lack of sortie data for aircraft flight operation originated from the aircraft carrier during the additional 47-day berthing schedule, the air emissions that would result from aircraft operations initiated from the aircraft carrier were estimated using the operational forecasts described in the Aircraft Noise Study for Guam Joint Military Master Plan at Andersen AFB (Wyle 2008). The net increase in the sortie level for each applicable aircraft type in additional 47-day berthing, input parameters, and the methodologies used to calculate them are described in Volume 9, Appendix I, Section 3.3.2 Aircraft Operational Emissions from Aircraft Carrier Berthing. The estimated emissions of the aircraft operations at the aircraft carrier berthing site are shown in Table 5.2-1.

In Volume 7, predicted construction emissions (2011 through 2015) and operational emissions (2015 and after) are combined with the emissions from other components of the proposed action to determine the overall potential air emissions impact significance using the impact thresholds described in Section

5.2.2.2 Onshore

The construction and operation emissions shown in Table 5.2-1 are all below the significance criteria of 250 TPY for air pollutants subject to regulations under the CAA, as described in Section 5.2.1.2. The SO_2 emissions were also all below the 100 TPY *de minimis* level, indicating that there would be no significant impact from SO_2 emissions.

5.2.2.3 Offshore

As discussed previously, offshore aircraft carrier, accompanying vessels, and tugboat emissions would not change from current levels, as these operations are associated with number of aircraft carrier visits, rather than the number of berthing days. Therefore, existing air quality conditions offshore would remain unchanged under Alternative 1. Offshore aircraft carrier presence, including accompanying vessels and air operation, is associated with continued operations in surrounding waters. Limited near shore activity within territorial waters of the United States would be associated with the limited port calls to Guam and would not result in a significant increase in emissions over present activities.

<u>Construction</u>

Existing air quality conditions offshore would remain unchanged under Alternative 1.

<u>Operation</u>

Existing air quality conditions offshore would remain unchanged under Alternative 1.

5.2.2.4 Summary of Alternative 1 Impacts

As summarized in Table 5.2-2, air emissions associated with both construction and operational components of Alternative 1 would be well below the significance criteria of 250 TPY for air pollutants subject to regulations under the CAA. The predicted SO_2 emissions would be below the 100 TPY *de minimis* level within the nonattainment area. Therefore, all project-specific air quality impacts are considered less than significant for all areas for this action. The overall air quality impacts, including the general conformity applicability requirements, are discussed in Volume 7, which addresses the combined effects from all project components under the proposed action and presents an overall aggregate effects determination.

5.2.2.5 Alternative 1 Proposed Mitigation Measures

No mitigation measures would be required for this action, as emissions are below criteria levels. However, the use of low sulfur fuels for construction vehicles could be used to minimize emissions. Proposed mitigation measures for combined effects of all components considered in this EIS are discussed in Volume 7.

Volume 7, Chapter 2 describes two additional mitigation measures; force flow reduction and adaptive program management of construction. Implementing either of these mitigation measures could further reduce impacts to air quality by lowering peak population levels during construction.

Table 5.2-2. Summary of Alternative 1 Impacts

Area	*Project Activities*	*Project Air Quality Impacts*
Onshore	Construction	Less than significant adverse impacts to air quality. Construction emissions from all components would be well below significance criteria.
	Operation	Less than significant adverse impacts to air quality. Operational emissions from all components would be well below significance criteria.
Offshore	Construction	No impacts to air quality.
	Operation	No impacts to air quality.

5.2.3 Alternative 2 Former Ship Repair Facility (SRF)

5.2.3.1 Onshore

<u>Construction</u>

The construction of a new deep-draft wharf at Alternative 2 would angle the structure through the finger piers at the site. As described in Section 2.3, Alternatives 1 and 2 share many of the same components. The construction, inclusive of dredging, and operation elements would be similar for Alternatives 1 and 2. Therefore, construction air emissions associated with Alternative 2 are the same as under Alternative 1, as presented in Section 5.2.

Operation

The operational emissions from the extended aircraft carrier berthing for Alternative 2 are considered to be the same as under Alternative 1. These emissions are summarized in Table 5.2-1.

5.2.3.2 Offshore

Air quality conditions under Alternative 2 would be the same as those described under Alternative 1. Therefore, potential air quality impacts would not result in a significant increase in emissions over present activities under Alternative 2.

Construction

Air quality conditions under Alternative 2 would be the same as those described under Alternative 1.

Operation

Air quality conditions under Alternative 2 would be the same as those described under Alternative 1.

5.2.3.3 Summary of Alternative 2 Impacts

As summarized in Table 5.2-3, air emissions associated with both construction and operational components of Alternative 2 would be well below the significance criteria of 250 TPY for air pollutants subject to regulations under the CAA. The predicted SO_2 emissions would be below the 100 TPY *de minimis* level within the nonattainment area. Therefore, all project-specific air quality impacts are considered less than significant for all areas for this action.

Table 5.2-3. Summary of Alternative 2 Impacts

Area	*Project Activities*	*Project Air Quality Impacts*
Onshore	Construction	Less than significant adverse impacts to air quality. Construction emissions from all components would be well below significance criteria.
	Operation	Less than significant adverse impacts to air quality. Operational emissions from all components would be well below significance criteria.
Offshore	Construction	No impacts to air quality.
	Operation	No impacts to air quality.

5.2.3.4 Alternative 2 Proposed Mitigation Measures

The predicted construction emissions (2011 to 2014) and operational emissions (2015 and after) for criteria pollutants within each ROI are all below the 250 TPY threshold or 100 TPY SO_2 threshold applicable for SO_2 nonattainment areas. Therefore, potential air quality impacts under Alternative 2 are considered less than significant and emissions mitigation measures are not warranted. As identified for Alternative 1, low sulfur fuels for construction vehicles could be used to minimize emissions.

Volume 7, Chapter 2 describes two mitigation measures; force flow reduction and adaptive program management of construction that could further reduce air emissions by lowering peak population levels during construction.

5.2.4 No-Action Alternative

Existing air quality conditions would remain unchanged under the no-action alternative. Under the no-action alternative there would be no wharf or associated facility construction to support the aircraft carrier extended visits in Apra Harbor and no dredging would be required.

5.2.5 Summary of Impacts

Table 5.2-4 provides a summary of the potential impacts of the two action alternatives and the no-action alternative. None of the alternatives associated with construction and operational activities would result in significant adverse air quality impacts when compared to the significance criteria of 250 TPY for air pollutants subject to regulations under the CAA. SO_2 emissions were also well below the 100 TPY *de minimis* level used as the threshold for emissions within a nonattainment area. Air quality impacts associated with vehicle trips generated from all proposed activities, including the action described in this Volume, are covered in Volume 6. It should be noted that emissions thresholds must be applied to all relevant emissions from the entire proposed action to determine potential impact significance. Overall, air quality impacts for Alternative 1 are addressed in Volume 7 through a detailed comparison of such thresholds. Volume 7 also addresses the combined effects of all project components, inclusive of GHG emissions, under the proposed action.

Table 5.2-4. Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
Potentially Impacted Resource: Onshore		
• LSI	• LSI	• NI
Potentially Impacted Resource: Offshore		
• LSI	• LSI	• NI

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

5.2.6 Summary of Proposed Mitigation Measures

As the predicted air emissions would result in less than significant impacts for all alternatives for both construction and operation components of the proposed action, no mitigation measures are warranted, as summarized in Table 5.2-5.

Table 5.2-5. Summary of Proposed Mitigation Measures

	Onshore Alternatives	*Offshore Alternatives*
Construction		
	• No Mitigation Required	• No Mitigation Required
Operation		
	• No Mitigation Required	• No Mitigation Required

Volume 7, Chapter 2 describes two mitigation measures; force flow reduction and adaptive program management of construction that could reduce air emissions by lowering peak population levels during construction.

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CHAPTER 6.
NOISE

6.1 INTRODUCTION

This chapter contains a discussion of the potential environmental consequences of noise associated with implementation of the alternatives within the region of influence (ROI). For a description of the affected environment, refer to the respective chapter of Volume 2 (Marine Corps Relocation – Guam). The locations described in that Volume include the ROI for the aircraft carrier berthing component of the proposed action (Apra Harbor), and the chapters are presented in the same order as the resource areas contained in this Volume.

6.2 ENVIRONMENTAL CONSEQUENCES

6.2.1 Approach to Analysis

Potential sound-generating events associated with the proposed action were identified and the potential sound levels from these activities were estimated on the basis of published military sound sources of information. These estimated sound levels were reviewed to determine: if they would represent a significant increase in the current ambient sound level, would have an adverse impact on a substantial population of sensitive receptors, or would be inconsistent with any relevant and applicable standards. This chapter focuses on potential impacts to human receptors (see Chapter 10, Terrestrial Biological Resources and Chapter 11, Marine Biological Resources in this Volume for potential noise impacts to wildlife).

6.2.1.1 Methodology

Construction

Construction noise is generated by the use of heavy equipment on job sites. Table 6.2-1 provides a list of representative examples of construction equipment and their associated noise levels. Impact devices typically generate more noise than non-impact devices. Acoustical Usage Factor refers to the percentage of time the equipment is running at full power on the job site. The Federal Highway Administration (FHWA) published a Roadway Construction Noise Model to predict noise levels adjusted from empirical data for construction operation to the actual distance of a receptor.

The decibel (dB) level of a sound decreases (or attenuates) exponentially as the distance from the source increases. For a single point source like a construction bulldozer, the sound level decreases by approximately 6 dBs for each doubling of distance from the source. Sound that originates from a linear, or 'line' source, such as a passing aircraft, attenuates by about 3 dBs for each doubling of distance where no other features such as vegetation, topography, or walls absorb or deflect the sound. Depending upon their nature, such features can range from having minimal to substantial noise level reduction capabilities.

Table 6.2-1. Examples of Construction Noise Equipment

Equipment Description	*Impact Device*[1]	*Acoustical Usage Factor*[2] *(%)*	*Actual Measured Lmax @ 50 feet*[3] *(dBA, slow) (Samples Averaged)*	*Number of Actual Data Samples*[4] *(Count)*
All Other Equipment > 5 HP	No	50	NA	0
Backhoe	No	40	78	372
Clam Shovel (dropping)	Yes	20	87	4
Compactor (ground)	No	20	83	57
Compressor (air)	No	40	78	18
Concrete Mixer Truck	No	40	79	40
Concrete Saw	No	20	90	55
Crane	No	16	81	405
Dozer	No	40	82	55
Dump Truck	No	40	76	31
Excavator	No	40	81	170
Front End Loader	No	40	79	96
Generator	No	50	81	19
Grader	No	40	NA	0
Impact Pile Driver	Yes	20	101	11
Jackhammer	Yes	20	89	133
Pavement Scarifier	No	20	90	2
Paver	No	50	77	9
Roller	No	20	80	16
Scraper	No	40	84	12
Tractor	No	40	NA	0
Vibratory Pile Driver	No	20	101	44

Notes:
[1]Indication whether or not the equipment is an impact device
[2]The acoustical usage factor to assume for modeling purposes
[3]The measured "Actual" emission level at 50 feet (15 meters) for each piece of equipment based on hundreds of emission measurements performed on Central Artery/Tunnel, Boston MA work sites
[4]The number of samples that were averaged together to compute the "Actual" emission level
Source: USDOT 2006

<u>Operation</u>

Operational noise associated with a visiting aircraft carrier would be primarily due to increased traffic on the roadways. FHWA has prepared a traffic study and potential road traffic noise is described in Section 6.2 of Volume 2.

6.2.1.2 Determination of Significance

Noise impacts result from perceptible changes in the overall noise environment that increase annoyance or affect human health. Annoyance is a subjective impression of noise and is subject to various physical and emotional variables. Annoyance levels generally increase when the cumulative noise energy also increases. Human health effects such as hearing loss and noise-related awakenings can result from noise.

For this EIS, noise is evaluated for both construction and operational activities. It is not anticipated that maintenance activities would noticeably contribute to the noise environment due to their intermittent nature and short duration. The threshold level of significant impacts for noise is:

- The increase of any incompatible noise contours where there are sensitive noise receptors (residences, hospitals, libraries, and etc.) due to operation. This threshold is intended to identify areas where there would be “high annoyance” effects associated with operational noise as well as identifying potential health effects and complaints.

- Construction noise resulting in an hourly equivalent sound level of 75 A-weighted decibels (dBA) (based on United States Environmental Protection Agency data for construction noise) at a sensitive receptor (such noise exposure would be equivalent to noise Zone III) or consistent exposure to noise levels at 85 dBA, over an 8-hour period, which is the National Institute for Occupational Safety and Health (NIOSH) recommended exposure limit (NIOSH 1998).
- The significance criteria expressed in this section apply to human receptors, but noise could also affect biological resources, land use, and cultural resources. Please refer to specific applicable resource sections for details about potential noise impacts to biological and other resources.

6.2.1.3 Issues Identified during Public Scoping Process

Comments received during the scoping process from the public, including regulatory stakeholders, do not specifically mention concerns about increased noise pollution due to the proposed action for the aircraft carrier berthing. Consequently, no related public scoping issues were identified.

6.2.2 Alternative 1 Polaris Point (Preferred Alternative)

Alternative 1, Polaris Point (referred to as Alternative 1), consists of the construction of a wharf and supporting infrastructure in Outer Apra Harbor that would result in increases in berthing visits from Nimitz and/or Ford Class nuclear powered aircraft carriers. Siting for these facilities would be along the northern shore of Apra Harbor at the Polaris Point site. Construction and construction-related noise may be divided into the two major construction phases: namely onshore facilities construction and offshore construction. Once construction is completed, noise impacts from daily operation of these facilities would begin. Potential noise impacts and their possible environmental consequences are described below.

6.2.2.1 Onshore

Onshore noise generating activities from Alternative 1 are divided into construction and operation phases. Construction is simply the activities that would generate noise during the building of facilities; operation would be the noise load generated from the day-to-day use of these newly constructed facilities.

<u>Construction</u>

Noise impacts during the construction phase of this alternative would include noise generated by the use of heavy equipment for:

- Grubbing, clearing, and grading of a construction staging area
- Demolition and replacement in-kind of three minor buildings totaling approximately 700 square feet (ft^2) (65 square meters [m^2])
- Minor roadway and pavement removal
- Realignment of utility lines along a portion of the adjacent roadway
- Filling of the marine revetment area—possibly with suitable dredged material
- Transportation of dredged material
- Pile driving for wharf construction

During facilities construction, use of heavy equipment generally occurs during daytime hours and would occur in industrial areas that have generally higher ambient noise levels. Heavy equipment would generate the highest noise levels throughout the construction phase, and would diminish the farther sensitive noise receptors are from the construction site. Use of heavy equipment would depend on the construction schedule, and would not be permanent. Temporary increases in truck traffic used to transport dredged material, as well as to bring materials on- and off-site would also produce greater noise disturbance within and near the construction corridors. Volume 6 contains a discussion of impacts from roadway noise. The method for disposing of dredged materials would be transporting to a beneficial reuse site, an upland placement site, or an Ocean Dredged Material Disposal Site. The latter would remain offshore as is discussed in the following section.

Transportation to a beneficial reuse site or an upland placement site would require truck transportation to the ultimate location. This would produce temporary, localized noise for brief periods, but it would not create any permanent, adverse noise impacts to human health or the local environment. Therefore, noise impacts would be less than significant.

Construction of the pile-supported dock would involve the use of an impact pile hammer to drive steel piles into the sediment, as well as a vibratory hammer for driving sheet piles for wharf construction. Associated noise and vibration impacts would be minor and temporary, for the duration of the wharf construction. Generally, both impact and vibratory pile driving operations produce airborne noise levels of 101 dBA 50 ft (15 m) from the source; however, as the distance from the pile driving operation increases, the level of disturbance from the noise decreases. By 400 ft (122 m) away the noise level would drop to approximately 83 dBA. Only construction workers with appropriate hearing protection would be allowed within the area where noise reaches this level. Maximum airborne construction noise from pile driving would be 61 dBA at the nearest residence located 1 mile (mi) (1,609 m) away on the east side of Route 1. For pile driving operations, equipment with noise attenuating features could potentially be used to minimize disturbances to the surrounding environment. Consequently, noise impacts would be less than significant. Construction workers would be required to utilize hearing protection.

Operation

Sources of noise pollution during daily onshore operations are common to both alternatives. These sources would include:

- An increase in the number of people arriving or waiting to depart the wharf area by bus or car
- Personnel congregating around the wharf's temporary Morale, Welfare and Recreation facilities
- Increased shoreside security patrols
- Periodic truck traffic to the wharf to re-supply the ship
- Cargo movement likely requiring mobile cranes and/or forklifts

Noise impacts associated with day-to-day operations from Alternative 1 would likely produce no adverse impacts to the surrounding environment. Periodic and temporary impacts would be associated with truck traffic and cargo movement, resulting in impacts that would be similar to those experienced during the construction phase. There would be an increase in general traffic during times when the wharf and facilities were in use; however, it is unlikely that this would create an unacceptable noise environment. In summary, potential operational noise impacts would be less than significant.

6.2.2.2 Offshore

Construction

Mechanical or hydraulic dredging would be necessary for either alternative. Noise pollution due to dredging activities would be caused by the dredging equipment, watercraft (tugboats and barges), and human activity. No blasting would be required. Noise levels would be comparable to those that currently occur during periodic maintenance dredging of the turning basin and entrance channel. Operations for the proposed dredging could take place up to 24 hours a day, 7 days a week, for approximately 8 to 18 months. Noise levels from dredging would be 87.3 dBA at 50 ft (15 m) dropping to 61.2 dBA at 1000 ft (305 m) and to 55.2 dBA at 2000 ft (610 m) from the source. Chapter 11 of this Volume contains a discussion of in-water noise impacts.

Wharf construction would occur under the proposed action. Along with the construction of a new wharf, all necessary utility infrastructure would be added to the sites. This construction has the potential to temporarily create adverse noise impacts to the offshore environment.

During pier construction, pile driving operations would create both waterborne and airborne noise. This method of construction would produce the most adverse noise impact to the project area. Waterborne noise created by vibratory pile driving at an average of approximately 160 dB re 1 µPa (Betke et al. 2004) and a peak of 192 dB re 1 µPa at 30 ft (9 m) could increase underwater noise levels to an average of 165 dB re 1 µPa and a peak of 192 dB re 1 µPa. Noise impacts to humans would be less than significant. Impacts to biological resources are discussed in the biological resources chapters (Chapters 10 and 11) of this Volume.

<u>Operation</u>

Sources of noise pollution during offshore operations would occur with both alternatives. These sources would include:

- Port calls by aircraft carriers estimated to be up to 21 days or combination thereof, for a total of approximately 63 days in port per year.
- Associated harbor craft, tugboats, security, and maintenance boats associated with navigation and support of an aircraft carrier within the harbor.
- Up to 59 aircraft flying from the aircraft carrier to beddown at Andersen AFB on a space-available basis. [*Note: Aircraft from visiting aircraft carriers would be flown off of the carrier while outside of port. Volume 2 discusses noise associated with current and proposed aircraft activities. This includes increased operations associated with aircraft from visiting aircraft carriers. The combined noise analyses of these aircraft and all other project-related aircraft are discussed in Volume 2.]

6.2.2.3 Summary of Alternative 1 Impacts

Alternative 1 noise impacts would be caused by construction and operations occurring both onshore and offshore. All of the activities would produce less than significant impacts (Table 6.2-2).

6.2.2.4 Alternative 1 Proposed Mitigation Measures

Noise impacts due to the aircraft carrier berthing would be less than significant. Although pile driving activities would generate high noise levels at the source, the noise level at the nearest human receptor is well within acceptable limits. Therefore, no noise mitigation measures have been determined to be necessary for Alternative 1 for the proposed aircraft carrier berthing at Apra Harbor.

Table 6.2-2 Summary of Alternative 1 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	LSI – Onshore construction noise would be typical of standard construction activities, but would include pile-driving for the wharf project. All of the activities would occur sufficiently far away from sensitive receptors to be considered less than significant.
	Operation	LSI – Noise emanating from onshore operations would be due to increased traffic. The lack of sensitive receptors in the Apra Harbor area makes the impacts less than significant.
Offshore	Construction	LSI – Underwater noise from pile-driving would be the dominate source of offshore noise impacts. Human receptors would not be impacted by these potential noises above acceptable levels. See the biological resource chapters for impacts to biological resources (Chapters 10 and 11).
	Operation	LSI – Noise from offshore operations would be from tugboats and other smaller vessels operating in the harbor. The operations would be concentrated during the periods when the aircraft carrier is in port, would be short-term, and are considered less than significant.

6.2.3 Alternative 2 Former Ship Repair Facility (SRF)

6.2.3.1 Onshore

Construction

Noise impacts during the construction phase of Alternative 2, Former SRF (referred to as Alternative 2), would be identical to those of Alternative 1 except the nearest residence is located in on base housing approximately 4,300 ft (1,311 m) away. Noise levels at that location would be 62 dBA and would be well below acceptable limits. The nearest school is the Commander William C. McCool Elementary/Middle School approximately 3,900 ft (1,189 m) away on Naval Base Guam. Noise levels at the school would be approximately 65 dBA which is also within acceptable levels. Therefore, the construction noise impacts associated with Alternative 2 would be less than significant.

Operation

Sources of noise pollution during daily onshore operations are common to both alternatives and are discussed as part of Alternative 1.

6.2.3.2 Offshore

Construction

Construction sources of noise pollution due to offshore construction are common to both alternatives and are described as part of Alternative 1.

Operation

Sources of noise pollution due to offshore operations are common to both alternatives and are described as part of Alternative 1.

6.2.3.3 Summary of Alternative 2 Impacts

Noise impacts associated with Alternative 2 would be the same as for Alternative 1 (Table 6.2-3).

Table 6.2-3. Summary of Alternative 2 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	LSI – Same as Alternative 1
	Operation	LSI – Same as Alternative 1
Offshore	Construction	LSI – Same as Alternative 1
	Operation	LSI – Same as Alternative 1

6.2.3.4 Alternative 2 Proposed Mitigation Measures

Noise impacts for Alternative 2 would be the same as for Alternative 1 and less than significant. Therefore, no noise mitigation measures have been determined to be necessary for Alternative 2.

6.2.4 No-Action Alternative

Under the no-action alternative, there would be no wharf construction to support the aircraft carrier extended visits to Apra Harbor. As a result, there would be no construction-related noise impacts and noise impacts due to operations would not increase. However, under this alternative, the objective, needs, and treaty commitments of DoD would not be met.

6.2.5 Summary of Impacts

Table 6.2-4 summarizes the potential impacts of each action alternative and the no-action alternative. A text summary is provided below.

Table 6.2-4. Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
LSI • Onshore construction noise impacts would be due to heavy equipment operation including pile-driving but are located away from sensitive receptors • Offshore construction noise impacts would be due to dredging and pile driving but are located away from sensitive human receptors (see biological chapters (Chapters 10 and 11) for impacts to biological resources) • Operational noise impacts would only occur while the ship is in port and no sensitive human receptors would be significantly affected.	LSI • Same as Alternative 1	NI

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

Noise sources related to the proposed aircraft carrier berthing at Apra Harbor would include construction noise, both onshore and offshore, and noise associated with normal operations. Onshore construction noise would occur due to heavy construction equipment operation and truck traffic during construction. Dredging and pile driving would be major sources of the offshore noise, last for 8 to 18 months, and possibly be conducted for up to 24 hours per day. Other construction noise would mainly occur during daylight hours. As construction noise ceases once construction ends, potential impacts would be short-term and localized.

Operational noise would primarily be due to increased traffic while the ship is in port. As the aircraft carrier is expected to be in port for a cumulative total of up to 63 days per year with approximately 21 days per visit, the noise impacts would be limited to these times.

6.2.6 Summary of Proposed Mitigation Measures

Because impacts from noise would be less than significant, there would be no required mitigation measures. However, Volume 7, Chapter 2 describes two additional mitigation measures; force flow reduction and adaptive program management of construction. Implementing either of these proposed mitigation measures could further reduce noise impacts by lowering peak population levels during construction.

CHAPTER 7.
AIRSPACE

7.1 INTRODUCTION

This chapter discusses the potential environmental consequences associated with implementation of the alternatives within the region of influence (ROI) for airspace. For a description of the affected environment, refer to Volume 2 Chapter 7 (Marine Corps Relocation – Guam). The locations described in that Volume include the ROI for the aircraft carrier berthing component of the proposed action (Apra Harbor), and the chapters are presented in the same order as the resource areas contained in this Volume.

7.2 ENVIRONMENTAL CONSEQUENCES

There would be no airspace environmental consequences associated with the proposed aircraft carrier berthing. The temporary flight activity within Guam airspace associated with a transient aircraft carrier would generate small increases in airfield operations at Andersen Air Force Base and use of existing airspace associated with the Mariana Islands Range Complex while the carrier air wing is in port. Increases in Andersen Air Force Base airfield operations would not alter existing flight patterns or airspace requirements. Flight activity would be based on a space available basis, as is the current practice. Therefore, there would be no impacts to airspace resources.

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CHAPTER 8.
LAND AND SUBMERGED LAND USE

8.1 INTRODUCTION

This chapter describes land and submerged lands ownership and use in and around Naval Base Guam, which is the site for the proposed new aircraft carrier wharf. The two wharf alternatives are located in proximity to each other on either side of the entrance channel to Inner Apra Harbor, but the land uses and utility infrastructure are different at the sites. One alternative requires an adjustment to an existing private lease and the other would have no potential impact on land ownership. Submerged lands are areas in coastal waters extending from the Guam coastline into the ocean 3 nautical miles (nm) (5.6 kilometers [km]). As points of reference, primary land use constraints are mentioned (e.g., Explosive Safety Quantity Distance [ESQD] arcs), but details are provided in other resource chapters of this Environmental Impact Statement (EIS).

A description of the affected environment for Naval Base Guam is presented in Volume 2. For example, the land use issues associated with upland placement of dredged material are addressed in Volume 2. The impacts to land and submerged lands use are identified in this chapter by alternatives and components, and the chapter concludes with identification and discussion of proposed mitigation measures that apply to significant impacts.

The region of influence for the Volume 4 land use discussion is land and submerged lands in and around Naval Base Guam within 3 nm (5.6 km) offshore, which is the limit of state or territorial jurisdiction.

8.2 ENVIRONMENTAL CONSEQUENCES

8.2.1 Approach to Analysis

The affected environment section for Land and Submerged Lands Use is organized under two categories: 1) land/submerged lands ownership and management; and 2) land/submerged lands use. There are different criteria for assessing potential impacts under the two categories. Short-term impacts would be related to facility construction activities that would be located within the project footprint or on previously disturbed lands. No construction staging area has been designated away from the project site. These construction activities would have minimal and localized impacts on land use. All impacts related to land ownership and use are assumed to occur during the long-term operational phase of the proposed action as the changed conditions would alter the development and use of the current site and its vicinity.

The potential indirect impacts that would be due to changes in land ownership and use are addressed under other specific resource categories such as traffic, noise, natural resources and recreation. Incompatibility with adjacent land uses to the extent that public health and safety is impacted is addressed under public health and safety and noise resource sections. Federal actions on federal lands are not subject to local zoning or land management regulations; however, consistency with surrounding non-federal land uses is an important consideration in land use planning. A Coastal Zone Management Act consistency determination assessment was prepared for all Guam proposed actions and the correspondence is included in Volume 9, Appendix H.

8.2.1.1 Land Ownership/Management

The impact assessment for land/submerged lands ownership and management was not based on regulatory authority or permit requirements. There is flexibility in the methodology and assumptions were made. The basic premise was that a release of federal lands/submerged lands to GovGuam or individuals would have beneficial impacts on the new landowners. Conversely, the acquisition of land by the federal government may be considered a beneficial or an adverse impact depending on the perspective of the individual landowner. Owners who are interested in selling to the federal government would presumably perceive the federal acquisition as a beneficial impact, whereas owners who are not interested in selling would presumably perceive the federal acquisition as an adverse impact. “Taking” of property in the context of this discussion refers to a legal involuntary acquisition of a property interest by a government authority. Owners who do not want to sell their property (or relocate) are likely to consider an involuntary acquisition or relocation as an adverse impact even though they are properly compensated. Until the land acquisition negotiations are concluded, the impact analysis assumes a significant adverse impact on an individual landowner. There are exceptions to this rule, such as in the case of acquisition of non-possessory affirmative easements for utilities or other rights-of-way.

The Navy is required to comply with federal land acquisition law and regulations, which includes the requirement to offer just compensation to the owner, to provide relocation assistance services and benefits to eligible displaced persons, to treat all owners in a fair and consistent manner, and to attempt first, in all instances, acquisition through negotiated purchase. A more detailed discussion of the land acquisition process is described in Volume 9, Appendix F, Socioeconomic Impact Assessment Study, Section 5.2.6.

The change in land ownership may result in a change in public access policies that may result in an adverse land ownership impact.

The aircraft carrier berthing alternatives are located within the Naval Base Guam on Navy submerged lands; therefore, land and submerged lands ownership is not a factor in the impact analysis.

8.2.1.2 Land Use

There are two criteria that are applied for assessing impacts on land/submerged lands use:

- Consistency with current or documented planned land/submerged lands use
- Restrictions on access due to changes in land use on federally controlled property

Land Use Criterion 1: Consistency with Current or Documented Planned Land/Submerged Lands Use

Land use plans are intended to guide future development. The Department of Defense (DoD) and non-DoD land use plans and constraint figures were presented in Volume 2, Chapter 8. Potential adverse land use impacts would result from a proposed land use that is inconsistent with the existing land use, planned land use, or if vacant land and open space would be developed. Potential adverse impacts would also result if there are incompatible changes in use within submerged lands.

The test for adverse impact significance is less rigorous for existing DoD land and submerged lands, where the limited land availability may force less than ideal land use changes. Federal actions on federal lands/submerged lands are subject to base command approval, but are not required to conform to state/territory land use plans or policies. The proposed waterfront improvements are water dependent activities that would be consistent with the Guam Coastal Zone Management Act policies. The proposed action alternatives of this EIS have been developed in consultation with base command planners and approved by base commands. As a result, there would be no anticipated significant adverse impact to land use within DoD parcel boundaries. Land use changes on existing DoD land could be the basis for significant adverse impacts to other resource categories (such as aesthetics, noise, traffic, recreation, cultural, and natural resources) within and beyond DoD land boundaries. Impacts to these resources and others are addressed elsewhere in this EIS.

Proposed land uses on newly acquired lands may have an adverse impact if they are not consistent with the existing or proposed land use at that site. Similarly, a change in use within non-DoD submerged lands could have an adverse impact. The test for significance is the degree of incompatibility and is qualitative. For example, proposed military housing would be consistent with existing or planned civilian residential communities and there would be no adverse impact to land use. A proposed industrial facility in an area that is designated for a public park may result in a significant adverse impact, while the same facility in an area proposed for heavy commercial would likely have no significant adverse impact.

While the proposed land use under the action alternatives may be consistent with the existing land use, there is potential for adverse impacts due to changes in land use intensity. For example, a training range that is used once per month would likely have no adverse impact, while daily use may result in an adverse impact. Potential adverse impacts associated with changes in land use intensity such as increases in marine traffic (Chapter 14), noise (Chapter 6), and unexploded ordnance (Chapter 18) are addressed under other resource area discussions of this EIS. No significance criterion is established for land use intensity impacts.

Land Use Criterion 2: Access Restrictions

Additional restrictions on public access would be a potential adverse impact. For example, an increase in the setback distance from Navy ships for security purposes may restrict access to a recreational swimming or SCUBA diving site. The test for significance is subjective and based on geographic area affected, the schedule or timing of the access restrictions (permanent or occasional), and the population affected.

Physical access restrictions can also result if land acquisition by the federal government results in a pocket or island of non-federal land. This would be an adverse impact on the landowner(s) of the land to which access has been restricted. The significance of the impact is based on the extent to which access to the non-federal land is restricted. Significant adverse impacts result when the property is surrounded by military property (even when access to property is provided). Similarly, such pockets of non-DoD land within a DoD installation would be a potential adverse impact on military land use.

The pockets of land use and public access restrictions have potential indirect impacts on other resources that are discussed elsewhere in this EIS.

Farmland Protection Policy Act

The Farmland Protection Policy Act (FPPA) (Public Law 97-98, 7 United States Code [USC] 4201 and 7 Code of Federal Regulations [CFR] 658) is intended for federal agencies to: 1) identify and take into account the potential adverse effects of federal programs on the preservation of farmland land; and 2) consider alternative actions, as appropriate, that could lessen such adverse effects; and assure that such federal programs, to the extent practicable, are compatible with state, unit of local government, and private programs and policies to protect farmland. The FPPA addresses prime and important farmlands. Consistency with FPPA was a land use significance criterion in the Draft EIS, but was removed for the Final EIS. In the interval between the two EISs, the Navy determined that the Guam and Commonwealth of the Northern Mariana Islands (CNMI) Military Relocation is exempt from FPPA regulations because the action is undertaken by a federal agency for national defense purposes (section 1547[b] of the Act, 7 USC. 4208[b]). Although consistency with FPPA is not a criterion for analysis, impacts to agricultural use are assessed in this EIS in conjunction with impacts to other land uses, such as residential or urban.

8.2.1.3 Issues Identified During Public Scoping Process

Many of the scoping issues regarding land use overlap with other resource areas such as noise and recreation and are discussed under those sections. The following are public, including regulatory stakeholders, concerns:

- No increase in federal land ownership (although there were some land owners interested to sell).
- No re-acquisition of lands that have been or are in the process of being released by the federal government.
- Current public rights-of-way should be retained.
- No further restrictions on recreational use of submerged lands. Current restrictions have interfered with boat races and competitions in Outer Apra Harbor.

8.2.2 Alternative 1 Polaris Point (Preferred Alternative)

8.2.2.1 Onshore

The proposed aircraft carrier wharf location at Alternative 1 Polaris Point (referred to as Alternative 1) and the proposed upland placement sites are proposed entirely on federal land within Naval Base Guam. No land acquisition is proposed. The project site does not border non-federal lands and would have no adverse impact on neighboring civilian communities.

<u>Construction</u>

There is adequate previously disturbed land at the proposed wharf areas for construction staging at the project site. The underground utilities would be within existing utility corridors, except for the local Polaris Point connections to the wharf structure.

As described in Volume 2, dredged material may be reused, placed in upland placement facilities and/or disposed of in an ocean dredged material disposal site (ODMDS). The EIS assumes five scenarios: 100% ODMDS disposal, 100% upland placement, 100% beneficial reuse, 50% beneficial reuse/50% ODMDS disposal, and 20-25% beneficial reuse/75-80% ODMDS disposal. No land use impacts are anticipated from use of the ODMDS site and its selection would avoid any use or impact on land use. The Navy is in the process of developing a detailed dredged material management plan that will incorporate the disposal options, specific plans for beneficial reuse to the extent possible, and include specific monitoring efforts required for each disposal option. Recent preliminary information from the upland placement study supplemental review has indicated that there may be substantially less upland capacity available on the five confined disposal facilities on Navy lands. Due to land use changes, Field 4, the PWC Compound, and the Polaris Point confined upland placement site may not be available for upland placement. Capacity may be reduced in Field 5 due to cell construction to separate different types of materials. Field 3 remains a suitable option for upland placement.

The potential land use impacts of the upland placement site options are as described in Volume 2, Chapter 8, Land Use. The only difference is the aircraft carrier volume of dredged material is greater than that proposed in Volume 2 for Sierra Wharf dredging. No adverse impact to land use near the site would result from the use of any of the remaining candidate upland disposal sites. There is a potentially adverse land use impact associated with the existing upland placement sites if there are other more productive uses of the land than stockpiling dry dredged material. Reuse of dredged material, described further in Volume 2 and Volume 4, Chapter 2, would provide other beneficial land use opportunities if the upland placement site is no longer needed, thus, creating a beneficial impact to land use.

Operation

The proposed new aircraft carrier wharf would be compatible with adjacent submarine compound operational facilities. The proposed wharf and associated facilities would be within and consistent with the Operation land use area of the land use plan (refer to Volume 2, Figure 8.1-12) and consistent with the nearby submarine compound land use. There would be negligible impacts on existing Polaris Point radiological response and emergency repair operations at the submarine compound. There would be sufficient capacity and staff to support the aircraft carrier (COMPACFLT 2009).

The development of a new wharf is consistent with historical use of the proposed project area for ship berthing. These facilities and the wharf would develop an area that is currently vacant and provides open space. The adjacent Fleet/Community Support land use designation is consistent with the planned Morale, Welfare, and Recreation (MWR) facilities. The impact on land use is minor and would be less than significant.

The proposed MWR area lies within and is consistent with the designated Fleet/Community Support land use area on base land use maps. MWR facilities are often provided close to the waterfront to support transient personnel. There may be interruptions to current MWR activities at Griffin Beach or nearby ballfields when the aircraft carrier is in port, but this would not be an adverse impact as there are alternative recreational areas on base. The proposed MWR area would be open space when the aircraft carrier is not in port and available for suitable MWR facilities and uses. When the aircraft carrier is in port, there would be temporary MWR facilities. These MWR activities would be consistent with the adjacent MWR uses that include ballfields and Griffin Beach. No adverse impacts were identified on existing land uses or future land use plan, including a fenced perimeter and manned gates.

No changes to existing public access policy are proposed. Land access to Polaris Point would continue to be limited to authorized personnel, including a fenced perimeter and manned gate. There would be additional security restrictions at the aircraft carrier wharf area when the aircraft carrier is in port. These restrictions would be comparable to those used at the existing submarine compound.

Minor structures (e.g., guard tower) at the project site would be removed or relocated. The proposed shoreside facilities operations are typical of other Navy waterfront development (i.e., wharf, utilities, storage facility, access roads, and paving). Volume 2, Section 2.4 summarizes the utility requirements. New construction and significant upgrades are proposed to meet the utility requirements. The buildings proposed at the wharf would include: Bilge and Oily Wastewater Treatment System (BOWTS), Bilge and Oily Wastewater (BOW) pump station, boiler house with fuel storage, air compressor building, water treatment building, Port Operations Support Building, watch towers, and electrical substation. Improvements to Piti Power Plant, with no change to footprint, and the proposed underground lines along existing utility corridors would have no impact on land use. Upgrades to the existing sewage pump station nine on Polaris Point and the proposed underground gravity sewer lines to the wharf that are necessary would have no impact on land use. Water and communication upgrades would require extensions to the underground lines from the Alpha/Bravo Wharves' area to the aircraft carrier wharf and, again, no impact to land use is anticipated. Minor roads would be added and modified in the aircraft carrier project area, with no adverse impact on land use.

8.2.2.2 Offshore

The navigational channel, turning basin, and wharf structure are all proposed within federal submerged lands. No change in submerged lands ownership is proposed. Multiple uses of Apra Harbor would continue, and existing restrictions including existing setback distances from Navy assets would remain, with no changes to public access policies.

Construction

Dredging and wharf construction is typical of an active harbor and would be consistent with the industrial activities of Apra Harbor. Maintenance dredging occurs periodically, as does construction dredging. The equipment and barges may temporarily block access to Inner Apra Harbor Channel resulting in minor impacts to access.

There would be no direct submerged lands use impacts during use of the ODMDS. There would be temporary impacts to navigation in the shipping lane due to scows carrying dredged material. These impacts would be managed through communication between the dredging contractor and other vessel operators. There would be ample room in the outer harbor for smaller vessels to go around dredging equipment and, where larger commercial vessels are involved, coordination between the dredging equipment and vessel operators would minimize any scheduling delays for either operation.

Operation

All in-water operational activities associated with berthing an aircraft carrier at a new Polaris Point wharf would be the same as those occurring at a typical Navy harbor. The widening of the ship navigation channel would not have an adverse impact on the use of the channel by other ship or boat operators. Channel markers would be relocated as needed. The navigation route in the vicinity of the new wharf would be dredged deeper, which would have no impact on submerged lands use. Use of the project area turning basin and submerged lands fronting the wharf would be restricted and subject to Navy Port Operations approval, as is current practice. Commercial ship traffic does not use the turning basin area and would not be impacted by security barriers at the wharf.

During typical aircraft carrier visits, there would be a disruption to normal ship traffic patterns because of force protection restrictions during aircraft carrier arrival and departure. Normal arrivals and departures would result in disruption of harbor traffic for periods not to exceed four hours (average two). Under the proposed action, there would be a cumulative total of up to 63 in-port days per year, with actual arrivals and departures being determined by operational requirements. Ship schedules have fluctuated over the past 10 years as noted in Section 1.1 of this EIS. For further discussion of navigation impacts refer to Chapter 14, Transportation.

Once the aircraft carrier is docked, there would be no impact on commercial or recreational ship traffic in the northern part of Outer Apra Harbor. No additional submerged lands use restrictions are anticipated while the aircraft carrier is in port. In-water security barriers surrounding the aircraft carrier in port would have to be moved to allow military vessels to enter and exit Inner Apra Harbor. This is considered a minor impact on harbor operations as it only affects military operations.

8.2.2.3 Summary of Alternative 1 Impacts

Table 8.2-1 summarizes the potential impacts of Alternative 1.

Table 8.2-1. Summary of Alternative 1 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	Activity and staging on DoD-owned compatible lands Disturbance of previously disturbed lands Loss of other potential uses for land designated as upland dredged material placement sites
	Operation	Temporary interruptions to current MWR activities Compatible with surrounding land uses Efficient use of non-DoD land
Offshore	Construction	Dredging activities would be consistent with existing land use Intermittent (1 to 2 ships per day) impact to harbor traffic Interruptions in access to Inner Apra Harbor Channel
	Operation	Temporary impacts to submerged lands use Temporary impact on harbor operations when security barriers are moved Restricted access to Outer Apra Harbor during the infrequent transient aircraft carrier movements

8.2.2.4 Alternative 1 Proposed Mitigation Measures

No significant impacts to land/submerged lands ownership, management, or use were identified under Alternative 1; therefore, no mitigation is necessary or proposed.

8.2.3 Alternative 2 Former Ship Repair Facility (SRF)

8.2.3.1 Onshore

The proposed site is within the current private shipyard leasehold area at Former Ship Repair Facility (SRF). The current lease term expires in 2012. Future use of the SRF lands beyond 2012 is currently being reviewed by the Navy. No decision has been made at the present time in connection with the future reuse of the Former SRF lands, which may include a new lease for commercial ship repair facility purposes beyond the current 2012 lease term expiration date. The proposed project construction would occur after the existing lease term expires in 2012. Consequently, there would be no effect on the current lease. The Former SRF lease area could be reduced and the proposed project area could be excluded from any new lease. The new aircraft carrier wharf would require reduction of the existing Guam Shipyard leased area but because of the timing of the expiration of the lease, would be considered a less than significant adverse impact on the lessee. This is a conservative assessment and assumes the lessee would prefer not to reduce the lease area during the present lease. The construction of the shoreside infrastructure would not commence until a new land use plan is implemented. Any impact would not be significant because any reduction in the current leasehold footprint would be done on a negotiated basis with the lessee; and if ship repair operations were to continue, they would be done with a more consolidated operation through a more efficient configuration of the physical plant with no reduction in capacity or service capability. No additional land acquisition is proposed. There would be no change to existing public access policy. Land access to the Former SRF would continue to be limited to authorized personnel only. Any new leased area would continue to be surrounded by DoD land, with no change in access policy.

Construction

Potential land use impacts during construction would be similar to those described for Alternative 1. However, Alternative 2 may result in a new real estate arrangement where construction activities may be adjacent to a private commercial leasehold interest.

Operation

Development of a Navy general purpose wharf at the Former SRF is consistent with the Navy's existing land use plan that designates the project area as Operations and Industrial Support (refer to Volume 2, Figure 8.1-12). The new wharf would remove the finger piers, which are not used anyway. The area is underutilized and no relocation of occupied facilities would be required. One abandoned building would be demolished. The proposed shoreside facility (i.e., wharf, utilities, storage facility, and paving) would be operated in a manner typical of other Navy waterfront facilities. MWR facilities are often provided close to the waterfront, within operational areas, to support transient personnel. The proposed MWR area would be open space when the aircraft carrier is not in port. When the aircraft carrier is in port, there would be temporary MWR facilities. No adverse impacts were identified on existing land uses or future land use plans.

Volume 2, Section 2.4 summarizes the utility requirements for a new aircraft carrier wharf. New construction and significant upgrades are proposed to meet the utility requirements. The buildings proposed at the wharf would include: BOWTS, BOW pump station, boiler house with fuel storage, air compressor building, water treatment building, Port Operations Support Building, watch towers, and electrical substation. Improvements to Piti Power Plant and Orote Substation would not change the footprint of the facilities. The underground lines would be within existing utility corridors. The three new submersible pump stations and underground pipelines would be on the existing utility corridor, except in the Former SRF area. Water and communication upgrades would require extensions of the underground lines from the existing Former SRF waterline and Building 3169 (near Victor Wharf) communications hub to the aircraft carrier wharf. No impact to land use is anticipated due to utility improvements.

Potential land use impacts for operations would be similar to those described for Alternative 1. However, Alternative 2 may result in a new real estate arrangement where aircraft carrier wharf operations may be adjacent to a private commercial leasehold interest. Any new lease area would continue to be surrounded by DoD land/submerged lands, continuing a pocket of non-DoD land.

Antiterrorism/force protection is a standard consideration for siting military facilities. Even with a commercial leasehold adjacent to the military property there is sufficient land area at the Former SRF site to accommodate the stand-off distances. Minor roads would be added and modified in the aircraft carrier project area, with no adverse impact on land use.

8.2.3.2 Offshore

Construction

The potential in-water impacts would be as described for Alternative 1, with one additional potential impact. The current design allows for adequate space to access the private shipyard floating dry-dock facility when the wharf is not in use. However, force protection standoff distances restrict ingress and egress to the floating dry dock when the wharf is in use. This limitation would restrict the scheduling of docking and undocking ships at the commercial shipyard. Though the impact would be short in duration, any impact to the private shipyard would be mitigated through scheduling of ship repairs. Therefore, Alternative 2 would result in less than significant impacts to land use.

Operation

The potential in-water impacts would be as described for Alternative 1, with one additional potential impact. The current design allows for adequate space to access the private shipyard floating dry-dock facility when the wharf is not in use. However, force protection standoff distances restrict ingress and egress to the floating dry dock when the wharf is in use. This limitation would restrict the scheduling of docking and undocking of ships at the commercial shipyard during periods when CSG support vessels may require docking capability.

8.2.3.3 Summary of Alternative 2 Impacts

Table 8.2-2 summarizes the potential impacts of Alternative 2.

Table 8.2-2. Summary of Alternative 2 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	• Activity and staging on DoD-owned compatible lands • Disturbance of previously disturbed lands • Loss of other potential uses for land designated as dredged material placement sites
	Operation	• Temporary interruptions to current MWR activities • Compatibility with surrounding land uses • Efficient use of non-DoD land • Reduction in the Guam Shipyard Lease area would be an impact if lease renegotiated prior to its current 2012 end
Offshore	Construction	• Dredging activities would be consistent with existing land use • Intermittent (1-2 ships per day) impact to harbor traffic movement • Interruptions in access to Inner Apra Harbor Channel
	Operation	• Temporary impacts to submerged lands use • Temporary impact on harbor operations when security barriers are moved • Temporary restricted access to Outer Apra Harbor during the infrequent transient aircraft carrier movements • Potential delays in private dry dock operations

8.2.3.4 Alternative 2 Proposed Mitigation Measures

No significant impacts to land/submerged lands ownership, management, or use were identified under Alternative 2 that would not be mitigated to less than significant. One proposed mitigation measure to reduce impacts to operations that could be employed is to negotiate long-term leases instead of purchase of non-federally-controlled land.

8.2.4 No-Action Alternative

No change to land ownership would occur at Apra Harbor. Under the no-action alternative, the lease area at the Former SRF would likely continue in its current or similar industrial use, resulting in the same less than significant impact identified under Alternative 2. The Former SRF area would continue to be underutilized and the existence of deteriorating buildings would continue. The Polaris Point site would not be fully utilized, but could potentially be used for submarine compound or MWR facility expansion. The area proposed for MWR could be developed as permanent MWR facilities. There would be no impact to submerged lands use. Except for the potential for negotiated modifications to the lease, no adverse land use impacts are anticipated under the no-action alternative.

8.2.5 Summary of Impacts

Table 8.2-3 summarizes the potential operation impacts of each action alternative and the no-action alternative. A text summary is provided below. The land use analysis assumes that all impacts would be long-term and direct, with the exception of upland placement of dredged material that is considered a temporary land use. The land use analysis assumes that all construction staging would be within the project footprint on land planned for development. In the case of upland placement of dredged material, the construction impact would be within the upland placement sites construction area. No adverse land use impacts associated with construction are anticipated. This assumption applies to all alternatives.

Table 8.2-3. Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
Land Ownership/Management		
• Land: NI • Submerged Lands: NI	• Land: LSI • Submerged Lands: NI	• Land: LSI • Submerged Lands: NI
Consistency with Existing or Proposed Land Use		
• DoD Land: NI • DoD submerged lands: NI • Non-DoD land: NI • Non-DoD submerged lands: NI • Access/pocket of non-DoD land: NI	• DoD Land: LSI • DoD submerged lands: NI • Non-DoD land (shipyard): LSI • Non-DoD submerged lands: NI • Access/pocket of non-DoD land: LSI	• DoD Land: LSI • DoD submerged lands: NI • Non-DoD land: NI • Non-DoD submerged lands: NI • Access/pocket of non-DoD land: LSI

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

From a land/submerged lands ownership and use perspective, there is little difference between the two action alternatives. However, Alternative 2 and the no-action alternative could both result in a change to the Guam Shipyard Lease area that maintains a pocket of non-DoD land surrounded by DoD land and represents a decrease in non-DoD land use, which is an adverse impact. This is a conservative assessment and assumes the lessee would prefer not to reduce the lease area, but does not evaluate the expiration of the lease prior to construction nor the increase in efficiency that may result from consolidation of shipyard activities within a new leased area. The impact would be a less than significant adverse impact because: 1) the Navy is entitled to change the terms of the lease at lease expiration; 2) the sublessee would be more efficient and continue ship repair operations with no reduction in capacity or service capability; and 3) existing access policies would be retained. A beneficial impact of the reduced footprint would be the increased land use efficiency in the area.

The proposed waterfront land and submerged lands use at either site is consistent with existing and planned waterfront uses. Upland placement of stockpiled dredged material would be an adverse impact because it would not represent the best use of the land; however, the upland placement sites being considered were selected to minimize impacts on land use.

8.2.6 Summary of Proposed Mitigation Measures

Table 8.2-4 summarizes the proposed mitigation measures.

Table 8.2-4. Summary of Proposed Mitigation Measures

Alternative 1	*Alternative 2*
Construction	
• Not warranted	• Not warranted
Operation	
• Not warranted	• Not warranted

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CHAPTER 9. RECREATIONAL RESOURCES

9.1 INTRODUCTION

This chapter contains the discussion of the potential environmental consequences associated with implementation of the alternatives to accommodate the proposed transient berthing of an aircraft carrier within the region of influence (ROI) for recreational resources. For a description of the affected environment, refer to the respective chapter of Volume 2 (Marine Corps Relocation – Guam). The locations described in that Volume include the ROI for the aircraft carrier berthing component of the proposed action (Apra Harbor), and the chapters are presented in the same order as the resource areas contained in this Volume.

9.2 ENVIRONMENTAL CONSEQUENCES

9.2.1 Approach to Analysis

9.2.1.1 Methodology

Information on recreational resources on Guam and public access was collected through stakeholder meetings in April 2007, geographic information system data compiled and reviewed for this Environmental Impact Statement (EIS), literature review, personal communications, and the limited visitor data that are available at a few specific locations on the island. A comprehensive recreational carrying capacity analysis, assessing the number of individuals that could be supported in a given area within natural resource limits without degrading the natural social, cultural, or economic environment (Global Development Research Center 2008), was not conducted as part of this EIS, but is suggested as a proposed mitigation measure to better quantify potential impacts to recreational resources and their users. Existing baseline data for conducting recreational resource impact analyses are somewhat limited because the Government of Guam (GovGuam), Department of Parks and Recreation does not collect visitor data (e.g., user counts, visitor satisfaction, user conflicts, visitor demands, etc.) for its recreational facilities (Department of Parks and Recreation 2009). Consequently, the analysis in this chapter relied considerably on information obtained through site reconnaissance and communications with natural resource planners at Andersen Air Force Base (AFB) and park rangers at the National Park Service (NPS) that manage the War in the Pacific National Historical Park.

9.2.1.2 Determination of Significance

For the purpose of the EIS, the proposed action and alternatives would cause a significant impact to recreational resources if they:

- Would impede access to recreational resources
- Would substantially reduce recreational opportunities
- Would cause substantial conflicts between recreational users
- Would cause substantial physical deterioration of recreational resources

9.2.1.3 Issues Identified during Public Scoping Process

As part of the analysis, concerns regarding the potential impact of the project mentioned by the public, including regulatory stakeholders, during the public scoping meetings were addressed. These include:

civilian access to Department of Defense (DoD) facilities, recreation areas, Apra Harbor, and other locations, both in terms of the impact of construction activity and actual implementation of the proposed action.

9.2.2 Alternative 1 Polaris Point (Preferred Alternative)

9.2.2.1 Onshore

<u>Construction</u>

There are existing Morale, Welfare, and Recreation (MWR) facilities at Polaris Point with access restricted to DoD personnel and guests only. Access to and the use of MWR facilities, which include the beach at Polaris Point, softball/baseball fields, cabana, tennis courts, and indoor recreational facilities would be impeded during construction activities at Polaris Point. Comparable and alternate forms of recreational resources are available outside of the base in adjoining villages, popular tourist locations, and on DoD lands. Therefore, Alternative 1 would result in less than significant impacts to onshore recreational resources and users at Polaris Point during the construction phase of the project.

The peak construction total impact would peak at 1,478 people in 2012. By 2015, the increase would stabilize at 386 people, related to economic activity created by the spending of transient personnel. Many of these foreign workers would be housed in workforce housing. Review to date of the workforce housing applications indicates that most of them would be providing recreational resources. Many of these workers would not have their own transportation and would be relying on employer buses for transportation, limiting their access to other public recreational resources. Because most persons relocating would be primarily occupied with employment and/or school, the degree of recreational resource uses is likely to be higher on weekends and holidays. This work force is temporary in nature and would not have long term impacts.

<u>Operation</u>

Under Alternative 1, there would be a cumulative total of up to 63 transient carrier visit days per year, with an anticipated length of 21 days or less per visit. One of the primary reasons for extended port visits is to provide the liberty for Sailors and Airmen deployed for extended periods of time to the Western Pacific. As such, personnel involved with the proposed action are considered potential users of recreational resources on Guam during aircraft carrier visit days. No housing would be provided on-shore and the ship would continue to support the ship's personnel. Popular existing MWR facilities, such as gyms, bowling alleys, baseball fields, cabanas, and swimming pools would experience increased use. A beach that is used exclusively by DoD personnel and guests is situated east of the location of the proposed wharf and adjacent to the MWR facilities and this beach would also experience increased use. Although the impacts to these resources would be short-term, recreational resource users—existing and new—would experience crowding and increased competition for the available recreational resources.

To alleviate impacts to the limited recreational resources at Polaris Point during carrier visits, it is suggested that additional on base shuttle bus services to Dadi Beach, Gabgab Beach, and other DoD recreational facilities be provided to ensure Sailors and Airmen have the ability to access comparable and/or alternate recreational resources. For off base resources, Sailors would be able to take commercial shuttles and taxis. The Sailors and Airmen would also have the use of the new quality of life (QOL) facilities at the Main Cantonment, thereby helping to reduce the burden on non-DoD resources. Alleviating the recreational demands by the visiting Sailors and Airmen in the manners described above is likely to produce the unintended effect whereby recreational resources in other areas may experience sudden increase in the number of visitors and users. Therefore, by applying the proposed mitigating measures, the potentially significant impacts to the recreational resources at Apra Harbor would be mitigated to a level of less than significant impact.

Increase in users to Guam's recreational resources during the carrier visits would likely result in increased competition for recreational opportunities and space. For instance, beaches would likely experience crowding. Other non-DoD recreational features that are popular and unique to the region (e.g., outdoor concerts at Ypao Park, snorkeling at the beaches in Tumon Bay, water parks at hotels, day use resorts, NPS units) could also be affected during the carrier visits. As is the case for the Government of Guam and DoD recreational resource administrators, the NPS has inadequate staffing (see Appendix G of the EIS on NPS comments); increase in the number of visitors to the Park and its assets is likely to exacerbate the described effects of the proposed action. However, the proposed action would involve an increase the number of in-port days for the aircraft carrier from approximately 16 to a cumulative total of up to 63 visit days per year. The remaining days would not have an increase in Sailors and Airmen population on Guam. Therefore, Alternative 1 would result in less than significant impacts to non-DoD recreational resources and users.

9.2.2.2 Offshore

<u>Construction</u>

Outer Apra Harbor hosts sunken historical relics and vessels from World Wars I and II and as a result, many dive sites exist today. The existing southward channel bend is between Jade and Western Shoals and in the vicinity of one dive site.

The proposed action would widen the channel at the bend and require dredging. The area of dredging is small and dredging would likely be completed within one to two days for a specific dredge section before moving into another dredging section, based on dredging production estimates. A conservative assumption of a week of dredging in the area to include silt curtain set up and interruptions in work due to Inner Apra Harbor transiting traffic, would result in an adverse impact on recreation. This impact would be less than significant because only the Western Shoals dive site would be impacted, and there are numerous recreational dive sites in Outer Apra Harbor and around Guam that could be used as alternatives. The short-term duration of the construction impact would not result in dive pressure on other Guam sites. No recreational sites were identified in the turning basin or proposed wharf area.

The east-west portion of the existing shipping channel in Outer Apra Harbor would be shared by the aircraft carrier and other ship traffic. No dredging would be required along this portion of the shipping channel. Dredging would result in an estimated one to two barges per day using this portion of the channel for an estimated 8 to 18 months. No impacts on recreational uses in Outer Apra Harbor are anticipated as there are no recreational sites located within the east –west portion of the shipping channel.

Alternative 1 would result in less than significant impacts to offshore recreational resources during construction. As a public awareness measure and to assist the public in planning its recreational activities near the project area, public notice of dredging activities would be provided. Dredging would proceed as rapidly as practicable to minimize the impact.

<u>Operation</u>

During aircraft carrier visits, a security clearance zone serving as a buffer to the ships would be enforced throughout the length of stay as a measure of force protection. The buffer distance is subject to change according to the force protection levels, with the minimum distance being 450 feet (ft) (137 meters [m]). Neither of the proposed wharves is in an area of offshore recreational water activities. The security barriers would not impact recreational uses in Outer Apra Harbor (Table 9.2-1). Therefore, Alternative 1 would result in no impacts to offshore recreational resources during operation.

9.2.2.3 Summary of Alternative 1 Impacts

Table 9.2-1 summarizes Alternative 1 impacts.

Table 9.2-1. Summary of Alternative 1 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	Access to recreational resources at Polaris Point may be impeded during construction activities, public recreational resources may see increased use from workforce growth
	Operation	Reduction in recreational opportunities; potential displacement of users; public recreational resources may see increased use
Offshore	Construction	Western Shoals dive sites would be impacted during dredging; other dive sites available for use
	Operation	No impacts

9.2.2.4 Alternative 1 Proposed Mitigation Measures

To alleviate impacts to the limited recreational resources at Polaris Point during carrier visits, one potential mitigation measure would be to provide additional on base shuttle/bus services to Dadi Beach, Gabgab Beach, and other DoD recreational facilities to ensure Sailors and Airmen have the ability to access comparable and/or alternate recreational resources. For off base recreational resources, Sailors would be able to take commercial shuttles and taxis.

Volume 7, Chapter 2 describes two additional mitigation measures; force flow reduction and adaptive program management of construction. Implementing either of these mitigation measures would further reduce impacts to recreational resources by lowering peak population levels during construction.

9.2.3 Alternative 2 Former Ship Repair Facility (SRF)

9.2.3.1 Onshore

Construction

At present, there are no recreational resources occurring at the Former Ship Repair Facility (SRF) site. Therefore, Alternative 2 Former SRF (referred to as Alternative 2) would result in no impacts to recreational resources at this site. However, as discussed in Alternative 1, some increase in pressure on public recreational resources could result from work force growth.

Operation

The proposed action would produce similar results as Alternative 1. There would be increased pressure on public recreational resources during the duration of aircraft carrier visits but also from work force growth. Although there are no existing MWR facilities on-site, additional shuttle services could be made available to transport ship personnel to recreation sites located elsewhere on base. Alternative 2 is closer to Naval Base Guam recreational activities and there may be less reliance on shuttle services. For off base resources, Sailors would be able to take commercial shuttles and taxis. Therefore, by relying on these proposed mitigating measures, the potentially significant impacts to recreational resources on and off base would be mitigated to a level of less than significant impact.

9.2.3.2 Offshore

Construction

The proposed action would produce identical results as Alternative 1. Therefore, Alternative 2 would result in less than significant impacts to recreational resources.

Operation

The proposed action would produce identical results as Alternative 1. Therefore, Alternative 2 would result in no impacts to recreational resources.

9.2.3.3 Summary of Alternative 2 Impacts

Table 9.2-2 summarizes Alternative 2 impacts.

Table 9.2-2. Summary of Alternative 2 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	No impacts to SRF but public recreational resources may see increased use from work force growth
	Operation	Reduction in recreational opportunities; potential displacement of users; public recreational resources may see increased use
Offshore	Construction	Western Shoals dive sites would be impacted during dredging; other dive sites available for use
	Operation	No impacts

9.2.3.4 Alternative 2 Proposed Mitigation Measures

Mitigation measures would be the same as described for Alternative 1.

9.2.4 No-Action Alternative

Under the no-action alternative, no construction, dredging, or operations associated with the aircraft carrier berthing would occur. Existing operations at Polaris Point, as a military training and recreational facility, and the Former SRF, as a commercial SRF, would continue. When an aircraft carrier is berthed at Kilo Wharf, there are restrictions to recreational uses including dive sites in the vicinity of the wharf. Kilo Wharf would not be able to accommodate the planned tempo of visits, but the current port visit schedule would be accommodated and there would continue to be impacts on recreational uses. The no-action alternative would have impacts on recreation, but there are sufficient alternative recreational areas that the impact is minimized to less than significant levels.

9.2.5 Summary of Impacts

Table 9.2-3 summarizes the potential impacts.

Table 9.2-3. Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
Onshore: Construction		
LSI • Access to recreational resources at Polaris Point may be impeded during the construction period. Public recreational resources may see increased use from workforce growth.	NI • No impacts to SRF expected. Public recreational resources may see increased use from workforce growth.	NI • No impacts expected
Onshore: Operation		
SI-M • Increased users at the existing MWR facilities. Crowding at other recreational resources on non-DoD lands; competition for space/opportunity. Impacts may be alleviated with the application of proposed mitigation measures.	SI-M • Increased users at the existing MWR facilities. Crowding at other recreational resources on non-DoD lands; competition for space/opportunity. Impacts may be alleviated with the application of proposed mitigation measures.	NI • No impacts expected
Offshore: Construction		
LSI • Western Shoals dive sites would be impacted during dredging. Other sites available for use.	LSI • Western Shoals dive sites would be impacted during dredging. Other sites available for use.	NI • No impacts expected
Offshore: Operation		
NI • No impacts expected	NI • No impacts expected	NI • No impacts expected

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

9.2.6 Summary of Proposed Mitigation Measures

Table 9.2-4 summarizes the proposed mitigation measures.

Table 9.2-4. Summary of Proposed Mitigation Measures

Area	*Alternative 1*	*Alternative 2*
Onshore	**Construction**	
	• To alleviate impacts to the limited recreational resources at Polaris Point during construction, additional on-base shuttle bus services to Dadi Beach, Gabgab Beach, and other DoD recreational facilities would be provided to ensure Sailors and airmen have the ability to access comparable and/or alternate recreational resources. For off-base recreational resources, Sailors and airmen would be able to take commercial shuttles and taxis.	• Same as Alternative 1
	Operation	
	• To alleviate impacts to the limited recreational resources at Polaris Point during carrier visits, additional on-base shuttle bus services to Dadi Beach, Gabgab Beach, and other DoD recreational facilities would be provided to ensure Sailors and Airmen have the ability to access comparable and/or alternate recreational resources. For off-base recreational resources, Sailors and Airmen would be able to take commercial shuttles and taxis.	• Same as Alternative 1
Offshore	**Construction**	
	• None	• None
	Operation	
	• None	• None

During aircraft carrier visits, bus and tour transport of ship personnel would be limited to tourist spots with higher carrying capacities than smaller and remote areas. To alleviate potentially significant impacts to the existing recreational resources at Polaris Point during carrier visits, it is suggested that additional on base shuttle services to Dadi Beach, Gabgab Beach, and other DoD recreational facilities be provided to ensure Sailors and Airmen have the ability to access comparable and/or alternate recreational resources. For off base recreational resources, Sailors would be able to take commercial shuttles and taxis. Other than the suggested use of alternative recreation sites in Outer Apra Harbor, no mitigation is proposed for the one week of restricted access due to construction at Western Shoals. For public awareness purposes, advance public notice of when that area would be dredged would be provided to assist the public in planning their recreational activities. Dredging would proceed as rapidly as practicable to minimize the impact.

Volume 7, Chapter 2 describes two additional mitigation measures; force flow reduction and adaptive program management of construction. Implementing either of these mitigation measures would further reduce impacts to recreational resources by lowering peak population levels during construction.

CHAPTER 10. TERRESTRIAL BIOLOGICAL RESOURCES

10.1 INTRODUCTION

This chapter contains the discussion of the potential environmental consequences associated with implementation of the alternatives within the region of influence (ROI) for terrestrial biological resources. For a description of the affected environment, refer to the respective chapter of Volume 2 (Marine Corps Relocation – Guam). The locations described in that Volume include the ROI for the aircraft carrier berthing component of the proposed action (Apra Harbor), and the chapters are presented in the same order as the resource areas contained in this Volume. Potential impacts to marine species from proposed offshore activities are addressed in Chapter 11, *Marine Biological Resources*.

10.2 ENVIRONMENTAL CONSEQUENCES

10.2.1 Approach to Analysis

10.2.1.1 Methodology

Biological resource issues and concerns include the potential direct, indirect, and cumulative impacts of the proposed action and alternatives during the construction and operation phases. Impacts may be either temporary (reversible) or permanent (irreversible). Direct and indirect impacts are distinguished as follows.

Direct impacts are associated with proposed construction activities (e.g., ground-disturbing activities) and operations (e.g., noise and lighting). Potential types of direct impacts include, but are not limited to:

- Loss of habitat due to vegetation removal during construction.
- Temporary loss of habitat during construction from noise, lighting, and human activity.
- Potential loss of habitat due to disturbance of species in areas surrounding operations from noise, lighting, and human activity.
- Injury or mortality to wildlife or special-status species.

Indirect impacts are caused by or result from project-related activities, are usually later in time, and are reasonably foreseeable (e.g., increased likelihood of non-native, invasive species moving into the area after disturbance). Potential indirect impacts include, but are not limited to:

- All disturbances from human activity, noise, and lighting that would potentially impact unoccupied recovery habitat for special-status species.
- Introduction of new non-native, invasive species or increased dispersal of existing non-native, invasive species on Guam.
- Dispersal of existing non-native, invasive species from Guam to the Commonwealth of the Northern Mariana Islands (CNMI), Hawaii, or other destinations.
- Adverse effects from pollutants that are released from construction or military operations.

General principles used to evaluate impacts are:

- The extent, if any, that the action would permanently lessen ecological habitat qualities that Endangered Species Act (ESA)-listed species depend upon, and which partly determines the species' prospects for conservation and recovery.
- The extent, if any, that the action would diminish population sizes, distribution, or habitat of regionally important native plant or animal species.
- The extent, if any, that the action would be likely to jeopardize the continued existence of any ESA-listed species.
- The extent, if any, that the action would be inconsistent with the goals of U.S. Fish and Wildlife Service (USFWS) recovery plans, Navy and Air Force Integrated Natural Resources Management Plans (INRMPs), or the Guam Comprehensive Wildlife Conservation Strategy (CWCS).

10.2.1.2 Determination of Significance

Significance of impacts to vegetation, wildlife, and special-status species were determined using guidelines as described in the previous section. Special-status species are defined as ESA- and Guam-listed species and species that are designated candidates for ESA listing. Specific significance criteria are discussed below. If significant impacts are determined, then mitigation may be proposed to offset the impacts. *Mitigation Measures* are discussed in Section 10.2.2.2.

<u>Vegetation</u>

Impacts would be determined significant if any primary limestone forest (mature forest dominated by native species) would be cleared, unless determined to be very minor in the context of the surrounding forest areas. Any loss of this forest vegetation community would be considered significant because of the large historical and continuing losses of this forest type on Guam. Loss of wetland or mangrove vegetation would also be considered potentially significant.

<u>Wildlife</u>

Impacts would be determined significant if native wildlife species are present and the proposed project would result in diminished population sizes or distributions of regionally important native animal species. These wildlife species include those designated as Species of Greatest Conservation Need in the Guam CWCS. Non-native species that have the potential for direct or indirect impacts were evaluated. Historical impacts from non-native species have been severe, particularly from the brown tree snake (BTS) (see discussion in Volume 2). Although the proposed action would not result in additional impacts from BTS on Guam, the concern is that the BTS would be inadvertently introduced to other islands throughout the Pacific. This concern is addressed comprehensively for all actions proposed in this EIS with the mitigation measures described in Section 10.2.2.2.

Migratory Birds

The Migratory Bird Treaty Act (MBTA) prohibits the taking, killing, or possession of migratory birds, with an exemption for military readiness activities (as defined in federal regulations) provided they do not result in a significant adverse effect on a population of a migratory bird species. Congress defined military readiness activities as all training and operations of the Armed Forces that relate to combat and the adequate and realistic testing of military equipment, vehicles, weapons, and sensors for proper operation and suitability for combat use. Military readiness activities do not include: (A) routine operation of installation support functions such as administrative offices, military exchanges, water treatment facilities, schools, housing, storage facilities, and morale, welfare, and recreation activities; (B) the operation of industrial activities; and (C) the construction or demolition of facilities used for a purpose described in A or B (50 Code of Federal Regulations [CFR] Part 21).

The Department of Defense (DoD) must consult with the USFWS if it is determined that a military readiness activity would have a significant adverse effect on a population of a migratory bird species. An activity has a significant adverse effect if, over a reasonable period of time, it diminishes the capacity of a population of a migratory bird species to maintain genetic diversity, to reproduce, and to function effectively in its native ecosystem.

Migratory bird conservation relative to non-military readiness activities is addressed separately in a Memorandum of Understanding developed in accordance with Executive Order (EO) 13186, *Responsibilities of Federal Agencies to Protect Migratory Birds*. The Memorandum of Understanding between the DoD and USFWS was signed in July 2006 and DoD responsibilities included, but are not limited to: (1) incorporating conservation measures addressed in regional or state bird conservation plans and INRMPs; (2) managing military lands and activities other than military readiness in a manner that supports migratory bird conservation; and (3) avoiding or minimizing impacts to migratory birds, including incidental take and the pollution or detrimental alteration of the environments used by migratory birds.

The following species that occur on Guam are considered non-migratory birds and are not covered under the MBTA: black francolin, black drongo, Eurasian tree sparrow, island-collard dove (previously known as Philippine turtle dove), common pigeon, and king quail; all other bird species occurring on Guam are covered under the MBTA.

<u>Special-Status Species</u>

The presence of special-status species in the project areas was described in Volume 2. Background information is presented in the species profiles in Appendix G. Impacts would be determined significant if special-status species are present in the project area and any project action is likely to result in harassment or harm of an individual, population, or species. Impacts to ESA-listed species would include vegetation clearing of designated undeveloped Overlay Refuge lands or identified recovery habitat, unless it is determined that the removal of habitat or other affect is minor when considering all the remaining habitat and quality of habitat available to that species and considering USFWS recovery plan goals. Potential indirect impacts would also include disturbing ESA- and Guam-listed species due to noise, lighting, or human activity. If unoccupied but suitable habitat is affected by operational noise, lighting, or human activity, impacts would be considered indirect and would be determined significant unless the area affected is considered minor when considering all the remaining habitat and quality of habitat available to that species.

For ESA-listed species, federal agencies are required to ensure that their actions do not jeopardize the continued existence of an endangered or threatened species or its critical habitat. Analyses of potential impacts were based on review of plans for the proposed action and the available current and historical distributional data for each species. In accordance with Section 7 of the ESA, a Biological Assessment (BA) has been prepared by the Navy to analyze the potential impacts on ESA-listed species. The Navy has also prepared a BA addressing potential impacts to marine species under the jurisdiction of the National Marine Fisheries Service (NMFS); refer to Chapter 11, Marine Biological Resources, for further discussion.

The BA and the subsequent Biological Opinion (BO) issued by the USFWS after their review of the BA would be the final determination of impacts to ESA-listed species that are being evaluated in this EIS. Candidate species were evaluated in the BA. However, if they are not formally listed by the time the BO is issued and the proposed action would not result in their listing, no determination for these species will be made in the BO. The BO may provide an Incidental Take Statement that lists the amount or extent of incidental take anticipated. The Incidental Take Statement specifies Terms and Conditions that the action proponent must comply with to be exempt from the prohibitions of Section 9 of the ESA. These are non-discretionary requirements. The BO may also specify conservation recommendations that are discretionary proponent activities to minimize or avoid adverse effects of a proposed action on listed species or critical habitat, to help implement recovery plans, or to develop information.

10.2.1.3 Issues Identified During Public Scoping Process

Terrestrial biological resource issues identified during the public scoping process, including by regulatory stakeholders, that are applicable to the proposed action include:

- Activities associated with the military expansion (i.e., construction, expansion, and renovation projects and military training activities) may result in habitat loss and physical disturbance of federally listed endangered species and other federal trust species.
- Potential for harm to fragile ecosystems on Guam and in the Marianas from the introduction of non-native species due to increased traffic among the islands from the movement of personnel and materials. Such species include the BTS, flatworms, various insects, and some plants. The EIS should outline inspection and sanitary procedures to prevent this movement.
- Existing control and containment activities at air and sea ports for BTS are insufficient to deal with the risk associated with the increased cargo and personnel movement from Guam to other vulnerable destinations. The issue "of utmost concern" is BTS interdiction and an effective and enforceable procedure for inspecting all military cargo, personnel, and equipment entering the CNMI. The Navy must assure funding to sustain a 100% inspection rate of all cargo, vehicles, munitions, and household goods. Guam Regulation Protocols 505 and 506 should be incorporated into a BTS control plan to be included as part of the EIS.
- Discuss streams and wetlands, including acreage and habitat type for mitigation areas, size and location of mitigation zones, and contingency plans.
- Concern that development along the shoreline has the potential to require removal of coastal marine and terrestrial habitat.

10.2.2 Alternative 1 Polaris Point (Preferred Alternative)

10.2.2.1 Onshore and Offshore

<u>Construction</u>

Vegetation

Alternative 1 Polaris Point (referred to as Alternative 1)is located within a developed area (Figure 10.2-1). There would be no significant impacts to vegetation.

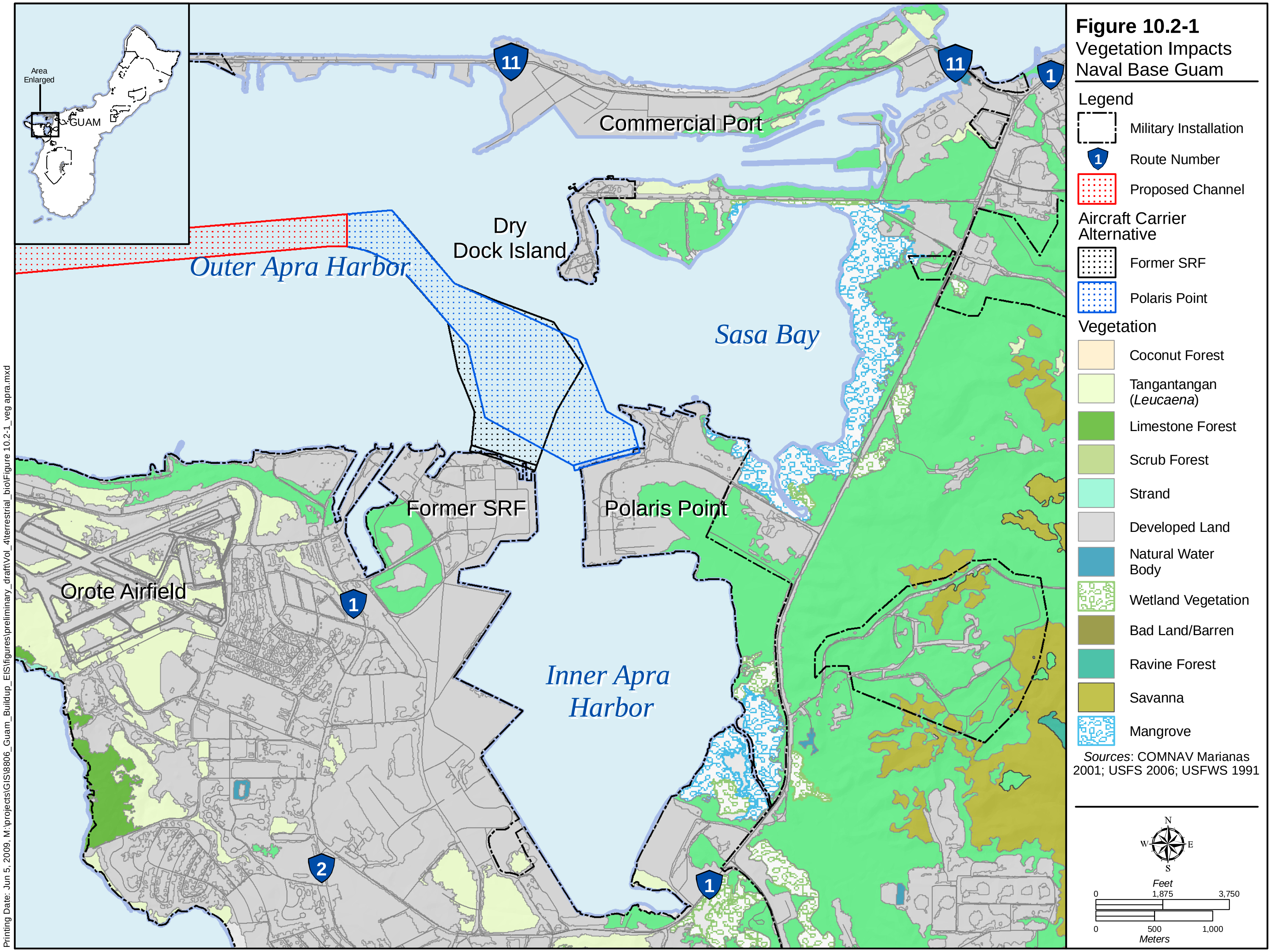

Figure 10.2-1
Vegetation Impacts
Naval Base Guam
Legend
Military Installation
Route Number
Proposed Channel
Aircraft Carrier Alternative
Former SRF
Polaris Point
Vegetation
Coconut Forest
Tangantangan (*Leucaena*)
Limestone Forest
Scrub Forest
Strand
Developed Land
Natural Water Body
Wetland Vegetation
Bad Land/Barren
Ravine Forest
Savanna
Mangrove
Sources: COMNAV Marianas 2001; USFS 2006; USFWS 1991
Feet
0
1,875
3,750
0
500
1,000
Meters
Area Enlarged
GUAM
Commercial Port
Dry Dock Island
Outer Apra Harbor
Sasa Bay
Former SRF
Polaris Point
Orote Airfield
Inner Apra Harbor
11
11
1
1
1
2
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Wildlife

Terrestrial project areas are developed areas of the base with minimal bird habitat, particularly for the shorebirds that are some of the most common bird species in the general area. The Pacific golden plover, whimbrel, ruddy turnstone, and brown noddies were documented in the Polaris Point shoreline areas in 2008 and 2009 (Eggleston 2009; Vogt 2009). Approximately 1,200 feet (ft) (366 meters [m]) of shoreline would be developed for the aircraft carrier berth. The shoreline in this developed portion of the base can be described as semi-natural, consisting of mixed sand and gravel beach. This is a small amount of shoreline habitat in relation to the total amount available in the Apra Harbor area (National Oceanic and Atmospheric Administration [NOAA] 2005); therefore, any birds using this relatively small amount of shoreline would have other similar or less-developed shoreline areas to move to for feeding or resting. There would be no significant changes in population sizes or distributions of migratory birds or regionally important native animal species. Therefore, impacts to wildlife due to proposed removal of habitat from construction activities would be less than significant.

Potential indirect impacts include noise, general construction activity, pollutants and dredging sedimentation. Noise and activity from construction would force shorebird species to move, but there are other areas of suitable habitat nearby so that impacts would be less than significant. Noise and lighting from night-time dredging would impact migratory birds using or potentially using Sasa Bay and its extensive mangroves. The temporary dredging operations would adversely affect bird feeding, roosting, and nesting. In order to minimize impacts, Best Management Practices (BMPs) would be implemented, including measures to limit night-time lighting and noise from the dredging operations (see Chapter 11, Marine Biological Resources in this Volume). Before the start of construction, all personnel involved would receive a briefing on special-status species potentially present and avoidance measures. In addition, construction-related vessels would be restricted from the Sasa Bay Preserve so as to reduce potential impacts to wildlife species. With implementation of these measures, impacts would be less than significant.

Fueling of project-related construction or operations vehicles, watercraft, and equipment could result in accidental releases of petroleum products that would migrate within Apra Harbor. The Sasa Bay mangrove area is over 4,000 ft (1,220 m) from the proposed aircraft carrier dredging location (Figure 10.2-1). Required BMPs during construction would make it unlikely for a major spill to occur (see Chapter 4 on water resources and Chapter 11 on marine biological resources for further information). Fueling of project-related construction vehicles and equipment would take place away from the water when feasible. In addition, a Spill Prevention, Control, and Countermeasure Plan (SPCCP) would be in place and BMPs that are applicable during construction and operation would be detailed in the SPCCP. These BMPs would prevent or control discharges and spills that may potentially occur during Navy activities within and adjacent to Apra Harbor. Absorbent materials and containment booms would be stored on-site to facilitate the clean-up of potential petroleum spills. Various booms, skimmers, and sorbents are available to response agencies, and the Navy has a waste oil barge. Additional BMPs are listed in Volume 7. Implementation of the SPCCP and associated BMPs would result in less than significant impacts.

Proposed dredging, as well as shoreline activities, would result in suspension of sediments that could migrate to shorelines. However, modeling results show that a sediment plume would not migrate into Sasa Bay or only a very short distance into the bay, and sediments would largely be contained within silt curtains employed for the dredging and would not reach shoreline areas (Ericksen 2009). Silt curtains are typically required in U.S. Army Corps of Engineers (USACE) construction and dredging permits.

Therefore, BMPs would include use of appropriate silt curtains and/or other silt containment measures in the nearshore environment to enclose project areas where in-water activities would occur. In addition, there would be frequent monitoring of the effectiveness of the silt curtains. These sedimentation control measures would minimize or eliminate the potential for impacts to the mangrove community and the associated species it supports. Therefore, there would be no impacts to wetlands or shoreline areas from sedimentation.

Special-Status Species

Mariana Common Moorhen. The ESA- and Guam-listed Mariana common moorhen is likely to use local wetland communities that are identified as secondary moorhen habitat in the USFWS recovery plan. These areas are located northwest and southeast of the Sumay inlet (Figure 10.2-2) and at the Atantano wetlands east of the inner harbor (USFWS 1991). These wetland habitats (not mangroves) are not directly adjacent to the harbor and would be unlikely to be affected by suspended sediments or potential small petroleum spills associated with the proposed action. Sasa wetlands behind the mangroves are also unlikely to be adversely impacted because the mangroves are 98 ft (30 m) to 574 ft (175 m) wide. Furthermore, there are no records of moorhens in the freshwater emergent portions of Sasa wetland behind the mangroves (Wiles and Ritter 1993). Impacts would be less than significant. Potential indirect impacts to the moorhen from construction include noise and activity. The moorhen may use the freshwater wetland area of the Sasa Bay wetlands well over a 0.5 mile (0.8 kilometer [km]) from where the dredging and construction would take place. Noise and activity from construction would be very unlikely to affect these areas. Therefore, impacts would be less than significant.

Sea Turtles. Green and hawksbill sea turtles are known to utilize Apra Harbor (Figure 10.2-2) but there are few records documenting use of beaches. Hawksbill turtles occasionally approach the edges of the mangroves to feed on sponges (G. Davis, pers. comm. cited in Wiles and Ritter 1993) (see Figure 10.2-1). Green sea turtles have nested along the northern beaches of Orote Point and there is a 1997 record of hawksbill nesting in or around Sumay inlet (G. Davis, pers. comm. cited in Grimm and Farley 2008). There is no documentation that sea turtles have ever used Polaris Point beaches (NAVFAC Marianas 2009). The potential for use of this beach by sea turtles is considered very low due to suboptimal beach morphology including the following features: minimal height above the water level, very narrow, and rubble substrate from dredge spoil origins (NAVFAC Marianas 2009). Indirect impacts from noise and artificial lighting is possible during dredging and pile-driving operations, but noise associated with pile driving at the proposed aircraft carrier berth is unlikely to be a concern because the distance to the nearest known nesting beach at Sumay Cove is approximately 3,800 ft (1,158 m). Potential impacts on sea turtles at beaches from lighting during dredging operations would be minimized through minimization of or lighting control and nesting beach monitoring. Nesting beach monitoring is currently being conducted. Details are described under the mitigation discussion in Section 10.2.2.2. Although sea turtles are not known to be particularly sensitive to noise, beach monitoring would help to evaluate any potential effects from noise (Bartol et al. 1999; Ketten and Bartol 2006). With these mitigation measures, impacts would be less than significant.

In accordance with Section 7 of the ESA, the Navy has prepared a BA and formal consultation has been completed regarding the potential impacts of the proposed action on ESA-listed species under the jurisdiction of the USFWS and NMFS.

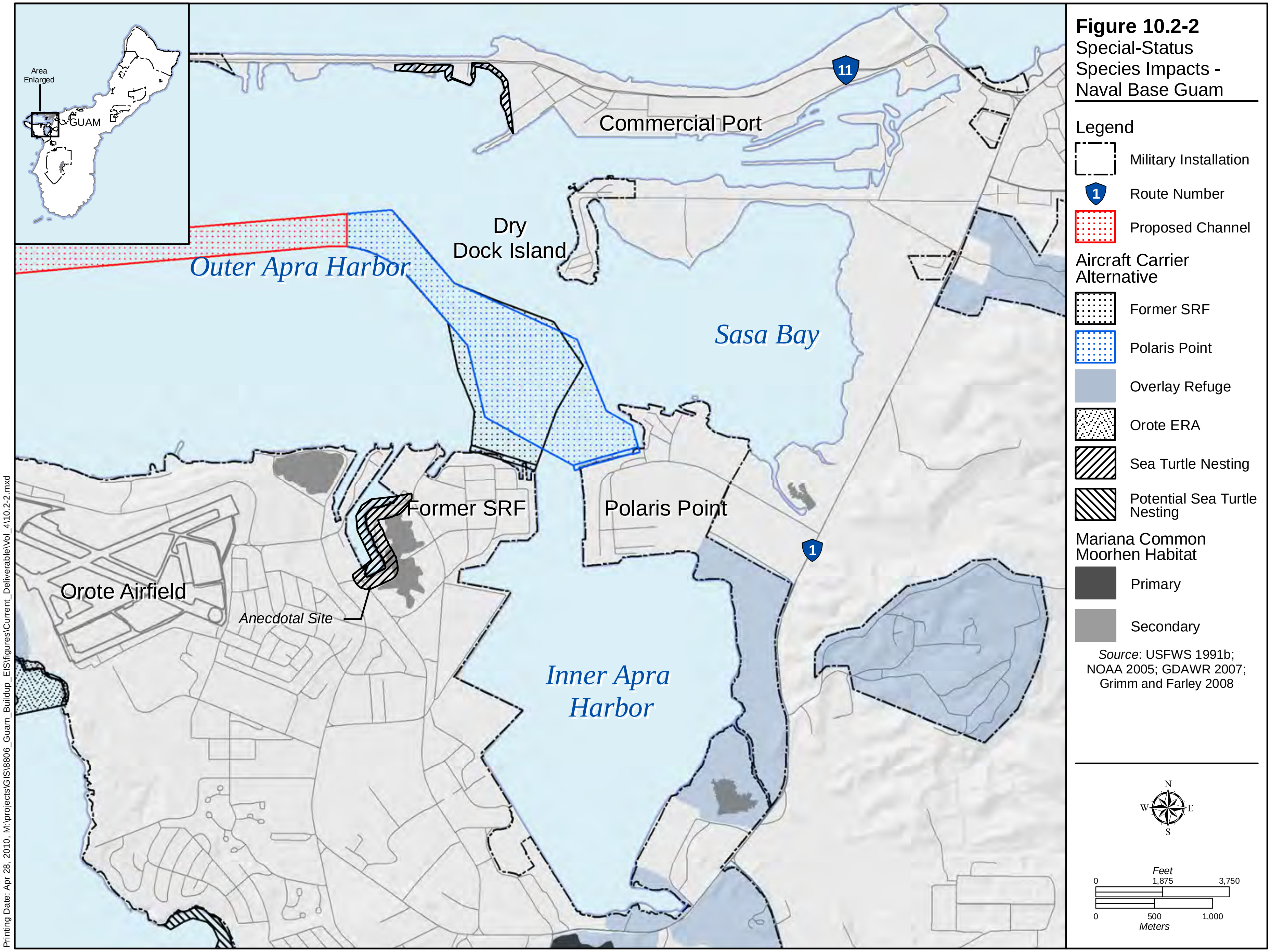

Figure 10.2-2
Special-Status Species Impacts - Naval Base Guam
Legend
Military Installation
Route Number
Proposed Channel
Aircraft Carrier Alternative
Former SRF
Polaris Point
Overlay Refuge
Orote ERA
Sea Turtle Nesting
Potential Sea Turtle Nesting
Mariana Common Moorhen Habitat
Primary
Secondary
Source: USFWS 1991b; NOAA 2005; GDAWR 2007; Grimm and Farley 2008
Area Enlarged
GUAM
Commercial Port
Dry Dock Island
Outer Apra Harbor
Sasa Bay
Former SRF
Polaris Point
Orote Airfield
Anecdotal Site
Inner Apra Harbor
11
1
N
S
E
W
Feet
0
1,875
3,750
0
500
1,000
Meters
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<u>Operation</u>

Vegetation

There would be no direct or indirect impacts to vegetation. No native vegetation would remain in the area after construction.

Wildlife

Very few terrestrial species use the area proposed for the aircraft carrier berth because it is a developed area. Direct impacts to terrestrial wildlife at the aircraft carrier berthing area would be less than significant.

The aircraft carrier wharf area is over 0.5 mile (0.8 km) from the Sasa Bay wetlands. Noise and activity from operations at the wharf would be very unlikely to affect these areas. Impacts would be less than significant. Ship operations out in the harbor would involve potential lighting and noise during night-time operations however these would not occur in Sasa Bay where mangroves and associated wildlife are abundant. Impacts would be less than significant.

Potential oil spills associated with Alternative 1 are unlikely given the history of Navy operations in Apra Harbor. However, if an oil spill were to occur and reach the mangroves, substantial damage to that community would be likely. The Sasa Bay mangrove area is approximately 4,000 ft (1,220 m) from the proposed wharf area project location. This wetland is a large natural wetland that fringes the bay in eastern Apra Harbor (Figure 10.2-2). The mangroves and associated wetlands further inland are supported by flows of the Sasa, Laguas, and Aguada rivers. Various mangrove species occupy the edge of the bay and there is a small grove of nipa near the Laguas River based on 2010 project-specific field reconnaissance observations. Other areas are occupied by dense, disturbed secondary forest that floods seasonally and in scattered areas are beds of reeds and an intertidal mudflat generally lacking in vegetation (Wiles and Ritter 1993). This wetland is important for aquatic organisms that are specific to mangroves, including molluscs, clams and oysters, fiddler crabs, land crabs, and mangrove crabs. The mangroves are also nursery grounds for various marine fishes (Wiles and Ritter 1993).

Mangrove responses to oil spills have been summarized by Hoff et al. (2002). Mangrove tree species themselves are highly susceptible to oil exposure and the lighter oils are more acutely toxic than heavier oils. Acute effects of oil (mortality) occur within 6 months of exposure and usually within a much shorter time frame (a few weeks). Common responses of mangrove tree species to oil include yellowing of leaves, defoliation, and tree death. Mangrove communities are complex but the available information suggests that the mangrove faunal community recovers faster than the mangrove trees themselves (Hoff et al. 2002).

The potential that oil spills at the berthing area would reach the mangroves is partly controlled by currents in Apra Harbor. Currents in the harbor are predominantly wind-driven, and occur as a two-layered system. Project area currents were found to be weak with surface currents of 4-8 centimeters per second (Eriksen 2009). Tidal effects within the harbor are small. The surface layer flows in the direction of the wind, and the deeper layer flows in the opposite direction. During typical trade wind conditions, surface flow is to the west out of the harbor, while deeper flow is to the east into the harbor. Surface flows to the west would move an oil spill away from the Sasa Bay mangroves. However, it is noted that during typhoons, when spills are more likely to occur based on historical records, surface water movements may be towards the mangroves. Minimization measures for responding to potential spills are discussed below.

The capability to respond to any spill resulting from the proposed action is substantial. NOAA has developed a modeling tool for spills called the General NOAA Operational Modeling Environment and has developed specific information for Apra Harbor (NOAA 2009). Other minimization is discussed in the mitigation measures section.

Additional BMPs and procedures that would be in place are outlined in the required SPCCP. With the combined prevention, response, and cleanup capabilities that would be in place, potential impacts from operations to the mangrove areas and migratory birds and other species it supports would be less than significant.

Special-Status Species

Mariana Common Moorhen. Noise and activity during operations would have less than significant impacts on the moorhen because the proposed berthing area is over 0.5 mile (0.8 km) from the nearest known moorhen habitat, the wetlands to the west of Sumay inlet. Potential petroleum spills would be unlikely to impact moorhen freshwater wetland habitat because the habitat areas are behind shorelines or behind mangroves. Impacts to the moorhen would be less than significant.

Sea Turtles. Sea turtles are known to use the marine environment in the area and these impacts are evaluated under in Chapter 11, Marine Biological Resources, of this Volume. As discussed under construction, the nearest known sea turtle nesting area is at Sumay Cove, approximately 3,800 ft (1,158 m) from the ship berthing area. Recommendations have been made in other studies that arm-mounted area lighting should not be closer than 500 ft (150 m) to a turtle nesting beach (Witherinton and Martin 1996) so there are unlikely to be significant indirect impacts to sea turtles from noise or lighting during operations in the berthing area. Potential petroleum spills (see also the discussion under wildlife above) would significantly impact the potential sea turtle nesting area at Sumay Cove and possibly other potential sea turtle beaches. With implementation of BMPs, spill plans, and with adequate spill equipment and response capabilities, impacts to terrestrial habitat used by sea turtles would be less than significant.

Table 10.2-1 summarizes Alternative 1 impacts.

Table 10.2-1 Summary of Alternative 1 Impacts

Area	*Activity*	*Project-Specific Impacts*
Apra Harbor, Polaris Point	Construction	Construction on land would occur in an area already developed with minimal or no native vegetation; wildlife use of this terrestrial area is also minimal or if used it is by species that are widespread on Guam; the nearest area with abundant wildlife is the GovGuam-designated Sasa Bay Preserve over 4,000 ft (1,220 m) away; noise and activity from night-time dredging of Apra Harbor would result in minor disturbance to migratory birds in terrestrial areas of Sasa Bay but impacts would be less than significant; potential impacts on the sea turtle nesting areas due to lighting during dredging operations would be minimized to less than significant.
	Operation	There would be less than significant impacts to wildlife at Sasa Bay from noise and lighting; there would be less than significant impacts to special-status species including sea turtles at Sumay Cove and other beaches from potential petroleum spills with implementation of standard BMPs.

10.2.2.2 Alternative 1 Proposed Mitigation Measures

The following mitigation measures would be required for Alternative 1.

- Construction-related vessels would be restricted from the Sasa Bay Preserve so as to reduce potential impacts to wildlife species.

- To the maximum extent practical, while meeting minimum safety, anti-terrorism, and force protection requirements, lighting would be minimized and hooded or shielded lights will be used during construction and at all proposed new roads and facilities within sea turtle land-based habitat.
- During the period of night-time dredging activities, observers would monitor all potential nesting beaches and look for recent turtle tracks and signs of nesting activity. If a nest is observed, the area would be photographed and marked, and the date and location recorded; hatching from the nest would be monitored. Any observed disturbance to the species that was noted during monitoring and particularly during nesting or hatchling activity would be halted. Periodic monitoring of potential nesting beaches on Navy lands and recordkeeping during operations of the new facilities would also be conducted.
- A Micronesia Biosecurity Plan (MBP) is being developed to address potential non–native species impacts associated with this EIS as well as to provide a plan for a comprehensive regional approach. The MBP will include risk assessments for non-native species throughout Micronesia and procedures to avoid, minimize, and mitigate these risks. It is being developed in conjunction with experts within other federal agencies including the National Invasive Species Council (NISC), U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS), the U.S. Geological Survey – Biological Resources Discipline (USGS-BRD), and the Smithsonian Environmental Research Center (SERC). The plan is intended to be a comprehensive evaluation of risks in the region, including all Marine Corps and Navy actions on Guam and Tinian. It will include BTS control measures to prevent BTS movement off Guam and management within Guam. For actions proposed in this EIS, biosecurity measures would be implemented to supplement existing practices to address invasive species. For additional information on existing and proposed measures for non-native, invasive species control, refer to Volume 2, Chapter 10, Section 10.2.2.6.

In addition, another relevant mitigation measure, sea turtle natural history studies, would be conducted and is a mitigation measure in Volume 2, Chapter 10, Section 10.2.2.6. Refer to that section for additional information.

10.2.3 Alternative 2 Former Ship Repair Facility (SRF)

10.2.3.1 Onshore and Offshore

All proposed activities under Alternative 2 Former SRF (referred to as Alternative 2) are the same as those proposed under Alternative 1 except that aircraft carrier berthing would occur at the Alternative 2 and not Alternative 1 (see Table 10.2-1). All proposed wharf and building construction actions under this alternative would be conducted in areas that are already developed and are currently used for existing Navy operations.

<u>Construction</u>

Vegetation

Impacts would be the same as for Alternative 1.

Wildlife

Impacts would be the same as for Alternative 1.

Special-Status Species

Mariana Common Moorhen. Impacts to the moorhen would be the same as for Alternative 1.

Sea Turtles. The potential Sumay Cove sea turtle nesting area is approximately 1,800 ft (549 m) from the Alternative 2 aircraft carrier berthing site. Although sea turtle nesting has been recorded only once (in 1997) and no activity has been recorded since that time at Sumay Cove, it is possible that the area could be used again. Artificial light sources at night during construction that shine on a nesting beach could result in a number of impacts including: deterring adult females from exiting the water to lay eggs on the beach, causing abandonment of nesting attempts, disorienting adult females after nesting, or disorienting hatchlings. Potential impacts on sea turtles from lighting during dredging operations would be reduced through minimization of or lighting control and nesting beach monitoring. Details are described under the mitigation discussion in Section 10.2.2.2. Nesting beach monitoring is currently being conducted at beaches in the vicinity.

Construction at the berthing area would generate noise. The Navy recognizes that there are many on-going and recent past studies on the subject of potential exposures to sea turtles from pile driving actions. Further research and validation of these studies are necessary prior to being able to determine the applicability of the methodologies and results to the proposed action within this EIS. The Navy will continue to research these studies. Applicability of these studies will also be coordinated through marine biological consultations with the NMFS. The monitoring that would be in place for potential sea turtle nesting areas would help to determine if there were any effects and, if necessary, noise reduction methods would be employed. With these BMPs and mitigation measures, impacts to sea turtles would be less than significant.

The same BMPs for Alternative 1 for construction at the berthing area would be employed for Alternative 2 to protect sea turtles during dredging.

Operation

Vegetation

Impacts would be the same as for Alternative 1.

Wildlife

Impacts would be the same as for Alternative 1.

Special-Status Species

Impacts to special-status species would be similar to those described for Alternative 1. An additional potential impact for sea turtles would be as described below.

Sea Turtles. Artificial lighting during operations would potentially affect Sumay Cove in a similar manner to that described for construction above. Mitigation measures would be employed to eliminate or reduce the impacts of artificial night lighting such as minimizing lighting or the use of hooded lights. Observers would monitor potential sea turtle nesting at any beaches in the vicinity that are determined to be viable and activity and nests would be recorded and monitored through hatching. Any identified disturbances would be halted or corrected. With these measures, impacts to sea turtles would be less than significant.

Table 10.2-2. Summary of Alternative 2 Impacts

Area	*Activity*	*Project Specific Impacts*
Apra Harbor, Former SRF	Construction	Construction on land would occur in an area already developed with minimal or no native vegetation; wildlife use of this terrestrial area is also minimal or if used it is by species that are widespread on Guam; the nearest area with abundant wildlife is the GovGuam-designated Sasa Bay Preserve over 4,000 ft (1,220 m) away; noise and activity from night-time dredging of Apra harbor would result in disturbance to migratory birds in terrestrial areas of Sasa Bay but impacts would not be significant; potential impacts on the sea turtle nesting area at Sumay Cove due to lighting during dredging operations would be minimized to less than significant.
	Operation	There would be less than significant impacts to wildlife at Sasa Bay from noise and lighting; potential impacts to sea turtle beaches from lighting would be minimized to less than significant; there would be less than significant impacts to special-status species including sea turtles at Sumay Cove and other beaches from potential petroleum spills with implementation of standard BMPs.

10.2.3.2 Alternative 2 Proposed Mitigation Measures

Proposed mitigation measures would be the same as those previously described for Alternative 1.

10.2.4 No-Action Alternative

Existing terrestrial biological resources would remain unchanged under the no-action alternative.

10.2.5 Summary of Impacts

Table 10.2-3 summarizes the potential impacts of each action alternative and the no-action alternative.

Table 10.2-3. Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
Vegetation		
• NI	• NI	• NI
Wildlife		
SI-M; LSI • Significant potential indirect impact to Sasa Bay wildlife from noise and activity during night-time dredging and construction, mitigated to less than significant. • Less than significant potential indirect impact to Sasa Bay wildlife from night-time operations.	SI-M; LSI • Significant potential indirect impact to Sasa Bay wildlife from noise and activity during night-time dredging and construction, mitigated to less than significant. • Less than significant potential indirect impact to Sasa Bay wildlife from noise and activity during night-time operations.	NI • No impacts to terrestrial biological resources
Special-Status Species		
SI-M;LSI • Significant potential indirect impacts to sea turtles at Sumay Cove beaches from lights and noise during dredging, mitigated to less than significant. • Less than significant indirect impact during operations.	SI-M • Significant potential indirect impacts to sea turtles at Sumay Cove beaches from lights and noise during dredging and construction, mitigated to less than significant. • Significant potential indirect impact to sea turtles at Sumay Cove beaches from night lights and noise during operation, mitigated to less than significant.	NI • No impacts to terrestrial biological resources

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

10.2.6 Summary of Proposed Mitigation Measures

Table 10.2-4 summarizes the proposed mitigation measures to compensate for the impacts.

Table 10.2-4. Summary of Proposed Mitigation Measures

Alternatives 1 and 2	*No-Action Alternative*
Vegetation	
None	None
Wildlife and Special-Status Species	
• Before the start of construction, all personnel involved would receive a briefing on special-status species potentially present and avoidance measures. • Construction-related vessels would be restricted from the Sasa Bay Preserve so as to prevent potential impacts to wildlife species. • Lighting will be designed to meet minimum safety, anti-terrorism, and force protection requirements. To the maximum extent practical, hooded lights would be used at all proposed roads and facilities near sea turtle land-based habitat. • The Micronesia Biosecurity Plan is being developed to address potential invasive species impacts associated with the actions proposed in this EIS as well as to provide a plan for a comprehensive regional approach. The MBP would include risk assessments for invasive species throughout Micronesia and procedures to avoid, minimize, and mitigate these risks. It is being developed in conjunction with experts within other federal agencies including the NISC, USDA-APHIS, USGS-BRD, and SERC. The plan is intended to be a comprehensive evaluation of risks in the region, including all Marine Corps and Navy actions on Guam and Tinian. For actions proposed in this EIS, biosecurity measures would be implemented to supplement existing practices to address invasive species.	None

CHAPTER 11. MARINE BIOLOGICAL RESOURCES

11.1 AFFECTED ENVIRONMENT

A description of the potentially affected environment fnor marine biological resources in Apra Harbor is presented in Volume 2, Chapter 11. This chapter describes the potentially affected environment for marine biological resources in Outer Apra Harbor, where the proposed aircraft carrier berthing would occur. The Marine Biological Resources chapters (Chapter 11) of both Volume 2 and Volume 4 should be read to understand the status of the existing marine environment in both Inner and Outer Apra Harbor with respect to the proposed action. See Volume 2, Chapter 16, Section 16.1.6 for a discussion of coral as it relates to an overall increased human population as a result of the proposed action.

Figure 11.1-1 shows a bathymetric map of the project area and the proposed aircraft carrier berthing alternatives (Alternative 1 Polaris Point and Alternative 2 Former Ship Repair Facility [SRF]). The proposed channel and turning basins are bordered by several large "patch reefs" or "shoal areas" that consist of shallow, flat-topped, and steep-sided features. The largest three of these reefs are Jade Shoals, Western Shoals, and Big Blue Reef (shoal areas). These reefs all consist of relatively flat and shallow upper surfaces that are covered with a mixture of live coral, rubble, algae-covered dead coral, and to a lesser extent, muddy sand. The western facing slopes of Western Shoals and Big Blue Reef are almost completely covered with living corals to a depth of approximately 50 to 60 feet (ft) (15 to 18 meters [m]), where the slopes intersect the channel floor. Coral cover on the eastern slopes of these two reefs is much less compared to the western slopes. The Jade Shoals site, located to the northeast of Western Shoals and Big Blue Reef, does not show the same degree of asymmetrical coral growth on the western edge, with most of the shoal ringed by slopes with high coral cover (Navy 2009a).

The area demarcated as the project area and turning basin, including the proposed wharf area, presently contains minimal areas of the shallow shoal patch reefs, including the deep edge areas of Jade Shoals and Middle Shoals and the western portion of an unnamed patch reef located to the northwest of Jade Shoals. This area was dredged in 1946 to allow safe access to the newly completed Inner Apra Harbor. As a result, the shallowest depth within the channel and turning basin is about 40 ft (12 m). It is likely that the large flat area in the southern end of the turning basin was another shoal area similar to the surrounding reefs prior to the 1946 dredging. Dredging likely removed the shallow area, resulting in the present configuration. While the top of the deep reef is essentially flat at a depth of approximately 40 ft (12 m), the remaining edges slope relatively steeply to the channel floor (Dollar et al. 2009). The elapsed time since dredging of the original channel suggests that much of the coral within the depth zone to be dredged for the aircraft carrier project (-49.5 ft [-15 m] mean lower low water [MLLW] plus 2 ft [0.6 m] of overdredge) is regrowth, which would indicate a community with a maximum age of 62 years (Dollar et al. 2009). As described by Smith (2007), a substantial percentage of the coral at all depth contours off Polaris Point was growing on metallic and/or concrete debris, was of marginal quality, and showed the greatest signs of stress. This stress appeared to be due in part to high levels of total suspended solids (TSS) coming from Inner Apra Harbor.

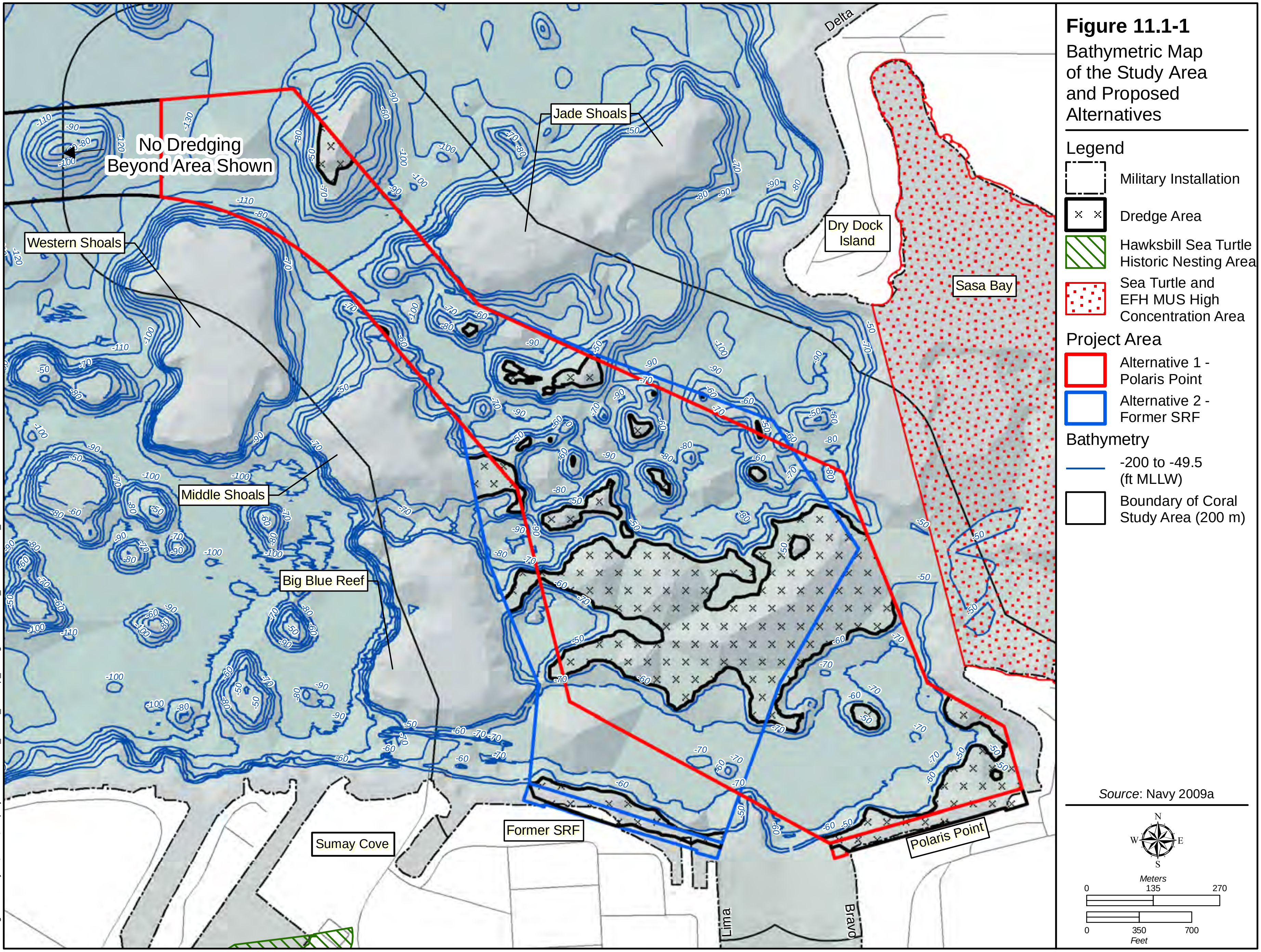

Figure 11.1-1
Bathymetric Map of the Study Area and Proposed Alternatives

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11.1.1 Coral Assessment Methodology

As coral and coral reef ecosystems are extremely important and fragile resources, various methods have been developed to quantitatively assess their condition and the nature and extent of human damage to coral populations and coral reef ecosytem functions and services when it occurs. A review by Viehman et. al. (2009) evaluates the pros, cons, and difficulties of alternative methods used to assess damage tocoral reefs. The Navy's methodology, including the use of Habitat Equivalency Analysis (HEA) and coral coverage measurements within the framework of natural resource damage assessment (NRDA), parallels the current state of science and practice as identified in the Viehman et al. (2009) review. The EPA and Resource Agencies recommended collecting additional size-frequency measurements to further define coral reef function.

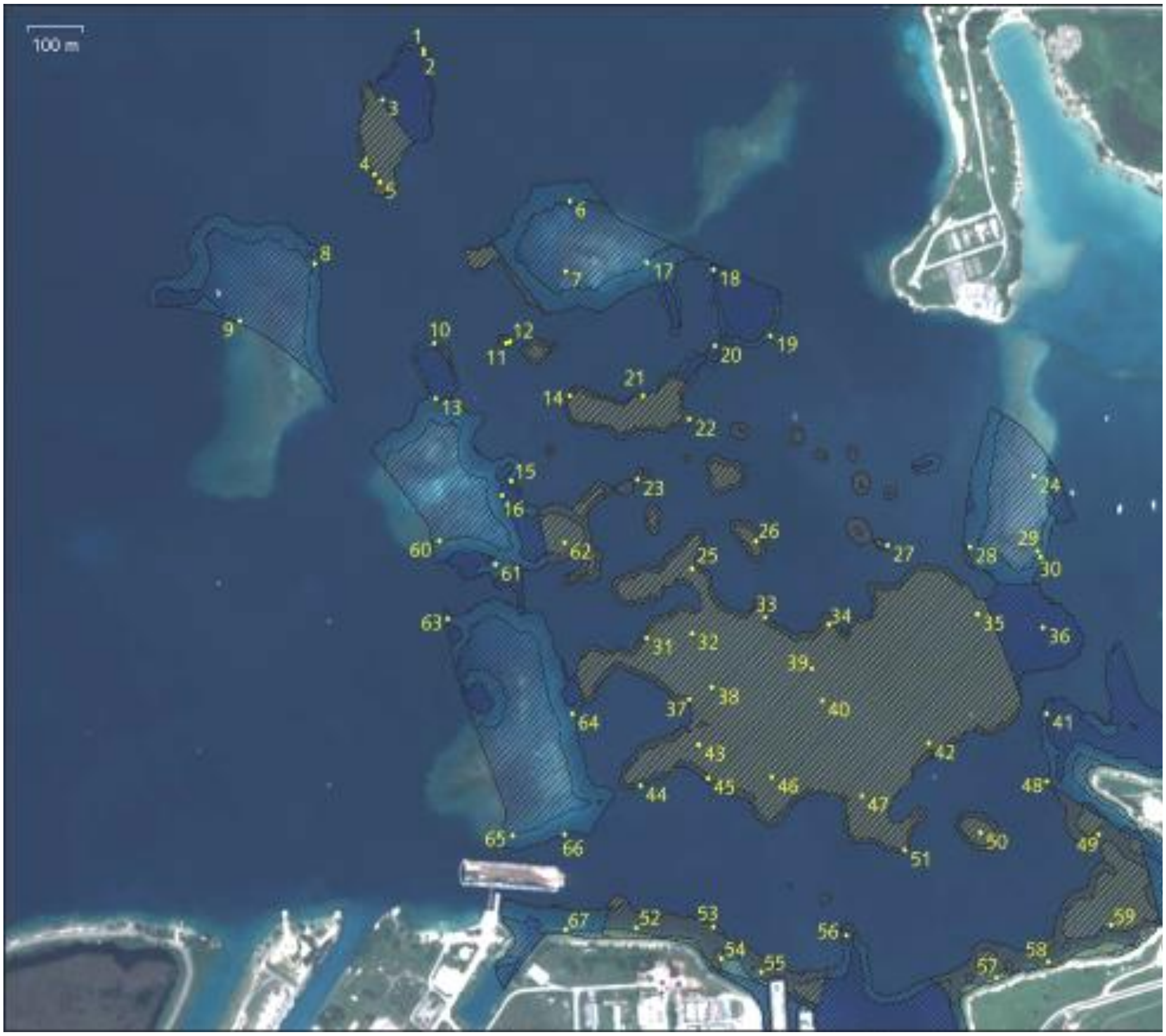
The original intent of NRDA was to address issues related to vessel groundings/oil spills, but the parameters used in NRDA to evaluate service loss and derive mitigation needs can also be applied to dredging or other types of impacts. Under the Clean Water Act (CWA), as identified in the 10 April 2008 compensatory mitigation rule (33 CFR 325, 332; 40 CFR Part 230), the issuance of a permit by the U.S. Army Corps of Engineers (USACE) for the discharge of dredged material or fill into the waters of the United States requires compensatory mitigation when necessary to ensure no net loss of ecosystem functions and services.

NRDA is an evolving science, and various methods of evaluating habitat loss exist. The use of HEA along with the incorporation of coral coverage measurements that are sufficient for the specific geographical area of habitat loss is one method that has been implemented and accepted by scientists as valid (Viehman et al. 2009).

The description of baseline conditions of the coral and coral reef ecosystem within Apra Harbor relies on several recent studies summarized below. Those studies that were prepared specifically for this proposed action are included in Volume 9, Appendix J.

i. *Assessment of Benthic Community Structure in the Vicinity of the Proposed Turning Basin and Berthing Area for Carrier Vessels Nuclear (CVN) Apra Harbor, Guam* (Dollar et al. 2009) included in Volume 9, Appendix J.

Survey data were collected from 67 transect points (Figure 11.1-2) to provide preliminary evaluation of the composition of benthic community structure within the area that would be affected by the proposed aircraft carrier wharf construction and operation. This was the primary source of affected environment and impact assessment information. The data were also used for inputs into an HEA. Volume 9, Appendix J provides detailed descriptions of survey methods, coral stress assessment, and remote sensing analysis. This report was peer reviewed by eight scientists and these reviews are also in Volume 9, Appendix J.



Source: Dollar et. al. 2009

Figure 11.1-2. Outer Apra Harbor Showing 67 Data Points/Transect Stations for Coral Habitat Surveys

(black hatching = potential direct impacts; blue hatching = potential indirect impacts)

ii. *Ecological Assessment of Stony Corals and Associated Organisms in the Eastern Portions of Apra Harbor, Guam* (Smith 2007).

The primary objective of this survey was to quantitatively assess the distribution and abundance of Scleractinian (stony) corals within seven selected portions of Apra Harbor. Data collection included determination of the presence of coral taxa, frequency of occurrence along transects (utilizing point-quarter methods), relative densities, size distribution, percentage of coral (hard and soft) coverage, and apparent "health." Qualitative and semi-quantitative data were also gathered on selected species of macroalgae and macrobenthic invertebrates, finfish, and sea turtles. Consideration was also given to Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPCs).

iii. *Habitat Equivalency Analysis (HEA) and Supporting Studies* (Navy 2009a).

This study is included in its entirety in Volume 9, Appendix E. The documents coral methodology was peer reviewed by eight world-renowned coral scientists and the reviews are included in Volume 9, Appendix J. The report contains an introduction (Section A), and five stand-alone technical reports (Sections B through F) as referenced below:

A. *Introduction*
B. *Reconnaissance Surveys of the Marine Environment, Eastern Outer Apra Harbor, Guam, and Baseline Assessment of Marine Water Chemistry* (MRC 2009a).
C. *Assessment of the Affected Marine Environment, Outer and Inner Harbor, Guam* (MRC 2009b).
D. *Marine Ecosystem Impact Analysis CVN Project Outer Apra Harbor, Guam* (MRC 2009c).
E. *Current Measurement and Numerical Model Study for CVN Berthing* (SEI 2009).
F. *Habitat Equivalency Analysis (HEA) Mitigation of Coral Habitat Losses* (IEI 2009).

iv. *Quantitative Assessment of the Reef Fish Communities in Apra Harbor, Guam (University of Guam* [UoG] 2009)

This study is also included in Volume 9, Appendix J. This assessment consisted of underwater surveys (Figure 11.1-2). The surveys were used to quantitatively assess species richness, abundance, and biomass of reef fish communities within and adjacent to the proposed project area. Multivariate analysis was performed on the data collected to determine groupings of fish communities based on depth/habitat gradient, diversity and biomass.

v. *Comparison of a Photographic and an In Situ Method to Assess the Coral Reef Benthic Community in Apra Harbor, Guam* (Minton et al. 2009).

The fifth study provided in Volume 9, Appendix J documents a joint-resource agency (U.S. Fish and Wildlife Service [USFWS], Guam Coastal Management Program, UoG, and National Marine Fisheries Service [NMFS]) effort to compare an *in situ* quadrat method (ISM) and a photographic quadrat method (PM) using eight different data types collected on a heterogeneous coral reef in Apra Harbor. This study has been used in the EIS for supplemental information.

Because the CVN project represents the first test of the functional assessment requirements (vs. area only) for large-scale coral reef impacts in the Pacific Ocean, EPA and the Resource agencies have recommended that additional size-frequency data be collected to augment the Navy's methodology.

11.1.2 Comparison of Methodologies to Assess Impacts to Coral

The Navy acknowledges there is no commonly accepted scientific methodology, nor regulatory mandated method to estimate coral reef function. In its simplest form, the objective of the NRDA process is to estimate the restoration services required to replace lost ecological services from the injuries caused by the responsible party. It is often difficult to know whether the proposed restoration actions are sufficientto reach this objective given the current state of reef restoration science. While the practical and measurable goals of restoration are to rapidly re-create the structure and functions of an injured habitat, the approaches for realizing this goal are continually evolving. There is a delicate balance between broad, general operating principles and site specificity. Careful selection of the theoretical NRDA approach (HEA-based using two-dimensional coral cover or composite metrics, or REA-based using size-frequency distributions) and metrics appropriate to both the degree and extent of injury and of habitat type will serve as a vital link between the damage assessment, recovery modeling, compensatory calculations, and recovery monitoring. An immense amount of information is necessary to fully understand the type and

magnitude of ecological services provided by the injured coral reef in its baseline condition, the manner in which those ecological services will recover following the injury, and the relationship of those services with those provided via compensatory restoration projects.

Size-frequency is an *in-situ* ("on-site" or "in place") measurement of discrete coral colonies to obtain size-frequency distribution data. Size-frequency measurements provide information about coral colonies and the roles individual corals play in an ecosystem. This size-frequency method has been proposed by other scientists as an additional quantifiable method of assessment.

Satellite imagery/rugosity consists of light detection and ranging (LIDAR) photographic imagery combined with *in-situ* measurements of coral community structure. The photographic data consists of satellite and underwater imagery. Satellite imagery was analyzed in a laboratory setting to obtain a percent coral cover estimate, and was added to subsequent rugosity data obtained in-situ at those sites.

The photographic percent coral cover and rugosity method was employed by the Navy to conduct the resource assessment during fieldwork performed. In addition to its current utility this method provides an opportunity for additional data to be derived as the science matures... Coral coverage estimates gleaned from remote sensing techniques capture the two-dimensional state of the habitat, can be

re-examined if necessary, can be replicated at any location, and is logistically simple and cost-effective to collect. This information, in addition with the rugosity data collected with subsequent surveys, provides an accurate and adequate representation of the coral habitat for the purposes of the programmatic decision to locate a transient CVN berthing facility.

It must be noted that all sampling methods used in a study area have limitations, but in this case and at this geographic location, the coral coverage method provides sufficient information for the programmatic decision to proceed with the proposed location of a CVN berthing facility on Guam, and additional studies will be conducted before the Navy decides where on Guam to propose to locate that facility.

The discussions with EPA, NOAA, and DOI also led to a better understanding on the part of the Navy regarding the concerns of the regulatory agencies and the public about the analysis presented in the DEIS. The discussions also clarified concerns about the sufficiency of the information that would be required to support future site selection and Federal permitting actions to allow for construction of the proposed transient aircraft carrier berth when it is time to make decisions on the specific site for the transient berth. Based on the level of concern expressed in comments on the DEIS, continued discussions with cooperating agencies under NEPA, and the Navy's continuing commitment to environmental stewardship, the Navy has elected to forego selection of a specific site for the transient aircraft carrier berth within Apra Harbor for the near term. The Navy will continue to proceed toward a decision whether to locate a transient aircraft carrier berth generally within Apra Harbor but will defer a decision on a specific site for the transient berth. Discussions with EPA, NOAA and DOI identified additional data these agencies would prefer to have available for analyzing specific sites for the CVN transient berth. The Navy will voluntarily collect additional data on marine resources in Apra Harbor at the alternative transient aircraft carrier berth sites still under consideration by the Navy. The type and scope of the additional data to be collected has been developed cooperatively with EPA, NOAA, and DOI and is described in the "Final Scope of Work Elements for Marine Surveys of the CVN Transient Berth Project Area, Potential Mitigation sites, and Habitat Equivalency Analysis" included in Volume 9. The additional data collected, associated analysis, and any other data that may be required by the USACE during the CWA and RHA permitting processes, will be used in the future to inform the selection of a specific site for the transient aircraft carrier berth and to support any CWA and RHA permitting decisions and appropriate compensatory mitigation. The additional data collected and analyzed for specific sites will be used by the Navy as provided in the CEQ regulations governing supplemental and tiered environmental impact analysis (40 CFR §§ 1502.09 and 1502.20). Based on those discussions, EPA, NOAA, and DOI acknowledged that the Navy's current analysis is sufficient to support a programmatic decision to locate a deep draft transient berth for a CVN on Guam. The Navy, EPA, NOAA, and DOI also recognize that the Navy has stated its preferred alternative and that decisions about the final location of the transient berth have not been made.

11.1.3 Marine Flora, Invertebrates, and Associated EFH

Similar to the information presented in Volume 2, this chapter provides a description of marine flora and macroinvertebrates found within the ROI, but also includes a substantially more detailed description of coral and coral reef ecosystems. For more detailed general descriptions of EFH within the ROI see Volume 2, Chapter 11, section 11.1.4.2. Organisms described include macroalgae (or seaweeds), sea grasses, emergent vegetation (plants that are rooted in the substrate beneath water, but grow tall enough to protrude above water or have leaves that float on the water), gastropods (snails), cephalopods (squid and octopus), crustaceans (lobsters and crabs), and sponges. These taxonomic groups are also included within the managed fisheries in the Western Pacific under five fisheries management plans (FMPs), now included in two recently approved fisheries ecosystem plans (FEPs), the Mariana Archipelago FEP and Pelagics FEP (NMFS 2010a): (1) coral reef ecosystems (2) bottomfish and seamount groundfish, (3) crustaceans, (4) precious corals, and (5) pelagic species. The FEPs identify specific management unit species (MUS) managed under the respective plan (Western Pacific Regional Fisheries Management Council [WPRFMC] 2009a and WPRFMC 2009b). Essential Fish Habitats defined under each FEP are described further below. Coral and coral reef ecosystem impacts are addressed under the EFH environmental consequences section.

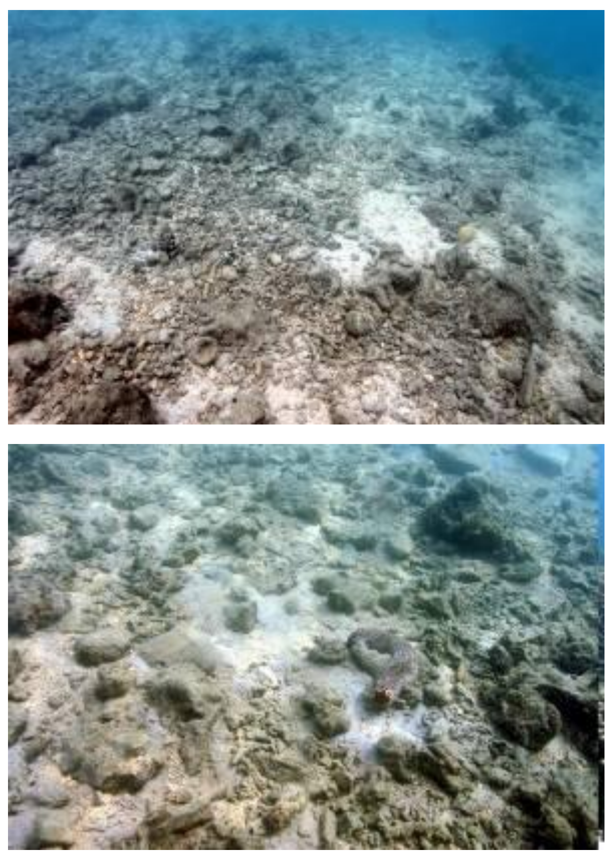


Figure 11.1-3. Sand-rubble bottom (0% coral coverage) at Transects 58 (upper) and 67 (lower) (both potential direct dredge impacted areas; 35% of the dredge area includes this bottom type).

The structure of the marine benthic environment off the eastern shoreline in the vicinity of the aircraft carrier channel and turning basin is composed primarily of three major biotopes and eight secondary biotopes. A biotope is defined as an area that is relatively uniform in environmental conditions and in its distribution of its animal and plant life (i.e., also benthic community structure). These three major areas are: 1) large flat-topped reefs 2) dredged reefs in the turning basin and entrance channel, and 3) soft sediment areas in the turning basin and entrance channel (Dollar et al. 2009). The eight secondary biotopes are described below with representative photos depicting examples of each secondary biotope. The photo captions also contain the approximate percentage of the proposed dredge area that would contain that particular type of biotope. The photos are representative visual examples of conditions observed throughout each secondary biotope during dive surveys.

11.1.3.1 Eight Secondary Biotopes of the Survey Area

Data on biotopes in the ROI were summarized by Dollar et al. (2009) and provided below, unless identified otherwise. "The survey area consists of a heterogeneous mix of a variety of several biotopes ranging from mud flats to algal meadows to a wide structural array of reef coral communities (in terms of both species assemblages and physical forms). Bray-Curtis similarity indices revealed seven distinct community groups with respect to the "general classes" of transect cover (e.g., algae, coral, sponges, sediment). When "detailed classes" containing all identified species and substratum types were analyzed, 16 distinct community groups emerge." Descriptions of these biotopes are summarized below. Transect locations are shown on Figure 11.1-2.

Figure 11.1-4. Algae dominated areas of the CVN study area (0% coral coverage) include mats of *Padina* spp. (40% of the dredge area includes an algal bottom type).

<u>Rubble, Mud and Sand</u>

Many regions of the aircraft carrier berthing study area were not colonized by any epi-benthic biota. Benthic cover in these areas consisted of plains of fine grained sand-mud (90% of the surficial sediments were very fine sand sized or coarser, and had a median grain size of approximately 0.004 in [0.1 mm] [very fine to fine sand]) (NAVFAC Pacific 2006), primarily composed of calcium carbonate (Figure 11.1-3). Numerous burrows and mounds from infaunal organisms like worms and crustaceans punctuated most of the sand-mud regions. In addition, the surface of the sediment was often covered with thin films of bacteria or micro-algae.

In addition to the sand-mud plains, some areas of the bottom were covered uniformly with a layer of mixed rubble and coarse sand. Most of the rubble is recognizable as dead coral fragments. The harbor floor associated with and fronting Polaris Point (Transects 57, 58, 35) and the Former SRF (Transects 52, 53, and 54), was composed predominantly of rubble and sand (Figure 11.1-3).

Algal Beds

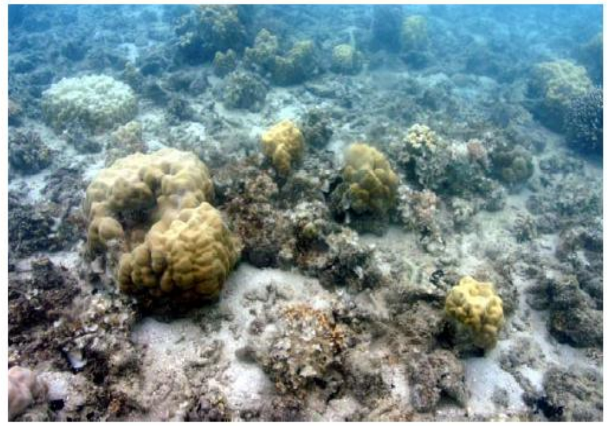


Figure 11.1-5. Representative areas of mixed algae and coral on Transect 17 (a potentially indirectly [siltation only] impacted site) is representative of an area with 30% to <50% coral coverage.

In addition to hermatypic corals, the other dominant benthic organisms within the study area are macroalgae, which consists of approximately 40% of the identified benthic cover. While there are biotopes that consist of "coral-algal mixes" (see mixed coral-algae below), there are also areas of predominantly algae stands. Three genera of algae are most prevalent, and in some areas are present in nearly monospecific meadows that extend over hundreds of square meters. The most common plant appears to be the brown alga *Padina spp*, which was found throughout the survey area. This alga is characterized by large, calcified, fan-shaped blades that grow in multiple clusters attached to rubble, sand or hard bottom (Figure 11.1-4). Also abundant is the calcareous green alga *Halimeda spp*., with fronds consisting of vertical series of connected flat segments. Much of the *Halimeda* observed in Apra Harbor was growing in dense beds over sandy bottoms. In these areas white calcified remains of plant segments form a component of the sandy substratum. The third dominant alga is *Dictyota spp*. which occurs as narrow, spirally twisting branches that are split on the ends. *Dictyota* was often seen in mats of mixed algae and mixed coral-algae, and was particularly abundant over sand-covered bottom.

Mixed Coral-Algae

Figure 11.1-6. Benthic cover of upper edges of patch reefs on Transect 21 (a potentially directly [dredged] impacted site) dominated by hemispherical colonies of *P. lutea* (represents 70% to <90% coverage) – 4.8% of this bottom type may be indirectly impacted.

Several biotopes which comprise the majority of benthic cover consist of combinations of two or more of the predominant communities described above. One of these combination biotopes can be termed "mixed coral-algae." One such combination consisted of hemispherical heads of *Porites lutea* amid stands of *Padina spp*. on the shallow tops and sides of patch reefs (Figure 11.1-5). In the deeper areas, particularly on the tops of the dredged platforms and pinnacles in the turning basin, combined algal-coral communities occurred in a variety of forms, including films of benthic bacteria on mud surfaces, short turfs on rubble fragments, and mats of *Halimeda* and *Dictyota* interspersed with colonies of *Porites*. A unique coral-algal assemblage occurred on Transect 9, where stands of living *Acropora aspera* were interspersed with sectors of dead branches encrusted with a layer of algal turf and cyanobacteria.

Patch Reef Margins – P. lutea Zone

P. lutea generally occurs as hemispherical or helmet shaped colonies and is a major component of benthic cover on the margins of the tops of patch reefs in the aircraft carrier berthing study area. Water depth of these flats is the shallowest of all biotopes, and is generally in the range of 3-7 ft (1-2 m). Within this zone, colonies of *P. lutea* are often densely packed together with adjacent colonies in contact with one another. Other dominant corals in this biotope included *P. cylindrica*, occurring in branched clusters, and *P. rus*, which occurred primarily of flat-topped clusters of densely packed branches (Figure 11.1-6). Moving off the flat surfaces of the patch reefs, community structure rapidly changes to a more uniform cover of *P. rus*, as described in the sections above.

Patch Reef Margins – *A. aspera* Mat

Transect 9, located on the top of the northwestern edge of Western Shoals, consisted entirely of a contiguous mat of the branching coral *A. aspera* (Figure 11.1-7). The field of *A. aspera* was limited to the top of the patch reef, and did not extend beyond a depth of approximately 3-7 ft (1-2 m), below which the benthic community was dominated by *Porites* species (Figure 11.1-7). This biotope was not observed in the vicinity of any of the other transects in the study area. The uniqueness of the biotope may be a result of orientation of the western edge of Western Shoals to the long axis of Outer Apra Harbor. During surveys, swells entering the harbor mouth were breaking at the transect location. A distinctive characteristic of the *A. aspera* mat was the occurrence of large sections of dead branches that were encrusted with algae or cyanobacterial mats. As the dead portions of these *Acropora* stands were completely intact, the cause of mortality cannot be attributed to any type of physical forces applied to the fragile branching matrix.

In addition, there were distinct boundaries between areas of apparently healthy branches and patches of dead branches. Within the dead patches, there were also clumps of "new" live branches with no sign of any abnormalities. One possible cause of the patchy mortality of the *Acropora* field is infestation of a black sponge that occurred within the coral thicket, completely covering branches (refer to Figure 11.1-7). While the smothering of live coral by the black sponge may be a cause of mortality, the presence of the sponge appeared ephemeral, as it was not evident in much of the area of algal-encrusted coral skeletons. In addition, the presence of patches of apparently healthy coral resulting from either planular settlement or vegetative spreading within the thickets of dead branches suggests that there is an ongoing dynamic process of coral-sponge interactions of mortality and recovery within the biotope (refer to Figure 11.1-7). Other possible causes of coral mortality include coral bleaching and coral disease.

Figure 11.1-7. Monospecific field of *A. aspera* with black sponge smothering coral located at Western Shoals, Transect 9 (a potentially indirectly [siltation only] impacted site).

Mixed Coral Communities

Coral community structure on some areas of the flatter sections of patch reef slopes as well as deep reef flats consisted of higher cover of a more diverse community than in the areas dominated solely by *P. rus*. Along with *P. rus*, two branching species, *Porites cylindrica (P. cylindrica)* and *Pavona cactus*, comprise substantial proportions of bottom cover. *P. cylindrica* occurs as thin rounded upright branches, with individual branches separated by an encrusting matrix base. *Pavona cactus* occurs as thin, upright, contorted fronds, each attached to a solid base. Both of these corals grow in interconnected stands that can extend over large areas of the reef surface. In particular, on Transect 15, located on the eastern edge of the unnamed patch reef between Western Shoals and Big Blue Reef, *Pavona cactus*, *P. cylindrica*, and *P. rus* formed mixed complexes with substantial contributions from all three species. Thus, three of the four most abundant corals encountered in the aircraft carrier berthing area surveys (*P. rus, P. cylindrica* and *Pavona cactus*) often occur in the form of supracolonies or spreading mats composed of multiple branches or fronds in the vicinity of Transect 15.

<u>*Porites rus* "Supracolonies"</u>

By far, the most common coral in Apra Harbor is *P. rus*. Colonies of *P. rus* can be massive, columnar, laminar, or branching and encrusting, and single colonies can contain multiple growth forms (Figure 11.1-8). It is also common to see growth forms that fit under the definition coined by Pichon (1978) of "supracolonies." By this definition, one "colony" is a formation originating from one planula. As new colonies in close proximity grow in size, they fuse. Such a phenomenon, when constantly repeated, leads to a continuous living coral formation, composed of elements belonging to different generations. These conglomerate colonial structures, or supracolonies, may extend over tens or hundreds of square meters. In some instances supracolonies may be so large as to represent a whole ecological identity (i.e., a sub-community).

While *P. rus* occurs throughout the survey area, it is particularly widespread on the outer (with respect to the aircraft carrier entry channel and tuning basin) sloping sides of the five large patch reefs (Jade, Western, and Middle Shoals, and Big Blue Reef, and an unnamed reef) (Figure 11.1-9). *P. rus* occurs in a variety of contiguous supracolony structural forms that dominate the benthic surface. Most of these structures are composed of multitudes of overlapping thin semi-circular plates. Supracolonies have the form of vertical walls, massive dome-shaped structures, conical spires, masses of fallacious cup-shaped and tabular plates. The upper photo of Figure 11.1-8 shows a "supracolony" of *P. rus* comprised of

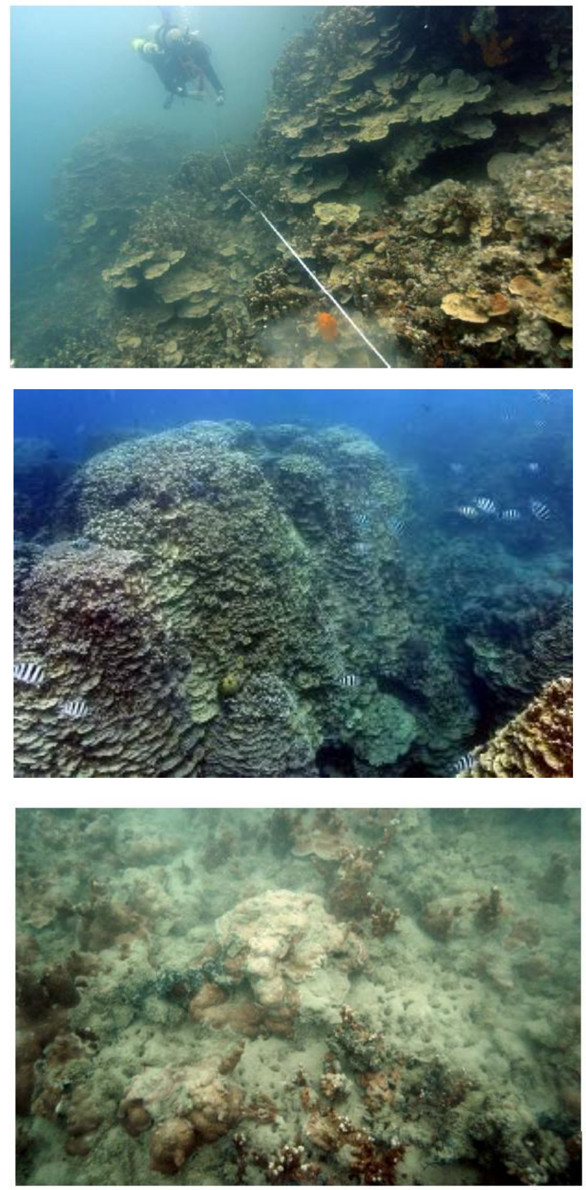


Figure 11.1-8. Various plating and laminar growth forms of *P. rus*, including colonies with upper living surfaces partially covered with sediment.

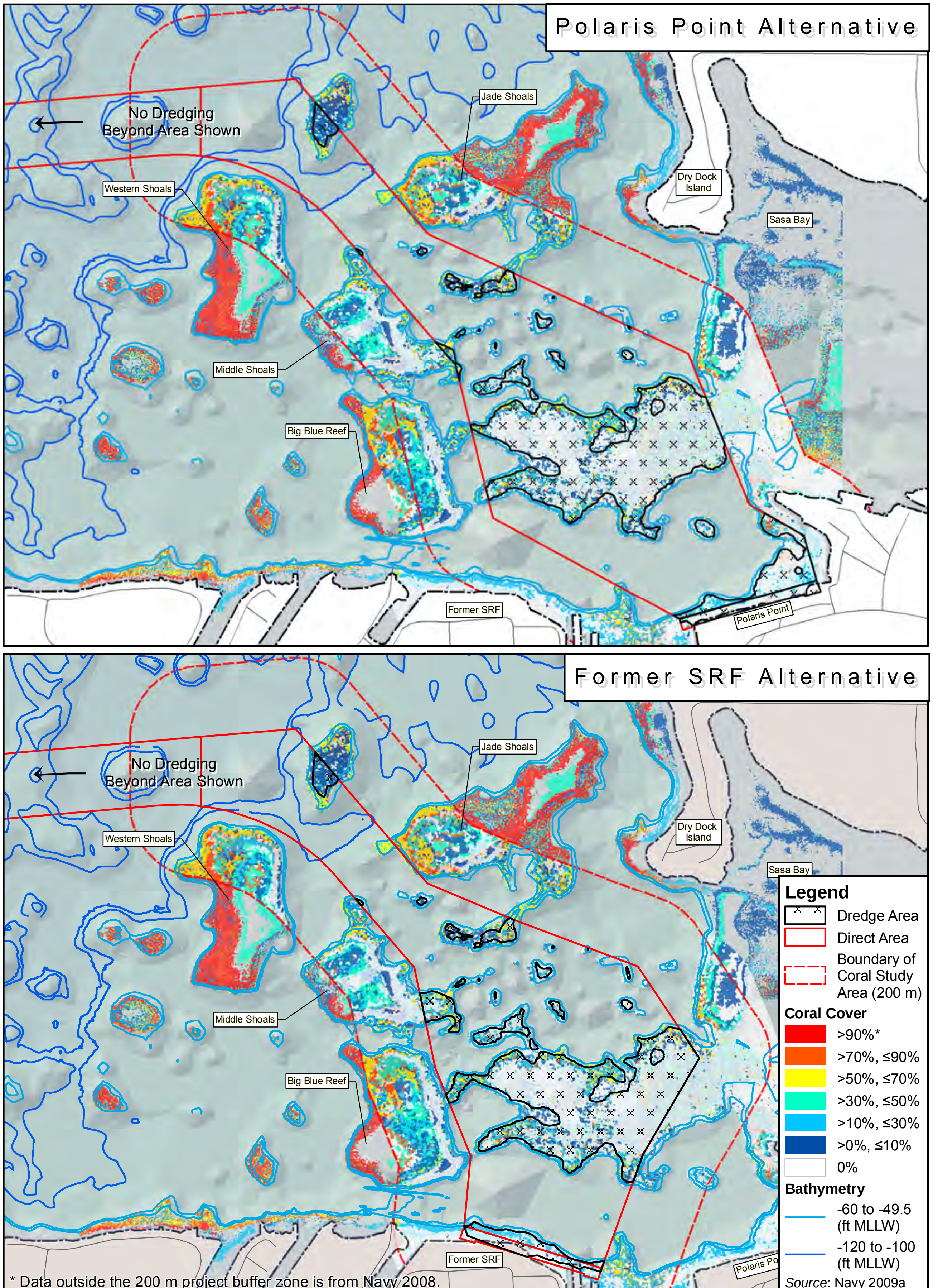


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Figure 11.1-9
Bathymetric Coral Abundance for Alternative 1 and 2

the amalgamation of numerous smaller colonies (39 ft [12 m] in length) at Transect 15. The middle photo shows overlapping amalgamated plates.

In addition, colonies and supracolonies of *P. rus* can assume a variety of branching forms that occur in contiguous thickets covering large sections of the benthic surface. It is also common to see multiple growth forms (branches growing out of laminar plates" (Dollar et. al. 2009).

Coral on Sediment

With the exception of stony coral skeletons, the substratum of the study area consists primarily of sediment of various grain sizes (mud, sand, rubble). As a result, an important aspect of coral community structure is the interaction between corals and soft sediment. Throughout the aircraft carrier berthing study area, and particularly in the deeper survey sites, corals are growing on, or out of the sediment surface. *P. rus*, in particular, occurs in a variety of growth forms that can be considered adapted to colonizing areas of soft sediment. Many of these colonies do not have a solid attachment to the bottom, with upper living areas overlying a base of dead skeletal material that is partially buried in the mud. In addition, many colonies growing in areas of abundant sediment had portions of the colonies covered with fine-grained sand or mud. Supracolonies of *P. rus* in many of the deeper survey locations were made up of complexes of laminar plates comprised of sections of both dead and living tissue. Much of the dead plated surfaces on these structures contain an accumulation of fine grained sediment.

11.1.3.2 Coral and Coral Reef Community Data

Assessment of Benthic Community Structure in the Vicinity of the Proposed Turning Basin and Berthing Area for Carrier Vessels Nuclear (CVN) Apra Harbor, Guam (Dollar et al. 2009) is provided in Volume 9, Appendix J, and is the basis for the following summary, unless otherwise noted. This assessment is referred to hereafter as "the study."

The study area is shown in Figure 11.1-9. Solid lines indicate the boundary of the direct impact area associated with dredging. Three zones were evaluated to assess the potential indirect impacts from dredging. The dashed lines indicate the outer boundary of the coral study area and the quantitatively-derived "maximum adverse impact" scenario for indirect sediment impacts from dredging operations. This distance was set at a 656 ft (200 m) distance from the direct impact area boundary and was not modeled. As described later in this chapter, the 656 ft (200 m) distance represents a conservative overestimate of the potential indirect impact area; it bounds the maximum extent of potential benthic impacts and delimits the area for collection of baseline data at the associated patch reef and shoal areas. As described in the SEI (2009) plume modeling summary (Volume 9, Appendix E) discussed later in this chapter (Section 11.2.2.2 and Figures 11.2-2 and 11.2-3), the potential indirect impacts were modeled and indicated that sedimentation exceeding 0.009 ounces per square inch (oz/in^2) (40 mg/cm^2) or 0.008 in (0.2 millimeters [mm]) extended an average distance of 144 ft (44 m) from dredging. Additional modeling identified that an area located 40 ft (12 m) beyond the direct dredge impact area is anticipated to receive cumulative sedimentation totaling at least 0.2 in (5 mm); 0.2 in (5 mm), which was established as the cumulative sedimentation threshold for corals. The U.S. Army Corps of Engineers, Engineer Research and Development Center (ERDC) is evaluating the fate and transport of resuspended dredged sediment in Apra Harbor, Guam and refining, if necessary, the Navy sediment plume estimate. The model, being developed by the U.S. Army Corps of Engineers, is called the Particle Tracking Model (PTM), and its simulations will be used for the purpose of determining sediment pathways to coral reef regions from dredging locations associated with the proposed action. The results of this work will assist with quantifying deposition of dredged sediment onto coral reefs. Sediment pathway and fate assessment during dredging operations will provide critical data for the exposure segments of risk assessment needed for USACE CWA 404 permit.

The study assumed a 60 ft (18 m) dredge depth, which is an overestimate of the proposed dredge depth of -49.5 ft (-15 m) plus 2 ft (0.6 m) overdredge MLLW, representing an approximate 10-15% increase in assessed benthic habitat in the dredged area. For this reason, the total dredged area as noted in Table 11.1-1 differs from the dredged area provided in Volume 4, Chapter 4. The 60-ft (18-m) contours are shown on Figure 11.1-9, and those contours within the direct impact area indicate the areas where dredging would be required. In the indirect impact area, these contours represent the depth limit of the coral assessment. There is a substantial amount of overlap between the two alternative aircraft carrier wharf project areas. The total dredge area (coral and non-coral), as noted in Table 11.1-1, for Alternative 1 is 71.2 ac (28.8 ha) and for Alternative 2 is 60.8 ac (24.6 ha). These are overestimates of the proposed projects' dredge footprints due to the use of a 60 ft (18 m) dredge depth. As described in Volume 4, Chapter 2 where the true dredge depth of -49.5 ft [15-m.] plus 2 ft [0.6-m] overdredge was used, total dredge area is 53.0 ac (21.4 ha) for Alternative 1 and 44.3 ac (17.9 ha) for Alternative 2.

The most relevant findings from the Dollar et al. (2009) study are the following.

- There are five large patch reefs (Jade, Western, and Middle Shoals, Big Blue Reef and an unnamed reef) as shown on Figure 11.1-9. This area was dredged in 1946 to allow safe access to the newly completed Inner Apra Harbor.
- Coral cover was dominated by a single species, *P. rus*, which accounted for about 74% of total coral cover. Along with *P. rus*, the next three most abundant species (*P. lutea, Pavona cactus*, and *P. cylindrica*) accounted for 95% of coral cover.
- Throughout the aircraft carrier study area, and particularly in the deeper survey sites, corals are growing on, or out of the sediment surface. *P. rus*, in particular, occurs in a variety of growth forms that can be considered adapted to colonizing areas of soft sediment. Many of these colonies do not have a solid attachment to the bottom, with upper living areas overlying a base of dead skeletal material that is partially buried in the mud. In addition, many colonies growing in areas of abundant sediment had portions of the colonies covered with fine-grained sand or mud.

It is also evident that the area within the dredge boundaries contains relatively small areas of the densest classifications of very high cover (>50% coral). Areas that did contain the densest categories were generally along the sloping margins of the large patch reef outside of the dredge envelope. While the mapping results indicate that about 7-9% of bottom cover and 20% of coral cover for both alternatives is in the two highest cover classes (>50%), such areas are not concentrated in any particular biotope or region, but are spread across the dredge zones in relatively low densities.

Table 11.1-1. Coral Cover in Six Levels for Direct and Indirect Areas at Polaris Point and Former SRF Alternative Aircraft Carrier Wharf Sites, Apra Harbor Guam

	Alternative 1					
	Direct		*Indirect***		*Total*	
Coral Level	*ha*	*ac (% coral*)*	*ha*	*ac (% coral*)*	*ha*	*Ac (% coral*)*
Coral = 0%	**18.61**	**45.98**	**22.00**	**54.36**	**40.61**	**100.34**
0% < coral ≤ 10%	3.74	9.24 (37)	5.45	13.48 (29)	9.20	22.72 (32)
10% < coral ≤ 30%	2.61	6.44 (26)	3.85	9.52 (21)	6.46	15.96 (22)
30% < coral ≤ 50%	0.96	2.37 (9)	3.25	8.04 (17)	4.22	10.41 (15)
50% < coral ≤ 70%	1.80	4.44 (18)	4.19	10.35 (22)	5.99	14.79 (21)
70% < coral ≤ 90%	1.10	2.71 (11)	1.96	4.85 (11)	3.06	7.56 (11)
Total dredge area with coral	**10.20**	**25.20**	**18.71**	**46.24**	**28.91**	**71.44**
Total dredge area	**28.80**	**71.18**	**40.71**	**100.6**	**69.52**	**171.78**
Percent coral cover		**35%**		**46%**		**42%**
	Alternative 2					
	Direct		*Indirect*		*Total*	
Coral Level	*ha*	*ac (% coral*)*	*ha*	*ac (% coral*)*	*ha*	*ac (% coral*)*
Coral = 0%	**14.98**	**37.03**	**18.90**	**46.71**	**33.89**	**83.74**
0% < coral ≤ 10%	3.44	8.51(36)	5.34	13.20 (28)	8.79	21.72 (31)
10% < coral ≤ 30%	2.41	5.96 (25)	3.72	9.19 (20)	6.14	15.15 (21)
30% < coral ≤ 50%	0.93	2.29 (10)	3.45	8.53 (18)	4.38	10.82 (15)
50% < coral ≤ 70%	1.82	4.49 (19)	4.46	11.03 (23)	6.28	15.52 (22)
70% < coral ≤ 90%	1.01	2.48 (10)	2.13	5.25 (11)	3.13	7.74 (11)
Total dredge area with coral	**9.61**	**23.74**	**19.10**	**47.21**	**28.71**	**70.95**
Total dredge area	**24.59**	**60.77**	**38.06**	**93.92**	**62.60**	**154.69**
Percent coral cover:		**39%**		**50%**		**46%**

*Coral cover is rounded to the nearest percent and therefore may not total to 100%.

** Indirect impact area is based on a qualitatively-derived worse-case scenario limit of anticipated sediment effects out to the 200 foot estimated impact, and not upon the USACE PTM.

Source: Navy 2009a.

As indicated in Table 11.1-1, within the direct impact areas for both Alternative 1 and Alternative 2, the most represented class is that of the lowest non-zero coral cover (i.e., Class 2 [> 0% to ≤ 10%]). Of the areas in both alternatives that contain any coral, this class comprises about 38% of the total. For both alternatives, over half (~75%) of the areas with any coral cover are within Classes 2 and 3 (i.e., 0% < coral ≤ 30%).

The resultant analysis produced tables and maps showing six classifications of coral cover:

Class 1: 0% coral (See Figures 11.1-3 and 11.1-4 as an example)
Class 2: > 0% - ≤ 10%
Class 3: >10% - ≤ 30%
Class 4: >30% - ≤ 50% (See Figure 11.1-5 as an example)
Class 5: >50% - ≤ 70%
Class 6: >70% - ≤ 90% (See Figure 11.1-6 as an example)

Calibration-validation data to support the classification scheme were collected using field data in the form of photographic quadrat transects. Table 11.1-1 lists the coverage area of each coral class for Alternatives 1 and 2. Also shown for each alternative is the percentage of each coral class with respect to the total area of coral coverage, and the percentage of coral potentially impacted (direct and indirect) with respect to the total dredge area. Figure 11.1-10 displays the resulting benthic habitat map. Spectral resolution of the image allowed for distinction of six bottom classifications according to coral cover as described above. The extent and density of coral cover is delineated to a degree that can be of value for mitigation of reef area altered by the aircraft carrier wharf project.

Examination of the coverage table (Table 11.1-1) and coral map (Figure 11.1-10) reveals several important points:

- The total area of potential direct and indirect impacts to the region with coral is approximately 71.44 ac (28.91 ha) for Alternative 1 and 70.95 ac (28.71 ha) for Alternative 2.
- The total area of potential direct and indirect impacts of the region with and without coral is approximately 171.78 ac (69.52 ha) for Alternative 1 and 154.69 ac (62.60 ha) for Alternative 2.
- The total area of coral coverage of all classes associated with potential direct impacts is approximately 25.20 ac (10.20 ha) for Alternative 1 and 23.74 ac (9.61 ha) for Alternative 2. Hence, about 35% and 39% of the area to be dredged to reach the required depth presently contains some level of coral coverage for Alternative 1 and 2, respectively.
- It is also evident that the area within the project boundaries, as well as within the dredge area boundaries (Figure 11.1-10), does not contain any of the continuous areas of very high cover (>70% coral) that is the dominant cover category on the western margins of the large shoal reefs bordering the project area.
- While the mapping results indicate that about 10% of coral for both alternatives is in the highest cover class (>70%), such areas are not concentrated in any particular biotope or region, but are spread across the dredge zones in relatively low densities, mainly at the edges of the dredge perimeters.

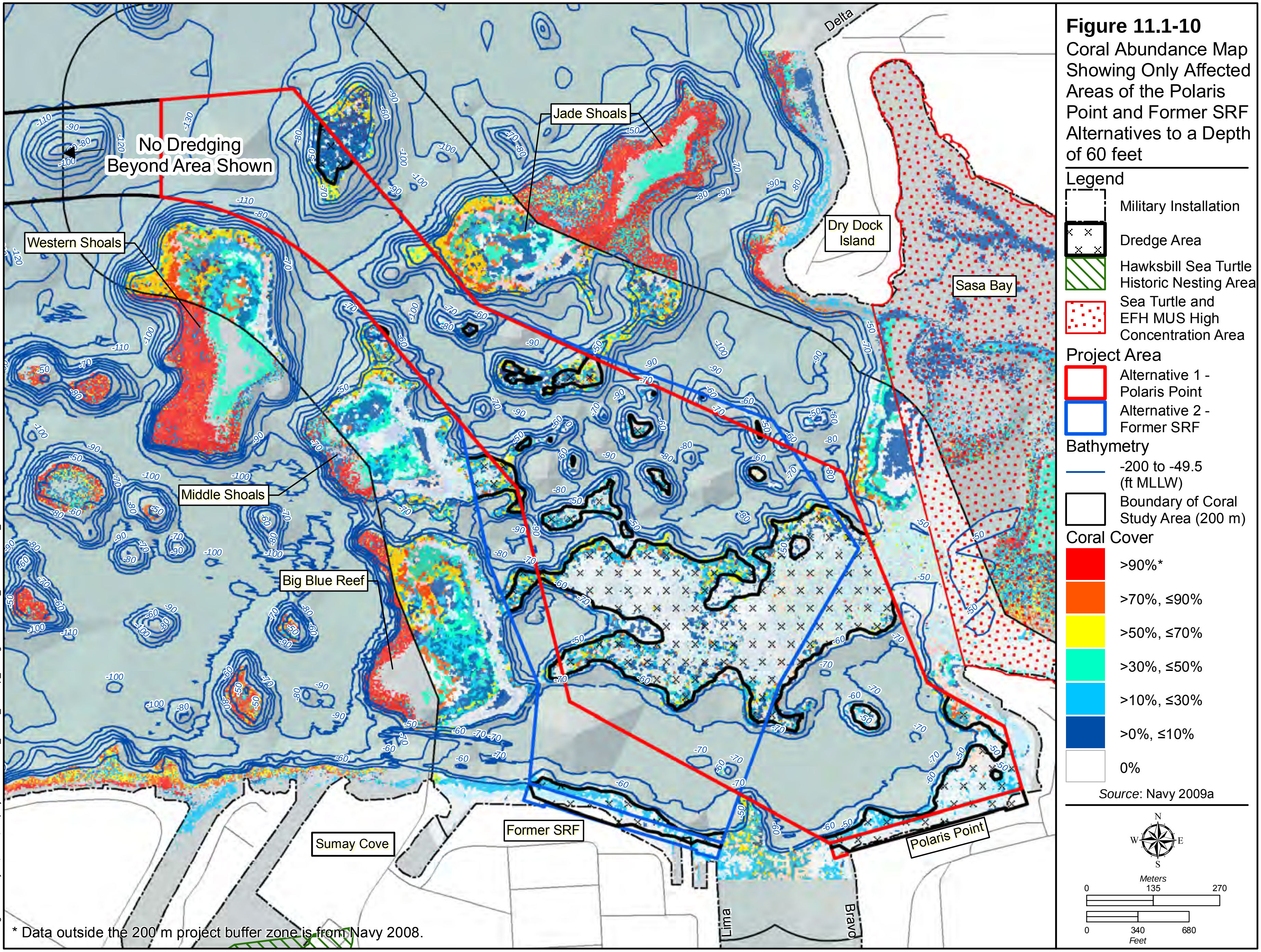

Figure 11.1-10
Coral Abundance Map Showing Only Affected Areas of the Polaris Point and Former SRF Alternatives to a Depth of 60 feet

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For both alternatives, the single highest percentage class with coral to be removed is the lowest abundance class (>0 to ≤10% cover) at 37% for Polaris Point and 36% for Former SRF). Additionally, coral cover within the less than 30% cover classes accounts for 62% for Polaris Point and 60% for Alternative 2, respectively (refer to Table 11.1-1).

<u>Transect Sites Unique to Each Alternative</u>

As identified in Table 11.1-1, the total area to be dredged is approximately 71 ac (29 ha) for Alternative 1, and 61 ac (25 ha) for Alternative 2. The total area of coral coverage of all classes is 25 ac (10 ha) for Alternative 1 and 24 ac (10 ha) for Alternative 2. Hence, about 35% and 39% of the area to be dredged at Alternative 1 and Alternative 2 sites, respectively, contains some level of coral coverage.

Table 11.1-2 shows a similar assessment, including a representation of percent benthic cover within the direct removal footprint for each alternative. Of the 67 transect sites, 27 are co-located with Alternative 1 and 2 direct impact areas (i.e., benthic habitat that would be removed no matter which alternative is chosen), and 14 sites (8 from Alternative 1 and 6 from Alternative 2) are not associated with each other in regards to direct dredging activities (i.e., benthic habitat would only be indirectly impacted). Twenty six of the transect sites would receive indirect impacts (Figure 11.1-11).

The general benthic cover classes of these 14 sites are compared in Table 11.1-2, and show relative percentages of benthic cover within the direct foot print for both alternatives. If these numbers are compared with the total region to be dredged, the total percent coral coverage for all classes is approximately 10% for Alternative 1 and 17% for Alternative 2.

Table 11.1-2. General Classes of Benthic Cover Percentages Exclusively Associated with Either Alternative 1 or Alternative 2 Direct Impact Areas

Transect Number	*Algae*	*Stony Coral*	*Soft Coral*	*Sponge*	*Ascidians*	*Echinoderm*	*Sediment*	*Total*
Alternative 1								
42	1.08	0	0	0	0	0	98.92	100
48	37.07	6	0	0	0	0	59.93	100
49	18.80	48.13	0	3.47	0	0	29.60	100
50	82.67	0	0	0.53	0	0	16.80	100
51	86.15	0.46	0	0.62	0	0	12.77	100
57	50.67	0	0	0.40	0	0	48.93	100
58	26.40	0	0	2.27	0	0	71.33	100
59	19.33	24.53	0	1.47	0	0	54.67	100
Mean %	**40.27**	**9.89**	**0**	**1.19**	**0**	**0**	**49.14**	**100**
Alternative 2								
44	72.13	2.53	0	0.80	0	0	24.53	100
52	8.53	0	0	2.53	0	0	89.93	100
53	0	0	0	0	0	0	100	100
54	21.47	0	0	2.40	0	0	76.13	100
55	23.47	36.93	0	4.80	0	0	34.80	100
62	21	65.20	0	1.60	0	0	11.33	100
Mean %	**24.43**	**17.44**	**0**	**2.01**	**0**	**0**	**56.12**	**100**

Note: All benthic cover numbers are in percentages.

Source: Photo-quadrats from 67 transects was analyzed using CPCe software to obtain a quantitative dataset that can be used to describe the community (Dollar et al. 2009).

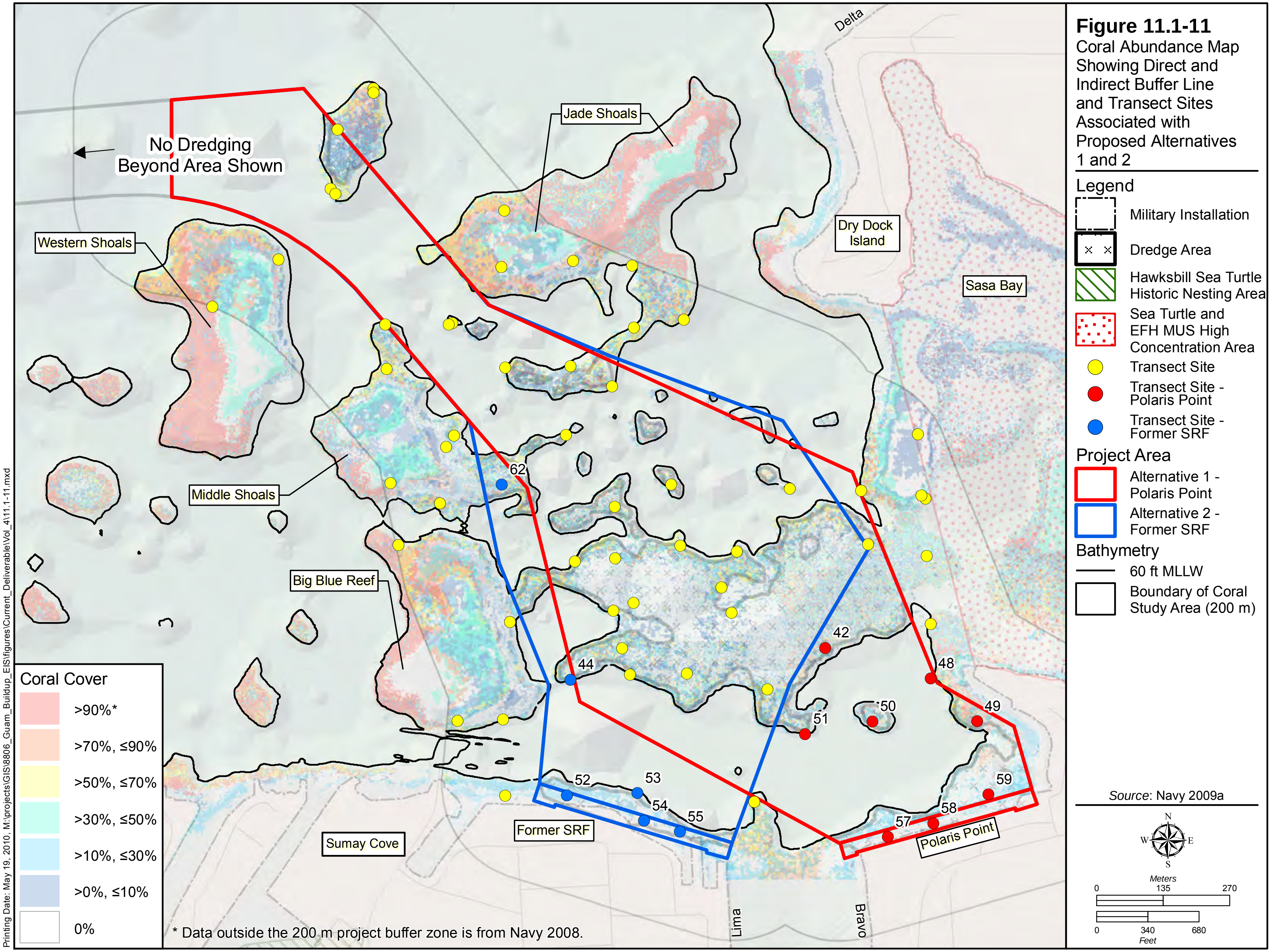

Figure 11.1-11
Coral Abundance Map Showing Direct and Indirect Buffer Line and Transect Sites Associated with Proposed Alternatives 1 and 2

In comparison, when data from all 67 transects were combined and analyzed, algae accounted for about 40% of benthic cover, sediment (sand, mud, and rubble) 35%, coral 22%, and sponges 3%. Algae occurred on all but one transect, and corals were present at 52 of the 67 survey sites. On transects with sediment cover greater than approximately 75%, corals were not present. All transects containing coral also contained algae. Coral cover was dominated by a single species, *P. rus*, which accounted for about 74% of total coral cover. Along with *P. rus*, the next three most abundant species (*P. lutea*, *Pavona cactus*, and *P. cylindrica*) accounted for 95% of coral cover (Dollar et al. 2009).

Additional Survey Data in the Study Area

Additional coral and coral reef community survey data are provided by Smith (2007). In general, coral development varies dramatically between sites and at different depths, with some locations supporting well developed complex coral reefs and other areas supporting only small patch reefs or sparsely scattered corals. Seventeen coral families were observed throughout the study area. The primary objective of the survey was to quantitatively assess the distribution and abundance of Scleractinian (stony) corals within seven selected portions of Apra Harbor. These seven areas included:

1. Mouth of Sumay Cove to mouth of Inner Apra Harbor
2. The Southeast component of the Western Shoals complex
3. Polaris Point and Polaris Bay
4. CVN turning basin between Inner Apra Harbor entrance, east side of Big Blue Reef, and south of Dry Dock Island
5. Fairway (navigation channel) shoals (Jade and Western)
6. Dry Dock Island
7. Delta/Echo Wharves on Dry Dock Island

Figure 11.1-12 shows the locations of dive survey sites in these seven areas. The major findings from the Smith (2007) study are as follows:

- Only one site (Big Blue Reef east) contained all of the observed coral families. At all other survey sites, the number of families ranged from 5 to 13. Point-quarter transect data revealed that of the 1,908 quarters surveyed, 69% contained coral, with 49% of all corals measured consisting of the single species *P. rus*.
- Mean coral size (maximum measurement parallel to the sea floor) was relatively low for Turning Basin sample locations (8.6 in [22 centimeters (cm)]), for shoal areas (8.3 in [21 cm]), and for Polaris Point (6.3 in [16 cm]). Qualitative observations of coral health revealed no areas of extensive bleaching or disease. Some colonies with hemispherical growth forms (e.g., *P. lobata*) at survey sites within the dredge footprint (Polaris Point, Fairway, and Turning Basin) were observed secreting copious amounts of mucus. As these areas are within the active ship transit lanes, the mucous secretion may be a sediment rejection response related to increased sediment resuspension from current ship activities.
- With respect to existing anthropogenic impacts to reef structure, there is some evidence of anchor and/or anchor chain damage at all sites. Movement of mooring chains on the southern side of the floating dry dock have produced a significant rubble field, although mooring chains on the northern (outer) side of the floating dry dock do not appear to have caused similar damage.

- The Polaris Point area, turning basin, Big Blue Reef east, navigation channel and Delta /Echo Wharves areas do not meet any of the HAPC criteria (See Volume 2, Section 11.1). However, Big Blue Reef west provides significant ecological function and is sensitive to human induced environmental degradation, thereby meeting two of the four criteria for HAPC designation.
- When reef survey zones are ranked by scaling a variety of measures of ecological function and value (percentage of sea floor covered by coral, reef complexity and rugosity, species diversity, coral health, size frequency distribution of coral colonies, diversity and abundance of sessile macro-benthos other than corals (e.g., sponges), diversity and abundance of mobile macro-invertebrates, and the diversity and abundance of finfishes), the areas within the dredge footprint (Turning Basin, shoal areas and Polaris Point) rank lowest on the scale, and are consistently lower ranked than the sites that are outside the footprint. The highest ranking was given to the Big Blue Reef west, likely owing to protection from exposure to water quality factors associated with Inner Apra Harbor and ship-induced sediment resuspension. The second highest ranking was given to the reefs off Dry Dock Island.
- Both Polaris Point and Dry Dock Island were artificially created during and shortly after World War II (WWII). While the two areas were created at essentially the same time, the coral communities are substantially different, suggesting that different environmental stressors have affected coral community development in the two areas. Potential differences in environmental stressors are the higher range of turbidity and suspended sediment originating from Inner Apra Harbor and the level of ship activities in the vicinity of Polaris Point relative to Dry Dock Island.
- The coral reef in the Polaris Point/Bay segment is of marginal quality and showed the greatest signs of stress. This stress appeared to be due in part to high levels of TSS coming from Inner Apra Harbor.
- Coral diversity (as measured by relative densities) is low. Although multiple coral taxa were observed at sampling locations within the project area, *P. rus*, *P. cylindrica* and *Porites spp*. comprised a substantial majority of all coral observed.
- Coral mean size (maximum measurement parallel to the sea floor) is relatively low, and some corals in the project area appear to show signs of stress. In the Polaris Point/Bay area, a substantial percentage of the coral at all depth contours was growing on metallic and/or concrete debris. It is arguable whether or not the Polaris Point/Bay community should be considered a coral reef. What is clear, however, is that more of the corals within the Polaris Point/Bay segment had copious mucous secretions and more algal overgrowth than at any other location in Apra Harbor evaluated during the current study or other recent Navy studies.

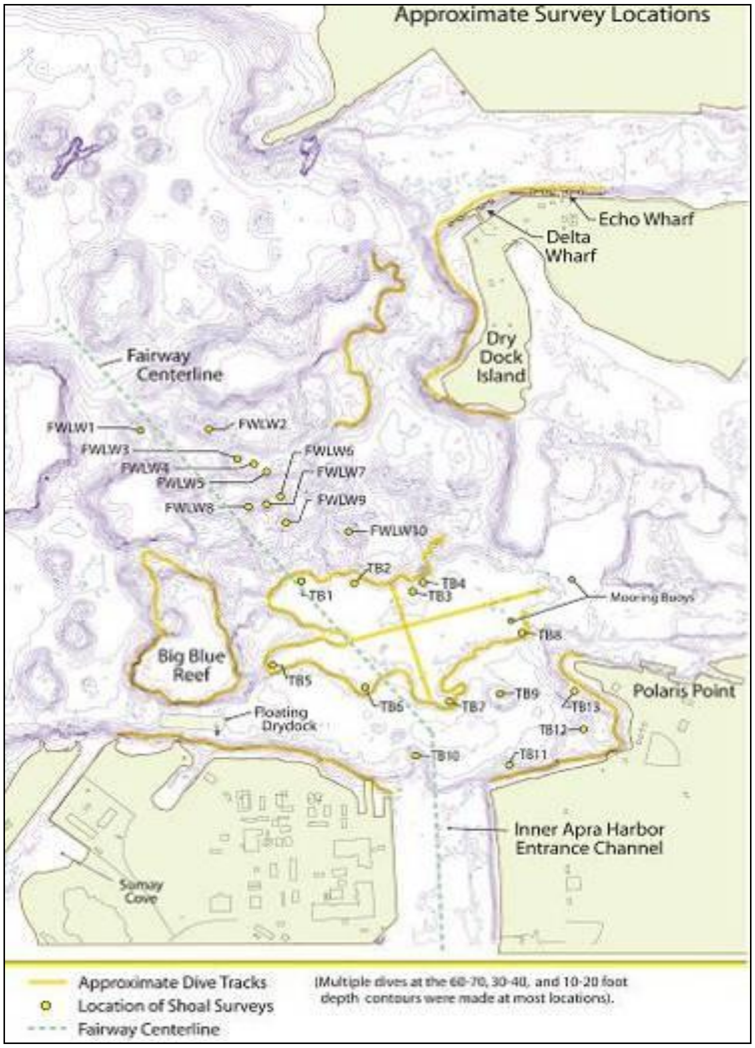

Figure 11.1-12. Dive Surveys and Transects

(Smith 2007)

Other field data collected by Dollar et al. (2009) included spectral reflectance of representative corals to develop a "stress index," coral size-frequency analysis, and analysis of sediment samples to determine the composition of material that would affect communities during dredging operations. The results of these analyses are briefly described in the Sediment Characteristics and Loading Stress subsection, below.

Sediment Effects on Coral

On a global scale, increased sedimentation is one of the most common and serious anthropogenic influences on coral reefs (e.g., Grigg and Dollar 1990). The scientific literature includes numerous documented cases of impacts to coral reefs by sedimentation related to human activity (i.e., anthropogenic), as well as laboratory investigations that quantify impacts under controlled conditions. Reviews by Brown and Howard (1985), Grigg and Dollar (1990), Rogers (1990) and Fabricius (2005) provide comprehensive treatment of all aspects of the effects of sedimentation to coral reefs. Impacts associated with sedimentation and sediment burial include reduced photosynthesis and increased respiration (e.g., Riegl and Branch 1995; Philipp and Fabricius 2003; and Weber et al. 2006), tissue mortality (e.g., Rogers 1983), reduced growth (e.g., Dodge et al. 1974; Rice and Hunter 1992), and reduced fertilization, larval survivorship, and recruitment (e.g., Gilmour 1999; Smith 2006).

While it is clear that increased sedimentation can have a deleterious effect on corals, it is also apparent from the scientific literature that the deleterious effects are not uniform or consistent, with responses depending primarily on a variety of factors including coral growth form and physiological capabilities, duration of exposure, and physicochemical composition of the sediment. When evaluating the effects of human-induced sedimentation, it is important to consider that sediments are also resuspended by natural processes in many reef environments, and as a result, most corals are adapted to withstand some level of sediment load. It has been well documented since the pioneering work on environmental tolerances of reef corals that some taxa are more resilient to turbidity and sedimentation than others (e.g., Mayer 1915; Yonge 1930; Marshall and Orr 1931; Hubbard and Pocock 1972; Riegl 1995; Wesseling et al. 1999). It has also been shown that corals growing in waters of moderate to extremely high turbidity are not automatically more stressed than their clear-water counterparts (Roy and Smith 1971; Done 1982; Johnson and Risk 1987; Acker and Stern 1990; Riegl 1995; Kleypas 1996; McClanahan and Obura 1997; Larcombe et al. 2001). Sanders and Baron-Szabo (2005) describe "siltation assemblages" of corals that occur in turbid water and/or muddy reef environments as a result of resilience to sediment through either effective rejection mechanisms or physiological tolerance to intermittent coverage.

Sediment resistance is generally distinguished as occurring by two separate processes, sediment rejection and sediment tolerance, which are reviewed in detail by Sanders and Baron-Szabo (2005). Sediment rejection is the active removal of sediment particles by polyp expansion by water uptake and expulsion ("pumping"), tentacle movement, ciliary action, and mucous secretion. Of note, it has been found that for all corals, it is more difficult to reject sediment from a horizontal surface than from an inclined or vertical surface (e.g., Bak 1976), and on flat surfaces sediment may be pushed to "dump areas" on the corallum (Reigl 1995). Experiments (Anthony 1999) and field measurements (Anthony 2000) indicate that corals from turbid water reefs have a background rate of sediment rejection two to four times higher than their conspecifics in clear-water reefs (Anthony and Fabricius 2000). For sediment clearance, the growth form of a coral is crucial, with branched and erect-foliaceous forms by far the most effective in clearance of sediment of silt to coarse sands (Hubbard and Pocock 1972; Stafford-Smith and Ormond 1992; Stafford-Smith 1993).

The outcome of various levels of sediment tolerance, or the ability of a coral to withstand a coating of sediment, differs markedly, ranging from death to localized necrosis to survival without any signs of damage or stress (Hodgson 1989; Wesseling et al. 1999). Hodgson (1989) reported that for some massive corals, tissue necrosis remained confined to flat and concave surfaces veneered by sediment, whereas unveneered short columns and convex knobs on the same colonies remained in good condition. The acroporid *Montipora* is quite sediment tolerant, and may be veneered for weeks without signs of permanent physiological damage (Hodgson 1989). Similarly, *Porites* is highly tolerant of being sediment-veneered, and can recover even after complete burial for up to three days (Stafford-Smith and Ormond 1992; Stafford-Smith 1993; Wesseling et al. 1999). Sofonia and Anthony (2008) found that the coral *Turbinaria mesenterina* on nearshore reefs in the central Great Barrier Reef lagoon was tolerant to sediment loads an order of magnitude higher than the most severe sediment conditions occurring *in situ*. The likely mechanisms for such high tolerance were that corals were able to clear themselves rapidly, and that the sediment provides a particulate food source.

It has also been suggested that small colonies may be more resistant to prolonged sedimentation than large colonies, owing to higher efficiency in terms of energy expenditure in sediment-rejection behavior (Dodge and Vaisnys 1977). With respect to impacts of sediment stress as a function of frequency, Connell's (1997) pioneering long-term studies of coral reef response to both acute and chronic disturbances have shown that reef systems are more vulnerable to chronic disturbance than to acute, infrequent episodes of stress. Hence, recovery from acute episodes of elevated sedimentation may take place, while the same or even lower levels of sediment stress on a continual basis would result in more extensive, or even permanent detrimental change. Sanders and Baron-Szabo (2005) also report that pulses of a few hours to a few days of rapid sediment fallout exert less of a lasting influence than frequent or chronic sedimentation at lower rates.

While it is generally believed that corals can only survive in waters with low turbidity and suspended particulate loads, it has been documented that apparently flourishing coral communities are found in naturally turbid conditions, although these communities are generally very different than those found in clearer water. For example, a turbid lagoon at Fanning Island (Central Pacific) had an abundance of primarily branching colonies, although the coral community was less diverse than in the clear lagoon with mostly massive and encrusting corals (Roy and Smith 1971). Roy and Smith (1971) conclude that while there was a decrease in abundance of coral knolls from the clear to the turbid water (less than 6.5 ft [2 m] visibility), both areas had lush reef development. In a study of the distribution of coral communities located near two rivers on Guam, Randall and Birkeland (1978) concluded that observed decreases in natural sedimentation rates along a gradient from the river mouths to the open sea explained the increase in number of coral species, from less than 10 in the area exposed to high sedimentation to over 100 in the areas farthest from riverine influence. The authors predicted that sedimentation rates ranging from 0.005 to 0.007 ounces per 0.39 inches per day (oz/in/d) (162 to 216 milligrams per centimeter per day [mg/cm/d]) would be associated with less than 10 total species in an area, while rates of 5 to 32 mg/cm/d (open ocean) would be associated with over 100 species in an area (data converted from original).

As summarized in Rogers (1990), the response to coral communities from dredging and other activities which increase sediments in the water can range from only localized or negligible effects on corals to long-term changes. Rogers (1990) makes the point that dredging often affects not only the portion of the reef which is actually removed or smothered, but also downstream areas where currents carry increased concentrations of fine suspended particles. However, impacts are not always severe and long-lasting. The dumping of 2,200 tons (1,996 metric tons) of kaolin clay cargo from a freighter grounded on a reef at French Frigate Shoals in the Northwestern Hawaiian Islands created large plumes of the suspended clay but had no apparent adverse effects beyond a radius of about 164 ft (50 m) from the grounding site (Dollar and Grigg 1981). Based on a brief qualitative survey, Sheppard (1980) suggested that dredging and blasting in Diego Garcia Lagoon (Indian Ocean) had resulted in variable and low coral cover but no reduction in coral diversity. Construction of Honokohau Harbor on the Island of Hawaii by dredging actually resulted in an overall increase in coral cover because of colonization of newly created harbor surfaces (USACE 1983). In 1979, work began to extend the runway of the airport at St. Thomas (U.S. Virgin Islands) 2,382 ft (726 m) into water 89 ft (27 m) deep. Monitoring over a period of 31 months of fish populations, seagrass beds and coral reefs in the vicinity revealed no significant deterioration attributable to the plume from the dredge and fill operation (Rogers 1982).

Pre- and Post-Monitoring of Dredging Sediment Effects on Coral Reefs

Although the effects of anthropogenic sedimentation on reef corals have been widely discussed and reviewed in the scientific literature, there are relatively few studies that specifically address the effects of dredging on reef corals at sites where the community has been monitored before, during and after the event. Marszalek (1981) surveyed reef areas before and after a large-scale dredging project off of Florida, where dredging took place for 3 months every year for 5 years. He reported no mass mortality of hard corals after short-term exposure to sediments (a few days), although several colonies showed partial mortality and excessive mucus secretion after prolonged exposure to suspended sediment. Marszalek (1981) suggested that prolonged turbidity was more detrimental than short-term accumulation of sediments. Brown et al. (1990) had the opportunity to utilize long-term ecological monitoring to conduct before, during and after studies of the effects of a 9-month dredging of a deep channel to adjacent reef flats at Phuket, Thailand. Reef corals, primarily massive heads of *Porites lutea*, showed as much as 30% reduction in living cover one year after the start of dredging, with a significant decline in diversity. However, after the termination of dredging, the reef recovered rapidly with coral cover values and diversity indices restored to former levels within approximately 22 months after dredging began. No significant changes in linear growth rate, calcification or skeletal density were measured in corals subjected to the increased sediment loads. The authors speculate that the rapid recovery was a result of regeneration of living tissue over formerly dead surfaces of colonies that suffered only partial mortality. The lack of change of growth rate, calcification rate and skeletal density was attributed to the short time that corals were subjected to fatally high concentrations of sediments (days to weeks). Changes that may have occurred during this short period may have been insufficient to affect the annual growth rate or calcification.

Sediment Characteristics and Loading on Coral Stress

Numerous studies have been conducted to evaluate the effects of sediment exposure to corals, and a universal theme is that impacts vary depending on a variety of factors such as oceanographic conditions, which coral species are present and their ability to adapt, the type of sediments being deposited, and the duration of exposure. The following text summarizes findings from some of the most informative and relevant studies with respect to the study area. An important consideration in the evaluation of sediment effects to corals is the duration of the stress. In an experimental design exposing corals to ten different sediment types at environmentally relevant concentrations 0.001 to 0.002 ounces per 0.15 square inch (oz/in^2) (33-160 milligrams per square centimeter [mg/cm^2]), Weber et al. (2006) found that the highest stress levels (in terms of reduction of photosynthetic yield of the coral *Montipora peltiformis*) occurred from short-term (20 to 44 hours [hr]) exposure to nutrient-rich silts, whereas no effect was measurable after greater than 48-hr exposure to fine and medium sand and pure aragonite (calcium carbonate) silt. All treatments that showed reduction in photosynthetic yield from sediment loading also exhibited immediate reversal of the trend following removal of sediment exposure, although recovery was not complete within the 48-hr recovery period after experiments were terminated. These authors conclude that their findings suggest a fundamentally different outcome of corals exposed to sedimentation by sandy nutrient-poor sediments, such as storm resuspended marine carbonate sediments, compared to sedimentation of silt-sized sediments rich in organic matter and nutrients. Philipp and Fabricius (2003) also showed that the photosynthetic activity of *M. peltiformis* decreased linearly with both the amount of sediment and the time it remained on the tissues, which indicated that any threshold value for sedimentation tolerance should incorporate both amount and time. *M. peltiformis* was able to recover function to pre-stress levels if the duration of stress was short (< 24 hr) or if doses were low. Wesseling et al. (1999) evaluated recovery of corals after full burial in field experiments in the NW Philippines where corals were buried for 0, 6, 20 and 68 hr. Species of *Porites* were not affected by 6-hr burial compared to controls, while increasing burial time had increasingly more serious effects in terms of discoloration and bleaching. Following removal of sediment, recovery took place, with time of recovery (2 to 4 weeks) proportional to time of burial. Colonies of *Acropora*, however, showed much more sensitivity, with all colonies dying after the 20-hr treatment.

Riegl and Branch (1995) measured the changes in physiological reactions to sediments. Under what was considered the observed sedimentation levels on South African reefs 0.007 oz/0.015 in^2 (200 mg/cm^2), corals that had been adapted to laboratory conditions for 6 weeks prior to the experiments in filtered seawater showed changes in energy balance by forcing respiratory losses up and photosynthetic production down, and displaying elevated mucus secretion. However, these experiments were not conducted with other varying sediment loads, and recovery was not measured following removal of the sediment.

Some corals have adapted to fluctuating levels of sedimentation. Lirman and Manzello (2009) documented the patterns of resistance and resilience of *Siderastrea radians* to sub-optimal salinity and sediment burial in a series of short-term, long-term, acute, chronic, single-stressor, and sequential-stressor experiments. Under conditions of no salinity stress, *S. radians* was very effective at clearing sediments, and >50% of the colonies' surfaces were cleared within 1 hr of burial. However, as burial periods increased, and colonies were covered at multiple chronic intervals, sediment burial resulted in extended photosynthetic recovery periods, reduced growth, and mortality.

It is important to note that effects from deposition of terrigenous sediments emanating from runoff can be substantially different than effects from sediments of marine origin. Te (2001) found that terrigenous sediments had a greater light extinction capability than carbonate (reef-derived) sediments. As noted above, Weber et al. (2006) found distinctly different responses depending on sediment composition, with substantially less effects from marine carbonates compared to organic-rich terrigenous sediments. Fine silts and sand composed of calcium carbonate have been shown to produce no negative effects on photosynthetic activity in one species of coral after more than 2 days of exposure (Weber et al. 2006).

Results of sediment core analysis reported by Weston Solutions (NAVFAC Pacific 2006) indicated that sediment in Outer Apra Harbor (within the aircraft carrier berthing action dredge footprint) and the entrance to Inner Apra Harbor were coarser-grained, comprised predominantly of gravelly sand. Analysis of twelve sediment samples collected within the aircraft carrier berthing action dredge footprint revealed that 79-96% of the samples by weight were composed of calcium carbonate, presumably of marine origin. Hence, terrigenous (i.e., non-carbonate) muds are not a major component of the sediment in the proposed dredge area (Dollar et al. 2009).

The effects to reef corals from increased sedimentation do not appear to result from any specific "threshold" level. Te (2001) states that "numerous forces in nature and the ability of corals to adjust to higher sediment loading levels makes it impossible to definitively state a generalized threshold level for sediment loading in corals." A summary of the existing scientific literature that categorizes the effects to reef corals, corresponding to the rates and exposure periods of sedimentation, is presented in Volume 9, Appendix J, Section D.

The range of effects to corals extends through the entire spectrum of stresses. As expected, the general trend is that the higher the deposition rate and the longer the period of deposition, the greater the effect. However, it is also apparent that this trend is very species specific. For instance, Hodgson (1989) found that under the same rates of sedimentation in both the field and in aquaria, the response varied considerably between species. Of 22 species exposed to a constant sedimentation rate of 40 mg/cm/d for 7 days in aquaria, 6 suffered mortality, 7 suffered sublethal tissue damage, and 9 did not incur visible damage. Of 36 species exposed to a sedimentation rate of 0.0007 oz/0.15 in^2/d (20.8 mg/cm^2/d) for 120 days in the field, 7 suffered mortality, 12 experienced tissue damage, and 17 were not visibly affected.

Te (2001) developed a predictive model that tested the hypothesis that the lower the light level as caused by increased turbidity and sediment loads, the lower the photosynthetic production of corals. His work indicated that while light was the most influential force in coral growth and survival, field experiments in which transplanted corals were subjected to sedimentation rates of <0.00003oz/0.15 in^2/d (<1 mg/cm^2/d) to greater than 0.01oz/0.15 in^2/d (300 mg/cm^2/d) resulted in no mortality and showed no significant effect on growth rates or survivability. Corals used in his study were able to adjust and adapt to even the worst sediment loading levels achieved in the laboratory and the field. No corals subjected to the worst conditions died, and many grew at rates similar to corals growing in areas unaffected by sediment. Rather, strong waves caused by storm events were found to be more detrimental to coral growth and survival in the field than increased sediment loading. In addition, turbidity, as linked to light availability but not sediment deposition, was found to significantly affect coral growth rates, but not coral survival in both field and laboratory experiments. Te (2001) also found that corals exposed to moderate to high sediment loading, and those growing under shade conditions were able to photo-adapt by increasing light harvesting capacity as evidenced by greater chlorophyll content and increased photosynthetic ability. When re-introduced into conditions with high light intensities, however, corals underwent photo-inhibition that disrupted photosynthetic functions.

The overall conditions in the study conducted by Te (2001) are comparable to reported conditions in the Inner Apra Harbor Channel, adjacent to the aircraft carrier dredge area, as well as the aircraft carrier dredge area *per se*. Observations in these areas indicate a layer of sediment on virtually all benthic surfaces that are not colonized by living organisms.

Marine Research Consultants (2005) and Smith (2004) have documented well-developed communities of reef corals in the northern portion of the Inner Apra Harbor Channel. Remote sensing using satellite imagery allowed mapping and quantification of the area coverage of the coral communities. Integrating the mapped area of coral cover revealed a total area of 3.32 ac (1.34 ha) of sparse coral and 6.8 ac (2.8 ha) of dense coral, for a total area of approximately 10.2 ac (4.1 ha) of coral cover in the Inner Apra Harbor Entrance Channel (Figure 11.1-13). The entire non-living benthic surface consists of calcareous sediment, ranging in grain size from fine silty muds to coral rubble. In addition, in areas where the predominant grain size is in the mud-silt range, sediment is easily re-suspended with subsequent re-deposition. As a result, all of the biotic components of the community must have the physiological adaptations to deal with a physical environmental characterized by soft bottoms (Dollar et al. 2009).

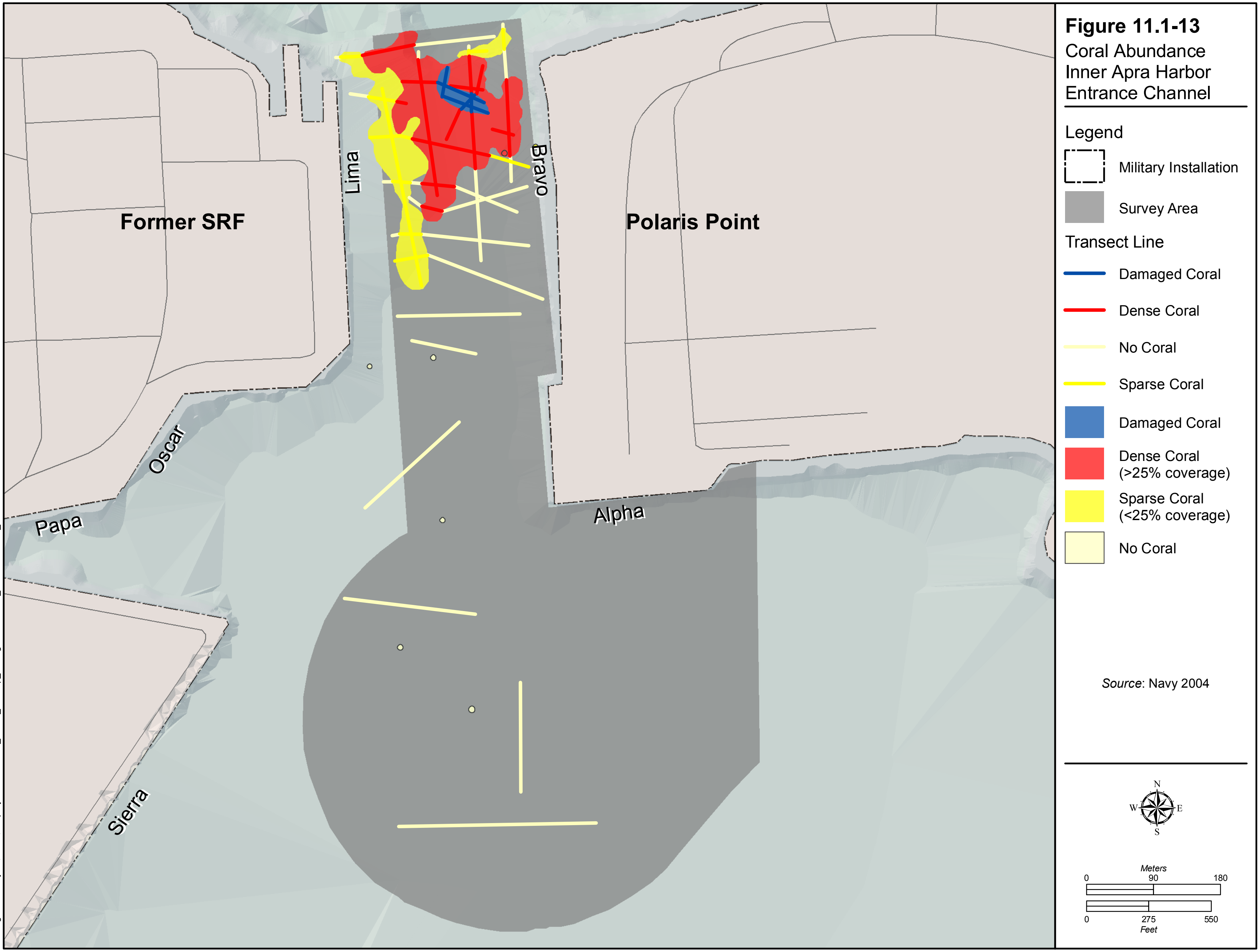

Figure 11.1-13
Coral Abundance
Inner Apra Harbor
Entrance Channel

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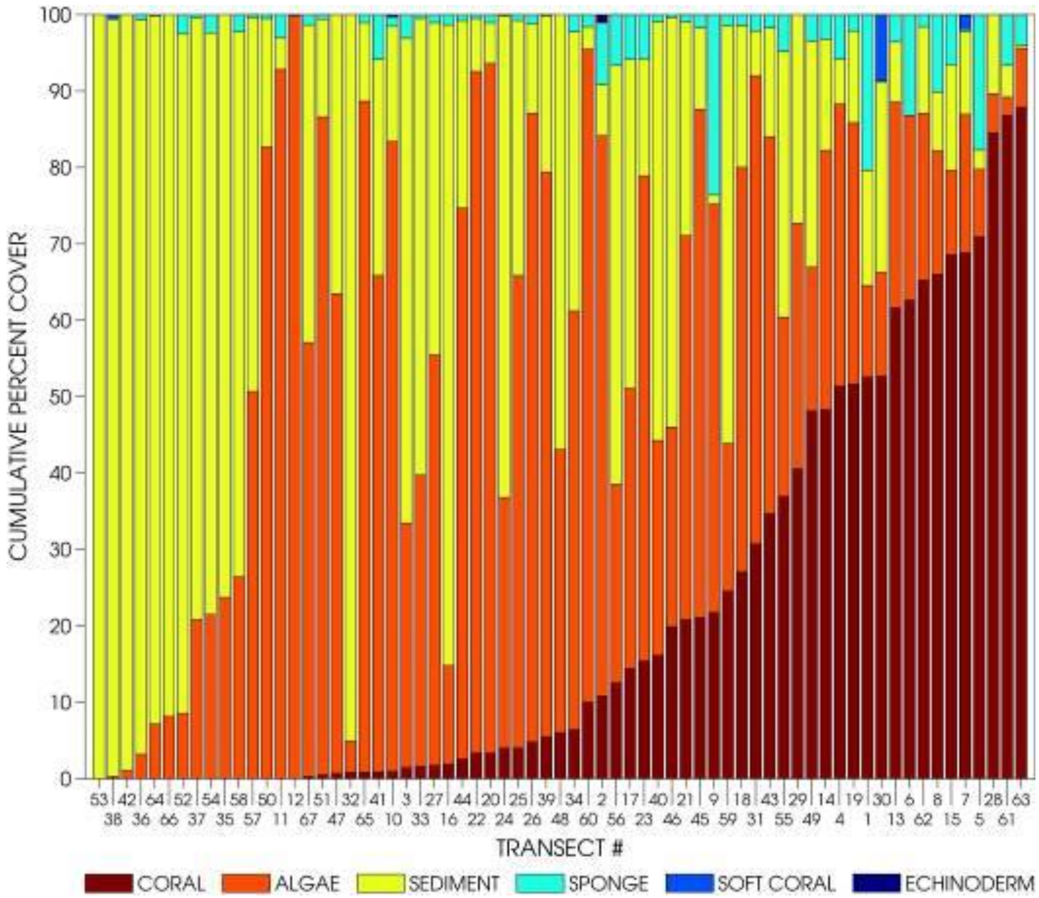
Index of Coral Stress

In situ spectral reflectance measured at the surfaces of the two most abundant species of coral (*P. rus*, *P. lutea*) were used to compute the Normalized Difference Vegetation Index (NDVI) for 27 sites in the aircraft carrier survey area. NDVI is a relative scale indicating amount of chlorophyll present; higher values indicate more chlorophyll, and therefore lower "stress." Although NDVI increased slightly withdepth, there was no apparent trend in the horizontal spatial distribution of NDVI. The lack of a spatial pattern suggests no difference in chlorophyll between the direct and indirect strata, and hence no difference in relative stress.

11.1.3.3 Evaluation of the Benthic Community Structure

Dollar et al. (2009) performed an evaluation of the benthic community structure of Outer Apra Harbor with respect to the 67 transect points associated with the aircraft carrier dredge area. A summary of the evaluation follows.

The general classes consisted of algae, stony coral, sponges, soft coral, ascidians, echinoderms and sediment. Sediment consisted of sand, mud and rubble. Algae and sediment each occurred on 66 transects, coral occurred on 52 transects, and sponges occurred on 55 transects. Ascidians occurred on three transects and echinoderms on four transects. In terms of ranges of cover of general classes, all classes had minimum cover of zero on at least one transect. Maximum transect cover of general classes were 100% for algae and sediment, 88% for coral, 24% for sponges, 9% for soft coral, 1% for echinoderms, and about 0.3% for ascidians. Cumulative means of general classes for each transect reveal the overall pattern of decreasing algae and sediment with increasing coral cover (Figure 11.1-14).

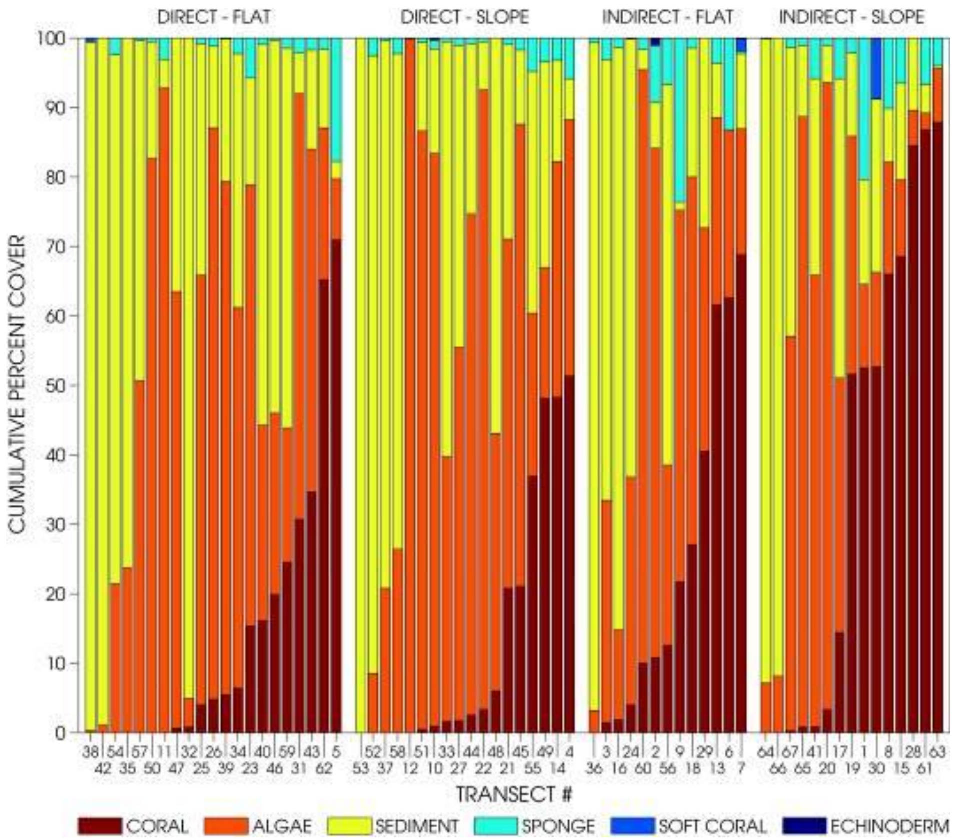


Source: Dollar et. al. 2009

Figure 11.1-14. Stacked Bar Graph Showing Cumulative Percent Covers for Each General Class in Each Transect. Transects are Arranged in Order of Lowest to Highest Coral Cover.

The detailed classes of benthic cover consisted of 37 categories identified in transect photo-quadrats. The most prevalent class of biota was mixed macroalgae, which occurred on 65 transects with a maximum transect cover of 74%. In terms of occurrence of a single macroalgal species, the most common was *Halimeda*, which was present on 30 transects, with a maximum transect cover of 59%, followed by *Dictyota* (23 transects; max cover of 37%) and *Padina* (15 transects; max cover of 27%). With respect to distribution of corals, the most abundant was *P. rus* which appeared on 47 transects with a maximum transect cover of 85%, followed by *P. lutea* (26 transects; max of 37%), *P. cylindrica* (18 transects; max of 12%) and *Pavona cactus* (13 transects; max transect cover of 43%) (Dollar et al. 2009).

Figure 11.1-15 shows benthic cover of general classes separated into four strata (Direct-Flat, Direct Slope, Indirect Flat, Indirect Slope). The "strata" are not the typical strata that most ecologists think of, which are biologically defined, which if not statistically different would not need to be discussed separately. However, these strata are artificially defined in terms of dredging zones (direct, indirect impact etc) so they have to be discussed separately. Mean algal cover within strata varied from a low of 31% in the Indirect Slope stratum to a high of 48% on the Direct Slope transects. The mean coral cover trend was opposite the trend for algae, with the highest cover on the Indirect Slope (38%) and the lowest on the Direct Slope (14%). On the combined Direct strata transects, mean algal cover was 45%, while mean coral cover was 14%. On the combined Indirect transects, mean algal cover was 33% compared to mean coral cover of 32%. When all transects are combined, mean algal cover was 40% compared to mean coral cover of 22% (Dollar et al. 2009).



Source: Dollar et. al. 2009

Figure 11.1-15. Cumulative Percent Covers for Each General Class in Each Transect, Arrange by Survey Stratum

When all species of coral are listed by order of abundance on transects, *P. rus* was an order of magnitude more abundant than any other species, accounting for 74% of all corals (Table 11.1-3). Along with *P. lutea*, *Pavona cactus*, and *P. cylindrica*, the four most abundant species comprise about 95% of coral cover of the aircraft carrier action survey area. When transects within a strata are ordered according to percent cover of *P. rus*, the overall pattern of coral cover is similar. In each zone, one-half of the transects had cover of *P. rus* less than 2% of bottom cover. Distribution of ranked order of *P. rus* throughout the other half of the transects within each strata occurred as a progressive increase with little overlap of mean cover up to the maximum value in each strata. As a result, the mean value of coral cover within any strata is influenced by both the relatively large number of transects with essentially no coral, as well as the steep gradient of increasing cover on transects that do contain coral (Dollar et al. 2009).

Table 11.1-3. Prevalence of All Coral Species from Photo-quadrat Transect Data

Coral Species	*Count*	*Fraction*	*Percentage*	*Cumulative Percentage*
Porites rus	7,935	0.745	74.458	74.458
Porites lutea	959	0.090	8.999	83.457
Pavona cactus	849	0.080	7.967	91.423
Porites cylindrica	409	0.038	3.838	95.261
Acropora aspera	147	0.014	1.379	96.641
Acropora nasuta	130	0.012	1.220	97.861
Herpolitha limax	69	0.006	0.647	98.508
Pachyseris speciosa	35	0.003	0.328	98.836
Astreopora myriophthalma	26	0.002	0.244	99.080
Lobophyllia corymbosa	25	0.002	0.235	99.315
Pocillopora damicornis	24	0.002	0.225	99.540
Lobophyllia hemprichii	17	0.002	0.160	99.700
Acrhelia horrescens	12	0.001	0.113	99.812
Astreopora randalli	5	0.000	0.047	99.859
Fungia echinata	5	0.000	0.047	99.906
Montipora verrucosa	4	0.000	0.038	99.944
Pavona varians	4	0.000	0.038	99.981
Lobophyllia (cf.) hataii	2	0.000	0.019	100.000
Total Coral Points	**10,657**			

Source: Dollar et. al. 2009

To select the most important community components in terms of percent of total variance explained, Dollar et al. (2009) applied a principal component analysis (PCA) to the detailed class percent cover data. In PCA, the first principal component (PC) describes the highest proportion of variance in the data, the second PC describes the second highest proportion of variance, and so on. In the present data set, the first five PCs describe >90% of the variance, and virtually all of the variability in the data is described by the first 14 PCs. This result indicates that the data are essentially five-dimensional (as opposed to the 38 dimensions described by the individual detailed classes). By plotting the coefficient value for each PC against the individual detailed classes, it is possible to identify which detailed classes are responsible for each PC, and thus which detailed classes are responsible for the variance in the whole data set. For PC 1, the two detailed classes with the highest coefficient (absolute) values were mud and *P. rus*. In PC 2, the two most important classes, other than the two from PC 1 (mud, *P. rus*), were mixed algae and *Halimeda* sp. In PC 3, the two most important additional classes were rubble and *P. lutea*. In PC 4, the two most important additional classes were *Padina* sp. and cyanobacteria. Finally, in PC 5, the two most important additional classes were turf algae and *P. cactus*. Together, these 10 classes are the most important to describe variability in benthic cover in the data set.

There are several other methods used to demonstrate the relationship between the three major types of benthic cover (algae, sediment, coral), which are described in Dollar et al. (2009). Several findings of interest include the following: 1) when sediment cover exceeds approximately 75% of transect cover, there is essentially no coral cover; no coral occurs without the presence of algae; and there is a weak trend of increasing rugosity with increasing coral cover; and 2) where sediment cover is less than about 75% and coral cover above approximately 5%, there is a relatively even distribution between algae and coral throughout the survey area.

Additional Marine Flora, Invertebrates and Associated EFH Data

Several species of marine flora were identified during the Smith (2007) survey, although a specific algal survey was not conducted. The crests of many of the shoals were rubble and sand with dense brown algae (*Padina*). Calcareous green algae (*Halimeda*) was common at depths of less than 20 ft (6.1 m) at Big Blue Reef east. Species that provide forage for sea turtles are discussed further below under the Special-Status Species, Section 11.1.5. Additional marine flora and invertebrate survey data are provided in Smith 2007.

Smith (2007) noted that large sea cucumbers (*Thelenota annas*) were common on the seafloor at the shoal areas. Elephant ear sponges (*Ianthell basta*), as well as oval shaped free living corals (*Family Fungidae*) were common on the slopes in deeper water of most shoals in the study areas. Other species of sea cucumbers were present at every study site and were abundant in the turning basin and shoal areas. Relatively few of the important harvested invertebrate species identified by Porter et al. (2005) were observed. Those that were observed were all at Big Blue Reef west and included octopus, top shell, spider conch, double-spined rock lobster, and xanthid reef crabs (Smith 2007).

The Navy surveys (Navy 2009a) yielded similar observations to those of Smith (2007) regarding the commonly harvested invertebrates identified by Porter et al. (2005). More specifically, octopus, top shell, spider conch, double-spined rock lobster, and xanthid reef crab "…were rarely seen during these surveys, and those that were observed were regarded as 'small' in size." None of these species were observed at Polaris Point or adjacent areas, Turning Basin or shoal areas sampling locations. These observations support the conclusions of Porter et al. (2005) that overfishing is a significant problem on Guam, and that finfish and harvested invertebrate stocks are biologically depressed (Navy 2009a).

Dollar et al. (2009) summarized invertebrate data in terms of mobile and sessile species counts at each transect within each strata, and taxa richness for all invertebrates. A summary of these data from Dollar et. al. (2009) is listed below:

- A total of 55 mobile species from 45 genera were encountered. The grand totals of the mean occurrence of mobile species (individuals per 1076 square feet [ft^2])(individuals per 100 square meters [m^2]) were higher in both Indirect strata than Direct strata, and higher on the flats of each strata relative to the slopes. With one exception, the most abundant phylum in each strata was the Mollusca, followed in order by the Echinodermata, Crustacea, Platyhelminthes, and Cnidaria (the exception being slightly higher numbers of crustaceans than echinoderms in the Indirect Slope stratum). Overall, abundance of each phylum was also greater in the Indirect strata than Direct strata.
- A total of 62 sessile species from 34 genera were encountered during surveys. Unlike mobile species, the grand totals of the means (individuals per 269 ft^2) (individuals per 25 m^2) were higher in both Slope Strata compared to both Flat strata. Overall, there was no consistent pattern of greater abundance between the Direct and Indirect areas. The overwhelmingly dominant phylum of sessile invertebrates in all strata was the Porifera, followed by the Ascidia, and with minor contributions from the Molluscs and Polycheates. Probably the most conspicuous member of the Porifera within the survey area was the "elephant-ear sponge" (*Ianthella spp*.), with individuals up to one meter in width commonly occurring in the deeper areas of the harbor floor.

- Invertebrate surveys were replicated at three transects (15, 49 and 61) during the day and night. The grand total of counts on the three transects was higher at night than during day. The greatest difference occurred on Transect 49, where a total of 144 individuals were counted at night compared to 10 during the day. The predominant difference was the occurrence of 117 crustacea at night compared to none during the day. Taxa richness at night was also greater on all transects compared to daytime. The greatest difference again occurred on Transect 49 where 15 species of crustacea were encountered at night compared to none during the day.
- Counts of mobile invertebrates at all 67 transect sites revealed considerably higher mean density in the two Indirect strata (26 Flat; 24 Slope) compared to the Direct strata (12 Flat, 7 Slope). Mobile invertebrate species composition consisted primarily of molluscs, with smaller contributions from echinoderms and crustaceans. Populations of sessile macroinvertebrates (other than stony corals) consisted predominantly of a wide variety of sponges (*Porifera*), with smaller contributions from the ascidians, molluscs and polycheates. Mean values of sessile invertebrates were higher on the Slope strata (92 Direct, 119 Indirect) than the Flat strata (71 Direct, 86 Indirect).

11.1.4 Essential Fish Habitat

As discussed in Volume 2, Sections 11.1 and 11.2, all of Apra Harbor is considered EFH and Jade Shoals is a HAPC. Figures 11.1-3 – 11.1-7 in Volume 2, Chapter 11, show the EFH and HAPC designated within Guam waters for various life stages of Management Unit Species (MUS). Information pertaining to the affected environment for coral and coral reef ecosystem, which is an important EFH, was addressed in Section 11.1.2 above, including a quantitative evaluation of the benthic community structure.

Coral and coral reef ecosystems are important substrate habitat components of EFH within Apra Harbor. The coral reef ecosystem is highly complex and contain a diversity of invertebrates, fishes, and vertebrate animals, such as sea turtles. Although reefs cycle some nutrients to and from other environments, they are largely self contained.

Coral reef fish communities are diverse and dense on many tropical reefs. However, due to local anthropogenic influences, the reefs within Apra Harbor are relatively depauperate (reduced diversity and density). Coral reef fishes, such as butterflyfishes and damselfishes, live not only among the reef-building corals, but also with sea fans and soft corals, sponges and sea anemones. Some fishes rest on patches of sand or peep out of holes in the reef, others hover above the reef or swim actively, and visitors from the open ocean come in to prey on the residents. Coral reefs within Outer Apra Harbor support fish communities.

A brief summary of sensitive marine biological resources and habitats of Apra Harbor is provided below and in Figure 11.1-16. The following five known MUS from the CRE group of the Mariana Archipelago FEP are associated with EFH within Apra Harbor(Table 11.1-4) and they include: Napoleon or humphead wrasse (NMFS species of concern [SOC] and EFH-Currently Harvested Coral Reef Taxa [CHCRT]); Bigeye scad (EFH-CHCRT); Scalloped hammerhead (EFH-Potentially Harvested Coral Reef Taxa [PHCRT]); Sessile MUS (EFH-PHCRT), including stony corals, soft corals, sponges, algae, etc.; and the Bumphead parrotfish (NMFS candidate species and EFH-CHCRT).

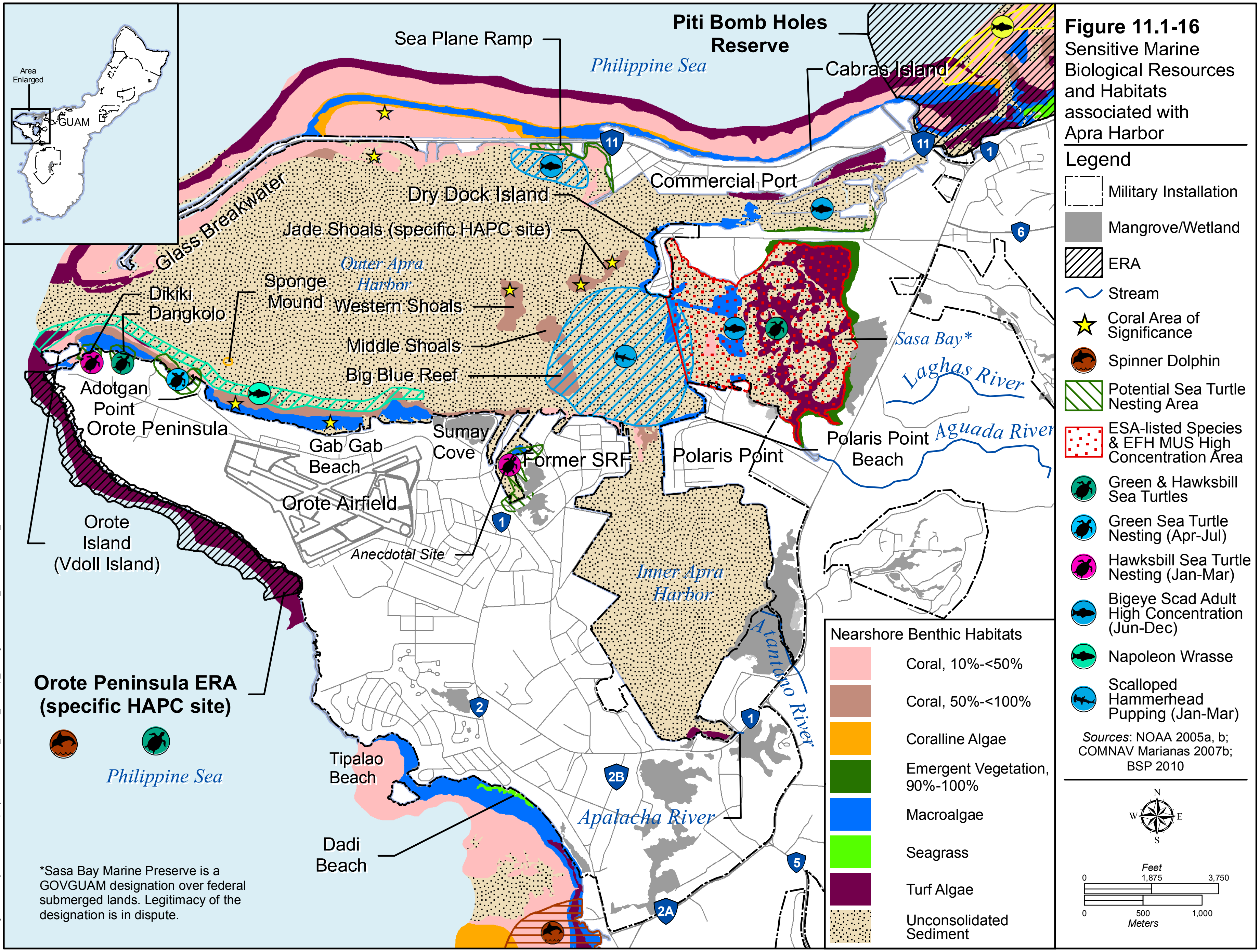


Figure 11.1-16
Sensitive Marine Biological Resources and Habitats associated with Apra Harbor

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Table 11.1-4. Sensitive CRE MUS Associated with EFH for Apra Harbor

Group	*Common Name/Chamorro Name*	*Status** *Federal*	*Guam*
Coral Reef Ecosystem (CRE)			
Fish MUS	Napoleon wrasse/*Tanguisson*	SOC EFH-CHCRT	SOGCN
	Bigeye scad/*Atulai*	EFH-CHCRT	SOGCN
	Scalloped hammerhead/*Halu'u* (general term)	EFH-PHCRT	SOGCN
	Bumphead parrotfish/*Atuhong*	C-EFH-CHCRT	SOGCN
Sessile Benthic MUS**	Stony coral/*Cho' cho'*	EFH-PHCRT	SOGCN

Notes: *E = endangered, T = threatened; SOC = NMFS Species of Concern; SOGCN = Species of Greatest Conservation Need; C= NMFS candidate species. There is no critical habitat designation for any marine species on Guam.

** includes algae, sea grass, and assorted invertebrates (sponges, hard and soft corals, etc.)

Sources: WPFRMC 2009a, USFWS 2009a, and NMFS 2010a.

The Napoleon wrasse has been observed in the area from Orote Point to Sumay Cove; however, it was not identified in the recent quantitative fish survey (UoG 2009). The bigeye scad is present at two areas in high concentrations in Apra Harbor; however, it is not directly associated with the study area (NOAA 2005b).

Early life history stages of the scalloped hammerhead (e.g. pupping)are reported to occur, although rarely (Navy 2009b), in areas outside the Inner Apra Harbor Entrance Channel (NOAA 2005b, BSP 2010). This species typically pups near structures (Navy 2009c). Stony corals are found in high concentrations in Outer Apra Harbor along with other sessile and motile invertebrates.

The bumphead parrotfish, a NMFS candidate species (NMFS 2010a), is reported nearby within Piti Bomb Holes Reserve (NOAA 2005b), however, no observations in Apra Harbor have been documented. Piti Bomb Holes Reserve is located approximately 4 mi (6 km) from Outer Apra Harbor Entrance Channel.

Additional fish MUS are found in the harbor area, and are discussed below.

11.1.4.1 Finfish Assessment

Reef fish assemblages vary considerably over multiple spatial scales. This "patchy" nature of most reef fish communities is easily explained by the variability in environmental parameters, such as nutrient availability, water quality, and most importantly, habitat structure. Habitat structure plays a very important role in structuring reef fish communities because many species are dependent on certain habitats at both small and large spatial scales. Predicting the response of reef fish communities to habitat disturbance, however, is much more complicated. Such predictions rely on the magnitude of environmental impact and the mobility and site-fidelity of particular species. Reef fish are arguably less affected than other reef organisms to many physical disturbances. However, there are many species that are highly site-attached (have high site fidelity) and remain within a very small home range throughout their entire lives (UoG 2009). Marnane (2000) studied site fidelity and homing behavior in tagged coral reef cardinalfishes (*Apogon doederlini*, *Cheilodipterus artus* and *Cheilodipterus quinquilineatus*) and study results indicated that fish persisted to within an average of 14 to 39 in (36 to 99 cm) of their initial resting positions within One Tree Reef lagoon for over 8 months. In addition, 56–81% of tagged fish displaced approximately 3,280 ft (1,000 m) and 33–63% of tagged fish displaced 6,500 ft (1,981 m) returned to their point of collection within 3 days. Sale and Dybdahl (1975, 1978) repeatedly removed fish from a series of small isolated coral heads and followed recolonization. They concluded that the species of such small assemblages recolonized by almost entirely a matter of chance.

They detected no fine-scale microhabitat discrimination, no mutual exclusion by pairs of species, and no separation of species by time of year at which recruitment occurred.

Quantitative Assessment of Reef Fish Communities (UoG 2009)

For the purposes of this EIS, the abundance and occurrence of fish families were estimated quantitatively through finfish population surveys performed in July 2009 (UoG 2009). Other qualitative fish studies were used to supplement this information. For a detailed description of the UoG (2009) methodology, results and discussion, survey points, and tables and figures showing mean diversity, biomass, and species richness, see Volume 9, Appendix J. The following text summarizes the findings of the UoG study.

An assessment of reef fish communities within the Outer Apra Harbor dredge footprint was conducted to quantify species richness, abundance, and biomass of reef fish communities within and adjacent to the proposed project area. The survey also recorded the dominant habitat type at each site as either coral-dominated, macroalgae-dominated, rubble-dominated, or sand-dominated. One additional site, unique to all others and referred to as the “dump site,” was comprised entirely of cinder blocks that had been deposited onto the seafloor at approximately 50 ft (15 m), creating an artificial habitat.

A total of 119 species representing 28 families were recorded. On average, the families Acanthuridae ("thorn tail" - is the family of surgeonfishes, tang, and unicornfishes), Caesionidae (fusilier fishes - related to the snappers, but adapted for feeding on plankton, rather than on larger prey), *Lutjanidae* (snappers), *Scaridae* (parrottfishes), and *Lethrinidae* (porgies, rudderfishes, scavengers, and emperors) had the highest biomass per transect, and the commercially important groupers of the family Serranidae were more common than anticipated, yet still rare. The most numerically dominant families were *Pomacentridae* (damselfishes and clownfishes), *Scaridae, Caesionidae, and Acanthuridae*. In this study, *Pomacentrids* represented 60% of the total fish abundance across the site.

Among the major habitat types surveyed, those dominated by coral and sand had the least similar fish communities, which is not surprising given that coral-dominated sites have high habitat complexity, while sand-dominated sites naturally lack fish habitat. Sites dominated by coral were generally the most speciose (comparatively rich in number of species) and diverse whereas the opposite was true for sand-dominated sites. The species most responsible for this difference were the staghorn damsel and daisy parrotfish, whose abundance increased by an order of magnitude in coral-dominated sites, and the blue devil damsel, whose abundance was greater in sand dominated sites. In general, the vast majority of species recorded increased in abundance at coral-dominated sites. The lone “dump site” stood out as a unique site with a high mean dissimilarity value compared with other habitats. This was due to the unusually high number of red breast wrasses, brassy trevally, and black-tailed snapper, which apparently favored the artificial habitat, and a very low abundance of *pomacentrid* species (staghorn damsel, blue devil damsel, and green chromis), which are very common in most other habitats.

Multivariate analyses indicated that fish assemblages were largely grouped along a depth/habitat gradient, and fish diversity and biomass were greatest at sites of high coral cover. Biomass of commercially important species is reported highest at the coral-dominated sites while those sites dominated by sand have depauperate fish communities. When analyses were performed with depth as a factor, there was a strong grouping among sites below 40 ft (12 m). The greater variability in fish assemblages among sites within the depth range of 40-60 ft (12-18 m) is likely explained by previous dredging of many of these sites. When sites were coded for their location with respect to future direct or indirect impacts of dredging, it can be seen that many of the low diversity sites would be directly affected. However, 50% (9 of 18) of the sites dominated by coral and having the most significant fish assemblages (identified above) would also be directly affected.

Water visibility during the Apra Harbor surveys is a major potential source of sampling bias, especially for quantification of fish communities. Water visibility was poor at several sites - three of those sites (56, 44 and 66) which were all associated with the Alternative 2 direct impact area, had to be removed from the study due to poor visibility. The sites are located as follows: Site 56 is just west of inner harbor entrance channel, Site 44 is near Big Blue Reef's eastern end, and Site 66 is located near Big Blue Reef's southern end (see Figure 11.1-16 above).

11.1.5 Special-Status Species

This section includes a brief summary of key points included within Volume 2, Chapter 11 as baseline information for this resource. A brief summary of special-status species is provided below. Sensitive marine biological resources and habitats of Apra Harbor are shown in Figure 11.1-16. The three special-status species potentially associated with Apra Harbor study area are listed in Table 11.1-5.

Table 11.1-5. Special-Status Species Potentially Occurring within Apra Harbor

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

Notes: *E = endangered, T = threatened, MMPA= Marine Mammal Protection Act, SOGCN= species of greatest conservation need. There is no critical habitat designation for any marine species on Guam. Spinner dolphins are occasionally sighted near the entrance of Outer Apra Harbor.

Sources: NMFS 2009; USFWS 2009a.

Recently 82 coral species were identified as NMFS candidate species for potential listing, some of which occur in the ROI (WPRFMC 2009a, NMFS 2010b). Also recently, the bumphead parrotfish was identified as a NMFS candidate species (NMFS 2010a). As candidate species are afforded no special protection, they will not be analyzed for potential impacts under Endangered Species Act (ESA); corals are considered EFH and the bumphead parrotfish is an EFH MUS, so they are included in the EFH analysis.

In accordance with Section 7 of the ESA, a Marine Resources Biological Assessment was prepared by the Navy and addressed the potential effects of the proposed federal action on all threatened, endangered, and proposed species known or suspected to occur in the proposed action influence area. Threatened, endangered, and proposed species are managed under the authority of the federal ESA (16 USC 1531 *et seq*.). The ESA requires federal agencies to ensure that all actions which they "authorize, fund, or carry out" are not likely to jeopardize the continued existence of any threatened, endangered, or proposed species. Agencies are further required to develop and carry out conservation programs for these species.

Spinner dolphins are noted on a rare, but somewhat regular basis at the entrance of Apra Harbor (personal communication, Roy Brown, September 2007 from COMNAV Marianas 2007b). Brown runs dolphin tours on Guam's waters and estimates that spinner dolphins are seen up to four times a year in Outer Apra Harbor near the entrance channel, which ranges from 7,500 - 11,250 ft (2,286 – 3429 m) away from the proposed action depending upon the stage of dredging. The pier construction would be at the furthest distance identified above.

The green and hawksbill sea turtles are the only special-status species reported in Apra Harbor, with observations of green sea turtles occurring on a more regular basis. Sasa Bay is a year round, high concentration area for sea turtles as identified by NOAA (2005b). Smith (2007) observed nine green sea turtles, five of which were on Big Blue Reef. All turtles sighted at Big Blue Reef west were 15 to 23 in

(38 to 58 cm) in length, with no visible fibropapilloma tumors or other signs of injury. No hawksbill sea turtles were observed. A cooperative effort between the Navy and resource agencies is ongoing for monitoring sea turtle nesting activity, however tagging programs and density information for sea turtles in Apra Harbor is deficient.

Algal species (and sea grass to a lesser degree) are reported at multiple other areas throughout Apra Harbor (NOAA 2005a, 2005b; Dollar et al. 2009), hence potential sea turtle foraging and resting areas are not limited. Although algal surveys were not conducted, Smith (2007) suggests that potential sea turtle resting habitat and preferred algal forage species were present on Big Blue Reef west and the shoal areas, where most turtle sightings occurred. Balazs et. al (1987) identified ten genera of algae that he considered to be preferred forage for green sea turtles in Hawaii.

Preferred sea turtle forage species observed included green algae (*Dictyospheria spp*. and *Ulva spp*.), brown algae (*Sargassum spp*.), and red algae (*Gracillaria spp*., *Jania spp*., *Hypnea spp*., *Acanthophora spicifera* and *Laurencia spp*.). Green sea turtles are probably opportunistic feeders; however, within the preferred food items listed above, three species (*Dictyospheria versluysii*, *Sargassum obtusifolium, and Acanthophora specifera*) have been reported from Guam (Lobban and Tsuda 2003), and were tentatively identified on Big Blue Reef west and the shoal areas. None of the algae listed above were abundant at any of the study sites during recent surveys (Smith 2007).

The reef area in the aircraft carrier dredge footprint does not represent a unique or unusual habitat in comparison to the entire Apra Harbor reef complex, and does not contain an abundance of important algal forage species that cannot be found elsewhere in Apra Harbor. Smith (2007) reported that five of the nine green sea turtles observed during a 2-day survey in the project area were at Big Blue Reef. Sasa Bay is reported as an area of high concentration for both ESA-listed sea turtle species (NOAA 2005b).

There have been limited studies on green sea turtle hearing capabilities, but the available data suggests hearing in the moderately low frequency range, and a relatively low sensitivity within the range they are capable of hearing (Bartol et al. 1999; Ketten and Bartol 2006). NOAA (2005b [pp 3-88 and 3-89]) identifies sea turtle hearing sensitivity, and includes the following information. The range of maximum sensitivity for sea turtles is 100 to 800 Hz, with an upper limit of about 2,000 Hz. Hearing below 80 Hz is less sensitive but still potentially usable to the animal (Lenhardt 1994). Green turtles are most sensitive to sounds between 200 and 700 Hz, with peak sensitivity at 300 to 400 Hz. They possess an overall hearing range of approximately 100 to 1,000 Hz (Ridgway et al. 1969). Sensitivity even within the optimal hearing range is apparently low—threshold detection levels in water are relatively high at 160 to 200 dB with a reference pressure of one dB re 1 μPa-m (Lenhardt 1994).

TEI (2006) gathered unpublished data on hearing thresholds for green sea turtles from an Office of Naval Research study at the New England Aquarium and combined these data with other information (Ruggero and Temchin 2002) to present the hearing thresholds in Table 11.1-6. These data shows results similar to those presented above and provide the best available estimates for the green sea turtle. The hearing bandwidth was relatively narrow, 50 to 1,000 Hz, with maximum sensitivity around 200 Hz. In addition, these animals have very high hearing thresholds at over 100 dB re 1 μPa in low frequencies where construction sound is concentrated.

Table 11.1-6. Hearing Thresholds and Bandwidth for Sea Turtles

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

Source: TEI 2006 and Ruggero and Temchin 2002.

As mentioned in Volume 2, Chapter 10 and 11, sea turtles have been observed nesting during all months of the year on Guam; however, the peak of nesting activity occurs from April to July. Sea turtle nesting activity has been reported from three Apra Harbor locations (see Figure 11.1-15): *Adotgan Dangkolo* (*Dangkolo*) (green sea turtles), *Adotgan Dikiki* (*Dikiki*) (hawksbill sea turtles), and *Kilo Wharf* (green sea turtles). Historic records of sea turtle nesting include a hawksbill reported at a beach near Sumay Cove in 1997, and a general report of nesting at a beach near the Sea Plane Ramp (COMNAV Marianas 2007a) (refer to Figure 11.1-15.) No nesting activity has occurred at these areas since that time (Grimm and Farley 2008; Navy 2009b). In general, sea turtles nest and hatch at night. They use natural light cues to orient toward the ocean. However, the bright lights from the dredging platforms may confuse nesting turtles and hatchlings, and result in them orienting away from the open ocean (COMNAV Marianas 2007a). See Volume 2 and 4, Chapter 11 Terrestrial Biological Resources for more detailed information.

See Volume 2, Chapter 11, for more baseline information on special-status species.

Critical Habitat

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

11.2 ENVIRONMENTAL CONSEQUENCES

11.2.1 Approach to Analysis

11.2.1.1 Methodology

The methodology for identifying, evaluating, and mitigating impacts to marine biological resources was based on federal laws and regulations including the ESA, MMPA, Magnuson-Stevens Fishery Conservation and Management Act or Magnuson-Stevens Act (MSA), Section 404(b)(1) Guidelines (Guidelines) of the CWA, and Executive Order (EO) 13089, *Coral Reef Protection*. Significant marine biological resources include all species that are ESA-listed as threatened and endangered under ESA, species protected under the MMPA, or species with designated EFH or HAPC established under the MSA. The MSA defines EFH as ". those waters and substrate necessary to fish for spawning, breeding, feeding, or growth to maturity." 'Waters' include aquatic areas and their associated physical, chemical, and biological properties that are used by fish. 'Substrate' includes sediment, hard bottom, structures underlying the waters, and associated biological communities. 'Necessary' means the habitat required to support a sustainable fishery and the managed species' contribution to a healthy ecosystem, and 'spawning, breeding, feeding, or growth to maturity' covers a species' full life cycle (16 U.S. Code [USC] 1801 et seq.). Additionally, at least one or more of the following criteria established by the NMFS must be met for HAPC designation: 1) the ecological function provided by the habitat is important, 2) the habitat is sensitive to human-induced environmental degradation, 3) development activities are, or will be, stressing the habitat type, or 4) the habitat type is rare. It is possible that an area can meet one HAPC criterion and not be designated an HAPC. The Western Pacific Regional Fishery Management Council (WPRFMC) used a fifth HAPC criterion, not established by NMFS, that includes areas that are already protected, such as Overlay Refuges (WPRFMC 2009a).

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

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

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

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

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

11.2.1.2 Determination of Significance

This section analyzes the potential for impacts to marine biological resources from implementation of the action alternatives and the no-action alternative. The factors used to assess the significance of the effects to marine biological resources include the extent or degree that implementation of an alternative would result in permanent loss or long-term degradation of the physical, chemical, and biotic components that make up a marine community. The following significance criteria were used to assess the impacts of implementing the alternatives:

- The extent, if any, that the action would diminish the habitat, population size, or distribution of a special-status species, negatively affecting the species' prospects for conservation and recovery.
- The extent, if any, that the action would permanently reduce the quality or quantity of designated EFH (especially HAPC) for the sustainment of managed fisheries.
- The extent, if any, that the action would be likely to jeopardize the continued existence of any federally listed species or result in the destruction or adverse modification of designated critical habitat of such species.
- The extent, if any, that the action would result in a substantial loss or degradation of habitat or ecosystem functions (natural features and processes) essential to the persistence of native flora or fauna populations.
- The extent, if any, that the action would be inconsistent with the goals of the Navy's Integrated Natural Resources Management Plan (INRMP).

The MMPA generally defines harassment for military readiness activities, i.e., training, as Level A or Level B. Public Law (PL) 108-136 amended. This MMPA definition of Level A and Level B harassment for military readiness activities applies to a portion of this action.

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

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

Effects determinations for EFH are either "no adverse effect on EFH" or "may adversely affect EFH" (WPRFMC 2009a). Pursuant to 50 CFR 600.910(a), an "adverse effect" on EFH is defined as any impact that reduces the quality and/or quantity of EFH. Adverse effects to EFH require further consultation if they are determined to be permanent versus temporary (NMFS 1999). An example of temporary (or short-term) and localized impacts would be dredging of soft bottom, benthic communities, living in shallow-water estuarine and nearshore environments that are well adapted to frequent physical disturbance. Tides, currents, waves, and storms cause sediments to be lifted, deposited, or shifted. The resilience of benthic organisms to these environmental changes allows them to recolonize areas of the seafloor affected by dredging (TEI 2009 as identified from NOAA 2007 [see Section 11.2.2.2 1.a.]).

Temporary or minimal impacts are not considered to "adversely affect" EFH. 50 CFR 600.815(a)(2)(ii) and the EFH Final Rule (67 FR 2354) were used as guidance for this determination. Temporary effects are those that are limited in duration and allow the particular environment to recover without measurable impact (67 FR 2354). Minimal effects are those that may result in relatively small changes in the affected environment and insignificant changes in ecological functions (67 FR 2354). Whether an impact is minimal would depend on a number of factors (DoN 2010):

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

The analysis of potential impacts to marine biological resources considered direct, indirect, and cumulative impacts. The *Council on Environmental Quality (CEQ), Section 1508.08 Effects,* defines direct impacts as those caused by the action and occur at the same time and place, while indirect impacts occur later in time or farther removed in distance, but are still reasonably foreseeable. CEQ defines cumulative impacts as "the impact on the environment which results from the incremental impact of the action when added to other past, present, and reasonably foreseeable future actions regardless of what agency (federal or non-federal) or person undertakes such other action."

Direct impacts may include: removal of coral and coral reef habitat (a CWA special aquatic site), "taking" of special-status species, increased noise, and lighting impacts resulting from construction or operational activities.

Indirect impacts, for the purposes of this evaluation, may include physiological effects on marine organisms that result from project-related changes in water quality, including any sedimentation/siltation of coral reef ecosystems resulting from construction or operational activities (i.e., dredging resuspension of sediment), or increased recreational activities in the vicinity of the resource that may lead to impacts to special-status species and EFH.

If marine resources could be significantly impacted by proposed project activities, potential impacts may be reduced or offset through implementation of appropriate Best Managment Practices (BMPs) or mitigation measures. "Significantly" as used in NEPA (per 43 FR 56003, Nov. 29, 1978; 44 FR 874, Jan. 3, 1979) requires considerations of both context and intensity:

- Context. This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant.

- Intensity. This refers to the severity of impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:

3. Impacts that may be both beneficial and adverse. A significant effect may exist even if the federal agency believes that on balance the effect will be beneficial.
4. The degree to which the proposed action affects public health or safety.
5. Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.
6. The degree to which the effects on the quality of the human environment are likely to be highly controversial.
7. The degree to which the possible effects on the human environment are highly uncertain or involve unique or unknown risks.
8. The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.
9. Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.
10. The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.
11. The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined to be critical under the Endangered Species Act of 1973.
12. Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment.

11.2.1.3 Issues Identified during Public Scoping Process

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

- Potential impacts on the Apra Harbor marine environment from aircraft carrier berthing, fully documenting impacts from dredging (acreage and ecosystem characteristics of affected area, depth of dredging operations, duration of effects)
- Potential impacts to endangered species (including nesting habitats), species of concern, and federal trust species such as corals and marine mammals
- Potential impacts from military expansion from all project sites on the marine resources, including removal or disturbance of the marine habitat
- Impacts to culturally significant marine-related areas for subsistence fishing and beliefs

- Increased “high impact” recreational use that would damage the ecosystem and impact fish habitat (e.g., Sasa Bay Marine Reserve)
- Increased land runoff impacting beaches and marine life (erosion and sediment stress)
- Increased anthropogenic factors impacting the coral reef ecosystem and concerns about the education and training that would be provided for newly arriving military and their dependants regarding reef protection
- Mitigation measures and non-structural alternatives to avoid and minimize impacts to coral reefs

11.2.2 Alternative 1 Polaris Point (Preferred Alternative)

11.2.2.1 Onshore

Alternative 1 Polaris Point (referred to as Alternative 1) has the potential to impact the quality and quantity of the surface runoff, during both the construction and operational phases of the project, without the application of appropriate BMPs. Both construction activities as well as long-term operation activities may cause erosion and sedimentation that can degrade coastal waters and potentially impact nearshore marine biological resources. In addition, the action alternatives would increase the potential for leaks and spills of petroleum, oil, lubrications (POLs), hazardous waste, pesticides, and fertilizers. These potential impacts may affect the coastal waters and in turn the biological resources and habitats.

CONSTRUCTION

Proposed onshore construction activities would occur in an area that is composed of fill material. Embankment excavation would be required to expand the existing shoreline north of the proposed aircraft carrier berthing and the face of the wharf. While alterations to the onshore environment have the potential to result in indirect impacts that could alter the harbor water quality as described above (see also Chapter 4, Water Resources), these potential effects (short-term and localized disturbances from noise, subsurface reverberations, and siltation of marine biological resources adjacent to the site) would be minimized by complying with all applicable orders, laws and regulations, including low impact development stormwater management strategies and BMPs (Volume 7).

Marine Flora, Invertebrates and Associated EFH

No direct impacts on these resources are expected. Construction activities associated with Alternative 1 would include the implementation and management of appropriate construction permit BMPs. These resources would not be appreciably modified from existing conditions by indirect impacts identified from temporary increases in suspended sediments and noise. Indirect impacts as a result of actions associated with Alternative 1 would not be significant for marine flora, invertebrates, or associated EFH, and would not adversely affect associated EFH.

Potential impacts to species included in a regional FEP are addressed accordingly under EFH.

Essential Fish Habitat

No direct impacts on these resources are expected. Construction activities associated with Alternative 1 would include the implementation and management of appropriate construction permit BMPs. These resources would not be appreciably modified from existing conditions by indirect impacts identified from temporary increases in suspended sediments and noise from construction activities. Indirect impacts as a result of actions associated with Alternative 1 would not be significant and would not adversely affect EFH.

Special-Status Species

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

This resource would not be appreciably modified from existing conditions by indirect impacts. No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1. For impacts on green sea turtles associated with onshore construction activities, see Chapter 10 of this Volume. Therefore, Alternative 1 would result in a less than significant impact to special-status species.

Non-native Species

There would be no direct impacts in relation to non-native species introduction caused by activities associated with Alternative 1. Any potential introduction/transport of non-native species may be lessened or even prevented through appropriate BMPs and implementation of the Micronesia Biosecurity Plan (MBP).

The MBP is being developed to address potential non-native invasive species impacts associated with this EIS as well as to provide a plan for a comprehensive regional approach. The MBP will include risk assessments for potentially invasive non-native species throughout Micronesia and procedures to avoid, minimize, and mitigate these risks. It is being developed in conjunction with experts within other federal agencies including the National Invasive Species Council (NISC), U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS), the U.S. Geological Survey (USGS), and the Smithsonian Environmental Research Center (SERC). The plan is intended to be a comprehensive evaluation of risks in the region, including all Marine Corps and Navy actions on Guam and Tinian and specifically those being proposed in this EIS.

The DoN will adopt protective measures associated construction, on shore, and near shore impacts of the proposed action to reduce the likelihood of the introduction and spread of non-native invasive marine species. These measures may include clarifying biosecurity requirements for all Navy vessels (including chartered Military Sealift Command [MSC] ships), improving hull husbandry documentation, and incorporating into contractual agreements with vessels chartered to support the military relocation specific criteria to ensure low levels of biofouling and ballast water management.

Therefore, Alternative 1 would result in a less than significant impact regarding non-native species introduction.

Based on the analysis presented above for onshore construction activities, Alternative 1 would result in less than significant impacts to marine biological resources.

OPERATION

The operational phase of Alternative 1 would increase the area of impervious surface which would result in an associated relatively minor increase in stormwater discharge intensities and volume. This increase would be accommodated by stormwater infrastructure, and stormwater flow paths would continue to mimic 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. It is the intent that all designs would result in 100% capture and treatment, if required, of stormwater runoff.

While onshore operation activities have the potential to result in indirect impacts that could alter the harbor water quality as described above (also see Chapter 4, Water Resources), these potential effects (localized disturbances from noise, subsurface reverberations, and decreased water quality for marine biological resources adjacent to the site) would be minimized by complying with all applicable orders, laws and regulations, including industrial management strategies and BMPs (Volume 7). Potential impacts from the operational phase of Alternative 1 are described below for each marine resource category.

Marine Flora, Invertebrates and Associated EFH

No direct impacts on these resources are expected. Operation activities associated with Alternative 1 would include the implementation and management of appropriate BMPs. These resources would not be appreciably modified from existing conditions by indirect impacts identified from minimal increases in suspended sediments and noise. Indirect impacts as a result of actions associated with Alternative 1 would not be significant for marine flora, invertebrates, or associated EFH, and would not adversely affect associated EFH.

Essential Fish Habitat

No direct impacts on these resources are expected. Operation activities associated with Alternative 1 would include the implementation and management of appropriate BMPs (see Volume 7). These resources would not be appreciably modified from existing conditions by indirect impacts identified from minimal increases in suspended sediments and noise. Indirect impacts as a result of actions associated with Alternative 1 would not be significant and would not adversely affect EFH.

Special-Status Species

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

This resource would not be appreciably modified from existing conditions by indirect impacts. No serious injury or mortality of any marine mammal species is reasonably foreseeable and no adverse effects on the annual rates of recruitment or survival of any of the species and stocks is expected with the implementation of Alternative 1. Green sea turtles may be disturbed by increased activity in the area, specifically, artificial lighting, but potential impacts would be minimal (see Chapter 10, Volume 2 and Volume 4). Alternative 1 would result in a less than significant impact to special-status species.

Non-native Species

There would be no direct impacts in relation to non-native species introductions caused by activities associated with Alternative 1.

There may be increased potential for transport of non-native species to and from other locations within the Mariana Islands chain. This increase above existing conditions is expected to be minimal. Any potential introduction/transport of non-native species may be lessened or even prevented through appropriate BMPs and implementation of the MBP. The DoN will adopt protective measures associated with operational onshore and near shore impacts of the proposed action to reduce the likelihood of the introduction and spread of non-native marine species. These measures may include clarifying biosecurity requirements for all Navy vessels (including chartered Military Sealift Command [MSC] ships), improving hull husbandry documentation, and incorporating into contractual agreements with vessels chartered to support the military relocation specific criteria to ensure low levels of biofouling and ballast water management.

Therefore, Alternative 1 would result in a less than significant impact regarding non-native species introduction.

Onshore operation activities for Alternative 1 would result in less than significant impacts to marine biological resources.

11.2.2.2 Offshore

CONSTRUCTION

The proposed in-water construction-related activities under Alternative 1 would significantly impact and/or may adversely affect marine biological resources by permanently removing benthic substratum, including coral and coral reef habitat, upon which marine flora and fauna are dependent. Given the proposed action as currently defined and existing environmental information on sea turtle habitat in outer Apra Harbor, the data at this point in time tends to suggest that sea turtles may be adversely affected by the proposed in-water activities. However, because the Navy has elected to defer selection of a specific site within Apra Harbor, no definitive conclusion can be reached regarding the impact on ESA-listed species. The Navy will voluntarily collect additional data and/or conduct additional analysis regarding marine resources within specific locations in Apra Harbor. When a proposal regarding the selection of a specific site is put forward, Section 7 consultation will be reinitiated.

Construction of the aircraft carrier wharf would involve dredging, pile driving and placement of fill material in approximately 3.6 ac (1.5 ha) of nearshore/intertidal waters under the proposed wharf structure. Potential construction impacts to marine life are summarized below for each resource type.

This EIS assumes five scenarios for the placement of dredged material: 100% disposal in a proposed ocean dredged material disposal site (ODMDS), 100% disposal upland, 100% beneficial reuse, 20-25% beneficial reuse/75-80% ocean disposal and 50% beneficial reuse/50% ocean disposal. These five scenarios are explained further below in Volume 4, Section 2.3.5.

Marine Flora, Invertebrates and Associated EFH

Potential impacts to marine flora and non-coral invertebrates include direct impacts to those organisms residing in the immediate dredge and fill areas. Large areas of live/hard bottom (non-coral) and submerged aquatic vegetation (SAV) would be removed. Organisms residing in the areas adjacent to and outside the dredged and fill impact areas could experience indirect impacts due to increased sedimentation from dredging activities. Coral impacts are addressed under Essential Fish Habitat. Physical impacts associated with this effort were estimated using the amount of the harbor bottom removed by dredging. Figure 11.2-1 shows the approximate limits of proposed dredging activities and associated coral abundance within and in the vicinity of the project area. The proposed dredge area includes all areas shallower than –51.5 ft (–15.7 m) mean lower low water (MLLW) (-49.5 ft [-15 m] plus 2 ft [0.6 m] overdredge). While mitigation measures such as the use of silt containment devices in deeper waters to protect sensitive coral areas would be employed during dredging operations, particulate material would be released by the breaking up of the reef surface, the re-suspension of particulate material contained within the fossil framework, and the leakage of sediment slurry out of the clamshell during uplift and transfer to scows for dredged material transport and disposal or reuse.

Those mobile organisms in the project area that are not directly subjected to removal or fill activities could sustain impacts as a result of transport, suspension and deposition of dredging-generated sediments.

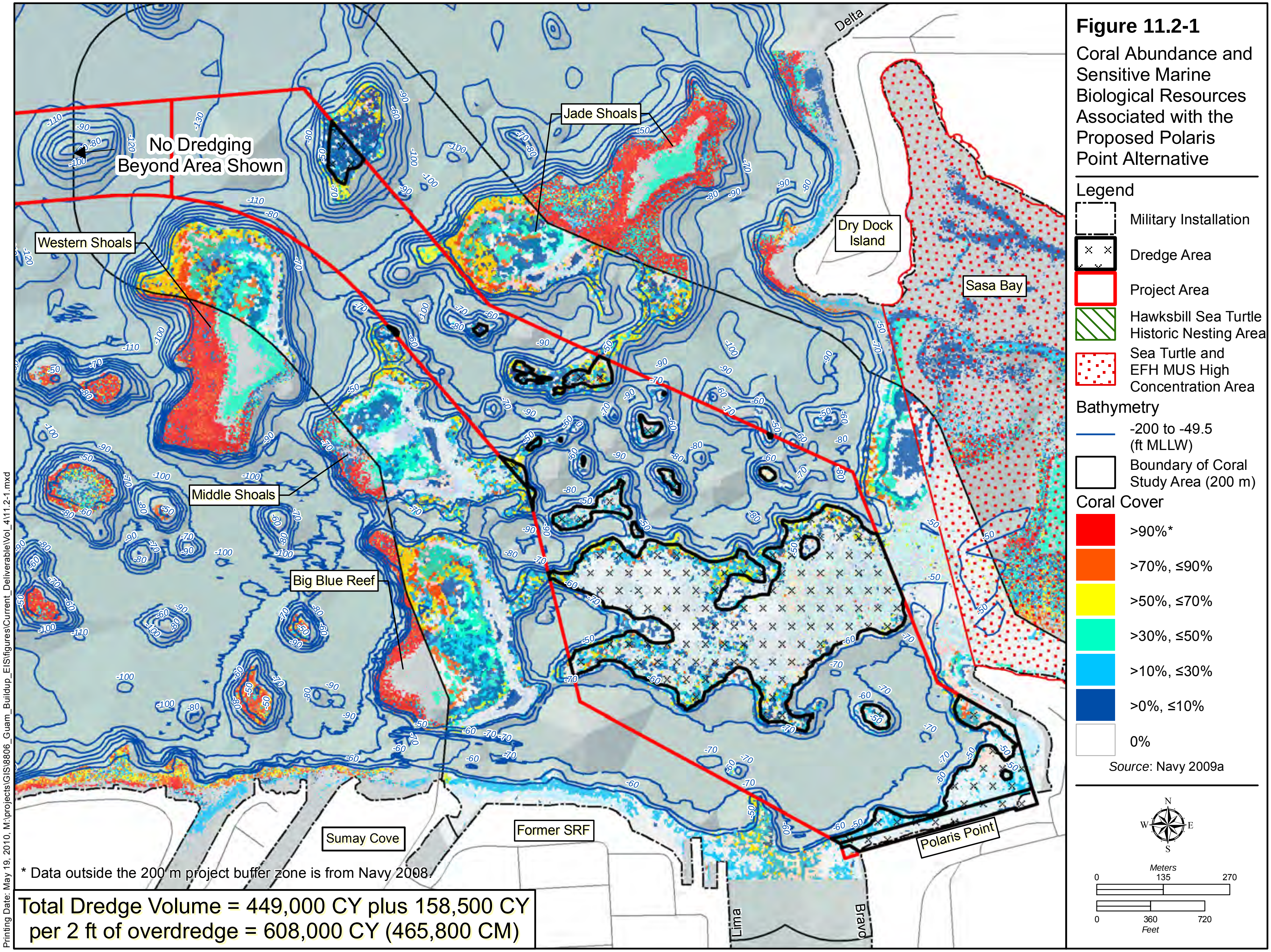
Figure 11.2-1
Coral Abundance and Sensitive Marine Biological Resources Associated with the Proposed Polaris Point Alternative
Legend
Military Installation
Dredge Area
Project Area
Hawksbill Sea Turtle Historic Nesting Area
Sea Turtle and EFH MUS High Concentration Area
Bathymetry
-200 to -49.5 (ft MLLW)
Boundary of Coral Study Area (200 m)
Coral Cover
>90%*
>70%, ≤90%
>50%, ≤70%
>30%, ≤50%
>10%, ≤30%
>0%, ≤10%
0%
Source: Navy 2009a
Meters
0
135
270
0
360
720
Feet
No Dredging Beyond Area Shown
Jade Shoals
Western Shoals
Middle Shoals
Big Blue Reef
Dry Dock Island
Sasa Bay
Delta
Sumay Cove
Former SRF
Polaris Point
Lima
Bravo
* Data outside the 200 m project buffer zone is from Navy 2008.
Total Dredge Volume = 449,000 CY plus 158,500 CY per 2 ft of overdredge = 608,000 CY (465,800 CM)
Printing Date: May 19, 2010, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_4\11.2-1.mxd

Sessile organisms such as marine floral communities (macroalgae) have been found to be the predominant benthic community residing within the area to be dredged. Marine algae can outcompete coral and overgrow coral reef sites under certain conditions. Removing the algae and improving water quality could improve the chances of coral reef recovery and growth. Nuisance and non-native invasive algae removal has been successfully implemented in Hawaii by the Nature Conservancy. Under Alternative 1, dredging and fill activities would have direct and permanent impacts on marine flora and sessile invertebrates in the dredged area through removal and subsequent maintenance dredging. Motile invertebrates would likely vacate the area once project activities begin due to the increased disturbance. Although mortality would occur to marine flora and sessile invertebrates, new recruits would most likely replenish these populations post-construction Taylor Engineering, Inc. (TEI) 2009) (TEI) (2009) performed a literature review of effects of beach nourishment, dredging and disposal projects on benthic infaunal-type and other habitats. The following paragraphs cite the reviewed articles and list the key findings related to benthic habitat effects:

1. NOAA Benthic Habitat Mapping. 2007. Applying Benthic Data: *Dredging and Disposal of Marine Sediment*.
    a. "Benthic organisms living in shallow water estuarine and nearshore environments are well adapted to frequent physical disturbance. Tides, currents, waves, and storms cause sediments to be lifted, deposited, or shifted. The resilience of benthic organisms to these environmental changes allows them to recolonize areas of the seafloor affected by dredging."
2. Dredging Operations and Environmental Research (DOER). 2005. *Sedimentation: Potential Biological Effects of Dredging Operations in Estuarine and Marine Environments.*
    a. "most shallow benthic habitats in estuarine and coastal systems are subject to deposition and resuspension events on daily or even tidal time scales"
    b. "Many organisms have physiological or behavioral methods of dealing with sediments that settle on or around them, ranging from avoidance to tolerance of attenuated light and/or anaerobic conditions caused by partial or complete burial"
3. Section 404(b) Evaluation, *Pinellas County Florida Beach Erosion Control Project Alternative Sand Source Utilization."*
    a. "Fill material will bury some benthic organisms."
    b. "Most organisms in this turbid environment are adapted for existence in an area of considerable substrate movement"
    c. "Re-colonization will occur in most cases within one year following construction"
4. Greene. 2002. *A Review of the Biological and Physical Impacts.*
    a. "Studies from 1985-1996 report short-term declines in infaunal abundance, biomass, and taxa richness following beach nourishment, with recovery occurring between 2 and 7 months"
    b. "Studies from 1994-2001 reported recolonization of infauna occurred within two weeks"
5. U.S. Army Corps of Engineers Coastal Engineering Research Center. 1982. *Biological Effects of Beach Restoration with Dredge Material on Mid-Atlantic Coasts*.

a. "animals that spend their entire life cycle in the substrate were not seriously impacted by burying from beach nourishment"

b. "nourishment destroyed or drove away the inertidal macrofauna; but, based on other regional studies, recovery should occur within one or two seasons (i.e. 3-6 months)

TEI (2009) identified short-term impacts to benthic habitat after conducting a thorough literature review. Impacts were considered short-term because most benthic flora and fauna have the ability to adapt for existence in areas of considerable substrate movement. Although most of the studies TEI included in their review involved natural substrate movement as opposed to substrate movement caused by human activities, the recovery of organisms after such events provided useful information on impacts from short-term sediment disturbances.

A beneficial long-term impact for the recruitment of marine flora and invertebrates and the ecology of the immediate area is expected with the increased area for potential settlement provided by the proposed aircraft carrier wharf armor rip rap and vertical pilings. These artificial substrates would provide suitable habitat for benthic algae and sessile invertebrates including sponges, tunicates, sea urchins, starfish, and mollusks, which are currently poorly represented within Inner Apra Harbor and the entrance channel areas (COMNAV Marianas 2006). The structures and associated biota would also provide shelter and food resources for fishes. Based on Paulay et. al. (2002), non-indigenous species occur primarily on artificial substrates in Apra Harbor and, along with indigenous species, would be likely to colonize the new structures. Paulay et al. (2002) did not find evidence that the non-indigenous species were spreading into and significantly impacting natural habitats in the region.

Due to the large size of live hard bottom and SAV to be removed (>40 acres [ac]) (>16.2 hectares [ha]), context and intensity, and cumulative effects of the impacts associated with dredging in a variety of habitats, the impact to SAV and live hard bottom would "be above minimal" (refer to Section 11.2.1.2). The staggered, 18-month dredging duration, will allow some SAV habitat to recolonize before the SAV habitat is fully removed during the dredging operation, therefore a temporary impact. The live hard bottom will be permanently removed and will not have time to recover during subsequent maintenance dredging operations anticipated to occur every 10 years. Therefore, the implementation of the offshore component of Alternative 1 may adversely affect EFH, specifically Live/Hard Bottom.

Essential Fish Habitat

As described in Volume 2, Chapter 11, all of Apra Harbor is considered EFH, which is defined as those waters and substrate necessary to fish (finfish, mollusks, crustaceans and other forms of marine animal and plant life other than marine reptiles, marine mammals and birds) for spawning, breeding, feeding, or growth to maturity (WPRFMC 2009a). EFH for managed fishery resources is designated in the FEPs prepared by the local regional fisheries management council - WPRFMC - and in conjunction with the Guam Division of Aquatic and Wildlife Resources (GDAWR), which among other duties, manages the fisheries resources on Guam. The WPRFMC recently shifted to managing fisheries in the Western Pacific under FEPs, and those which pertain to Guam include the Mariana Archipelago FEP and Pacific Pelagic Fisheries FEP. The Mariana Archipelago FEP includes demersal organisms grouped in the same categories as past FMPs, including the Bottomfish and Seamount, Crustaceans, Precious Corals, and Coral Reef Ecosystems. Due to the highly migratory nature of some pelagic species, an individual FEP was created for pelagic species in the entire Western Pacific region (WPRFMC 2009b). The new FEPs identify areas of EFH and HAPC for different life stages of species managed under the respective plan in the same fashion as the FMPs did (WPRFMC 2009a 2009b). There is no designated EFH or HAPC for precious corals or seamount groundfish around Guam, but other designations do apply (COMNAV Marianas 2007a).

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

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

The Navy is currently at Step 3, awaiting conservation recommendations from NMFS.

Jade Shoals, just west of Dry Dock Island, is a specific HAPC site. Potential effects to EFH may include direct or indirect impacts to the habitat and/or the individual species that occupy the habitat. These are evaluated as described in Section 11.2.1 Approach to Analysis.

The key assumptions for the assessment of coral impacts are as follows:

- Dredging is anticipated to last from 8 to 18 months to complete the entire proposed action based on dredging 24 hr/d; however, dredging frequency and duration would be determined at the final design stage.
- The impact analysis assumes that all areas less than 60 ft (18 m) deep within the dredged area would be removed, although in reality, the dredge or direct impact area would be at a depth of -49.5 ft [-15.1 m] plus 2 ft [0.6 m] overdredge and remove less coral than described in Table 11.2-1. The coral loss in the direct impact areas is assumed to be permanent.
- The boundary of the coral study area extended approximately 656 ft (200 m) outside the dredge footprint. The severity of indirect impacts from sediment accumulation would extend at varying degrees out from the dredge footprint, not anticipated to exceed the coral study area.
- Indirect impacts were modeled and indicated that sedimentation exceeding 0.001oz/0.15in^2) (40 mg/cm^2)or 0.008 in (0.2 mm) extended an average distance of 144 ft (44 m) from the dredging. This is the assessment of the benthic communities area and may be within the coral's physiological tolerance limit for sediment accumulation (e.g., Hubbard and Pocock 1972).
- A 40 ft (12 m) adverse impact area extending from the dredged footprint was derived from the SEI (2009) oceanographic cumulative plume modeling estimations. This area is anticipated to

receive cumulative sedimentation totaling at least 0.2 in (5 mm), which was established as the cumulative sedimentation threshold for corals (adverse impact area) (Dollar 2009).

The following summarizes the direct and indirect impacts to corals from Alternative 1 actions (Table 11.2-1):

- Areas with the greatest coral abundance (>70 to ≤ 90%) would comprise the smallest portion (10%) of the total coral coverage category that would be lost due to proposed dredging.
- Areas with the least amount of coral coverage (0 – ≤10%) would comprise the largest portion (approximately 36%) of the total coral coverage category that would be lost due to proposed dredging.
- About 62% of the area proposed for dredging contains corals with a coverage of less than 30%. Approximately 3% of the total area proposed for dredging contains corals in the 70-90%, coverage category and 10% for the 50-90% range of coverage.
- The total area impacted is about 172 ac (69.6 ha), which includes direct and indirect impacts of 72 ac (29.1 ha) and 101 ac (40.9 ha), respectively. This equates to a percent coral cover impact of 42%, which includes direct (35%) and indirect (46%) impacts of the total area affected, respectively.

In general, approximately 35% of the proposed dredge area contains some coral coverage and virtually all of the area consists of reefs that were dredged 60 years ago during the creation of Inner Apra Harbor.

In addition to dredging and fill activities, direct impacts to benthic habitats may occur from construction activities related to securing or anchoring the dredge barge and supporting vessels. Anchor chains and mooring cables would not be placed on or over reef areas that support high percentages of coral cover or complex reef structures. Therefore, there would be unavoidable permanent significant impacts to coral and coral reef ecosystem from dredged removal of approximately 25 ac (10 ha) of live coral (all classes [>0% to ≤90%]) with the implementation of Alternative 1.

Table 11.2-1. Estimated Coral Area and Percentages Impacted by Proposed Dredging Activities with Implementation of Alternative 1

Coral Level	*Alternative 1*					
	Direct		*Indirect*		*Total*	
	ha	*ac (% coral[1])*	*ha*	*ac (% coral[1])*	*ha*	*ac (% coral[1])*
coral = 0%	18.61	45.98	22.00	54.36	40.61	100.34
0% < coral ≤ 10%	3.74	9.24 (37)	5.45	13.48 (29)	9.20	22.72 (32)
10% < coral ≤ 30%	2.61	6.44 (26)	3.85	9.52 (21)	6.46	15.96 (22)
30% < coral ≤ 50%	0.96	2.37 (9)	3.25	8.04 (17)	4.22	10.41 (15)
50% < coral ≤ 70%	1.80	4.44 (18)	4.19	10.35 (22)	5.99	14.79 (21)
70% < coral ≤ 90%	1.10	2.71 (11)	1.96	4.85 (11)	3.06	7.56 (11)
Total with coral	**10.20**	**25.20**	**18.71**	**46.24**	**28.91**	**71.44**
Total dredge area	**28.80**	**71.18**	**40.71**	**100.6**	**69.52**	**171.78**
Percent coral cover		**35%**		**46%**		**42%**

[1]Coral percents are rounded to the nearest percent and therefore may not sum to 100%

Source: Dollar et al. 2009

Although the boundary of the coral study area extends out to 656 ft (200 m) from the dredged footprint, it's important to restate that estimated indirect impacts, based on SEI (2009) oceanographic modeling, extended an average distance of 144 ft (44 m) from the dredging footprint and the temporary adverse affects from indirect impacts extended approximately 40 ft (12 m).

Dredging of reef material within the aircraft carrier project area would result in elevated suspended sediments in the water column as a result of both leakage of excavated material from the dredge bucket, and the release of fine-grained calcium carbonate mud (micrite) from the interstitial reef framework (MRC 2009a, Dollar et al. 2009). However, as described in Chapter 4 of this Volume, Water Resources, sediment grain size analyses indicate that sediments in the area of the navigation channel and proposed turning basin, in areas that do not contain coral, consist primarily of sand and rubble; silty sediments are found along the proposed berthing areas (NAVFAC Pacific 2006). The coarse grain size of the material to be dredged indicates that the majority of the resuspended sediment would settle out of the water column rapidly.

The majority of the sediment (e.g., >50%) is comprised of larger grained material and, therefore is generally referred to as being "coarse" in the EIS. Sediment grain size data is presented as a percentage and is discussed as such in the EIS. The EIS will be updated to include a clear presentation of collected grain size data. The three-dimensional circulation and transport model of the project area was developed using the Environmental Fluid Dynamics Code (EFDC). The model included wind and tide forcing, and fresh water inflow into the Inner Apra Harbor; the dredge plume was simulated by loading the water column with specified quantities of suspended sediment composed of 5 different grain sizes. The sediment grain distribution was determined from bottom samples taken in the project area.

While sediment retention devices (i.e., silt curtains) would be deployed to minimize dispersal of this material, it is anticipated that some fraction would escape containment and potentially impact coral reef communities. A sediment plume is an inevitable effect of in-water construction activities and the Navy proposes to minimize by using silt curtains and operational controls of dredging equipment. On Guam, the use of silt curtains in the nearshore, shallow environment (e.g. around wharves) is considered a BMP, as it is a standard operation procedure. The use of silt curtains within the channel to protect sensitive coral habitat (i.e. shoal areas), would be considered a mitigation measure. Other BMPs and mitigation measures will be determined and agreed upon during the U.S. Army Corps of Engineers (USACE) permit phase of the projects. The Navy has monitoring dredging activity at Kilo Wharf and is aware of issues involving the subcontractor managing the silt curtain BMPs. Changes to the height of the silt curtains and some operational changes have been made to correct these issues and will be passed on to future dredging activities. The Kilo wharf project and the proposed action occur in very different areas of Apra Harbor. The setting of Kilo wharf is much more exposed to wind and wave action that impact the BMPs and mitigation measures. The proposed action area is anticipated to be less challenging with regard to the Navy's ability to minimize environmental impacts from sediment plumes. The dredging plume models that were run for the Draft EIS were based on high silt curtain sediment retention of 90% that were observed at other locations in Apra Harbor having similar conditions to the proposed action area. During pile driving or dredging activities, if a visible plume is observed over sensitive coral habitat outside the silt curtains, the construction activity would stop, silt curtain would be evaluated, and corrective measures taken. Construction would not resume until the water quality has returned to ambient conditions.

In addition, breakage of coral by the dredge that is not removed from the seafloor can also result in impacts to the reef habitats that are bordering the dredge sites. For the purposes of this document, these effects are termed "potential indirect impacts."

It is well documented since the pioneering work on environmental tolerances of reef corals that some taxa are more resilient to turbidity and sedimentation than others (e.g., Mayer 1915; Yonge 1930; Marshall and

Orr 1931; Hubbard and Pocock 1972; Riegl 1995; Wesseling et al. 1999). It has also been shown that corals growing in waters of moderate to extremely high turbidity are not automatically more stressed than their clear-water counterparts (Roy and Smith 1971, Done 1982, Johnson and Risk 1987, Acker and Stern 1990, Riegl 1995, Kleypas 1996, McClanahan and Obura 1997, Larcombe et al. 2001). Sanders and Baron-Szabo (2005) describe "siltation assemblages" of corals that occur in turbid water and/or muddy reef environments as a result of resilience to sediment through either effective rejection mechanisms or physiological tolerance to intermittent coverage. See Affected Environment, Section 11.2.2.2, Sediment Effects on Coral.

Review of the scientific literature to identify harmful sedimentation rates on corals revealed that there was no specific threshold level of sedimentation that resulted in coral mortality. The literature review (described in Volume 9, Appendix E, Section D) did reveal, however, that negative effects of sediment loading to reef corals were dependent on both the duration and the rate of sediment deposition. As expected, the general trend is that the higher the deposition rate, and the longer the period of deposition, the greater the effect. Threshold rates cited in the literature range from 0.0001oz/0.15in^2/d to 0.003oz/0.15in^2/d (5 mg/cm^2/d to 100 mg/cm^2/d). The extent of this impact is species-specific based on tolerances, the location or organisms relative to the construction activities, and water currents during proposed construction and dredging activities. Since these parameters cannot be specified for each individual, it is assumed that the impact to EFH and FEP MUS would occur throughout the area potentially impacted by turbidity plumes with sediment deposition rates greater than or equal to 0.008 in (0.2 mm), or 0.03oz/0.15 in^2 (1,000 mg/cm^2) (0.9 in [23 mm]) total, for the estimated dredging duration (Navy 2009a).

Sediment Deposition Models. The Current Measurement and Numerical Model Study for CVN Berthing (SEI 2009) is included in Volume 9, Appendix E, Section E. It presents the current modeling and sediment transport modeling specific to the proposed aircraft carrier project, including the details of methodology and the modeling graphics. The following summarizes the most relevant findings:

- Currents are predominantly wind-driven, and occur as a two-layer system. The surface layer flows in the direction of the wind, and the deeper layer flows in the opposite direction. During typical trade wind conditions, surface flow is to the west out of the harbor, while deeper flow is directed to the east, into the harbor. The exception to this is the entrance channel to Inner Apra Harbor, where currents may reverse with the tides. Local bathymetric features and pronounced reef shoals also control local current directions.
- Currents in the project vicinity are normally weak, which means sediment plumes will not be spreading appreciably.
- The highest current speed measured in Inner Apra Harbor was 1.2 knots (0.62 m/s), with east winds of 8 to 12 knots (4.1 to 6.2 m/s) during a high water slack tide. This example reveals that even with some wind, currents are weak.
- In Outer Apra Harbor, the fastest drogue current speed was 1.7 knots (0.87 m/s) with east wind of 12 knots (6.2 m/s), also during a high water slack tide. A two-layer flow was evident for some deployments. Most data showed that the surface layer moved in westerly directions and the deeper water layer deviated in speed and direction from the surface layer.
- Tidal effects are small in the harbor basins, but are important in the entrance channel to Inner Apra Harbor, where currents may reverse with the tides.

Twenty model cases were completed, bracketing a range of wind forcing conditions, dredging duration, production rates and dredge locations, and suspended sediment release. Model runs were completed for nine different locations throughout the project area. Silt curtain effectiveness was simulated based on 145 days of TSS measurements inside and outside of the silt curtain deployed for the Alpha-Bravo Wharves dredging project in Inner Apra Harbor. These measurements showed that the silt curtains retained 90% of the material inside of the curtain. Model computed TSS levels compared well with the Alpha-Bravo Wharves project measurements outside the silt curtain. Possible maximum adverse impacts 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.

The Navy is monitoring dredging activity at Kilo Wharf and is aware of issues involving the subcontractor managing the silt curtain. Changes to the height of the silt curtains and some operational changes have been made to correct these issues. The Kilo Wharf project and the proposed action occur in very different areas of Apra Harbor. The setting of Kilo Wharf is much more exposed to wind and wave action that impact the effectiveness of the silt curtain. The proposed action area is anticipated to be less challenging with regard to the Navy's ability to minimize environmental impacts from sediment plumes. Additionally, if a visible plume is observed over sensitive coral habitat outside the silt curtains, the construction activity would stop, be evaluated, and corrective measures taken. Construction would not resume until the water quality has returned to ambient conditions.

One of the scenarios that could result in the maximum potential adverse impact assumed the 24-hr per day dredging generating 1,800 cubic yards (cy) (1,376 cubic meters [m^3]) was located in an area close to Big Blue Reef. Figure 11.2-2 shows the contours of sediment deposition equal to 0.0001, 0.0003, 0.001, 0.003, 0.01 oz/0.15in^2/d (5, 10, 40, 100, 500 mg/cm^2/d) and shows that virtually all of the plume at deposition rates of 0.01 and 0.003 oz/0.15in^2/d (500 and 100 mg/cm^2/d) is retained within the dredge footprint. None of the plume extends past the dredged boundary (i.e., where the shovel impacts the hard surface) near Big Blue Reef for Alternative 1. Similar scenarios for the remaining model runs indicate little extension of the plumes beyond the project area (SEI 2009, Volume 9, Appendix E, Section E of this EIS). The dispersion beyond the dredge area and cumulative deposition effects are based on several inter-related factors as described earlier and include wind speed, current speed, tide, dredging operation duration, and silt curtain effectiveness.

Results of the SEI (2009) modeling are summarized below:

- Sediment deposition resulting from the dredging would be largely confined to the immediate vicinity of the specific dredge site. Maximum sediment deposition of 0.06oz/0.15in^2 (1,742 mg/cm^{-2}), or 0.4 in (10 mm), was calculated assuming 24 hr of dredging at a rate of 1,800 cy/day (1,376 m^3/day) (Model Case 6.3). The modeling indicated that sedimentation exceeding 0.001oz/0.15in^2 (40 mg/$cm^{2)}$, a cited threshold for coral impacts, would extend an average distance of 144 ft (44 m) from the dredging.
- Thickness of substrate to be dredged is only 1.6 to 3.3 ft (0.5 to 1 m) throughout most of the project area. Dredging would therefore pass rapidly from site to site; a 75.5 x 75.5 ft (23 by 23 m) grid area would require only a half day for dredging. This means that exposure to sediment plumes and significant sedimentation >0.001oz/0.15in^2/d (>40 mg/cm^2/d) would be limited to only one or two days. The exception to this is at the Polaris Point coastline, where sediment thicknesses of 13 ft (4 m) or greater would be dredged.

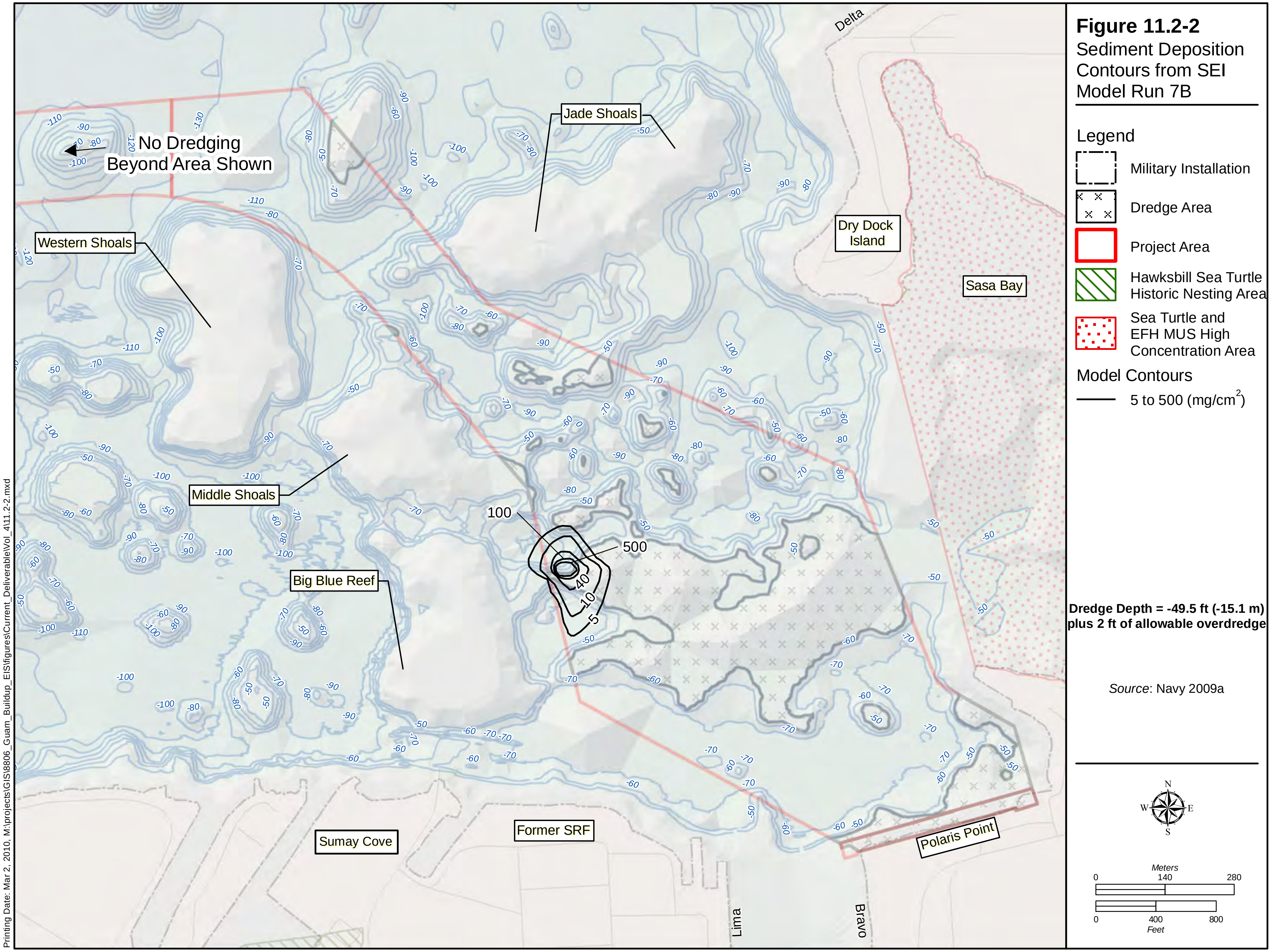

Figure 11.2-2
Sediment Deposition Contours from SEI Model Run 7B
Legend
Military Installation
Dredge Area
Project Area
Hawksbill Sea Turtle Historic Nesting Area
Sea Turtle and EFH MUS High Concentration Area
Model Contours
5 to 500 (mg/cm2)
Dredge Depth = -49.5 ft (-15.1 m) plus 2 ft of allowable overdredge
Source: Navy 2009a
No Dredging Beyond Area Shown
Western Shoals
Jade Shoals
Middle Shoals
Big Blue Reef
Dry Dock Island
Sasa Bay
Sumay Cove
Former SRF
Polaris Point
Delta
Lima
Bravo
100
500
40
10
5
Meters
0
140
280
Feet
0
400
800
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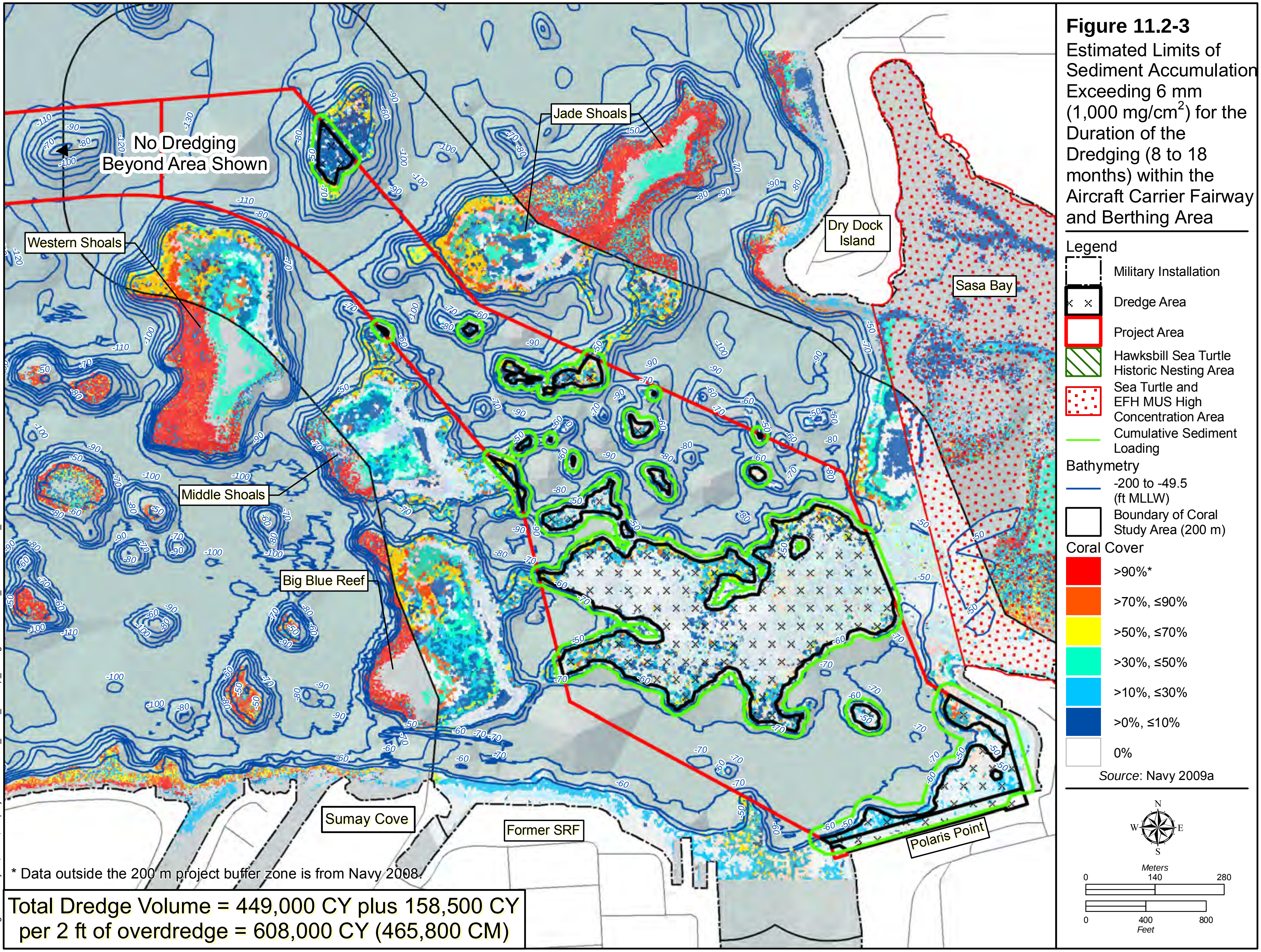
- Analysis of possible total sediment accumulation during the project indicates that accumulations of greater than 0.03oz/0.15in^2 (1,000 mg/cm^2), or 0.2 in (5 mm) (and adverse impact to EFH)), would be confined to within 75.5 ft (23 m) of the dredge limits at Polaris Point, and to within 32.8 ft (10 m) of the dredge limits in the rest of the project area.
- Surface TSS plumes exceeding background levels of 0.0004 ounces/gallon (3 mg/L) are generally predicted to occur only directly at the dredge site. Plumes near the bottom would be more extensive because most of the suspended sediment would be released into the bottom layer, and it also receives all of the TSS contained by the silt curtain. Plume concentrations exceeding the background levels of 0.0004 ounces/gallon (3 mg/L) would typically extend 262.5 to 394 ft (80 to 120 m) from the dredge site. The plumes would dissipate rapidly following completion of the dredging.
- The maximum environmental adverse impact scenarios were simulated by increasing the sediment release rate from 1% to 2%, and decreasing silt curtain effectiveness by a factor of four. This approximates the highest 10% TSS measurements recorded outside the silt curtain during recent dredging at Alpha-Bravo Wharves. During these conditions, maximum sediment deposition at the dredge site would be 0.09 oz/0.15 in^2 (2,690 mg/cm^2), or 0.6 in (15 mm), and deposition greater than 0.001 oz/0.15 in^2 (40 mg/cm^2), or 0.008 in (0.2 mm), would occur to a distance of 262.5 ft (80 m) from the dredge site.

Surface and bottom TSS concentrations exceeding typical background levels of 0.0001oz/0.2 gallons (3 mg/L) would extend 262.5 to 328 ft (80 to 100 m) from the dredge site, respectively. This numerical analysis was designed to approximate, to the extent practical, the dredging that may occur during the aircraft carrier project. The circulation model was verified with actual current data recorded in the project area. The sediment grain size was derived from numerous bottom samples collected in the area.

Cumulative Sediment Deposition Model. Possible cumulative sedimentation during the project was assessed by extrapolating in time and space the daily results, assuming a 24-hr dredging operation and dredging production of 1,800 cy (1,376 m^3) per day (SEI 2009 Model Cases 6.1 to 6.7). Throughout almost the entire dredge area, only 1.6 to 3.3 ft (0.5 to 1 m) of sediment would be removed. The exception is at the proposed Polaris Point Wharf area where the embankment would be dredged. Dredging operations at the rate identified above would proceed through two 75.5 by 75.5 ft (23 by 23 m) grids per day throughout all of the project area except the Polaris Point Wharf area. Such rapid passage of the dredging operation means that prolonged exposure to plumes and significant accumulation of sediment would not occur in most of the project area. In the area adjacent to Polaris Point, it is estimated that two to three days of dredging would be required for each 75.5 by 75.5 ft (23 by 23 m) grid, compared to a half of a day in the remainder of the project area.

Application of these dredging rates per model grid cell to the daily computed sediment loads provides an estimate of cumulative sedimentation. Sedimentation of 0.03 oz/0.15 in^2 (1,000 mg/cm$^{2)}$, or 0.9 in (23 mm), was selected as a reasonable threshold of sediment accumulation over the duration of the dredging project (8 to 18 months). This thickness corresponds to less than 0.25 in (6.4 mm) for the duration of dredging, or less than an average of 0.04 in (1 mm) accumulation per month. Accumulation of sediment greater than 0.25 in (6.4 mm) thick for the duration of dredging activities would occur only within a distance of 39.4 ft (12 m) from the dredge limit in most of the project area, and within 75.5 ft (23 m) of the dredge limit adjacent to Polaris Point. Figure 11.2-3 illustrates the additional area (outlined in green) that may be impacted by this accumulated sediment.



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Plume Modeling Summary. The plume modeling results suggest that cumulative sediment deposition during project construction totaling at least 0.03 oz/0.15 in^2 (1,000 $mg/cm^{2)}$ (approximately 6 mm based on site-specific sediment characteristics) would accumulate up to 39 ft (12 m) beyond the area subject to direct impacts. Additionally, some larger-grained sediments generated by the dredging activity above have the potential to accumulate in depressions on plate forms of coral, causing negative impacts. This would be the maximum adverse effects on coral scenario under EFH.

While these estimates of potential indirect impacts represent relatively small percentages of the total area of coral reef habitat, they are likely overestimates for several reasons:

1. The deposition rate of >0.008 in (0.2 mm)/day may be within the coral's physiological tolerance limit for sediment accumulation (e.g., Hubbard and Pocock 1972).
2. Sediment can be resuspended and removed from coral surfaces by physical processes such as wave and current action that occur within reef habitats. Currents in the project area are known to be weak, with surface currents during trade wind conditions typically 4 to 8 cm/second while bottom layer currents were typically 0.06 to 0.13 ft/second (2 to 4 cm/second) (SEI 2009). Brown et al. (1990) suggest that relatively slow current speeds <0.09 ft/second (<3 cm/second) are often sufficient to remove the small aggregates from the tops and flanks of mound-shaped and branching corals. Modeling indicates that following the cessation of dredging, TSS in the water column would return to background levels within several hours SEI (2009). With TSS returning to background levels, sediment deposition to the reef surface would also
3. return to background levels within a very short time. Such a scenario could result in regular periods where corals can utilize a physiological cleaning mechanism to shed deposited sediment MRC 2009c).
4. The slope of the reef faces for the majority of the proposed dredged footprint is steep. Most of the dredge area consists of the flattened tops of previously dredged pinnacles and patch reefs. These features all have steeply sloping margins that extend to the sandy harbor floor. While these reef slopes are among the areas of highest coral cover, indirect impacts from suspended sediment would be mitigated by down gradient flow with little accumulation on the steep reef face (MRC 2009c). It is possible that negative impacts to species with plate forms, such as *P.rus*, could occur.

It is evident from the SEI (2009) modeling results that a large portion of the deposition plume contour would occur in habitats other than the coral reef slopes. A large percentage of the sediment plume contour would cover the coral platform within the dredge envelope, as well as the areas of the harbor floor that are not covered with coral. These areas without coral are characterized by substantial cover of "unconsolidated sediment" that is primarily sand and rubble. The composition of the sand and rubble in these habitats is reef material and is qualitatively similar to the sediment that would be generated by the dredging activity. Hence, while the deposition rate of suspended material may increase temporarily during the period of dredging, it is not likely that this would represent any qualitative change to the sand-covered habitats. Organisms that inhabit these habitats are either infaunal (living within the seafloor) or epifaunal (living on the surface of the seafloor), and the potential additional deposition of sediment associated with dredging would not represent a change in the integrity of this habitat. Any impact to infaunal or epifaunal organisms would be short-term and localized, as discussed previously in this Chapter (MRC 2009c).

Coral Dislodgement. An additional secondary or indirect effect at the dredge area boundaries is dislodgment of coral colonies by dredging operations without the collection of these colonies within the dredge bucket. These uncollected colonies may subsequently tumble down the sloping sides of the patch reefs and pinnacles. While such tumbling downslope is likely to result in some damage to other corals, possibly creating more fragments, there is also the possibility that not all the fragments would die. In fact, fragmentation as a mode of asexual reproduction in coral has been documented in the scientific literature. Highsmith (1982) states that fragmentation and subsequent cascading caused primarily by storm wave energy is "the predominant mode of reproduction in certain corals and an important mode in others." This review also points out that the ecological and geomorphological consequences of fragmentation can be "beneficial" in terms of expanding reef area to sand bottoms that cannot be colonized by larvae, and decreasing reef recovery time from disturbances over strictly sexual reproductive recovery. Highsmith (1980) found that the net effect of frequent storms on Caribbean reefs may be to maintain the reefs in the highest range of reef calcification through high survivorship of coral fragments.

Downward movement of coral fragments following hurricanes and tropical storms has been well-documented in French Polynesia (Harmelin-Vivien and Laboute 1986) and in Hawaii (Dollar 1982 and Dollar and Tribble 1993). In Hawaii, downslope movement of living coral fragments broken by intermediate intensity storm action appears to widen the narrow reef slope zone area, thereby increasing overall coral cover and adding suitable substratum for planular (flat, free-swimming, ciliated larva of coral) settlement and growth in areas that were previously sand. Other high intensity events in the same area of a magnitude that turned virtually all broken fragments into non-living coral rubble did not have the same effect of extending the horizontal margin of the reef (Dollar and Tribble 1993). Stimson (1978) has suggested that for branching corals in Hawaii and Eniwetok that apparently do not planulate, asexual reproduction by means of colony fragments may be the normal mode of reproduction. In Guam, Birkeland (1997) reported most colonies of staghorn coral (*A. aspera*) were derived from fragments, with 79% of colonies living unattached and the remainder, though attached, apparently originating from fragments. Fragmentation, combined with regeneration and fast growth rates, account for dominance of *A. aspera* and *A. acuminata* on inner reef flats on Guam (Highsmith 1982).

On a dredged coral knoll at Diego Garcia Lagoon, Sheppard (1980) found many fragments and detached corals had survived, and subsequent to the dredging many of these living fragments were found to have reattached, contributing significantly to consolidation of the dredge-produced talus. Lirman and Manzello (2009) found that the survivorship and propagation of *Acropora palmata (A. palmata)* was tied to its capability to recover after fragmentation. Survivorship was not directly related to size of fragments, but by the type of substratum, with the greatest mortality observed on sand. Fragments placed on top of live colonies fused to the underlying tissue and did not experience any loss. *A. palmata* is a Caribbean coral, which is typically found in high-wave-energy, generally shallow fore-reef type environments.

Due to the low-wave-energy environment at the base of the dredged area, it is not likely that unattached coral fragments would be moved to the extent of damaging other neighboring corals.

Coral Impacts Significance Discussion. As described in the beginning of the chapter, an adverse effect is: 1) more than minimal, 2) not temporary, 3) causes significant changes in ecological function, and 4) does not allow the environment to recover without measureable impact. These criteria are used in the following text to determine the degree of impacts to coral.

Anticipated indirect effects from the dredging associated with the proposed aircraft carrier project are not expected to exceed the "normal" conditions observed over several days in the Inner Apra Harbor Entrance Channel (MRC 2009c). There are distinct water quality differences (i.e., turbidity zones) in Apra Harbor. While turbid conditions in the Inner Apra Harbor Entrance Channel were not as poor as in the Inner Apra Harbor Basin, field observations during surveys indicated substantially higher turbidity in the Inner Apra

Harbor Entrance Channel than in the proposed aircraft carrier turning basin dredge area. It was also observed that ships transiting through the Inner Apra Harbor Entrance Channel created plumes of resuspended sediment that reached the surface directly over the area occupied by "dense coral communities" within the Inner Apra Harbor Entrance Channel (Smith 2007; MRC 2005; MRC 2009a; Dollar et al. 2009). Hence, the continued existence of these communities supports the expectation that minimal indirect impacts would occur as a result of the proposed dredging. A major difference, however, is that the effects associated with the Inner Apra Harbor Entrance Channel communities are essentially continuous due to turbid discharges from the Apalacha and Atantano rivers into the southeastern portion of Inner Apra Harbor, while the proposed dredging associated with the aircraft carrier at any particular location would occur for only a matter of days (MRC 2009c; SEI 2009) (see Volume 9, Appendix E, Section E).

Based on previous fieldwork and studies, the primary limiting factor for coral recruitment and development in Apra Harbor is believed to be substrate rather than the suspended sediment levels (MRC 2007b personal communication in COMNAV Marianas 2007b). Where adult coral colonies presently exist, either recruitment of coral planulae (sexual reproduction and subsequent successful settlement and growth) or some mode of asexual reproduction (i.e., fragmentation) has resulted in the establishment of living coral communities. Results of reconnaissance surveys that have been conducted throughout the entirety of Inner and Outer Apra Harbor for the purpose of characterizing the distribution, abundance, and condition of reef corals indicate that at present, nearly all areas with suitable substratum in the form of hard bottom that is not subjected to sediment stress (either in the form of bottom cover or abrasion), are colonized by corals and associated reef organisms (MRC 2007b personal communication in COMNAV Marianas 2007b). In other words, corals are well developed in virtually all portions of Apra Harbor that contain suitable substrate (hard stable surfaces). In contrast, areas that do not presently contain coral communities are characterized by unsuitable substratum, primarily in the form of permanent sediment cover of the bottom. Areas that lack hard stable surfaces, such as sand, mud, and algae covered sea floor areas, do not support substantial coral growth. Many portions of the harbor are routinely subjected to moderate to high levels of TSS. Some areas, such as Dry Dock Island, have both suitable substrate and high TSS levels, and have well developed coral reefs. Other areas with lower levels of TSS that lack hard stable surfaces do not support coral growth. These areas are not expected to experience adverse effects on coral recruitment from the increased sedimentation during dredging because sedimentation does not appear to be the limiting factor for coral recruitment and growth in Apra Harbor (Smith 2007b personnel communication in COMNAV Marianas 2007b).

Notwithstanding the above description of coral growth in Apra harbor, there would be a significant and permanent direct impact to the Coral Reef Ecosystem Management Unit Species (CREMUS), specifically hard corals, through direct removal that would adversely affect EFH. The removal of the hard coral benthic community may adversely affect some high fidelity species that were dependent upon that habitat for refuge and forage. The area of potential effects comprises a relatively small fraction (approximately 1%) of the total live reef area mapped in Apra Harbor (Dollar Hochberg 2010). Long-term, localized impacts to coral and coral reef ecosystem would not result in a significant change to the existing EFH conditions in Apra Harbor and would also not likely result in decreased reproductive potential (i.e., coral spawning) of the Apra Harbor reef community as a whole with the required implementation of USACE Section 10/404 permit requirements (i.e. stopping in-water work during coral spawning periods).

Based on the most environmentally adverse scenario model run, none of the projected contours of sediment deposition extend to the large patch reefs characterized as benthic communities with high coral coverage (i.e., Big Blue Reef, Jade Shoals, and Western Shoals). Additionally, the coral community in the potentially affected area is not comprised of unique species; almost two thirds (63%) of the area to be dredged contains coral coverage of less than 30%, the project area is previously disturbed, having been dredged in 1945, and although not "unhealthy," the coral in the project area is sediment-laden and not as healthy as coral at the shoal area further away from the channel (Dollar 2009).

Analysis of possible total sediment accumulation during the project (HEA Volume 9, Section E) indicated that accumulations of greater than 0.03 oz/0.15 in^2 (1,000 $mg/cm^{2)}$, or 0.25 in (6.4 mm), were confined to within 75 ft (23 m) of the dredge limits at Polaris Point, and to within 40 ft (12 m) of the dredge limits in the remainder of the project area. The modeling indicated that sedimentation exceeding 0.001oz/0.15 in^2 (40 mg/cm^2) or 0.008 inch (0.2 mm) extended an average distance of 144 ft (44 m) from the dredging.

For an assessment of the maximum extent of indirect impacts it is assumed that the area of varied sediment deposition would extend an average distance of 144 ft (44 m) from the dredging as modeled, based on sedimentation exceeding 0.001oz/0.15 in^2 (40 mg/cm^2) or 0.008 inch (0.2 mm). The 656 ft (200 m) wide "buffer area" surrounding the direct impact dredge area is considered the coral study area boundary. The area of coral within the coral study area that is shallower than 60 ft (18 m) is assumed to receive temporary adverse indirect impacts from increased dredging-related sediment deposition. Compared to the modeled sediment dispersion contours of 40 ft. (12 m) described above, the size of the coral study area potentially receiving indirect impacts is approximately 16 times larger than the modeled adverse indirect impact area assumed to be permanent.

Therefore, Alternative 1 may have an initial temporary adverse effect on EFH within the coral study area boundary 656 ft (200 m) and a permanent adverse effect on EFH directly located in the dredge footprint based on estimated modeling. Compensatory mitigation would compensate for a 25% and 100% loss in ecological services, respectively, based on the HEA [Navy 2009a]). The temporary adverse indirect impacts would be considered short-term and localized, as recovery would be expected within five years. This is based on references provided in Section 11.1.2.2, Sediment Affects on Coral, Specifically Brown et. al. (2009), and detailed in Navy 2009a. A compensatory mitigation plan that offsets unavoidable losses to aquatic resources, including but not limited to coral reef resources, will be finalized prior to issuance of a Department of Army (DA) permit.

Potential Impacts to Finfish Including EFH. As identified in Table 11.2-1, there would be direct and indirect impacts from the proposed project. In regards to impacts to EFH and reef fish MUS designated under existing FEPs, in-water construction activities would result in direct impacts from dredging removal or fill activities, noise (from dredging and impact pile driving from wharf construction), and indirect impacts from degradation of water quality and sedimentation of habitat.

The removal of coral and coral reef habitat would reduce the structural complexity of Apra Harbor's reef system, resulting in fewer places of refuge for fish from predation. Predicting the impact on the fish communities at these sites is difficult and highly dependent on the impacts to the benthic habitat and availability of adjacent habitat. Sites in close proximity to the dredged footprint would likely suffer more than others. Although the effect on highly mobile species could be variable, it is expected to be negligible. Finfish species occupying habitats that would be permanently removed (coral-, macroalgae-, rubble-, or sand-dominated) would either be displaced to other adjacent sites and adapt, or perish due to habitat modification and loss. Site-attached species such as those from the families Pomacentridae and Chaetodontidae may be adversely affected by changes in habitat structure. Pomacentrids are commonly used to measure community change across sites because of their high abundance, small home ranges, and site specificity. It is anticipated that most displaced finfish species would recolonize other adjacent sites if available. Some finfish would be directly impacted through habitat removal. Other finfish species would be temporarily displaced (e.g., habitats disturbed but remain intact after dredging), possibly returning to those habitats, or repopulating other habitat areas, assuming vacant habitats are available.

Direct impacts from Alternative 1 dredging activities would have an adverse affect on EFH and FEP MUS due to the permanent removal of coral reef ecosystem habitat. Direct removal of other benthic habitat (0% coral with macroalgae, rubble, sand = 45.98 ac [18.61 ha]) would result in no adverse effect by itself, however when considered cumulatively with other habitat removal, leads to a may adversely affect EFH determination. A temporary adverse effect to EFH is expected during the time dredging and in-water construction activities are occurring because the motile MUS would avoid the area due to noise and sedimentation, but may return once these activities were completed. A 25% initial loss was assumed based on these temporary impacts, which is consistent with the estimate that cumulative sediment caused by dredging would be low (i.e. < 0.40 in [< 1 cm]), and the relatively low sensitivity of dominant corals in the affected area (i.e., *P.rus* and *P.cylindrica*) to such levels of sedimentation. A permanent, indirect adverse effect to EFH is expected within the estimated 40 ft (12 m) limits, as identified in Figure 11.2-3. Implementation and enforcement of USACE permit required BMPs and mitigation measures would reduce the direct and indirect effects of dredging and in-water construction activities on EFH.

Noise is another potential source of negative impacts associated with in-water construction activities. Noise disturbances would likely cause fish to disperse and leave the area. Noise from dredging activities (87.3 dB at 50 ft [15 m]) and pile driving (average 165 dB at 30 ft [9 m]) would be below levels determined by NMFS to harm fish hearing (> 180 dB). Sound levels would decline to ambient levels (120 dB) within approximately 150 ft (45.7 m) from in-water construction activities (NMFS 2008b). See Chapter 4 for more information on noise levels. Results of a recent study on three diverse species of fish determined that the 180 dB threshold level identified by NMFS was found to be very conservative, as harm to fish only occurred at markedly higher sound exposure levels (Popper et al. 2006). "Short-term behavioral and/or physiological responses to finfish (e.g., swimming away and increased heart rate) would result for all in-water work, however, such responses would not be expected to compromise the general health or condition of individual fish" (COMNAV Marianas 2007b). Therefore, due to the mobility of finfish and the short-term and localized nature of the disturbance, impacts would be temporary and minimal.

Construction vessel transport would increase during dredging activities. It is estimated that a tug and scow would make 1 round trip/day for 8 to 18 months for dredged material disposal. Wharf construction is anticipated to take three and a half years with some periodic vessel transport expected. (See Volume 2, Chapter 14, Marine Transportation for a detailed description.) The vessels would use the existing Outer Apra Harbor navigational channel to access the ocean dredge disposal site and return to Inner Apra Harbor. The noise associated with in-water construction activities and vessel movements would result in short-term and localized disturbances to organisms living in or on the shallow portions of the benthic substrate.

The EFH for planktonic eggs and larvae of all species as identified for Coral Reef, Bottomfish, Pelagic Fish, and Crustacean MUSs may be impacted by Alternative 1 actions. These life stages typically are weak swimming forms carried about by local currents (COMNAV Marianas 2007b). Based on wind and current measurements (SEI 2009), which show counter surface- and sub-surface currents, planktonic larvae of many species most likely never leave the confines of the harbor. "Some recruitment to Apra Harbor may occur from eggs and larvae being carried into the harbor by local currents, as well as by active recruitment (swimming into and settling in the area) by juveniles. The relative contributions from each of these sources of larvae are unknown, although recruits from outside Apra Harbor must pass through the relatively narrow entrance channel (relative to the volume of Apra Harbor)" (COMNAV Marianas 2007b). Therefore, the probability of their occurrence in the vicinity of the Alternative 1 action area is small. However, the eggs and larvae of these MUS in the water column of the project area would experience short-term and localized impacts. Based on the small coverage areas, these impacts would be temporary or minimal , and therefore, there would be no adverse effect on EFH for planktonic eggs and larvae.

Table 11.2-2 shows the EFH areas within Apra Harbor and their potential construction-related impacts.

Table 11.2-2. EFH Areas Associated with Apra Harbor and Potential Construction-related Impacts with Implementation of Alternative 1

Habitat	*Area of Occurrence*	*Associated Activity*	*Impact*
Live/Hard Bottom	Outer Apra Harbor	Dredging of aircraft carrier channel, turning basin, and berth. Backfill and pile driving for wharf construction Increased vessel movements	• May adversely affect EFH through direct, permanent and localized removal. Due to the large area and intensity of the impact, and cumulative impacts associated with dredging of a variety of habitats (refer to Section 11.2.1.2), there would be "more than minimal" significant effects on live/hard bottom habitat. • No adverse effect from indirect short-term and localized vessel movements.
Soft Bottom	Apra Harbor	Dredging of aircraft carrier channel, turning basin, and berth. Backfill and pile driving for wharf construction and increased vessel movements	• No adverse effect. Direct removal and indirect, periodic and localized resuspension of sediment. Benthic infaunal community is expected to reestablish quickly from adjacent, undisturbed areas.
Corals/Coral Reef Ecosystem	Outer Apra Harbor Shoal Areas, Entrance Channel	Dredging of aircraft carrier channel, turning basin, and berth. Backfill and pile driving for wharf construction	• May adversely affect EFH through direct, permanent and localized removal. • May adversely affect EFH through indirect, short-term and localized increase in underwater noise and localized resuspension of sediments out to 39 ft. (12 m) from dredged area (> 0.2 in. [5 mm] cumulative sedimentation). • No adverse effect on sessile (non-coral) invertebrate benthic community as they are expected to recolonize from adjacent, undisturbed areas • No adverse effect from indirect short-term and localized resuspension of sediments out to 144 ft. (44 m) from dredged area (approximately. 008 in. [0.2 mm] cumulative sedimentation),

Table 11.2-2. EFH Areas Associated with Apra Harbor and Potential Construction-related Impacts with Implementation of Alternative 1

Habitat	*Area of Occurrence*	*Associated Activity*	*Impact*
		Increased vessel movements	increase of noise and potential pollutants • No adverse effect on EFH from increased short term and localized vessel movements.
Water Column	Apra Harbor	Dredging of aircraft carrier channel, turning basin, and berth. Backfill and pile driving for wharf construction and other in-water construction activities. Increased vessel movements	• No adverse effect on EFH from direct and indirect, temporary and localized elevation of turbidity, noise, and potential pollutants with implementation of required USACE permits and BMPs • No adverse effect on EFH from direct and indirect short-term, localized resuspension of sediments, increase of noise and potential pollutants from an increase in vessel movements with implementation of USACE permits and BMPs.
Estuarine Emergent Vegetation	Apra Harbor, Sasa Bay	Dredging of aircraft carrier channel, turning basin, and berth. Backfill and pile driving for wharf construction. Increased vessel movements	• No effects • No adverse effect on EFH from short-term and localized increase of noise, resuspension of sediment, and potential increase of pollutants.
Submerged Aquatic Vegetation (SAV)	Apra Harbor, Sasa Bay	Dredging of aircraft carrier channel, turning basin, and berth. Increased vessel movements	• No adverse affect to EFH from direct, short-term and localized removal of approximately 10 acres of algae bed habitat. Although a large area will be removed, and the intensity of the impact, and cumulative impacts associated with dredging of a variety of habitats (refer to Section 11.2.1.2) points toward a "more than minimal" significant effects on SAV habitat, effects are temporary. • No adverse effect on EFH from indirect short-term and localized in-water work and vessel movement.
Estuarine Water Column	Sasa Bay	Dredging of aircraft carrier channel, turning basin, and berth. Backfill and pile driving for wharf construction Increased vessel movements	• No adverse effect on EFH from direct and indirect temporary and localized elevation of turbidity, noise, and potential pollutants • No adverse effect on EFH from direct and indirect short-term, localized resuspension of sediments, increase of noise and

Table 11.2-2. EFH Areas Associated with Apra Harbor and Potential Construction-related Impacts with Implementation of Alternative 1

Habitat	*Area of Occurrence*	*Associated Activity*	*Impact*
			potential pollutants

Table 11.2-3 shows the sensitive months for EFH MUS found in Apra Harbor, while Figure 11.2-4 identifies all sensitive marine biological resources and habitats in Apra Harbor. The seasonal pupping of scalloped hammerhead sharks (NOAA 2005b, BSP 2010), although reported to be extremely rare in the project area (DoN 2010), and seasonal high concentrations of adult bigeye scad, may also be temporarily disturbed by increased vessel traffic and in-water construction activities. EFH for these PHCRT species would not likely be adversely affected with appropriate NMFS-recommended BMPs and conservation measures; the probability of collisions between vessels and adult and juvenile fish, which could result in injury, would be extremely low due to this highly mobile life stage and slow moving vessels within the navigational channel and shipping lanes in the project area (Navy 2009a).

Table 11.2-3. Sensitive Months for EFH MUS within Apra Harbor

Species	*Status*	*Location*	*Months*
Adult bigeye scad	EFH-CHCRT	See Figure 11.2-4	Jun – Dec
Scalloped hammerhead	EFH-PHCRT	Aircraft carrier turning basin - see Figure 11.2-4	Pupping (Jan – Mar)
Juvenile fish*	EFH	Sasa Bay and other nearshore areas	Nursery (Jan – Dec)
Hard corals	EFH-PHCRT	Apra Harbor	Full Moon Spawning (Jul-Aug)

Note: *Includes barracudas, emperors, goatfishes, groupers, mullets, parrotfishes, puffers, snappers, surgeonfishes, wrasses, and small-toothed whiptails. Sources: NOAA 2005b; BSP 2010; WPRFMC 2009a

EFH Assessment Summary. Alternative 1 dredging impacts to EFH would be greatest for all life stages of coral and sessile reef species, and some crustacean MUS. Site-attached reef fish and pelagic egg/larval stages of bottomfish and pelagic MUS may also be affected. Coral reef habitat would be permanently lost and would be compensated for through mitigation. Dredging activities would cause turbidity plumes and underwater noise that would temporarily disturb FEP MUS. These indirect impacts to EFH would include adverse effects from degradation of water quality as a result of suspended solids, reduction of light penetration and interference with filter-feeding benthic organisms. However, the increase in turbidity would be short-term and localized.

The proposed construction of the aircraft carrier wharf would change the bottom habitat of Polaris Point. However, considering that the area has been previously dredged and that dynamic physical conditions dominate the area, it is expected that pre-construction conditions would return relatively quickly. An exception to this would be the area changed by the presence of back fill and pilings, which would add benthic habitat suitable for colonization by sessile organisms. Impact pile driving would have effects similar to those of dredging activities, including noise and degradation of water quality, but these effects would be of shorter duration and more localized. The noise generated would be somewhat higher than that of dredging.

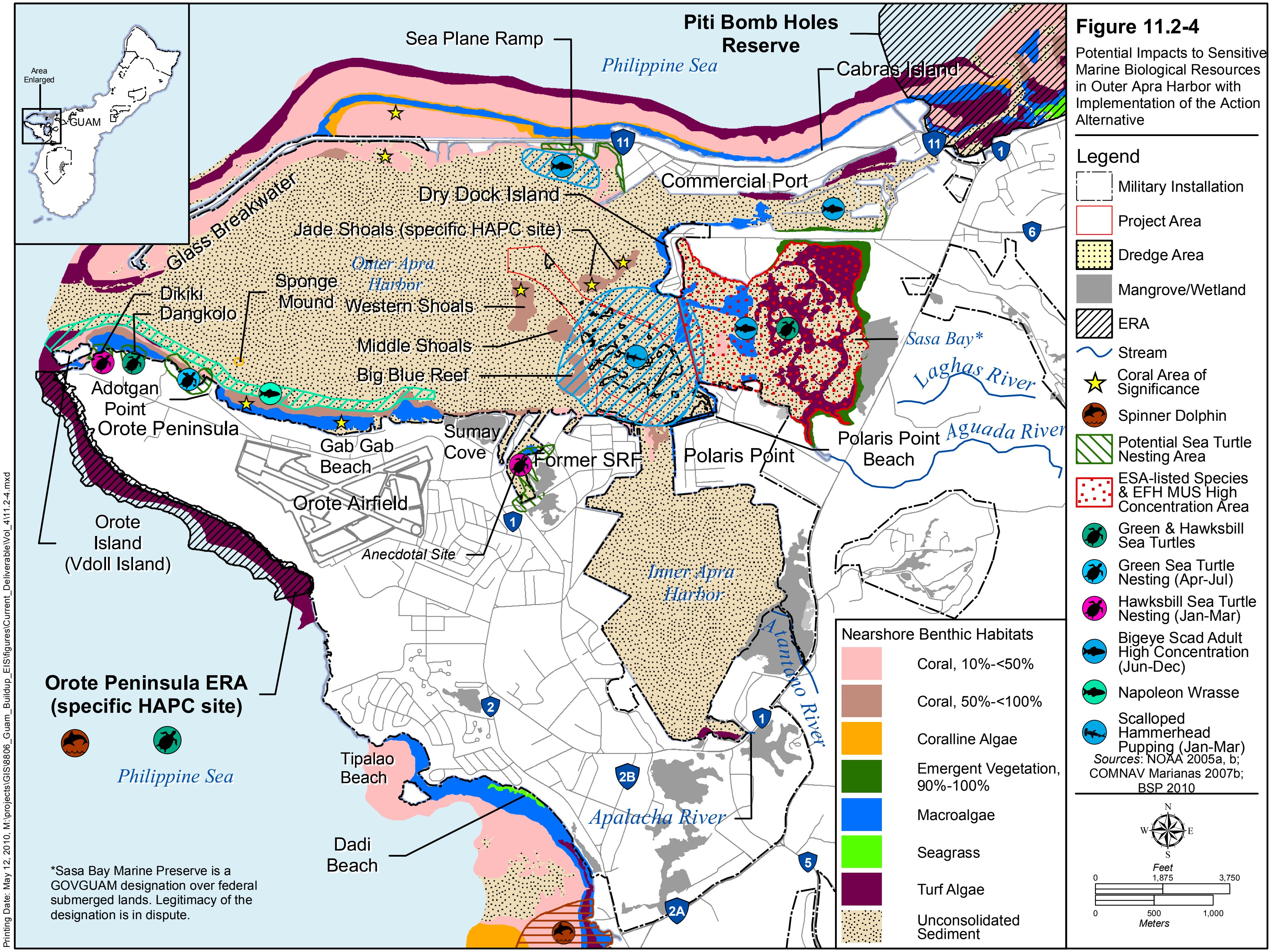

Figure 11.2-4
Potential Impacts to Sensitive Marine Biological Resources in Outer Apra Harbor with Implementation of the Action Alternative

The placement of the aircraft carrier wharf and associated piles would introduce an artificial hard surface that opportunistic benthic species could colonize, as evidenced by inner harbor studies (Paulay et al. 2002) (see also Volume 2, Chapter 11). Minor changes in species compositions associated with soft bottom communities could also occur (Hiscock et al. 2002). Fish and invertebrates would likely be attracted to the newly formed habitat complex, and the abundance of seafloor organisms in the immediate vicinity of the pilings likely would be higher than in surrounding areas away from the structures (see Volume 2, Chapter 11).

Due to the close proximity to Sasa Bay, juvenile fish might recruit from that area and establish themselves. The overall change in the habitat could result in some beneficial changes in local community assemblages that would partially offset potential short-term, localized negative impacts after the aircraft carrier wharf construction is complete and hard surfaces are populated.

The EFH Assessment (EFHA) prepared for Alternative 1 construction-related actions concluded that the action could result in the following:

- Permanent, localized destruction to 25.20 ac (10.20 ha) of live coral and coral reef habitat (all coverage >0% to ≤ 90%) resulting in a direct adverse effect on EFH.
- Long-term and localized adverse impacts to live/hard bottom due to the intensity and cumulative impacts of the project resulting in an initial direct adverse effect on associated EFH.
- Short-term and localized adverse impacts to SAV due to the intensity and cumulative impacts of the project resulting in an initial direct adverse effect on associated EFH.
- Long-term and localized indirect impact to coral reef ecosystem and displacement of species (could take years to recover) from excessive accumulation of sediment, resulting in an adverse effect on EFH.
- Permanent loss to some displaced, site-attached finfish species, resulting in an adverse effect on EFH.
- Short-term and localized temporary adverse effect on EFH from displacement of mobile FEP MUS (fish and some invertebrates) during in-water construction activities.
- Short-term and localized degradation to water quality (i.e., increases of siltation and turbidity), resulting in a temporary adverse effect to EFH.
- Short-term and localized minor indirect impacts to live coral and coral reef habitat (46.24 ac [18.71 ha]) from increased siltation (below 6 mm accumulation levels) and noise, resulting in no adverse effect on EFH.
- Short-term and localized significant impacts to FEP MUS in planktonic eggs and larvae stages of development, however based on small coverage areas temporary and minimal, resulting in no adverse effect on EFH.
- Short-term and localized minor disturbances to coral reef ecosystems from increased vessel movements, resulting in no adverse effect on EFH.
- Short-term seasonal disturbances to potentially pupping scalloped hammerhead sharks and high concentrations of adult bigeye scad. Considering the rarity of this action (pupping), the mobility of this species and preference for in-water structures for pupping (see earlier references), there would be no adverse effect on these EFH MUS.
- Aircraft carrier wharf structure would most likely result in an increase of community assemblages partially offsetting the short-term, localized adverse effects on EFH.

- Total coral coverage impacted (direct and indirect) is 71.44 ac (28.91 ha).

Based on this assessment, Alternative 1 may adversely affect EFH in Outer Apra Harbor. Some of these impacts would be offset (e.g. some indirect effects) or reduced through implementation and management of USACE permit required BMPs and mitigation measures. Unavoidable loss of ecological function will be offset with appropriate compensatory mitigation measures.

Special-Status Species

Green and hawksbill sea turtles and spinner dolphins are the only special-status species reported in Apra Harbor. The green sea turtle is sighted on a regular basis, while hawksbills are less common, and spinner dolphins are rare. Based on the rarity of their presence within Apra Harbor, no serious injury or mortality of any marine mammal species (spinner dolphins) is reasonably foreseeable. No adverse effects on the annual rates of recruitment or survival of any of the species and stocks are expected with the implementation of Alternative 1. Table 11.2-4 shows the sensitive months for sea turtles within Apra Harbor, while Figure 11.2-4 identifies all sensitive marine biological resources and habitats in Apra Harbor.

Table 11.2-4. Sensitive Months for Sea Turtles within Apra Harbor

Species	*Status*	*Location*	*Months*
Green sea turtle	ESA- Threatened	See Figure 11.2-4	Nesting (Jan – Mar) Foraging (Jan – Dec)
Hawksbill Sea Turtle	ESA-Endangered	See Figure 11.2-4	Nesting (Apr – Jul) Foraging (Jan – Dec)

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

As identified in the affected environment section, no sea turtle density information is available for Apra Harbor, however thousands of dive hours have been conducted by the Navy and it's contractors in the past seven years. Sea turtles have not been observed foraging or resting within the proposed project area; it has been observed to function as a transit area to and from Sasa Bay (Navy 2009c).

The available data on sea turtle hearing suggests auditory capabilities in the moderately low frequency range, and a relatively low sensitivity within the range they are capable of hearing (Bartol et al. 1999; Ketten and Bartol 2006). Green turtles are most sensitive to sounds between 200 and 700 Hz, with peak sensitivity at 300 to 400 Hz (Ridgway et al. 1969). Sensitivity even within the optimal hearing range is apparently low—threshold detection levels in water are relatively high at 160 to 200 dB with a reference pressure of one dB re 1 µPa-m (Lenhardt 1994).

As described earlier, the ability of sea turtles to detect noise and slow moving vessels via auditory and/or visual cues would be expected based on knowledge of their sensory biology (Navy 2009a). Noise from dredging activities (87.3 dB at 50 ft [15 m]) and pile driving (average 165 dB at 30 ft [9 m]) would occur. Sound levels would decline to ambient levels (120 dB) within approximately 150 ft (45.7 m) from in-water construction activities (NMFS 2008b). (See Chapter 4 for more information on noise levels.)

Tech Environmental (2009) predicted underwater sound levels of pile driving perceived by sea turtles-all species (hearing threshold sound levels – dB_{ht} re 1 µPa) is 56 at 1640 ft (500 m), 60 at 1049 ft (320 m), and 80 at 98 ft (30 m). Research shows marine animals avoidance reactions occur for 50% of individuals at 90 dB_{ht} re 1 µPa, occur for 80% of the individuals at 98 dB_{ht} re 1 µPa, and occur for the single most sensitive individual at 70 dB_{ht} re 1 µPa. This threshold for significant behavioral response is consistent with NOAA/NMFS guidelines defining a zone of influence (i.e., annoyance, disturbance). For estimating the zone of injury for marine mammals, a sound pressure level of 130 dB_{ht} re 1 µPa (i.e., 130 dB above an animal's hearing threshold) is recommended (Nedwell and Howell 2004). Therefore the calculated zone of behavior response for significant avoidance reaction (i.e., distance where dB_{ht} = 90 dB re 1 μPa and avoidance reaction may occur) to pile driving for sea turtles-all species is <98 ft (<30 m) (Tech Environmental, Inc. 2006). In other words, no injury to any marine animals, including sea turtles, is predicted even if an individual were to approach as close as 98 ft (30 m) to pile driving because all dB_{ht} values at this minimum distance are well below specified thresholds.

To be protective of sea turtles, it is anticipated that NMFS-trained monitors would perform visual surveys prior to and during in-water construction work as part of the USACE permit conditions. If sea turtles are detected (within a designated auditory protective distance), in-water construction activities would be postponed until the animals voluntarily leave the area. In-water work can continue work fifteen minutes after the sea turtle submerges and is no longer seen. This practice is the same for turtle seen within or outside the silt curtains. These mitigation measures are currently being employed at Kilo Wharf, Apra Harbor and are described further in Volume 7.

Sea turtles are highly mobile and capable of leaving or avoiding an area during proposed dredging and in-water wharf construction (i.e., pile driving) activities. Sea turtles are expected to avoid areas of noise and disturbances. Dredging and pile driving activities would likely deter green sea turtles from closely approaching the work area. As a result, the likelihood that a green sea turtle would swim close enough to experience any effects is remote, especially with the silt curtain barriers and other BMPs and mitigation measures in place. Additionally, "during surveys conducted during active Kilo Wharf dredging and chiseling operations during the four periods of December 2008, March 2009, May 2009, and November 2009 in surveys covering waters up to the seaward edge of the silt curtain. All turtle sightings were green turtles; hawksbill turtles were not sighted. All turtles sighted were normal in both appearance and behavior (*e.g.*, swimming or resting), and gave no indication of being disturbed by the dredging or chiseling operations despite being in close proximity of 328 to 656 ft (100 to 200 m) to the operation. In particular, during the dives of 17-21 March 2009, the diver reported that although no SPL measurements were made, the sounds from chisel drop impacts onto the fossilized reef bed qualitatively were of *sufficient impulsive energy to make his body noticeably vibrate physically*, yet nearby observed turtles, including a female ~100m from the operation, were exhibiting normal resting and swimming behaviors" (Navy 2010).

Additionally, the Navy would comply with USACE permit conditions, which include resource agency recommended BMPs for sea turtle avoidance and minimization measures and protocols during in-water construction activities (dredging and pile driving) and vessel operations. These measures (including look outs, stop work policies when turtles approach the area, "ramping up" on pile driving activities, and others) are described in detail in the Mitigation Measures section, Volume 7, and are expected to considerably lessen any potential impacts to sea turtles in the area.

Potential impacts to sea turtles in the marine environment with implementation of Alternative 1 include short-term and isolated impacts through temporary disruption of normal behavioral patterns (swimming, resting or foraging behaviors at Sasa Bay and Big Blue Reef) during the estimated three and ½ year duration for all in-water construction activities. Potential impacts include the following:

- The total dredging duration is estimated at 8 to 18 months; however, work to widen and deepen portions of the existing channel near the bend would not be anticipated to affect sea turtles.
- Given the proposed action as currently defined, pile-driving and wharf construction would last approximately 6-18 months and may affect, and would be likely to adversely affect, sea turtles if they are present in the immediate vicinity.

- Increased vessel movement and in-water mitigation measures may impact sea turtle behavior. There would be a short-term and localized minimal increase in potential for vessel strikes of sea turtles due to the proposed in-water construction increase in ship traffic. The implementation of BMPs and mitigation measures would minimize these potential effects to sea turtles to less than significant. Alternative 1 may affect, but is not likely to adversely affect ESA-listed sea turtles through the short-term increase in ship traffic associated with in-water construction.

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

The Navy recognizes that there are many on-going and recent past studies of potential noise exposures to sea turtles and other marine species from pile driving actions. Further research and validation of these studies are necessary prior to being able to determine the applicability of the methodologies and results to the proposed action within this EIS. The Navy would continue to monitor these studies and where appropriate, incorporate and apply methodologies, analyses, and results to the on-going impact analysis to sea turtles from the proposed action. Applicability of these studies would also be coordinated through consultations with the National Marine Fisheries Service. Further information on in-water sound, as it relates to impacts on sea turtles, can be found in the Biological Assessment (Navy 2010) prepared for Section 7 consultation with NMFS.

In summary, it is anticipated that implementation of Alternative 1 may affect, but is not likely to adversely affect the ESA-listed green sea turtles with regards to dredging associated with forage habitat loss, nesting and physical injury. Given the proposed action as currently defined, the pile driving components of Alternative 1, although not likely to take sea turtles, due to limited visibility from elevated turbidity of waters in the action area, may potentially expose sea turtles to noise levels that exceed the NOAA's criterion for Level B Take. Therefore, activities associated with pile driving may affect, and are likely to adversely affect the green sea turtle and the hawksbill sea turtle.

Given the proposed action as currently defined and existing environmental information on sea turtle habitat in outer Apra Harbor, the data at this point in time tends to suggest that sea turtles may be adversely affected by the proposed in-water activities. However, because the Navy has elected to defer selection of a specific site within Apra Harbor, no definitive conclusion can be reached regarding the impact on marine biological resources. The Navy will voluntarily collect additional data and/or conduct additional analysis regarding marine resources within specific locations in Apra Harbor. When a proposal regarding the selection of a specific site is put forward, Section 7 consultation will be reinitiated.

Non-native Species

Although terrestrial introductions (exemplified by the brown tree snake) have received much attention, marine introductions had been minimally studied until five major marine biodiversity surveys were conducted on Guam between the mid-1990s and 2001. Although coverage was uneven both taxonomically and in terms of habitats surveyed, approximately 5,500 species were recorded in these surveys (Paulay et al. 2002). Most of the 85 non-native species were found to be restricted to Apra Harbor

(Paulay et al. 2002). Potential long-term impacts to the marine habitat within Apra Harbor from non-native marine organisms, pathogens, or pollutants taken up with ship ballast water (or attached to vessel hulls) are a real threat.

As discussed in Volume 2, Chapter 11, non-native species in Apra Harbor include both purposeful introductions for fisheries and aquaculture, and inadvertent introductions of species that arrived with seed stock or by hull and ballast transport with shipping traffic. These species are found to be more prevalent on artificial structures than natural reef bottoms (Paulay et al. 2002), thus some non-native species recruitment from the inner harbor area to the new aircraft carrier wharf pilings may be expected. Minor changes associated with softer sediments may also be expected to occur around pilings (Hiscock et al. 2002). There would be a need for additional requirements and hull inspection of vessels (e.g., dry docks, tugboats, barges, and dredging scows) before leaving/entering harbors after extended stays.

In addition, the Navy, in cooperation with USEPA, fully complies with the Uniform National Discharge Standards. National Discharge Standards regulate discharges incidental to normal vessel operation and apply out to 12 nautical miles (nm) (22.2 kilometers) from shore. All vessels are required to maintain a vessel-specific ballast water management plan. The Vessel Master is responsible for understanding and executing the management plan (COMNAV Marianas 2007b).

The DoN will adopt protective measures associated with offshore impacts of the proposed action to reduce the likelihood of the introduction and spread of non-native invasive marine species. These measures may include clarifying biosecurity requirements for all Navy vessels (including chartered Military Sealift Command [MSC] ships), improving hull husbandry documentation, and incorporating into contractual agreements with vessels chartered to support the military relocation specific criteria to ensure low levels of biofouling and ballast water management.

Less than significant impacts from construction-related actions associated with introduction of non-native species are anticipated from Alternative 1, if appropriate U.S. Coast Guard (USCG) and Navy ballast water and hull management policies are followed.

OPERATION

As described in Volumes 2 and 4, Chapter 2 and 14, the number of annual visits would increase by approximately four over current conditions with anticipated length of 21 days or less per visit. This would increase the in-port days for the Carrier Strike Group (CSG) from 16 to cumulative total of up to 63 days per year.

Marine Flora, Invertebrates and Associated EFH

Less than significant impacts would be expected to occur for marine flora, invertebrates and associated EFH. Increased vessel traffic may disturb organisms living in the upper water column or in or on the sediments due to propeller wash and resuspension of sediments as described under the construction section and Volume 2, Chapter 11 operation section. Increased impacts to marine flora and invertebrates would be proportionate to the extra transient trips into Apra Harbor and is considered minor over the no-action alternative. Therefore, Alternative 1 would result in less than significant impacts to marine flora, invertebrates and associated EFH, and would not adversely affect associated EFH.

Essential Fish Habitat

There would be long-term, minor and localized impacts associated with use of the aircraft carrier turning basin and wharf at Polaris Point. Although the depth will be increased, the tugboats may still disturb bottom sediments that could potentially be deposited on corals in and near the turning basin, including Big Blue Reef. However, analysis of grab samples collected within the turning basin area indicated that approximately 90% of the surficial sediments were very fine sand sized or coarser, and had a median grain size of approximately 0.0003 in (0.1 mm) (very fine to fine sand). Sediment cores from the same area classified the material as well-sorted sand consisting of 73% sand and gravel and 17% silt (NAVFAC Pacific 2006). These data suggest that most of the material on the seafloor in the deeper turning basin area that may be resuspended by tug-assisted aircraft carrier maneuvering would be sand-sized or greater, thereby minimizing the extent and duration of possible plumes that may result from vessel operation. Additionally, as described earlier, research findings suggest a fundamentally different outcome for corals exposed to sedimentation by sandy, nutrient-poor sediments, such as vessel resuspended marine carbonate sediments found in Apra Harbor, compared to sedimentation of silt-sized sediments rich in organic matter and nutrients.

The operational indirect impacts would be far less than those modeled for 10 to 24 hours of dredging (Volume 9, Appendix E, Section E of this EIS), as the deposition contours do not extend to Big Blue Reef. The use of the aircraft carrier wharf for other ships would result in fewer impacts than for the aircraft carrier because only two tugboats would be required. While the turning point would remain in the center of the turning basin, the ships would be much shorter and the tugboats would be further from Big Blue Reef.

Other ship traffic (including commercial vessels) would use the proposed aircraft carrier navigation channel, which would have the same centerline as the current channel, but would be wider. Other ships would navigate along the centerline and would not use the full width of the aircraft carrier channel. There would be a long-term localized increased potential, although negligible, for direct impacts to EFH and HAPC (Jade Shoals) from coral reef strikes due to an increase in harbor activities (e.g., aircraft carrier traffic, tugboats, ship berthing and unberthing). The aircraft carrier beam (most extreme width or breadth) at the water line is 134 ft (41 m). The narrowest passage within the aircraft carrier fairway is at Jade Shoals at approximately 551 ft (168 m), allowing for roughly a 210 ft (64 m) buffer on either side of the aircraft carrier at this point in the channel. This buffer zone, in addition to strict Navy ship operation protocols within the harbor, including navigating the centerline of the channel, would decrease the potential for direct impacts to Jade Shoals and other nearby areas. The indirect impacts of ship traffic within the proposed aircraft carrier channel on nearby coral shoals would be comparable to existing impacts for current ship traffic, which are minor and short-term.

Indirect disturbances of EFH for reef fish MUS may occur. The impacts would be similar to those described under the construction section above and in Volume 2, Apra Harbor construction and operation. However, the construction of the aircraft carrier wharf would likely provide refuge for finfish and invertebrates. A beneficial long-term impact to the recruitment of finfish and invertebrate MUS and the ecology of the immediate area would be expected with the added relief and settlement potential the aircraft carrier wharf vertical pilings and rip rap would provide. Short-term and periodic minor disturbances to these new recruits during aircraft carrier docking would be expected. Benthic invertebrates such as sponges, sea urchins, starfish, and mollusks, as well as finfish are poorly represented within Inner Apra Harbor, except for on vertical wharf structures (COMNAV Marianas 2006). Smith B.D. et. al., (2008) identified that man-made structures (i.e., wharves, vertical pilings) provided considerable habitat for a diverse array of fishes compared to the reef at Abo Cove or the harbor floor offshore from the wharves. Benthic species, such as cardinalfishes, damselfishes, and gobies, favored corals, debris, sand, soft corals, and the wharf wall and pilings. Species that were active swimmers, such as butterflyfishes, emperors, snappers, surgeonfishes, sweetlips, trevallys and jacks, etc., were found in the water column directly adjacent to the wharves.

Fish within the Apra Harbor channel and associated nearby shoals and nurseries (Sasa Bay) may be disturbed by increased aircraft carrier and MEU embarkation and commercial ship movement through underwater noise or physical disturbances and resuspension of sediments from proposed dredging or propeller wash. However, there may also be additional recruitment potential of juvenile finfish from Sasa Bay to the aircraft carrier wharf as an extended nursery area. While fish may exit the immediate area during vessel movement, it is not likely that there would be any permanent impacts to the present populations.

The deeper channel resulting from dredging activities could help reduce resuspension of fine sediment, decreasing turbidity during vessel operations in Apra Harbor, including carrier operations near the proposed wharf.

Operation impacts to EFH for sensitive MUS potentially present (i.e., Napoleon wrasse, bigeye scad, and scalloped hammerhead) would be short-term and localized, and therefore, there would be no adverse affects to EFH for these species. As described within the EFH construction section above, the impacts to EFH for planktonic eggs and larvae of all species present in the upper water column could be impacted by Alternative 1 actions. However, based on the small coverage areas, these impacts would be negligible, and therefore, no adverse effect on EFH for planktonic eggs and larvae is anticipated.

EFH Assessment. Alternative 1 operation activities, including an increase in vessel movements and operational pollutants could result in:

- Long-term, however, minor, periodic and localized disturbance and displacement of motile species (fish) during in-water transit activities
- Long-term, however, minor, periodic and localized increase of turbidity and pollutants (decreased water quality) in the water column from propeller wash and operation activities
- Long-term, however, minor, periodic and localized increase in benthic sedimentation
- Long-term, however, periodic and localized potentially significant impacts to eggs and larvae in the upper water column from increased vessel traffic
- Seasonal disturbances to potentially pupping scalloped hammerhead sharks and high concentrations of adult bigeye scad

Based on this assessment, all impacts would be minimal, and therefore there would be no adverse effect on EFH from operations. Therefore, Alternative 1 would result in less than significant impacts to Essential Fish Habitat with the implementation of Standard Navy operating procedures and BMPs to protect marine resources, as discussed in Volume 7. Measures would be implemented by vessels while underway within Apra Harbor. Table 11.2-5 summarizes the EFH present in the project area and potential effects with implementation of Alternative 1.

Special-Status Species Summary

The MMPA-protected species and fish species of concern are not expected to occur in the project area.

There would be a long-term, localized increase in the potential for vessel strikes of sea turtles due to the proposed increased ship traffic associated with Alternative 1. Increased vessel movements associated with the aircraft carrier and MEU embarkation operation and commercial shipping traffic have the potential for increased sea turtle disturbances and strikes in route to and from Sasa Bay (a high turtle concentration area) within Apra Harbor. However this increase (approximately 3 extra trips per year) is considered negligible in regards to impacts on the sea turtle population. Potential impacts would be as described in the construction section above and the operation section of Volume 2, Apra Harbor.

Table 11.2-5. EFH Areas Associated with Apra Harbor and Operational Impacts with Implementation of Alternative 1

Habitat	*Area of Occurrence*	*Associated Activity*	*Impact*
Live/Hard Bottom	Outer Apra Harbor	Increased vessel movements and harbor operation	No adverse effect on EFH from long-term periodic (operation) localized vessel movements.
Soft Bottom	Apra Harbor	Increased vessel movements and harbor operation	No adverse effect on EFH; increased vessel movements are not expected to disturb soft bottom communities.
Corals/Coral Reef Ecosystem	Outer Apra Harbor Shoal Areas, Entrance Channel	Increased vessel movements and harbor operation	No adverse effect on EFH from increased localized vessel movements and harbor operations.
Water Column	Apra Harbor	Increased vessel movements and harbor operation	No adverse effect on EFH from direct and indirect long-term but periodic, localized resuspension of sediments, increase of noise and potential pollutants from increased vessel movements and harbor operations. A beneficial impact may be seen to water quality (and associated marine biological resources) from the removal of fine benthic sediment and reduced turbidity within the Outer Apra Harbor Channel
Estuarine Emergent Vegetation	Apra Harbor, Sasa Bay	Increased vessel movements and harbor operation	No adverse effect on EFH from localized potential increase of pollutants from increased vessel movements and harbor operations.
Submerged Aquatic Vegetation	Apra Harbor, Sasa Bay	Increased vessel movements and harbor operation	No adverse effect on EFH from long-term (but periodic) and short-term localized in-water work, vessel movements, and harbor operations.
Estuarine Water Column	Sasa Bay	Increased vessel movements and harbor operation	No adverse effect on EFH from long-term (but periodic) and short-term localized in-water work, vessel movements, and harbor operations.

The long-term, periodic impacts associated with Alternative 1 actions may affect, but are not likely to adversely affect, ESA-listed sea turtles associated with in-water areas (excludes beaches). Therefore, Alternative 1 would result in less than significant impacts to special-status species. Impacts to nesting sea turtles on the beach are addressed in more detail in Volume 4, Chapter 10 (Terrestrial Biological Resources).

The implementation of NOAA/NMFS-recommended BMPs (Volume 7) would be anticipated to reduce any potential impacts of vessel interactions with sea turtles. These BMPs would be implemented while vessels are underway within Apra Harbor (including within the vicinity of Sasa Bay). Additionally, general maritime measures in place by the military, including lookouts trained to sight marine mammals or sea turtles, are in use and designed to avoid collisions with protected species.

Non-native Species

Impacts would be similar to those described under the construction section above. Less than significant operation-related impacts associated with introduction of non-native species would be anticipated from Alternative 1, when appropriate USCG and Navy ballast water and hull management policies are followed. The MBP would further reduce, and assist with control of and response to any potential non-native species introduction.

Avoidance and Minimization Measures

Implementation of Alternative 1 would result in potentially significant impacts to marine biological resources from proposed in-water and nearshore construction activities. Through project design, the Navy has taken significant steps to reduce these potential impacts to marine aquatic resources. Actions taken during the planning phase to avoid and minimize impacts included:

- Realignment of the initially proposed straight channel approach to use the existing commercial shipping channel and widening this channel to accommodate the aircraft carrier
- Minimizing the turning basin diameter to the minimum needed to safely maneuver the aircraft carrier to lessen direct impacts to coral communities
- Identification of Polaris Point as the least environmentally damaging of the two alternatives considering both construction and operational impacts (further away from Big Blue Reef)
- Reduction of the area to be dredged at the eastern end of Alternative 1 to avoid removing coral communities.

In addition, the potential impacts described previously are expected to be minimized by implementation of BMPs. Some of these practices would be consistent with OPNAVINST 5090.1C Chapter 4 Pollution Prevention; OPNAVINST 5090.1C Chapter 9, Clean Water Ashore; OPNAVINST 5090.1C Chapter 11, Oil Management Ashore; OPNAVINST 5090.1C Chapter 12, Oil and Hazardous Substance Spill Preparedness and Response; OSHA Regulation 29 CFR 1910.119 Process Safety Management of Highly Hazardous Chemicals; OSHA Regulation 29 CFR 1910.120 Hazardous Waste Operations and Emergency Response, the ESA, and the Coastal Zone Management Protection Act (CSMA).

- Contractors are required to have and to implement a contingency plan to control and contain toxic spills, including petroleum products. Appropriate materials to contain and clean potential spills would be maintained and readily available at the work site.
- All construction project-related materials and equipment placed in the water would be free of pollutants. The project manager and heavy equipment operators would perform daily pre-work equipment inspections for cleanliness and leaks. All heavy equipment operations would be postponed or halted should a leak be detected, and would not proceed until the leak is repaired and equipment cleaned. This information would be written into the construction contract conditions.
- Fueling of construction project-related vehicles and equipment would take place at least 50 feet away from the water, preferably over an impervious surface. With respect to construction equipment (dredging barges) that cannot be fueled out of the water, spill prevention booms would be employed to contain any potential spills. Any fuel spilled would be cleaned up immediately.
- Turbidity and siltation from upland construction would be minimized through employment of modern designs that promote infiltration and natural processes to the greatest extent practicable.

- Turbidity and siltation from project-related work would be minimized and contained through the appropriate use of effective silt containment devices and the curtailment of work during adverse tidal and weather conditions. Silt curtains will completely enclose dredging operations, including use of curtains that extend fully between the surface and the sea floor, to the maximum extent practicable.
- During pile driving or dredging activities, if a visible plume is observed over sensitive coral habitat outside the silt curtains, the construction activity would stop, be evaluated, and corrective measures taken. Construction would not resume until the water quality has returned to ambient conditions.
    - Adherence to Navy INRMP measures
    - Do not attempt to feed, touch, ride, or otherwise intentionally interact with any ESA-listed sea turtles.
- Anchor lines from construction vessels would be deployed with appropriate tension to avoid entanglement with sea turtles. Construction-related materials that may pose an entanglement hazard would be removed from the project site if not actively being used.

Non-Native Invasive Species Control.

As described in Volume 2, Section 11.1.4.4, a MBP is being developed to address potential invasive species impacts associated with this EIS, as well as to provide a plan for a comprehensive regional approach. The MBP will include risk assessments for invasive species throughout Micronesia and procedures to avoid, minimize, and mitigate these risks. It is being developed in conjunction with experts within other federal agencies including the NISC, U.S. Department of Agriculture Animal and Plant Health Inspection Service (USDA-APHIS), the U.S. Geological Survey (USGS), and the Smithsonian Environmental Research Center (SERC). The plan is intended to be a comprehensive evaluation of risks in the region, including all Marine Corps and Navy actions on Guam and Tinian and specifically those being proposed in this EIS.

The DoD will adopt appropriate BMPs recommended by MBP working groups during the MBP development to reduce the likelihood of the introduction and spread of invasive marine organisms. Some example BMPs may include clarifying biosecurity requirements for all Navy vessels (including chartered Military Sealift Command [MSC] ships), improving hull husbandry documentation, and incorporating into contractual agreements with vessels chartered to support the military relocation specific criteria to ensure low levels of biofouling and ballast water management.

Volume 7 includes a more detailed description of a MBP.

11.2.2.3 Summary of Alternative 1 (Preferred Alternative) Impacts

Table 11.2-6 summarizes Alternative 1 impacts.

Table 11.2-6. Summary of Alternative 1 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	Negligible, short-term and localized impacts associated with lighting, ground vibrations, noise, and a potential decrease in water quality from pollutant runoff.
	Operation	Negligible, short-term and localized impacts associated with lighting, ground vibrations, noise, and a potential decrease in water quality from pollutant runoff.
Offshore	Construction	Significant impacts from direct and indirect effects associated with in-water construction (i.e., dredging and impact pile driving) activities on Essential Fish Habitat and special-status species, respectively. • Marine Flora, Invertebrates and Associated EFH: Unavoidable, long-term and short-term adverse direct impacts to marine flora, non-coral invertebrates and associated EFH are anticipated. Permanent physical removal of live hard bottom would occur within the dredge footprint. SAV is anticipated to reestablish within the dredge footprint from adjacent areas after construction. Considering the size of the impact area, and due to the context and intensity, and cumulative effects (see Section 11.2.1.2), the impacts to live hard bottom and SAV would be “more than minimal,” but temporary for SAV. Motile invertebrates would likely vacate the area due to the increased disturbance and find other habitat. Some may perish if seeking cover in reef holes being removed. • Essential Fish Habitat: Unavoidable, long-term significant direct impacts from dredged removal of 25 ac (10 ha) of coral reef habitat (>0% to ≤ 90%) and 46 ac (19 ha) of other benthic habitat (0% coral). Short-term and localized adverse indirect impacts from sediment accumulation (> 0.2 in. or 5 mm in depth) on a portion of an additional 46 ac (19 ha) of coral reef habitat (>0% to ≤ 90%) and 54 ac (22 ha) of other benthic habitat (0% coral) adjacent to, but outside of, the dredge footprint to approximately 39 ft. (12 m). Indirect impacts from sedimentation may adversely affect a portion of the site-attached finfish species. Limited injury or mortality to site-attached finfish and fish eggs and larvae is expected. Short-term and localized disturbance to water column is anticipated. There would be an insignificant long-term population-level effect or reduction in the quality and/or quantity of EFH for finfish with implementation of identified BMPs and mitigation measures. However, after all mitigation efforts, there still would remain unavoidable adverse impacts associated with coral and coral reef ecosystem removal (direct impact) and associated sedimentation (indirect impact). Compensatory mitigation would be required. The HEA assumed dredging impacts accounted for an initial 100% ecological loss from direct impacts and an initial 25% loss of ecological services from indirect impacts. • Special-Status Species: Short-term and localized significant effects on sea turtle behavior during in-water construction may occur; however, there are many alternate sea turtle foraging and resting sites throughout Apra Harbor unassociated with the proposed action, so sea turtle foraging and resting habitat would not be impacted during dredging activities. Mitigation measures would postpone in-water work if sea turtles approach the construction area. Impacts to sea turtles would be reduced with the implementation of identified BMPs and potential mitigation measures, including USACE permit conditions. The Navy is working with NMFS through the ESA Section 7 consultation process to ensure that adverse effects to sea turtles are minimized and significant impacts do not result from implementation of the proposed

Table 11.2-6. Summary of Alternative 1 Impacts

Area	*Project Activities*	*Project Specific Impacts*
		action. All of Alternative 1 actions, except noise from pile driving activities, may affect, but are not likely to adversely affect sea turtles. Pile driving activities may significantly impact sea turtles from increased noise levels. Increased noise from pile driving activities may affect, and is likely to adversely affect, ESA-listed sea turtles. • Non-native Species: Less than significant impacts are expected from introductions of non-native species since construction vessels would comply with USCG and Navy requirements for ballast water and hull management policies. The Navy would also prepare a MBP with risk analysis (see Volume 7 for more details).
	Operation	Less than significant impacts from direct and indirect effects associated with an increase in operational activities. A beneficial impact may be seen to water quality (and associated marine biological resources) from the removal of fine benthic sediment and decreased resuspension within Outer Apra Harbor. • Marine Flora, Invertebrates and Associated EFH: Long-term, localized and infrequent minor impacts from increased tubulance and resuspension of sediment during vessel movements, and the potential for increased discharges of pollutants into the water column. • Essential Fish Habitat: Long-term, however minor, localized and infrequent impacts associated with increased vessel movements and harbor operation resulting in disturbance to water column and finfish through noise, potential increased discharge of pollutants into the water column, and re-suspension of sediments. Limited injury or mortality to fish eggs and larvae. Insignificant long-term populations-level effects or reduction in the quality and/or quantity of EFH. • Special-Status Species: Short-term, periodic and localized minimal effects on sea turtle behavior during increased operation activities and vessel movements with implemented BMPs, mitigation measures, and Navy vessel policies. • Non-native Species: Less than significant impacts from introduction of non-native species are expected as vessels operating within Apra Harbor would comply with USCG and Navy requirements for ballast water and hull management policies. The Navy would also prepare a MBP with risk analysis (see Volume 7 for more details).

11.2.2.4 Alternative 1 (Preferred Alternative) Proposed Mitigation Measures

Because the Navy has voluntarily deferred selection of a transient aircraft carrier berth site in Apra Harbor, the collection of mitigation measures that follows has not been finalized. The proposed mitigation measures may include but are not limited to those outlined below. The results of consultations and permit discussions may form the basis of mitigation measures and may be included in a future ROD or permit.

In addition to those measures contained in Chapter 4 and Chapter 10 of this Volume and summarized in Volume 7, the Navy will consider the following measures:

- No in-water blasting would be allowed.
- Water quality would be monitored for in-water construction projects during the construction phase.
- Preliminary shutdown safety zones corresponding to where sea turtles could be injured or harassed would be established based upon empirical field measurements of pile driving sound levels at the construction site. The sound pressure levels (SPLs) would be monitored on the first

day of pile driving to ensure accuracy of contours. Until validation of the harm threshold, no pile driving may occur within 328 ft (100 m) of sea turtles and no dredging operations shall occur within 164 ft (50 m) of sea turtles. Safety zones would be re-established to accommodate validated harm threshold and reported to NMFS with acoustic monitoring data. Monitoring of sea turtle harassment safety zones would be conducted by qualified observers, including two observers for safety zones around each pile driving and dredging site. Monitoring shall commence 30 minutes prior to the start of pile driving. If a sea turtle is found within the safety zone, pile driving or dredging of the segment shall be halted until the animal(s) has been visually observed beyond the impact zone or 30 minutes have passed without re-detection. Pile driving of dredging may continue into the night, but where there has been an interruption of the activity the activity would not be initiated or re-initiated during nighttime hours when visual clearance cannot be conducted.

- Pile driving and dredging would commence using soft-start or ramp-up techniques, at the start of each work day or following a break of more than 30 minutes. Pile driving would employ a slow increase in hammering, whereas dredging would commence with slow and deliberate deployment of the bucket or chisel to the bottom for the first several cycles to alert protected species and allow them an opportunity to vacate the area prior to full-intensity operations.
- No pile driving or dredging would be conducted after dark unless that work has proceeded uninterrupted since at least one hour prior to sunset, and no protected species have been observed near the respective safety range for that work.
- If a sea turtle or other listed species is found injured within the vicinity of the action area, all in-water pile driving or dredging activities shall cease immediately, regardless of their effect on the noted turtle and the Navy would contact the regional NMFS stranding coordinator.
- Construction related vessels within Apra Harbor shall remain at least 50 yards (45 m) from sea turtles, reduce speed to 10 knots (514 cm/second) or less in the proximity of sea turtles (if practicable, 5 knots [257 cm/second] or less in areas of suspected turtle activity), and, when consistent with safety practices, put engine in neutral and allow the turtle to pass if approached by a turtle. Additionally, sea turtles shall not be encircled or trapped between multiple construction-related vessels or between construction-related vessels and the shore.
- All construction-related equipment would be operated and anchored to avoid contacting coral reef resources during construction activities or extreme weather conditions. Anchor lines from construction vessels would be deployed with appropriate tension to avoid entanglement with sea turtles. Construction-related materials that may pose an entanglement hazard would be removed from the project site if not actively being used.
- Anchors, anchor chain, wire rope and associated anchor rigging from construction related vessels would be restricted to designated anchoring areas within the construction footprint (ie, soft bottom) or within the area that would be permanently impacted.
- As prescribed in permits for previous construction activities (ie, Kilo Wharf) during pile driving or dredging activities, if a visible plume is observed outside the silt curtains, the construction activity would be suspended, evaluated, and corrective measures taken.
- No barge overflow during dredging operations.
- Where practicable, installation of silt curtains during channel and/or harbor dredging operations to maintain water quality and provide coral protection.

- The Micronesia Biosecurity Plan is being developed to address potential invasive species impacts associated with the actions proposed in this EIS as well as to provide a plan for a comprehensive regional approach. The MBP would include risk assessments for invasive species throughout Micronesia and procedures to avoid, minimize, and mitigate these risks. It is being developed in conjunction with experts within other federal agencies including the NISC, USDA-APHIS, the USGS, and the SERC. The plan is intended to be a comprehensive evaluation of risks in the region, including all Marine Corps and Navy actions on Guam and Tinian.
- Incorporate seasonal dredging prohibitions , which may include:
  - Cessation of dredging operations during the period of peak coral spawning (7-10 days after the full moon in July) in consultation with the University of Guam (UoG) Marine Lab.
  - Dredging or filling of tidal waters would not occur during hard coral spawning periods, usually around the full moons of June, July, and August.
  - Construction related vessels would be restricted from Sasa Bay so as to reduce potential impacts to sea turtles and other protected marine and/or wildlife species.
  - Provide natural resource education and training to military personnel on ESA, MMPA, and EFH. This may include Base Orders, natural resource educational training (i.e., watching of short ERA/MPA video) and documentation (i.e., preparation of *Military Environmental/ Natural Resource Handbook, distribution of natural resource educational materials to dive boat operators*), or a combination of all.
  - Compensatory Mitigation for coral (see Section 11.2.2.5) for a detailed discussion.
  - See Section 4.2.2.4, Chapter 4 of this Volume for mitigation measures associated with water resources.
  - Aboard dredge-related tug, barge or scow vessels at sea, use the minimum lighting necessary to comply with navigation rules and best safety practices.

Mitigation Projects for Coral Reefs

Because the Navy has voluntarily deferred selection of a transient aircraft carrier berth site in Apra Harbor, the collection of specific coral reef mitigation projects that follow have not been finalized. The proposed coral reef mitigation projects may include but are not limited to those discussed below. The results of consultations and permit discussions may form the basis of mitigation measures and may be included in a future ROD or permit.

The proposed action would result in unavoidable impacts to coral communities and compensatory mitigation would be required and identified through a compensatory mitigation plan prepared by the Navy (Section 11.2.3, below). Compensatory mitigation is defined as the restoration, establishment, enhancement, and/or preservation of aquatic resources to offset unavoidable impacts to waters of the U.S. (including SAS such as coral reefs). After all efforts to minimize and avoid the impacts of the aircraft carrier project, there remain unavoidable adverse impacts associated with dredging coral reef ecosystems in Outer Apra Harbor. The compensatory mitigation is subject to approval by USACE, under Section 404 and Section 10 permit requirements.

As identified in the 10 April 2008 Federal Register, 40 CFR Part 230, the final USACE compensatory mitigation rule, permit applicants are required to mitigate to no net loss of ecological services and function. The regulations establish performance standards and criteria for the use of permittee-responsible compensatory mitigation, mitigation banks, and in-lieu programs to improve the quality and success of compensatory mitigation projects for activities authorized by Department of the Army permits. Habitat Equivalency Analysis is a tool that has been used in a variety of legal and technical contexts to quantify impacts to natural resources and the services/functions they provide, and quantify the amount of restoration/mitigation required to offset documented losses. The Navy's preparation and approval of a compensatory mitigation plan would meet the requirements of the compensatory mitigation rule.

HABITAT EQUIVALENCY ANALYSIS (HEA)

Coral loss assessment, coral restoration and the parameters used in a HEA are an evolving science. HEA, like any model, relies on user-specified inputs and calculations that simplify complex processes, both of which can introduce uncertainties into model results. However, HEA applications have been published in peer-reviewed technical literature, courts have upheld the use of HEA in litigation, and HEA often underlies settlements reached on cases involving the impacts to and restoration/mitigation of natural resource services and functions. To address the concern of USFWS and USEPA that coral cover as a single metric is inadequate, the revised HEA model is based on percent coral cover plus rugosity (horizontal: vertical measurements) to capture the 3-D complexity of the reef.

The USACE has regulatory authority; compensatory mitigation would be developed during permitting and appropriate units for quantifying credits and debits would be determined by district engineers on a case-by-case basis. District engineers are encouraged to use science-based assessment methods for determining aquatic habitat condition, such as the index of biological integrity, where practicable.

One example of HEA use was to establish the appropriate scale of compensatory restoration in the context of damage assessments conducted under the 1990 Oil Pollution Act and the Comprehensive Environmental Response, Compensation and Liability Act. A HEA was used for the Kilo Wharf dredging project in Apra Harbor.

A HEA model was conducted for both aircraft carrier alternatives and a report entitled *Habitat Equivalency Analysis (HEA) Mitigation of Coral Habitat Losses* was prepared. It is included in Volume 9, Appendix E, Section F of this EIS. The scientific basis for the affected environment description and many of the HEA assumptions is described in *Assessment of Benthic Community Structure in the Vicinity of the Proposed Turning Basin and Berthing Area for Carrier Vessels Nuclear (CVN)*, which is included in Volume 9, Appendix J of this EIS.

The assessment of benthic communities report assumes a 60 ft (18 m) dredge depth, which is an overestimate of the proposed dredge depth of -49.5 ft (-15 m) MLLW plus 2 ft (0.6 m) overdredge, representing an approximately 10-15% increase in assessed benthic habitat in the dredged area. For this reason, the total dredged area differs from the dredged area provided in Volume 4, Chapter 4.

The indirect impacts were modeled and indicated that sedimentation exceeding 0.001oz/0.15 in^2 (40 mg/cm$^{2)}$ or 0.008 inch (0.2 mm) extended an average distance of 144 ft (44 m) from the dredging, the assessment of benthic communities assumes this distance, however the HEA assumes an indirect impact distance of 656 ft (200 m) from the direct impact area boundary, which is an overestimate of the impact area. As previously noted in Section 11.1.2.2, this is an overestimate because the SEI (2009) plume modeling summary identifies only 40 ft (12 m) beyond the direct dredge impact area as anticipated to receive cumulative sedimentation totaling at least 0.2 in (5 mm), which was established as the cumulative sedimentation threshold for corals.

The total direct impact dredge area (as noted in Table 11.1-1) for Alternative 1 is 71 ac (29 ha) and 61 ac (25 ha) and for Alternative 2. As discussed above, this total direct dredged area assumes a 60 ft (18 m) depth. This is an overestimate of the proposed project's dredge footprint (-49.5 ft [-15 m] MLLW, plus 2 ft. (0.6m) overdredge) noted in Volume 4, Chapter 2 where the total dredge area is 53 ac (21 ha) for Alternative 1 and 44 ac (18 ha) for Alternative 2, respectively.

The description below is a brief summary of a HEA that was created as an evaluation tool for this document. The findings for both the Polaris Point and the Former SRF alternatives are provided together in this section to facilitate comparison.

The HEA addresses direct and indirect impacts to coral habitat arising from dredging to support aircraft carrier berthing and maneuvering in Outer Apra Harbor. The basic HEA steps include:

Loss calculation: Document and estimate the duration and extent of injury from the time of injury until the resource recovers to baseline, or possibly to a maximum level below baseline.

Restoration calculation: a) Document and estimate the services provided by the compensatory project over the full life of the habitat, and b) Calculate the size of the replacement project for which the total increase in services provided by the replacement project equals the total interim loss of services due to the injury.

Loss Calculation (Step 1). As a first step in determining appropriate mitigation, HEA impact inputs to estimate potential coral habitat losses due to dredging were developed, based on currently available information. These inputs reflect site-specific data and analyses, information from relevant literature, and the professional judgment of technical experts familiar with the project plans, potentially affected habitats and biota, environmental impact assessment, and the HEA methodology.

The estimated input values for the variables needed to perform HEA loss calculations, included:

- The acreage of coral habitat expected to be affected by dredging, including direct (dredging) and indirect (dredging-related sedimentation) impacts. Based on pixel counts from the remote sensing map, the total area (“plan” view) with any level of coral coverage is about 25.20 ac (10.20 ha) for Alternative 1 and 23.74 ac (9.61 ha) for the Alternative 2 in the direct impact area.
- The coral habitat index was generated by merging Quickbird multispectral imagery, field survey habitat data (Dollar et al. 2009, Volume 9, Appendix J), and reef rugosity derived from bathymetric data (airborne LIDAR and boat hydrographic surveys). The coral habitat index is on a logarithmic scale. Ten categories of coral habitat index ranges were defined as shown in Table 11.2-7. Category 1 represents the least coral cover and least complex structure and Category 10 represents the greatest coral cover and most complexity.
- The expected severity and duration of expected impacts, relative to baseline conditions (i.e., the anticipated future condition of coral habitat in the project area if the CVN project never occurred); and
- The shape of the recovery curve, the period over which losses are calculated, expected project timing and an appropriate discount rate.

Table 11.2-7. Coral Habitat Index Ranges

Coral Habitat Index Category	*Coral Habitat Index Range of Values (log_{10})*
Category 1	0 to ≤ 0.235
Category 2	0.235 to ≤ 0.471
Category 3	0.471 to ≤ 0.706
Category 4	0.706 to ≤ 0.942
Category 5	0.942 to ≤ 1.177
Category 6	1.177 to ≤ 1.413
Category 7	1.413 to ≤ 1.648
Category 8	1.648 to ≤ 1.884
Category 9	1.884 to ≤ 2.119
Category 10	2.119 to ≤ 2.355

This analysis focused on the coral habitat expected to be either permanently lost due to dredging or temporarily affected by sedimentation. Much of the habitat within the dredge footprint is unconsolidated soft sediment with no coral cover (Smith 2007, Dollar et al. 2009). Soft bottom habitat was not addressed in the HEA.

The total area (three dimensional view) of habitat with some coral coverage is approximately 33 ac (13 ha) for Alternative 1, and approximately 32 ac (13 ha) for Alternative 2.

Based on these inputs, an estimate was made of the discounted service acre-years expected to be lost due to aircraft carrier dredging-related activities. The "acre-year" metric allows the analysis to consider not only the number of acres lost, but also injury severity and recovery over time. A loss of one acre-year equates to a complete loss of ecological function provided by the identified habitat for one year. Such a loss could be arrived at in numerous ways (e.g., 50% degradation of two ac [0.8 ha] of habitat for one year, 10% degradation of five ac (2 ha) of habitat for two years, 5% degradation of one ac (0.4 ha) of habitat for 20 years, etc.).

The simplified examples above do not take into account the effects of discounting, which is applied in the HEA methodology to convert losses occurring in different years into a single, common year. A 3% annual discount rate is added to the calculations, which is the most common discount rate used in HEA applications and one that research indicates reasonably reflects society's general preference for current use and enjoyment of resources, compared to future resource use and enjoyment (NOAA 1999; Freeman 1993). The sum of these discounted losses across years represents the present value acre-years of ecological services lost.

Tables 11.2-8 and 11.2-9 summarize the data used in the HEA calculations to estimate aircraft carrier-related coral habitat impacts and the resulting loss estimates. As shown in these tables, Polaris Point (Table 11.2-8) is expected to result in a loss of approximately 1,048 discounted service acre-years (DSAYs) of coral habitat (across all coral habitat categories), approximately 996 DSAYs due to direct impacts and 52 DSAYs due to indirect impacts. The Alternative 2 is expected to result in a loss of approximately 1,023 DSAYs, 969 DSAYs due to direct impacts and 54 DSAYs due to indirect impacts.

Table 11.2-8. HEA Loss Calculations for Direct Impacts Arising from the Aircraft Carrier Project

Project Alternative	*Habitat Index Category*	*Year Dredging Occurs*	*Estimated Post-Dredging Service Level (Initial)*	*Year Recovery Begins*	*Length of Recovery Period (years)*	*Shape of Recovery Curve*	*Post-Dredging Service Level*	*End of HEA Analysis Period*	*Estimated Loss (2009 DSYs)*
Direct Impacts									
Polaris Point	Category 1 Category 2 Category 3 Category 4 Category 5 Category 6 Category 7 Category 8 Category 9 Category 10 Subtotal	2012 (a)	0% (b)	None (c)	No Recovery (c)	NA (c)	0% (c)	Perpetuity (d)	303.93 243.99 179.40 163.39 71.23 26.92 7.17 0.35 0.00 0.00 996.37
Former SRF	Category 1 Category 2 Category 3 Category 4 Category 5 Category 6 Category 7 Category 8 Category 9 Category 10 Subtotal	2012 (a)	0% (b)	None (c)	No Recovery (c)	NA (c)	0% (c)	Perpetuity (d)	288.95 232.69 178.32 166.13 70.06 26.15 5.88 0.18 0.00 0.00 968.36

Notes:

a) Estimated year for dredging implementation.

b) Assumes complete loss of coral habitat services, beginning immediately after dredging.

c) Assumes ongoing maintenance of dredge channel would prevent significant re-establishment of coral in dredged areas.

d) HEA impacts calculated in perpetuity.

Refer to Table 11.2-6 for the Coral Habitat Index range per category.

Table 11.2-9. HEA Loss Calculations for Indirect Impacts Arising from the Aircraft Carrier Project

Project Alternative	*Habitat Index Ca*	*Year Dredging Occurs*	*Estimated Post-dredging Service level (Initial)*	*Year Recovery Begins*	*Length of Recovery Period (Years)*	*Shape of Recovery Curve*	*Post-Dredging Service Level*	*Estimated Loss (2009 DSYs)*
Indirect Impacts								
Polaris Point	Category 1	2012 (a)	75% (b)	2013 (c)	5 (d)	Linear (e)	100% (f)	10.31
	Category 2							9.46
	Category 3							11.75
	Category 4							7.79
	Category 5							5.09
	Category 6							3.82
	Category 7							2.42
	Category 8							0.80
	Category 9							0.21
	Category 10							0.13
	Subtotal							**51.79**
Former SRF	Category 1	2012 (a)	75% (b)	2013 (c)	5 (d)	Linear (e)	100% (f)	10.70
	Category 2							9.48
	Category 3							12.04
	Category 4							8.28
	Category 5							5.45
	Category 6							4.24
	Category 7							2.80
	Category 8							0.97
	Category 9							0.23
	Category 10							0.13
	Subtotal							**54.32**

Notes:

a) Estimated year for dredging implementation.
b) A modest (25%) initial service level loss is consistent with the expectation that cumulative sedimentation caused by dredging is expected to be low (less than approximately 1 cm), and the expected low sensitivity of dominant corals in affected area (*P. rus* and *P. cyindrica*) to such levels of sedimentation.
c) Recovery is assumed to begin the year after the completion of dredging (i.e. 2013).
d) A 5-year recovery time is conservative in light of the expected low level of initial impact and relevant literature (e.g., Brown et al. (1990) study of dredging impacts on intertidal coral reefs at Ko Phuket, Thailand, which suggests a one to two year recovery period is reasonable for impacts of this type).
e) For simplicity (and in the absence of field data warranting a different approach), a linear recovery rate is utilized for HEA purposes.
f) Affected coral communities are expected to fully recover to baseline condition.

Refer to Table 11.2-7 for the Coral Habitat Index range per category

Initial Service Loss and Duration of Injury. For direct impacts, the HEA assumed an initial 100% loss in ecological services (i.e., the resource suffers a complete loss of ecological function). For indirect impacts, affected habitat is expected to experience an initial 25% loss. This estimate is consistent with the expectation that cumulative sedimentation caused by dredging is expected to be low (i.e. < 0.40 in [< 1 cm]), and the relatively lower sensitivity of dominant corals in the affected area (*P. rus* and *P. cylindrica*) to such levels of sedimentation.

Areas directly impacted by dredging are considered permanently injured, and therefore experience a 100% loss in ecological services in perpetuity (i.e., no recovery). Any recovery would be lost during future maintenance dredging. Indirect impacts are expected to be temporary, and affected areas are expected to recover to baseline condition within five years, which the Navy believes to be a conservative assumption in light of the expected low level of initial impact and relevant literature (e.g. Brown et. al. 1990) described earlier in the EFH indirect impacts subsection above.

Restoration Calculation (Step 2). Step 2 requires a mitigation project and artificial reefs were the mitigation approach used in the HEA. There is a discussion later in this section on the rationale for using artificial reefs.

A typical pattern for Z-block placement utilized by the state of Hawaii deploys up to approximately 300 Z-blocks per ac (0.4 ha) of subtidal bottom in approximately six "sets" of 50 Z-blocks each, resulting in 15 ft (w) x 15 ft (l) x 12 ft (h) [4.6 m (w) x 4.6 m (l) x 3.7 m (h)] dimensions for each set (COMNAV Marianas 2007b). An alternate deployment proposed for the Kalaeloa artificial reef intended to mitigate impacts to coral reef ecosystem arising from the Ocean Pointe Marina project (also referred to as Hoakalei Marina) would place 350-400 Z-blocks in a single set with dimensions approximately 100 ft (30.5 m) in diameter and 20 ft (6 m) in height (HDNAR 2007).

Applying the algorithm used to assign injuries to Habitat Index Categories, 1 ac (0.4 ha) of artificial reef (i.e., 300 Z-blocks deployed in a site-appropriate configuration) would be classified in Category 1. Therefore, the Navy utilizes a 1:1 ratio for artificial reef to injured Category 1 reef. Recognizing the greater coral cover, surface area, and/or rugosity of Category 2 habitat, the Navy assumes a 2:1 artificial reef to injured Category 2 reef, a 3:1 ratio artificial reef to injured Category 3 reef, and so on.

For simplicity (and in the absence of field data warranting a different approach), a linear recovery rate from the use of artificial reefs was utilized for HEA purposes. This implies an annual service gain of 10%, based on a 10-year period post-deployment for artificial reefs to provide comparable replacement functions and services. This type of artificial reef was estimated to provide ecological benefits for 100 years. This estimate was based on the two-block design described above, and the inclusion of substantial maintenance and contingency allowances in the project budget.

Some soft bottom habitat would be lost if mitigation measures include the placement of an artificial reef. That is, the habitat directly underlying the footprint of the reef structure and its corresponding ecological services would be permanently altered. This would be offset by placing the reefs in areas with limited ecological contributions. Although the HEA assumes permanent loss of habitat due to dredging, in reality there would be coral regrowth that would provide minor functions/services in the dredged areas. This could offset losses of habitat on which artificial reefs are placed.

The HEA was used to develop an estimate of the discounted service acre-years (DSAYs) gained per acre of artificial reef, discounted in the same manner as HEA loss calculations. Given a total expected loss of 1,048 DSAYS, a total of approximately 123 ac (49.8 ha) of artificial reef would be required to compensate for coral habitat impacts expected due to Alternative 1. Results indicate that each acre of artificial reef would provide approximately 22.1 DSAYs. Approximately 121 ac (49.0 ha) of artificial reef would be required for mitigation of impacts due to Alternative 2.

The HEA example was used to establish the appropriate scale of compensatory restoration in the context of coral damage assessments. Compensatory mitigation would be developed during permitting and appropriate units for quantifying credits and debits would be determined by USACE for identified projects. The compensatory mitigation plan to be prepared by the Navy would include information received from resource agencies on how the data will be used in the HEA.

11.2.2.5 Implementation of Coral Restoration

Within DoD, regulatory agencies and other stakeholders on Guam support the use of In-Lieu-Fee or mitigation banking programs to manage, implement and monitor the success of natural resource compensatory mitigation projects on Guam. These programs are not yet established on Guam and would be developed in a timely manner to the satisfaction of the USACE. Direct mitigation by the Navy is the alternative to these programs.

Regardless of whether the Navy implements the mitigation project directly or provides funds to a In-Lieu-Fee or Mitigation Bank program, all mitigation projects require a mitigation plan approved by USACE that would include the following components:

- Objective(s) of the compensatory mitigation project
- Site protection instrument to be used
- Baseline information (impact and compensation site)
- Mitigation work plan
- Maintenance plan
- Ecological performance standards
- Monitoring requirements
- Financial assurances
- Site selection information
- Number of credits (fee) to be provided
- Long-term management plan
- Adaptive management plan

11.2.2.6 Development of Compensatory Mitigation Proposals

The *HEA and Supporting Studies* report (Volume 9, Appendix E, Section A) provides background on the mitigation proposals discussed among regulatory agencies and DoD. Many ideas were proposed at a HEA workshop that was hosted by USFWS in 2008 (Guam agencies were unable to attend due to scheduling difficulties). Regulatory agencies prefer a watershed management approach to the use of artificial reefs as mitigation, as agencies believe that watershed management projects would result in greater beneficial impacts to the marine environment; however, as described further below, the effectiveness of either artificial reefs or upland watershed management schemes to replace coral loss have been studied and conclusions concerning success differ. Guidelines for project acceptability were:

- Project would replace the loss functions and services of coral reef ecosystems.
- Scientific data are available that the project would, in fact, have the desired result of in-kind replacement. In other words, there must be confidence in the success of the project.

- The ratio of restoration to loss is quantifiable.
- The project is legal.
- The project is feasible.
- Project may enhance but not replace activities that are already occurring or be used to achieve ongoing mandated responsibility.

All proposals discussed would benefit the environment, but some were dismissed outright for not meeting CWA requirements for compensatory mitigation including the guidelines above. The dismissed ideas and the primary reason for dismissal are listed below:

- Increase enforcement of existing marine protected areas. Dismissed because transferring DoD funds to other federal agencies or local agencies to support policing action may encounter fiscal law constraints and enforcement is a pre-existing mandated responsibility.
- Purchase land for new preserve or to prevent future development that could degrade water quality. Dismissed because it is not feasible in a reasonable time-frame and it would be difficult to demonstrate that coral restoration would be the result.
- Prepare management plans for submerged lands and lands, DoD lands or island-wide. Dismissed because compensatory mitigation cannot be used to achieve other mandated responsibility as in the case of DoD lands. Plans by themselves do not restore ecological function; therefore, they are not considered suitable mitigation.
- Pursue aquaculture to increase biomass. Dismissed because it would not replace or restore coral function.

The Navy is considering a suite of four categories for compensatory mitigation for the loss of ecological service provided by corals being adversely impacted in Outer Apra Harbor. The four categories developed include Watershed Restoration and Management, Coastal Water Resource Management, Apra Harbor Water Resource Management, and In-Lieu Fee or Mitigation Banking Programs. The results of an interagency working group, led by the CEQ, identified potential compensatory mitigation projects for implementation by federal agency principals. These CEQ recommended mitigation project options were developed by EPA, USFWS and NOAA, with input from NPS, USACE, and Guam environmental agencies. These are described in detail below.

1. Coral reef restoration via water quality improvements through protection and watershed restoration. The goal is to reduce the negative effects of land runoff through actions that reduce erosion and organic matter runoff. Physical corrective measures could include afforestation, stream bank stabilization**,** riparian restoration, road stormwater BMPs, erosion control practices, wetland enhancement, and designation of conservation areas. A public education program would be associated with these measures to promote public support and respect for conservation.

2. Coral reef restoration via water quality improvements through WWTP upgrades/ improvements. A number of WWTPs throughout Guam are not performing up to their design standards for water quality output. If those WWTPs were upgraded to meet their design performance criteria, outflow quality would be improved and that would improve water quality near outflow sites.

3. Coral reef restoration via site-specific water quality improvements through retrofitting road stormwater controls at a range of sites on Guam.

Past restoration projects and scientific evidence support the notion that coral reef restoration follows water quality improvements (*e.g.*, Kaneohe Bay and Mamala Bay, Hawaii following improved water quality after sewage diversion; Pago Pago Harbor, American Samoa after removal of tuna effluent; Kahoolawe, Hawaii after erosion control).

4. Coral reef restoration within non-DOD federal property lands. The Navy could participate in coral reef restoration on other lands owned by the Federal Government, including providing erosion control, wetland restoration, boundary marking, law enforcement, and monitoring for ecosystem health. A public education program associated with this effort would serve to promote public support and respect for conservation.

Federal property affords long-term protection for resources on the land, particularly when appropriate infrastructure and enforcement are implemented. The National Historic Parks are examples of fully protected federal property often cited for conserving natural resources and providing a resource to the public. Restoration of coral reefs by the Navy could provide similar protection of marine resources (Sandin et al. 2008).

5. Aquaculture of native herbivorous fish. This measure would include the construction, oversight, and maintenance of a fish hatchery. The species would be grown and released to enhance herbivory on coral reefs and improve coral reef conditions. Some reef areas around Guam suffer from depauperate fish populations, and the paucity of herbivorous fishes allows macroalgae to outcompete the coral.

Coral reef sites with healthy fish assemblages tend to have healthy reefs. Science supports the importance of herbivorous fish as an important part of fish communities in maintaining healthy reefs. Fish hatcheries are a proven method for enhancing local fish populations and husbandry is feasible for many fish and invertebrate species.

6. Coral transplantation. The Navy can contract with local experienced scientists who have demonstrated success with transplanting coral. Sites for artificial reefs or natural reef sites can be chosen with careful attention to environmental factors that would promote the healthiest reefs. This type of measure can be used in conjunction with other measures to rapidly establish healthier reefs in areas with reefs in decline.

Moving coral that will be affected by construction projects or taking small fragments from healthy reefs and placing them on an artificial reef structure or available natural sites is an effective means of starting a new reef and/or managing coral reef community composition. Past projects on Guam have had survivorship rates of 70% or better. Expanding and dispersing new reef may increase the coral larval supply for Guam.

7. Establishment of marine protected area(s) (MPA(s)). This is a measure that would allow for the protection of healthy reefs and other high-quality environments as well as threatened areas to be protected and set aside.

Establishment of MPAs has already been successfully executed on Guam in Tumon Bay MPA. Maintaining high-quality reef is easier than restoring a damaged reef or creating a new reef, and MPAs are a clear method for protecting specific sites.

8. Artificial reefs. This measure provides a mechanism for establishing reefs in areas with ideal nutrient and oxygen transport, good water quality, and light penetration, but lack sufficient substrate for establishing coral.

Artificial reefs have been established successfully throughout the world, particularly in tropical climates. The coral community composition on an artificial reef can be manipulated to encourage a diverse and healthy reef development. New reefs may increase the coral larval supply for Guam.

9. Support for enhanced enforcement of fishing and recreational diving regulations. Although regulations exist to reduce impacts of fishing and recreational activities, lack of enforcement allows the impacts to continue. GovGuam would receive help from the Navy in enforcing already existing laws and regulations.

Enhanced enforcement can help reduce stress on existing coral reefs, particularly in areas that have Ecological Reserve Area (ERA) or MPA designation. When this measure is used in conjunction with other options, it may help to ensure greater conservation success.

10. Marine debris removal. The Navy has assets and personnel capable of removing debris from coral reefs. A marine debris removal program could be implemented in combination with public outreach that diverse parties could agree on. GovGuam supports marine debris removal.

The USCG removes tons of marine debris from the Northwest Hawaiian Islands each year in the Papahanaumokuakea Marine National Monument. This has contributed to the renewed health of the underwater portion of the Monument. A public outreach program would provide good awareness of marine debris issues which could improve islandwide compliance across Guam.

11. Remove nuisance algae. Marine algae can outcompete coral and overgrow coral reef sites under certain conditions. Removing the algae and improving water quality could improve the chances of coral reef recovery and growth.

Nuisance and non-native invasive algae removal has been successfully implemented in Hawaii by the Nature Conservancy.

12. Installation of recreational mooring buoys. In Apra Harbor recreational areas, the Navy would contract for the installation of permanent mooring buoys that would obviate the need to drop anchor to keep vessels in place. This measure allows the public to continue enjoying the coral reefs while reducing their effects on coral reefs.

Anchors and anchor chains cause serious damage to coral reefs. Removing the need for vessels to drop anchor in recreational areas around coral reefs will contribute to the continued health of growing coral.

13. Coral reef restoration inside Apra Harbor through water quality and habitat improvements. The suite of mitigation measures outlined above could be implemented in the immediate vicinity of Apra Harbor to have more immediate effects on coral reef health in the Outer Harbor. The measures could include erosion control, stormwater management, artificial reefs, afforestation, wetland enhancement, and establishing an ERA.

The following list of four categories for coral mitigation incorporates all 13 of the CEQ potential compensatory mitigation projects, categorized by type of mitigation or program. The CEQ projects are discussed in detail in terms of specific mitigation projects in the compensatory mitigation impact analysis section (11.2.3, below).

Watershed Restoration and Management

- Afforestation
- Stream bank stabilization
- Riparian restoration
- Road stormwater BMPs
- Erosion control

- Wetland enhancement
- Land/submerged land acquisition/easement for conservation
- Education

Coastal Water Resource Management

- Road stormwater control at a range of sites on Guam
- Shallow water reef enhancement within non-DoD federal lands (e.g. National Historic Parks)
- Land acquisition
- Erosion control
- Wetland restoration
- Artificial reefs
- Coral transplanting
- Boundary marking & enforcement
- Monitoring
- Education
- Aquaculture (e.g. fish hatchery) for native herbivorous species
- Support for enhanced enforcement of fishing and recreational diving regulations
- Protection and conservation actions
- Marine debris removal
- Nuisance algae removal
- Installation of recreational mooring buoys
- Establishment of marine protected area(s) (MPAs)
- Upgrades/Improvements Wastewater Management Systems

Apra Harbor Water Resource Management

- Erosion control
- Stormwater management (roads, wharves, industrial facilities)
- Artificial reefs
- Coral transplantation
- Glass breakwater modifications
- Wetland enhancement
- Revise Navy management plans
- Support for enhanced enforcement of fishing and recreational diving regulations
- Education
- Protection and Conservation Actions
- Marine debris removal
- Nuisance algae removal
- Installation of recreational mooring buoys

In-Lieu Fee or Mitigation Banking Program

- In-lieu fee or mitigation banking programs are generally considered methods for implementing mitigation strategies and projects. However, for purposes of determining coral reef compensatory mitigation, In-Lieu fee and Mitigation Banking programs are considered separate categories to implement specific projects and adaptive management strategies.

The Navy has not advanced a proposal at this time and specific mitigation measures would be subject to the permitting action/mitigation decision of the USACE. The effectiveness of either upland watershed management or artificial reefs schemes to replace coral loss have been studied and conclusions concerning success differ. Section A of the *HEA and Supporting Studies* report (Volume 9, Appendix E, Section A) summarizes key points of discussion that were raised during review of the draft HEA, including relative merits (pros and counterpoints/cons) of artificial reefs and watershed management projects (HEA Section A, 3.3.4, Table 2 and 3, respectively). Compensatory mitigation for unavoidable coral community impacts includes the following categories.

Watershed Restoration and Management

Watershed restoration and management is a collective term to describe a variety of projects that would remove or diminish anthropogenic stresses on receiving coastal waters in order to improve water quality, resulting in recolonization or improved growth of existing coral in those coastal waters. Restoration of a watershed returns the ecosystem to as close an approximation as possible of its state prior to a specific incident or period of deterioration and restores the ability of the ecosystem to function. Watershed restoration can be complicated because an ecosystem has a myriad of interactions. These include interactions between the watershed's inhabitants, water level and flow, nutrient cycling, and the inevitable, natural changes that occur over time that change ecosystem dynamics (e.g., soil erosion and replacement). When deterioration of a watershed occurs gradually, restoration can require rigorous scientific protocols and involve lengthy, complicated, and costly investigations.

The approach to address reef degradations from discharge of eroded sediments from upland sources is watershed/restoration conservation. Restoring vegetation to barren areas to reduce soil runoff and subsequent discharge into coastal waters is a major step in watershed restoration and thus improvement of coastal waters. Most potential watershed restoration projects would involve planting tree seedlings in grasslands and badland areas as well as in fertile valley areas of watersheds. Other important elements of a successful watershed restoration project include but are not limited to animal control, monitoring and continuous watershed management.

EPA looks at the watershed restoration process as consisting of the following major steps: (1) build partnerships, (2) characterize the watershed to identify problems, (3) set goals and identify solutions, (4) design an implementation program, (5) implement the watershed plan, (6) measure progress and make adjustments (GEPA 2008).

The following projects could be used separately or in conjunction to develop a conceptual mitigation plan for watershed restoration:

AfForestation. Coastal marine waters and associated rivers and watersheds on Guam have been recommended by resource agencies for potential compensatory mitigation for coral reef impacts. The approach to restoration/conservation of sites rather than a detailed assessment is described to address on-going problems of reef degradation from discharge of eroded sediments from upland sources.

The Navy has held several conversations with federal and Guam resource agencies on coral impact assessment and compensatory mitigation methods associated with the Guam Military Relocation EIS. Resource agencies have recommended coastal marine waters and associated rivers and watersheds as restoration candidates for potential compensatory mitigation for coral reef impacts. USFWS recently provided the following potential sites for watershed afforestation coral reef restoration options (USFWS 2009a). The information below is also supplemented by information from GEPA (2008).

- *Achugao Subwatershed* – Coastal waters and beach south of Achugao Point located in the southwestern portion of Guam. This beach is the discharge point for Agaga River associated with the Cetti Watershed.
- *Fouha Subwatershed* – Coastal waters at the head of Fouha Bay, located south of Cetti Bay, in the southwestern portion of Guam. Fouha Bay is the discharge point for the La Sa Fua River associated with Umatac Watershed in the southwestern portion of Guam.
- *Geus Watershed* – Coastal waters and marine bay (5 mi^2 [13 km^2]) associated with Cocos Lagoon located at the southern tip of Guam. The Geus River, associated with the Geus Watershed, discharges into the Cocos Lagoon.
- *Ajayan Subwatershed* – Coastal waters and intermittent beach at Ajayan Bay located east of Cocos Lagoon. The Ajayan River, associated with the Manell Watershed, discharges into Ajayan Bay.

The recommended watersheds have not been fully evaluated to determine their suitability, but are being considered by the Navy as options for mitigation. These watersheds are associated with reefs that are degraded by sedimentation, but were healthy a few decades ago (USFWS 2009b).

Additional restoration/enhancement projects as recommended by Guam Bureau of Statistics and Plans (BSP) (2009) include the following Project Locations: Apra, Tumon, Tamuning, Piti, Asan, Fonte, Southern Agat, Togcha, Ylig, Pago, and Ugum. Project objectives would be to improve water quality and forest habitat restoration in these watersheds as they flow into waters that host marine preserves and other valuable marine resource areas. Most of the potential restoration projects would involve the planting of native seedlings in grasslands and badland areas as well as in fertile valley areas of watersheds. Other important elements of a successful watershed restoration project include but are not limited to animal control, monitoring and continuous watershed management.

Guam BSP (2009) provided figures delineating the boundary of the watershed area in which the listed projects would occur (Figures 11.2-5 through 11.2-8 provided below without modification, except for the addition of a location map.). The drainage area of the watersheds shown on the figures is approximately 22.18 mi^2 (57.45 km^2) along the southwestern coast of Guam, extending from south of Naval Base Guam (*Agat watershed*) to the southern point of Guam and Cocos Island (*Manell watershed*). The watershed areas (*Agat, Taelayag, Cetti, Umatac, Toguan, Geus, and Manell*) were selected because there is evidence that coral communities have previously existed in the receiving coastal waters. Under improved water quality conditions, these coral communities could be restored.

The Talofofo watershed (22.37 mi^2 [57.94 km^2]) and Ugum watershed (7.31 mi^2 [18.93 km^2]) associated with the Naval Munitions Site (NMS) is located on Navy-owned land. The watershed currently suffers from soil erosion which manifests in sediment transfer to various streams that feed into Talofolo Bay. The NMS Watershed of savanna grassland vegetation would be restored and protected within the northeastern portion to address an on-going problem of reef degradation in Talofofo Bay from the transport of eroded sediments.

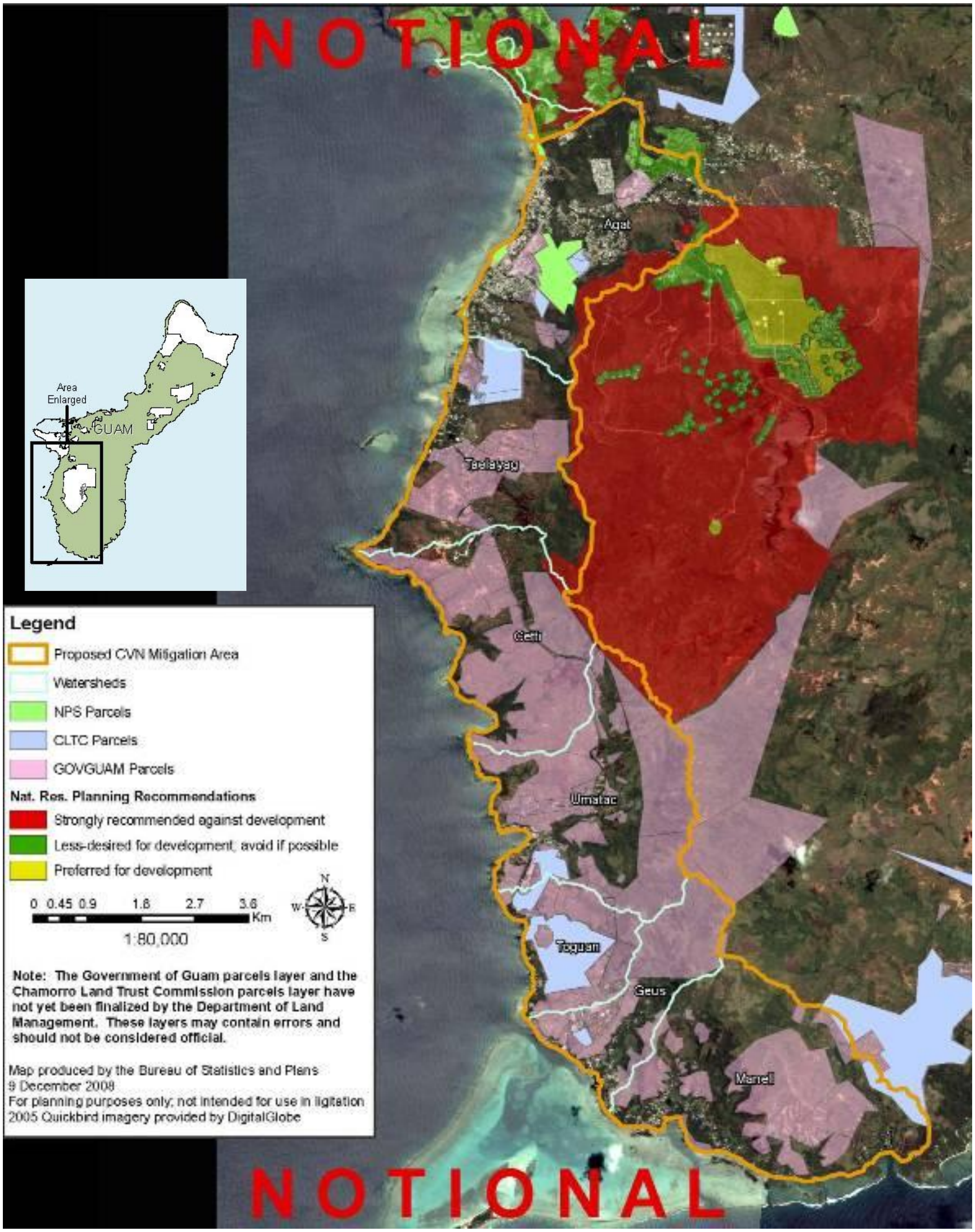

Figure 11.2-5. Boundary of Guam Agency Proposed CVN Mitigation Area

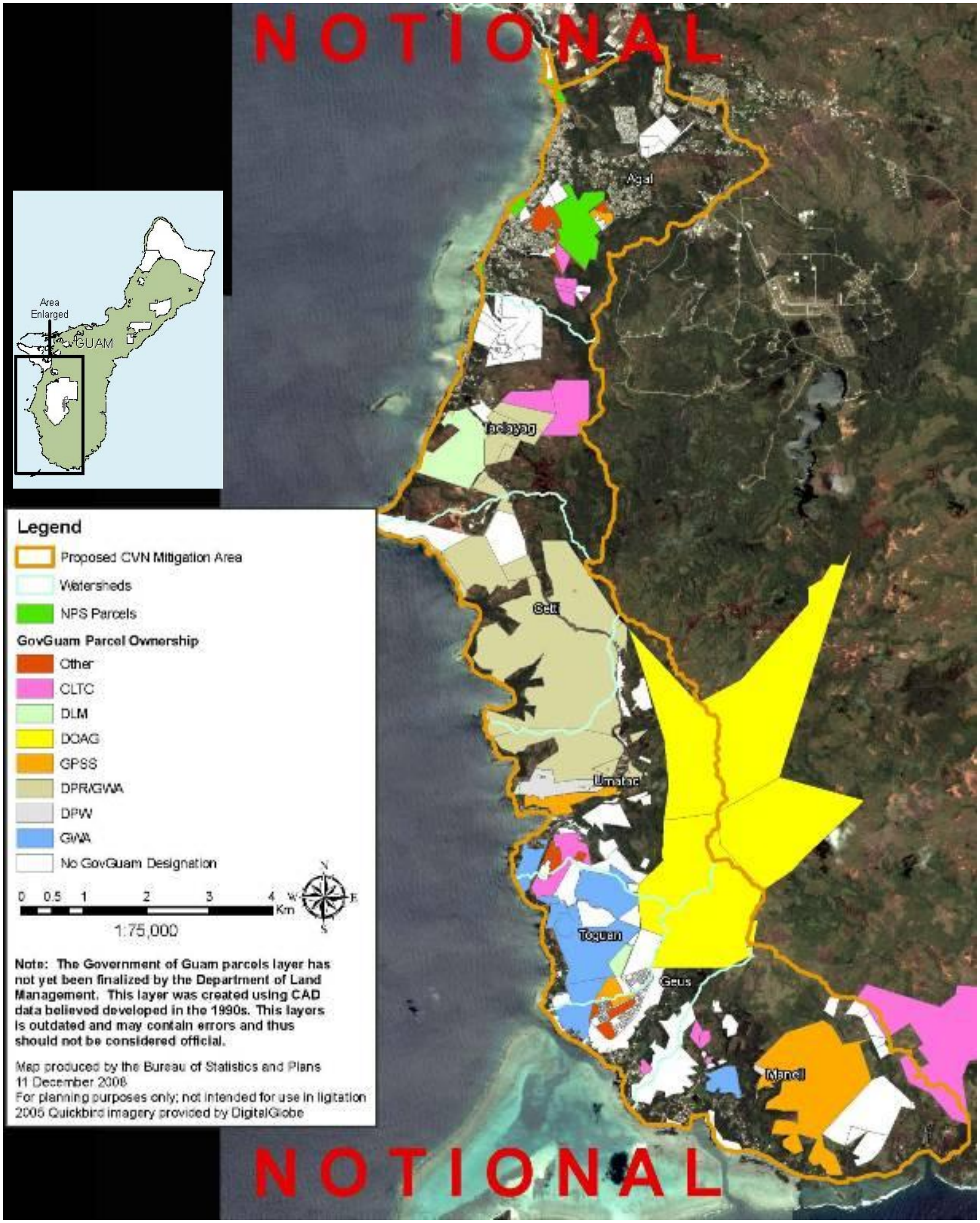

Figure 11.2-6. Mitigation Area, GovGuam Parcel Ownership

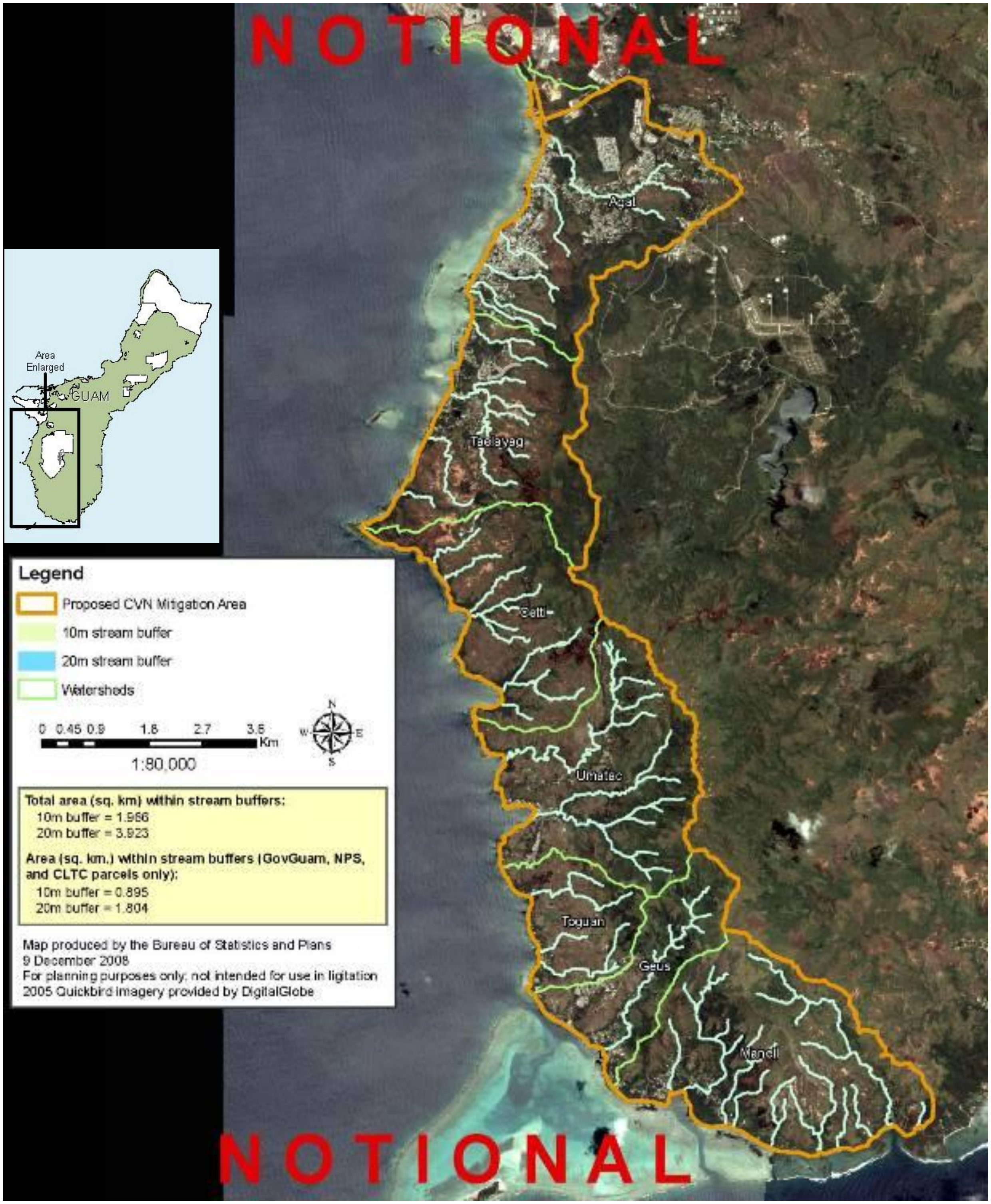

Figure 11.2-7. Mitigation Area, Riparian Buffers for Stream

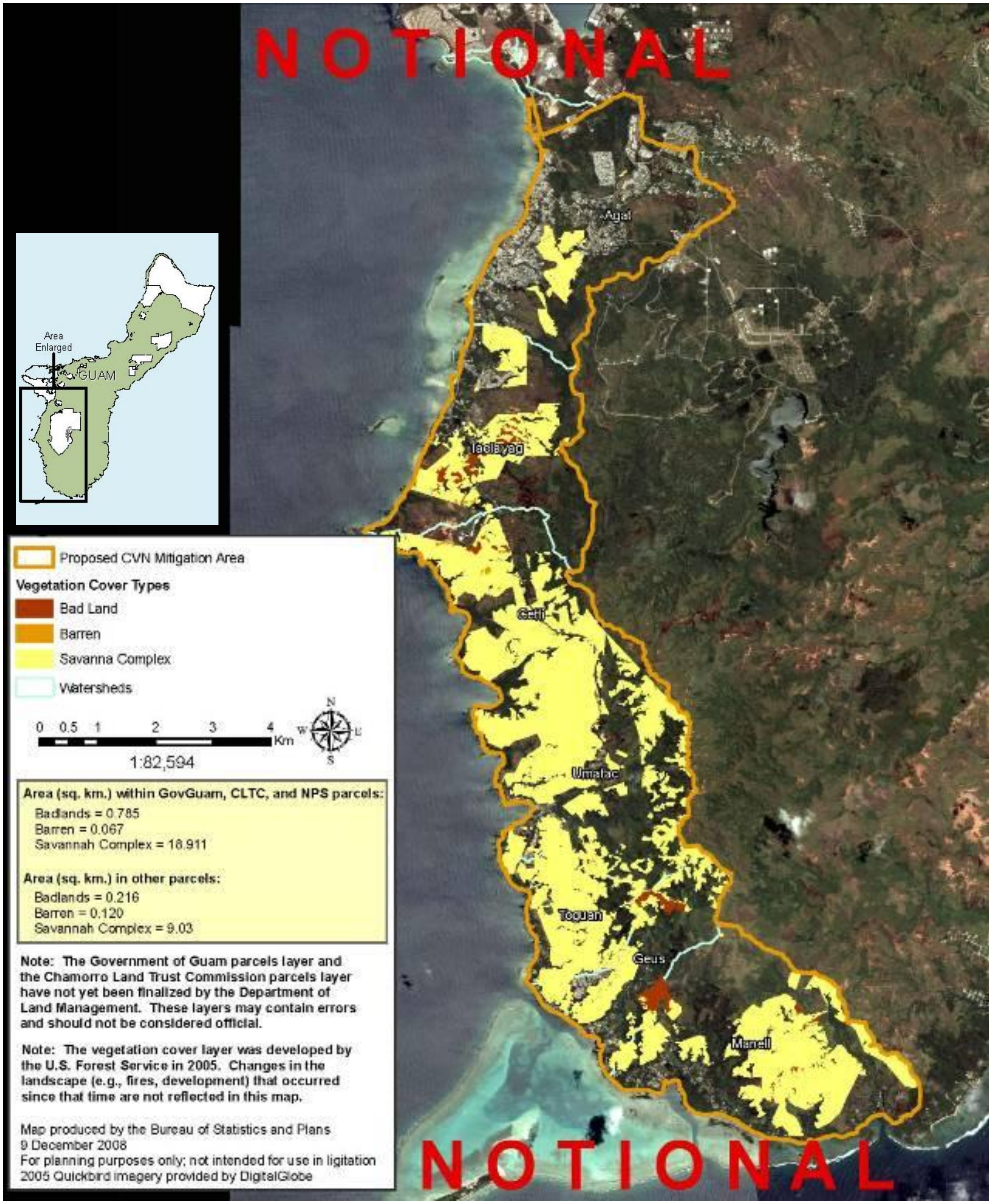

Figure 11.2-8. Mitigation Area Vegetation Types

The potential for watershed restoration on privately owned lands would be limited as these types of projects require full control of the land and its uses to be successful. A Sella Bay watershed restoration project was proposed as compensatory mitigation for coral loss at Kilo Wharf. However, because land use was not totally controlled and management agreements could not be concluded, the project had to be moved to Cetti Watershed on GovGuam land. It may be possible, however, to have a combination of reforestation/afforestation on some smaller scale when done in conjunction with watershed restoration projects on Navy-owned or GovGuam lands, artificial reef installation within Apra Harbor or other areas, and/or riparian enhancement that would benefit fish, corals, and other marine organisms. According to GDAWR (2010) "The Ceti Bay watershed restoration project is a ten year project and currently the project is only in its third year. Logistical issues are more of a concern than control of land."

Stream bank stabilization. Stabilization of stream banks within watersheds would involve the placement of vegetation and/or mechanical rip rap revetment on banks of rivers and streams to minimize erosion and sediment laden run-off from entering sensitive riverine systems. The design's major factors would include: a) capability of conveying peak runoff flows produced by major storms and b) maintenance crew accessibility to structural BMPs for vegetation maintenance (i.e., through cutting vs. spraying) and rip rap/revetment repair.

Coastal Water Resources Management

Coastal water resource management is a collective term to describe a variety of projects that would improve the quality or diminish anthropogenic stresses on nearshore coastal waters in order to improve management efforts and water quality, resulting in recolonization or improved growth of existing coral in those coastal waters. Addressing upland watershed issues prior to coastal efforts is an important process.

The following projects could be used separately or in conjunction to develop a conceptual mitigation plan for coastal water resources management:

Shallow Water Reef Enhancement – coral transplanting within non-DoD lands (e.g. National Historic Parks). This type of project would include the transplanting of a significant quantity of coral that would be removed by the proposed dredging project. The objective of shallow water reef enhancement is to minimize coral colony mortality by transplanting coral to several new sites on Navy submerged lands. Transplantation site selection criteria would include physical, chemical, and biological factors. Studies have shown that larger intact colonies survive transplanting much better than small or fragmented colonies. Larger colonies also have far greater reproductive potential than small ones. Therefore, these types of projects often focus on transplanting large specimens. A detailed transplantation plan would be prepared which would include methods for moving large colonies, techniques for stabilizing the colonies at the transplant site, and monitoring protocols.

A direct and predictable relationship between a specific watershed project(s) and replacement of coral function is difficult to determine. Therefore, it would be difficult to predict how many watershed projects and of what type would be required to restore the productivity lost due to dredging. On the other hand, the effectiveness of artificial reefs would be more readily quantified as to its success in replacing lost coral function and value. However, all mitigation options are under consideration at this time.

Wetland/mangrove restoration. This type of project would include mangrove and/or wetlands enhancement. This may be determined using the Guam BSP developed system of reference wetlands as a baseline for future classification and to establish a basis for ecological function when formulating the scope and extent of potential compensatory mitigation.

Establishment of Marine Protected Areas. This would include the addition of special conservation areas associated with federally-owned submerged lands in and around Guam and the possibility of agreements with GovGuam to create contiguous areas. This option may also include the expansion of existing federally-owned marine and adjacent terrestrial conservation areas around Guam, including the beaches and limestone forest area inland from the marine conservation areas. The expanded marine conservation areas would include shallow water benthic habitat that contains both hard and soft corals. The management plans for the creation of new conservation areas or the expansion of existing conservation areas would be modified, in coordination with GOVGUAM, to provide for adaptive management which could include limitations on activities that could result in adverse effects to EFH.

Additional information would be provided in the compensatory mitigation plan prior to issuance of the USACE permit.

Upgrades/Improvements Wastewater Management Systems. This project would involve upgrading Guam treatment plants and ocean outfalls to have refurbished primary and/or upgraded to secondary treated effluent to improve coastal water quality that may result in benefits to the coral reef community and EFH in the coastal zone of Guam.

Apra Harbor Water Resource Management

This category includes a variety of projects that intend to diminish anthropogenic stresses on Apra Harbor in order to improve water quality, resulting in improved conditions and growth for the coral reef ecosystems present.

The following projects could be used separately or in conjunction to develop a conceptual mitigation plan for Apra Harbor water resources management:

Artificial reefs. An artificial reef is a man-made, underwater structure, typically built for the purpose of promoting marine life in areas of generally featureless bottom. Artificial reefs can be created by a number of different methods. Many reefs "are built" by deploying existing materials in order to create a reef (e.g., sinking oilrigs, scuttling ships, or by deploying rubble, tires, or construction debris). Other artificial reefs are purpose built (e.g., the reef balls) from PVC and/or concrete. Regardless of construction method, artificial reefs are generally designed to provide hard, 3-dimmentional surfaces to which algae and invertebrates attach, which in turn attracts fish species providing food habitat for fish assemblages. Car and Hixon (1997) "identified that methods used to evaluate the performance of an artificial reef will vary according to the purpose for which the reef was built. They found that artificial reefs with structural complexity and other abiotic and biotic features similar to those of natural reefs would best mitigate in-kind losses of reef fish populations and assemblages from natural reefs – specifically they compared colonization and subsequent assemblage structure of reef fishes on coral and artificial (concrete block) reefs where reef size, age, and isolation were standardized. Although species richness and fish abundance (all species combined) were greater on natural reefs vs. artificial structures, substantial differences in species composition were not detected."

This type of project would be a direct application of a HEA derived artificial reef project in Apra Harbor. The Navy would install an artificial reef in approximately 80+ ft (24.4 + m) of water (to ensure its survival even in a super-typhoon) using one or more agreed upon artificial reef concepts. Reef alternatives may include "Z blocks" (used in Hawaii), Biorock, and Reefballs. Suggestions of other artificial reef options would be welcomed. Placement would be on the harbor floor and would not affect hard substrate. A mitigation site would be located within the ESQD arc of Kilo Wharf (to prevent the reef from being used as a Fish Aggregation Device that would invite recreational or commercial fishing or diving activities). As part of the artificial reef proposal, the HEA restoration project would include the potential use of transplanted coral as part of its compensation strategy.

Success criteria would be based on a replacement of benthic structure and on percent coral cover, as a proxy to ecosystem function. Long-term monitoring would be implemented to measure success. Potential Guam INRMP projects associated with the artificial reef could include assessment of functions these structures provide. Artificial reefs, though quantitatively easier to scale for a ratio between replacement and function lost than watersheds, have been criticized as being primarily fish aggregating devices that do not increase coral community productivity. In other words, the replacement of structure does not necessarily equate to a restoration of coral community function.

Shallow water reef enhancement – coral transplanting. This may include transplantation of a significant quantity of coral that would be impacted by the proposed dredging action. The objective of shallow water reef enhancement is to minimize coral colony mortality by transplanting coral to several new sites on Navy submerged lands within Apra Harbor. Transplantation site selection criteria would include physical, chemical, and biological factors.

Wetland/Mangrove enhancement. This would include mangrove and/or wetlands enhancement in Apra Harbor. This may be based on the Guam BSP developed system of reference wetlands as a baseline for future classification and to establish a basis for ecological function when formulating the scope and extent of potential compensatory mitigation.

In-Lieu Fee or Mitigation Banking Program

Within the HEA Administrative Working Group, DoD, and other stakeholders on Guam, there remains support for the use of In-Lieu Fee or mitigation banking programs to manage, implement and monitor the success of natural resource compensatory mitigation projects on Guam. Revised regulations by the USACE and EPA in March 2008 govern compensatory mitigation for authorized impacts to waters of the U.S. under Section 404 of the CWA. In-lieu fee mitigation and mitigation banks have not been established on Guam.

Under mitigation banks, units of restored, created, enhanced, or preserved resources are expressed as "credits" which may subsequently be withdrawn to offset "debits" incurred at a project development site. Ideally, mitigation banks are constructed and functioning in advance of development impacts, and are seen as a way of reducing uncertainty in the USACE Regulatory program by having established compensatory mitigation credit available to an applicant.

In-Lieu-Fee mitigation occurs in circumstances where a permittee provides funds to an In-Lieu-Fee sponsor instead of either completing project-specific mitigation or purchasing credits from an approved mitigation bank. The program sponsor periodically funds a consolidated mitigation project from the proceeds of the accumulated In-Lieu-Fees. A memorandum of understanding would be executed among DoD, regulators and stakeholders that establishes an In-Lieu-Fee Mitigation Sponsor (typically a non-government organization) and a Review Team to determine how the bank would work.

The In-Lieu-Fee amount is based upon the compensation costs that would be necessary to restore, enhance, create or preserve coral ecosystems or other habitats with similar functions or values to the one affected. The fee is banked in an investment account until a project is approved for implementation. The In-Lieu-Fee mitigation bank would be managed by the In-Lieu-Fee Mitigation Sponsor (Sponsor) that uses the accumulated funds to implement projects that restore, enhance, or preserve ecosystems with similar functions and values that are located within the same biophysical region as the permitted disturbance. Key stakeholders, including regulatory agencies, DoD and the Sponsor, form an advisory committee that determines the projects that would be implemented, which provides for effective natural resource adaptive management. The Sponsor is responsible for implementing the project according to an approved work plan.

DEVELOPMENT OF COMPENSATORY MITIGATION PLAN

As more information is gathered on the likely impacts and costs of the compensatory mitigation projects under consideration, a more detailed mitigation plan would be developed to comply with requirements of the USACE-GEPA 2008 Compensatory Mitigation Rule. The preparation and implementation of an approved Compensatory Mitigation Plan is the Navy's mitigation for adverse impacts to coral. A USACE permit would be required for the construction of the aircraft carrier wharf due to alteration of navigable waters and discharge of fill materials into the water. This permit is the vehicle through which compensatory mitigation will be implemented. Under the permit, selection, scaling, and implementation of compensatory mitigation projects would be carried out in consultation with USACE, NOAA, USFWS, USEPA and GovGuam. The HEA discussed previously is one tool designed to quantify the ecological loss to coral reef habitat. The HEA or other ecological equivalency evaluation tools would then be used to evaluate the ecological benefits from the proposed compensatory mitigation projects. The permit, which includes the compensatory mitigation plan, would determine the ecological loss and the equivalent ecological benefit (i.e. no net ecological loss) from the proposed compensatory mitigation projects. The financial aspect does not come into consideration until after the mitigation projects have been selected (e.g., execution costs of the mitigation projects).

11.2.3 Compensatory Mitigation Impact Analysis

Both Alternative 1 and Alternative 2 berthing alternatives underwent the Navy's project planning and development process, which included detailed engineering, oceanographic, and biological studies in an effort to avoid and/or minimize adverse impacts to coral reefs or coral reef habitat, and special aquatic resources, while also considering necessary operational and cost factors. The construction alternatives would have unavoidable adverse impacts to coral reefs. The impact analysis for each alternative is summarized in Section 11.2.5 and found that direct impacts on coral reef communities from dredging removal would be long-term, while indirect impacts from dredging-related sedimentation may be initially adverse out to 40 ft (12 m), long-term adverse impacts are likely to be minimal and reversible.

Impacts to coral reef communities will also be prevented and lessened through the implementation of BMPs during the construction process. In particular, placement of construction barge and vessel anchors and mooring lines, cables, and chains will be prohibited on areas of high (i.e., >90 %) live coral cover. Silt curtains will also be employed to reduce the potential impacts of increased sedimentation on the coral reef community. During pile driving or dredging activities, if a visible plume is observed over sensitive coral habitat outside the silt curtains, the construction activity would stop, be evaluated, and corrective measures taken. Construction would not resume until the water quality has returned to ambient conditions.

As described earlier in this Chapter, a USACE permit would be required for both Alternatives for alteration of navigable waters and discharge of fill material into the water. This permit is the vehicle through which compensatory mitigation would be implemented. The project will be designed to avoid coral reef habitat impacts and to minimize any unavoidable impacts. Unavoidable impacts will be mitigated through implementation and/or funding of mitigation measures to compensate for the resulting loss of ecological functions and/or services. Selection, scaling, and implementation of appropriate compensatory mitigation actions is being carried out in consultation with USACE, NOAA Fisheries, USFWS, USEPA, and GovGuam resource agencies. The action alternatives would take place on DoD lands. The Navy determined that both Alternatives would be consistent with the Guam Coastal Management Program to the maximum extent practicable. As previously stated, there are three programmatic compensatory mitigation categories, which may include a combination of projects from each category, under consideration (described earlier in this Chapter and evaluated later in this Section): (1) Watershed Restoration and Management; (2) Coastal Water Resource Management; and (3) Apra Harbor Water Resource Management.

Reducing the flow of terrigenous sediments into Guam's southwest coastal areas associated with the four main watersheds would have beneficial impacts to coral reef communities and associated habitats adversely affected by ongoing sedimentation and decreased water quality by allowing them to re-establish themselves, other anthropogenic or natural factors notwithstanding (e.g., overfishing, major storm events, bleaching events, etc.). The USACE has indicated that compensatory mitigation projects need to be maintained in perpetuity, requiring the execution of binding agreements in perpetuity. Parties need to execute long-term agreements that meet federal and GovGuam real estate and legal requirements for watershed projects to be implemented. Accordingly, the Navy, with USACE support, will identify a package of compensatory mitigation projects to be implemented on lands that can be committed in perpetuity. The Navy's compensatory mitigation plan will consist of three categories, including multiple project components of each: Watershed Restoration and Management; Coastal Water Resource Management, and Apra Harbor Water Resource Management (Table 11.2-10).

Table 11.2-10: Summary of Compensatory Mitigation Actions

Proposed Mitigation Action	*Description*
Proponent: Federal & Territory Resource Agencies	
Watershed Restoration and Management	Reforestation/Afforestation of savanna vegetation in four potential watersheds (Ugum, Umatac, Toguan, and Geus) to address on-going problems of reef degradation due to eroded sediments from upland sources. This may also include: stream bank stabilization; riparian restoration; road stormwater BMPs; erosion control; wetland enhancement; land acquisition/easement for conservation; and educational efforts.
Coastal Water Resource Management	Restoration and improved water quality and natural resource management of the following subwatershed and watershed areas: • Achugao Subwatershed – Coastal waters and beach south of Achugao Point located in the southwestern portion of Guam. This beach is the discharge point for *Agaga River* associated with the Cetti Watershed. • Fouha Subwatershed – Coastal waters at the head of Fouha Bay, located south of Cetti Bay, in the southwestern portion of Guam. Fouha Bay is the discharge point for the *La Sa Fua River* associated with Umatac Watershed in the southwestern portion of Guam. • Geus Watershed – Coastal waters and marine bay (5 mi^2 [13 km^2]) associated with Cocos Lagoon located at the southern tip of Guam. The *Geus River*, associated with the Geus Watershed, discharges into the Cocos Lagoon. • Ajayan Subwatershed – Coastal waters and intermittent beach at Ajayan Bay located east of Cocos Lagoon. The *Ajayan River*, associated with the Manell Watershed, discharges into Ajayan Bay. Also included: road stormwater control at a range of sites on Guam; shallow water reef enhancement within non-DoD lands (e.g. National Historic Parks) (e.g. acquisition, erosion control, wetland restoration, artificial reefs, coral transplanting, boundary marking & enforcement, monitoring, education); aquaculture (e.g. fish hatchery) for native herbivorous species; support for enhanced enforcement of fishing and recreational diving regulations, protection and conservation actions (e.g. marine debris removal, nuisance algae removal, installation of recreational mooring buoys); establishment of marine protected areas(s); upgrades/improvements to wastewater management systems
Apra Harbor Water Resource Management	• Improved water quality and natural resource management, including the following types of projects: erosion control; stormwater management (e.g. roads, wharves, industrial facilities); artificial reefs in deep water artificial reef in Outer Apra Harbor; shallow water reef enhancement – coral

Table 11.2-10: Summary of Compensatory Mitigation Actions

Proposed Mitigation Action	*Description*
Proponent: Federal & Territory Resource Agencies	
	transplanting; glass breakwater modifications; wetland/mangrove enhancement; revised Navy management plans; support for enhanced enforcement of fishing and recreational diving regulations; education; protection and conservation actions (e.g. marine debris removal, nuisance algae removal, installation of recreational mooring buoys); • Artificial reefs would be either scaled to complement other mitigation projects or fully offset estimated acre-year losses from either Alternative 1 or 2. Four sites (Glass Breakwater, Kilo Wharf, San Luis Beach, and Sasa Bay) have been evaluated as candidate deep water artificial reef sites. The artificial reef will increase overall biomass and provide direct compensation for lost ecological services through new benthic habitat. • Shallow water reef enhancement may include transplantation of a significant quantity of coral that would be impacted by the proposed action to several new sites on Navy submerged lands in Outer Apra Harbor.
In-Lieu Fee	• As described above, mitigation banking of units of restored, created, enhanced, or preserved resources are expressed as "credits" which may subsequently be withdrawn to offset "debits" incurred at a project development site. Ideally, mitigation banks are constructed and functioning in advance of development impacts, and are seen as a way of reducing uncertainty in the USACE Regulatory program by having established compensatory mitigation credit available to an applicant. • In-Lieu-Fee mitigation occurs in circumstances where a permittee provides funds to an In-Lieu-Fee sponsor instead of either completing project-specific mitigation or purchasing credits from an approved mitigation bank. The program sponsor periodically funds a consolidated mitigation project from the proceeds of the accumulated In-Lieu-Fees. A memorandum of understanding would be executed among DoD, regulators and stakeholders that establishes an In-Lieu-Fee Mitigation Sponsor (typically a non-government organization) and a Review Team to determine how the bank would work. • The In-Lieu-Fee amount is based upon the compensation costs that would be necessary to restore, enhance, create or preserve coral ecosystems or other habitats with similar functions or values to the one affected. The fee is banked in an investment account until a project is approved for implementation. The • In-Lieu-Fee mitigation bank would be managed by the In-Lieu-Fee Mitigation Sponsor (Sponsor) that uses the accumulated funds to implement projects that restore, enhance, or preserve ecosystems with similar functions and values that are located within the same biophysical region as the permitted disturbance. Key stakeholders, including regulatory agencies, DoD and the Sponsor, form an advisory committee that determines the projects that would be implemented, which provides for effective natural resource adaptive management. The Sponsor is responsible for implementing the project according to an approved work plan.

11.2.3.1 Watershed Restoration and Management for Ugum, Umatac, Toguan, and Geus Areas

The recommended watersheds have not been fully evaluated to determine their suitability, but are being considered by the Navy as options for mitigation. These watersheds are associated with reefs that are degraded by sedimentation, but were healthy a few decades ago (USFWS 2009a).

Project objectives would be to conduct forest habitat restoration to ultimately improve water quality in a watersheds that has waters that flow into valuable marine resource areas. Most of the potential restoration projects would involve the planting of tree seedlings in grasslands and grasses or tree seedlings in badland areas as well as in fertile valley areas of watersheds. Important elements of a successful watershed restoration project include but are not limited to animal control, monitoring and continuous watershed management.

The watershed areas total approximately 12,500 ac (5,058 ha) along the southwestern coast of Guam, extending from south of Naval Base Guam to the southern point of Guam and Cocos Island. The watershed area was selected because there is evidence that coral communities have previously existed in the receiving coastal waters. Under improved water quality conditions, these coral communities could be restored. A general summary of each watershed is described below and shown on Figure 11.2-9.

UGUM

"The Ugum watershed is located in the southwest of Talofofo Bay. It is an inland watershed, which drains into Talofofo watershed. It has a drainage area of 7.31 mi^2 (18.93 km^2). The main rivers in the watershed include Ugum River, Bubulao River, Atate River and Leygo River with approximate lengths of 6.05 mi (9.7 km), 4.84 mi (7.7 km), 1.24 mi (1.9 km) and 1.16 mi (1.8 km) respectively. Leygo River discharges to Atate River, which merges to Ugum River in the southwest of the watershed. Bubulao River discharges to Ugum River from west to east. Uguam River discharges to Talofofo River. The highest elevation is about 1,227 feet (374 meters) in the southwestern boundary of the watershed. The vegetated area is about 96.9%. This is a less developed watershed. The soil types mainly include Ylig clay, Akina-Atate silty clay, Akina silty clay, Togcha-Akina silty clays, Pulantat clay, Akina-Badland complex, Agfayan clay, Sasalaguan clay, rock and urban land complex" (WERI 2010).

UMATAC

"The Umatac watershed is located in the southwest coast of Guam, in the north of Merizo and the south of Agat. It has a drainage area of 3.84 mi^2 (9.9 km^2). The main rivers in the watershed include La Sa Fua River, Laelae River, Madog River, Chagame River and Astaban River with approximate lengths of 2.11 mi (3.3 km), 1.9 mi (3.0 km), 1.59 mi (2.5 km), 1.02 mi (1.6 km) and 0.2 mi (0.3 km) respectively. Chagame River flows from north to south, and merges to La Sa Fua River which discharges to Fouha Bay in the Philippine Sea. Astaban River discharges to Madog River, which merges to Umatac River. Laelae River drains from east to west to Umatac River. Umatac River discharges to Umatac Bay. The highest elevation is about 1,243 ft (379 m) in the eastern boundary of the watershed. The vegetated area is about 97.4%, and urban area is about 2%. The soil types mainly include Ylig clay, Akina-Atate silty clays, Togcha-Akina silty clays, Akina-Badland complex, Inarajan clay, rock and urban land complex" (WERI 2010).

TOGUAN

"The Toguan watershed is located between the villages of Umatac and Merizo. It has a drainage area of 1.41 mi^2 (3.6 km^2). The main rivers in the watershed include Toguan Creek, Pigua River and Bile River with approximate lengths of 1.38 mi (2.2 km), 1.09 mi (1.7 km) and 0.73 mi (1.1 km) respectively. Toguan Creek drains to Toguan Bay in the Philippine Sea, and Bile River and Piguan River discharge to Bile Bay in the Philippine Sea. All these rivers flow from east to west. The highest elevation is about 1043 ft (318 m) in the eastern boundary of the watershed. The vegetated area is about 94.6%, and urban area is about 4%. The soil types mainly include Ylig clay, Togcha-Akina silty clays, Akina-Badland complex, Sasalaguan clay, Inarajan clay, rock and urban land complex" (WERI 2010).

GEUS

"The Geus watershed is located in the southwest of Guam. Most of the watershed is located in Merizo Village. It has a drainage area of 1.73 mi^2 (4.5 km^2). The main river Geus River with approximate lengths of 2.71 mi (4.3 km). Geus River discharges to the Philippine Sea. The highest elevation is about 833 feet (254 m) in the east of the northern watershed. The forest area is about 90.1%, and the developed area is about 4.8%. The soil types mainly include Ylig clay, Inarajan clay, rock and urban land complex" (WERI 2010).

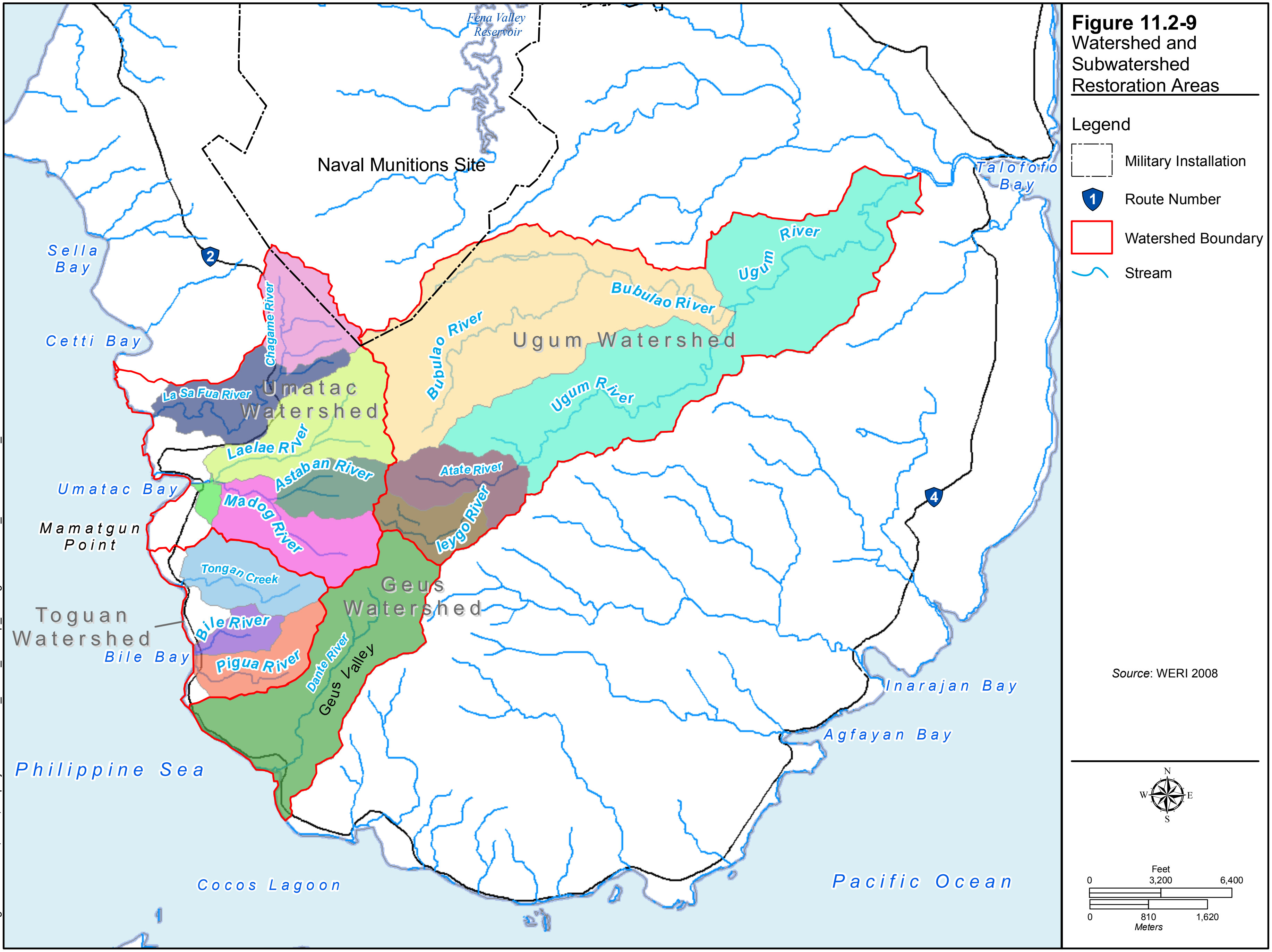

Figure 11.2-9
Watershed and Subwatershed Restoration Areas
Legend
Military Installation
Route Number
Watershed Boundary
Stream
Source: WERI 2008
Feet
0
3,200
6,400
0
810
1,620
Meters
N
S
E
W
Naval Munitions Site
Fena Valley Reservoir
Talofofo Bay
Sella Bay
Cetti Bay
Umatac Bay
Mamatgun Point
Toguan Watershed
Bile Bay
Philippine Sea
Cocos Lagoon
Pacific Ocean
Inarajan Bay
Agfayan Bay
Ugum Watershed
Umatac Watershed
Geus Watershed
Geus Valley
Ugum River
Bubulao River
Chagame River
La Sa Fua River
Laelae River
Astaban River
Madog River
Atate River
Ieygo River
Tongan Creek
Bile River
Pigua River
Dante River
2
4

AFFECTED ENVIRONMENT

The discussion of the existing watershed environment includes a summary of the physical, marine and terrestrial biological setting, social and economic environment; infrastructure and services; and hazardous and regulated materials and waste.

Air Quality

Guam's air quality is discussed in Chapter 5 of this Volume. The subject watersheds contain Badlands or areas of bare soil subject to high erosion rates and dusty conditions and the watershed experiences wild land fires which create dust and smoke particulates in the area.

Geology and Soils

The subject watersheds are located in the southern structural province of Guam which is predominantly volcanic in origin and underlain by highly weathered basalt and tuff-derived sedimentary rocks. The western boundary of some of the watersheds coincides with Mount Jummulong Manglo, rising to 1,095 ft (334 m) above sea level. These watersheds are largely underlain by the Facpi Formation, one of the two oldest geologic units on Guam. The Facpi Formation is composed of Eocene age volcanics which underlie all other exposed rock units on the island. This formation contains a series of pillow basalts and water-laid pyroclastic rocks ranging from tuffaceous shale to coarse boulder conglomerate and breccias (Gingerich 2003). Separate volcanic rocks of Oligocene to late Miocene age comprise the Umatac Formation and lay on top of the Alutom Formation. They crop out principally in the south-central highlands and plateaus and contain reef and forereef limestone, tuff breccia and volcanic conglomerate, and basalt flows (Meijer and others 1983; Reagan and Meijer 1984). The permeability of the formation is considered low (Gingerich 2003). The drainage pattern within the southern structural province is the result of numerous faults. A range of low mountains forms the majority of the topographic divide of the catchment area (GovGuam DOA GEPA 2007).

Volcanic rocks of southern Guam are locally overlain by limestone. The top of the mountainous ridge and central basin are covered by old limestone units. They are Miocene to Pliocene age and are known as Bonya and Alifan Limestone. Eastern coast and Orote Peninsula comprise of younger limestone. It is

Pliocene to Pleistocene age and is called Mariana Limestone. This limestone is clay-rich in the vicinity of volcanic uplands.

Finally, there are minor reef limestone, beach deposits, and alluvium of Holocene age. The beach deposits are composed of poorly consolidated calcareous sand and gravel or volcanic sand. Alluvial deposits fill stream valleys and cover parts of the coastal lowlands.

Southern Guam has eight simplified soils: Akina-Agfayan, Akina-Togcha-Ylig; Guam; Guam-urban land-Pulantat; Inarajan; Pulantat; Pulantat-Kagman-Chacha; and Ritidian-rock outcrop-Guam (WERI 2010). Specific soil types for each water shed are described in Table 11.2-11.

Table 11.2-11 Watershed Soil Types

Watershed	*Main Soil Types**
Ugum	Ylig clay, Akina-Atate silty clay, Akina silty clay, Togcha-Akina silty clays, Pulantat clay, Akina-Badland complex, Agfayan clay, Sasalaguan clay, rock and urban land complex
Umatac	Ylig clay, Akina-Atate silty clays, Togcha-Akina silty clays, Akina-Badland complex, Inarajan clay, rock and urban land complex
Toguan	Ylig clay, Togcha-Akina silty clays, Akina-Badland complex, Sasalaguan clay, Inarajan clay, rock and urban land complex.
Geus	Ylig clay, Inarajan clay, rock and urban land complex

Source: WERI 2010

The Akina soils, which are formed in residuum derived dominantly from tuff and tuff breccia, are generally very deep and well drained. This contrasts with Agfayan soils, which are also formed in residuum, although derived predominantly from marine-deposited tuffaceous sandstones and are very shallow and well drained. Included in these soils are severely eroded areas, commonly called Badlands, as well as small areas of Rock outcrop on ridgelines and knobs. Both Akina and Agfayan are highly susceptible to sheet and rill erosion if not adequately protected by plant cover and litter (COMNAV Marinas 2007b).

Talofofo Bay has a well-documented history of excessive sedimentation. Estimated erosion rates from annual soil detachment from sheet and rill erosion for the nearby Navy-land in Fena subwatershed (included in the Talafofo Watershed) is 49 tons (44 mt) per ac (0.4 ha) per year. The average annual rate of detachment from forested landscapes was estimated at 31 tons (28 mt) per ac (0.4 ha) per year (COMNAV Marinas 2007b).

Current mitigation activities on Navy-land includes manual cutting of vegetation (site preparation), nursery propagation of Acacia seedling, seedling planting at a minimum of 435 seedlings per ac (176 trees/ha), pre- and post-planting monitoring of height and canopy growth. The desired future condition of this area is forested plant community with a minimum tree canopy cover of 70 % (within five years) and less than 30 % exposed soil. Once established, the planted mitigation sites will be identified as protected sites and will be maintained in perpetuity through operations and maintenance funds identified in the COMNAV Marinas INRMP (COMNAV Marinas 2007b).

Hydrology

On Guam, streams are present only in the south where low-permeability volcanic rocks slow the infiltration of rainwater and allow groundwater to discharge to streams. In southern Guam, much of the fresh groundwater discharges directly to stream valleys above sea level where the ground surface intersects the water table. Minor perched systems are found in some of the higher-altitude limestone overlying the volcanic rocks of southern Guam. Groundwater flows laterally along the impervious layers of volcanic rock unit until it diffuses into seeps, springs, streams, or wetlands. The quantity of surface water stored in streams and wetlands is dependent on the seasonality, intensity, and duration of rainfall. Once the soil profile is saturated, any additional rainfall is diffused into the streams and travels to the ocean (Gingerich 2003).

As described previously in this Section and shown below in Table 11.2-12, the watersheds and their hydrologic information as described by WERI (2010) is summarized:

The Ugum watershed is has a drainage area of 7.31 sq. miles (2.8 km^2). The main rivers in the watershed include Ugum River, Bubulao River, Atate River and Leygo River with approximate lengths of 6.05

miles (9.7 km), 4.84 miles (7.7 km), 1.24 miles (1.9 km) and 1.16 miles (1.8 km) respectively. The Leygo River discharges to Atate River, which merges to Ugum River in the southwest of the watershed. Bubulao River discharges to Ugum River from west to east. The Ugum River discharges to Talofofo River. The highest elevation is about 1,227 feet (374 meters) in the southwestern boundary of the watershed. The Umatac watershed has a drainage area of 3.84 square miles (9.9 km^2). The main rivers in the watershed include La Sa Fua River, Laelae River, Madog River, Chagame River and Astaban River with approximate lengths of 2.11 miles (3.3 km), 1.9 miles(3.0 km), 1.59 miles (2.5 km), 1.02 miles (1.6 km) and 0.2 mile (0.3 km) respectively. Chagame River flows from north to south, and merges to La Sa Fua River which discharges to Fouha Bay in the Philippine Sea. Astaban River discharges to Madog River, which merges to Umatac River. Laelae River drains from east to west to Umatac River. Umatac River discharges to Umatac Bay. The highest elevation is about 1,243 feet (379 meters) in the eastern boundary of the watershed. The Toguan watershed has a drainage area of 1.41 sq. miles (3.6 km^2). The main rivers in the watershed include Toguan Creek, Pigua River and Bile River with approximate lengths of 1.38 miles (2.2 km), 1.09 miles (1.7 km) and 0.73 mile (1.1 km) respectively. Toguan Creek drains to Toguan Bay in the Philippine Sea, and Bile River and Piguan River discharge to Bile Bay in the Philippine Sea. All these rivers flow from east to west. The Geus has a drainage area of 1.73 sq. miles (4.4 km^2). The main river Geus River with approximate lengths of 2.71 miles (4.3 km). Geus River discharges to the Philippine Sea. The highest elevation is about 833 feet (254 meters) in the east of the northern watershed.

Table 11.2-12. Watershed Hydrologic Characteristics

Watershed	*Total Area*	*Main Rivers*	*River Lengths*	*Highest Elevation*
Ugum (and Talofofo)	7.31 mi^2 (2.8 $km^{2)}$	Ugum Bubulao Atate Leygo	6.05 mi (9.7 km) 4.84 mi (7.7 km) 1.24 mi (1.9 km) 1.16mi (1.8 km)	1,227 ft. (374 m)
Umatac	3.84 mi^2 (9.9 km^2)	La Sa Fua Laelae Madog Chagame Astaban	2.11 mi (3.3 km) 1.9 mi (3.0 km) 1.59 mi (2.5 km) 1.02 mi (1.6 km) 0.2 mi (0.3 km)	1,243 ft. (379 m)
Toguan	1.41 mi^2 (3.6 km^2)	Toguan (creek) Pigua Bile	1.38 mi (2.2 km) 1.09 mi (1.7 km) 0.73 mi (1.1 km)	1,043 ft. (318 m)
Geus	1.73 mi^2 (4.4 km^2)	Geus	2.71 mi (4.3 km)	833 ft. (254 m)

Coastal Environment

Figure 11.2-10 and 11 provides the coastal wetland and benthic habitat mapping for the watersheds of southern Guam (Burdick 2006).

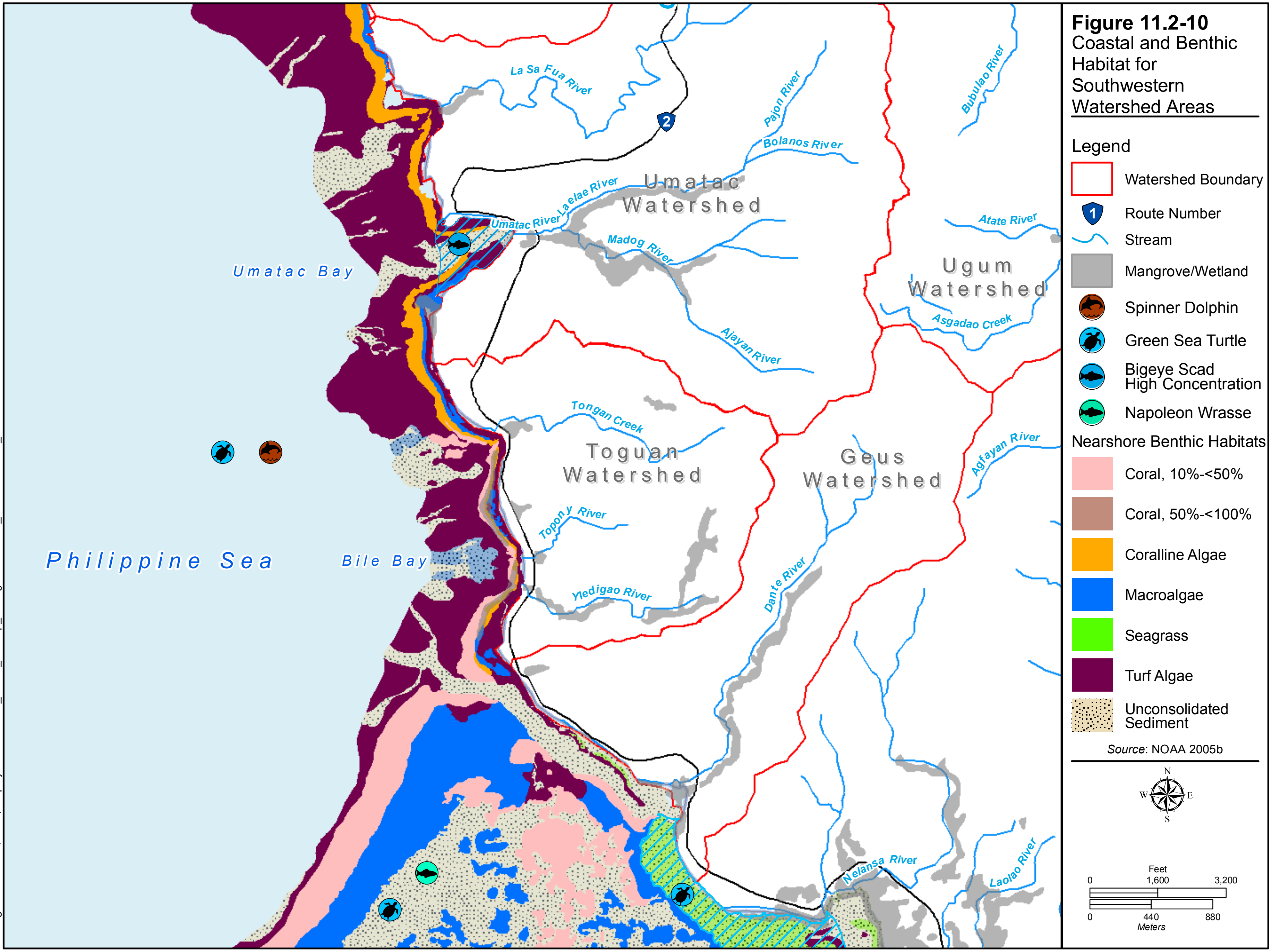

Figure 11.2-10 Coastal and Benthic Habitat for Southwestern Watershed Areas

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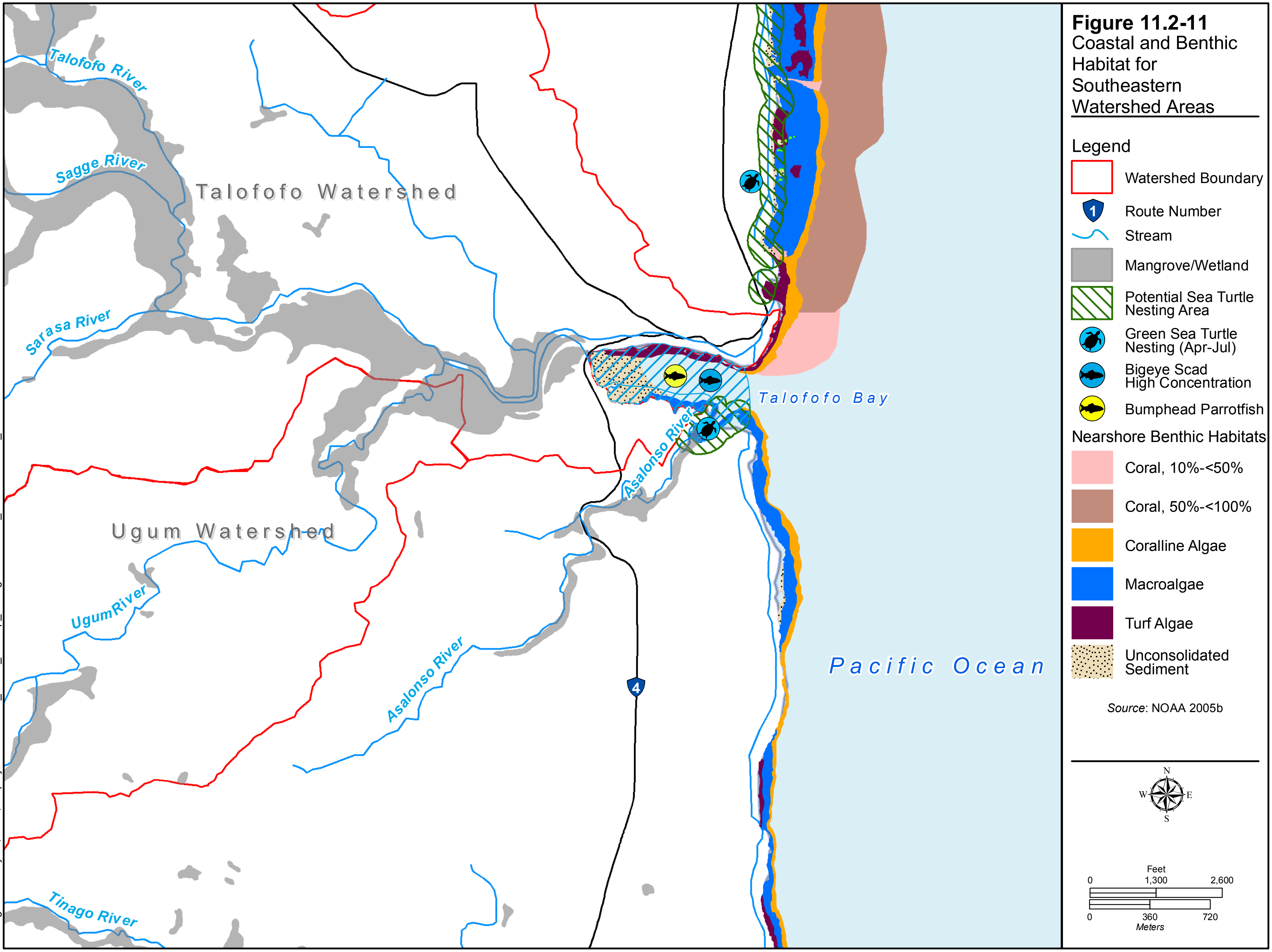

Figure 11.2-11
Coastal and Benthic Habitat for Southeastern Watershed Areas

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With respect to the Ugum and Talofofo watersheds, WERI states: "The Ugum water shed (and Talofofo watershed) drains to Talofofo Bay on the east side of the island. It is a long, narrow embayment, heavily influenced by the Talofofo River. Dimensions of the bay are about 1,000 ft (305 m) wide by 3,500 ft (1,067 m) long, comprising about 1.5 mi (2.4 km) of coastline (between Adjoulan Point and Matala Point – the two prominent headlands). Benthic habitats identified by NOAA (NCCOS 2005) include a large uncolonized area adjacent to the Talofofo River estuary with turf and macroalgae margins on north and south sides of the bay, respectively (refer to Figure 11.2-11). Coraline algae and coral reef habitats are found outside the mouth of the bay on the north side around Adjoulan Point. The beach and harbor bottom consists of fine, chocolate-brown sand deposited by the river which gives the water in the bay a murky orange color. The shoreline of the bay is eroding in places and shoreline hardening projects have been implemented to protect public facilities" (WERI 2010).

As described by WERI (2010) reefs almost completely surround southern Guam. They are cut by numerous bays at the mouths of the large permanent streams that drain volcanic uplands. Reefs in southern Guam are extremely diverse environments and consist of many distinct habitats.

Reef flats are relatively flat platforms that extend from the shoreline to the wave-washed reef margin. They can be from just a few meters to over a kilometer wide. Some reef flats are intertidal and nearly completely exposed during low tides. Others have deeper areas known as "moats", which retain water at all times. The reef flat zone can be covered by algal pavement, sea grass beds, staghorn (*Acropora*) thickets, *Porites* microatolls, fields of sand and rubble, and macroalgae.

Reef margin is the edge of a fringing reef, where the waves crash against the reef. They are almost always washed with surf and support encrusting algae and other tough organisms that can resist constant wave action.

The area extending seaward from the reef margin is known as the reef front. Coral communities in this zone are directly related to the level and frequency of wave action. Areas protected from severe waves usually have gentle slopes with tabular or branching corals. Areas with more wave action are steeper and dominated by lower, stout branched corals. The most typical feature of this zone are alternative ridges and vertical sides channels known as "spur and groove" formations.

Slopes descending from the reef to deep water belong to the outer reef zones. They support various coral communities that remain rich and diverse to depths of 131.2 to 196.8 ft. (40-60 m).

Field surveys supplementing the WERI (2010) information discussed above were conducted in May 2010 to assess and document the existing conditions of near-shore marine resources offshore of watersheds on the southwestern coastal area of Guam from Fouha Bay to Bile Bay. Surveys included all reef areas extending from the shoreline to a depth limit of 60 feet (18.3 m). The report is considered a preliminary review and is included in Volume 9, Appendix J.

Surveys were conducted by collecting a total of 780 "calibration/validation" points, each of which consisted of five digital photographs comprising 35.5 ft^2 (3.3 m^2) of the benthic surface (294 sites were within the southwestern watersheds). Preliminary results of these surveys based on visual interpretation of benthic composition were used to develop an initial assessment of the overall reef community structure (Dollar and Hochberg 2010).

The overall physiographic structure of each of the four bays, Fouha Bay, Bile Bay, Toguan Bay, and Umatac Bay, that receive drainage from the southwestern watersheds is similar, consisting of U-shaped bays bisected by sand-filled paleostream channels. On either side of the channels shallow reef flats extend from the shoreline to steeply sloping reef edges that extend to the sandy channel floors. The reef flats are colonized by a variety of small corals and in many cases abundant algae. The reef slopes generally consist large colonies of *Porites* spp. Terrigenous mud from river drainage is apparent on the inner reefs of all of the bays, although in greatly varying amounts, with a north-south gradient of decreasing occurrence. The effects of mud to reef community structure are most apparent in Fouha Bay, where impacts are substantial throughout nearly the entire embayment. In Toguan and Bile Bays, the effects of sediment are restricted to the areas close to the points of river discharge, with the remainders of these bays showing virtually no effects of sediment. The reefs between the embayments consist of gently sloping platforms that extend from the shoreline to offshore sand flats. At the time of the surveys in May 2010, benthic cover of the between-bay areas was dominated by two species of algae (*Padina* sp. and *Chrysocystis fragilis*) which are known to be seasonal in occurrence and will likely disappear during the winter. Based on collected field data, there is a total of 53 acres (21.4 ha) of coral within the survey area of the southwestern watershed reefs, a total of 342 acres (138.4 ha) of frondose and turf algae, and 34 acres (13.7 ha) of mud covered bottom (Dollar and Hochberg 2010).

There are four wetland type communities in southern Guam; freshwater marshes, freshwater swamps, estuaries, and mangrove forests and are described briefly below as stated in WERI (2010).

- Freshwater marshes are a common type of wetlands in southern Guam. These freshwater wetlands in southern Guam are dominated by dense, nearly pure stands of *Phragmites karka* (WERI 2010). Grasses (e.g. *Panicum muticum*), sedges (e.g. *Eleocharis ochrostachys* and *Cyperus spp*.) and the fern *Acrostichum aureum* are also common but are less prevalent (WERI 2010). Freshwater marshes are important habitats for the endangered Marianas Common Moorhen (*Gallinula chloropus guami*) and migratory birds (WERI 2010).
- A second wetland type in southern Guam are freshwater swamps. These swamps are wetlands that contain woody vegetation. Freshwater swamps are typically found on the edges of marshes, along river courses, and in wet depressions in forests (WERI 2010). The largest tract of swamp forest on the island is the Talofofo River Valley (WERI 2010). The most common species found in these areas are *Hibiscus tiliaceus* and *Barringtonia racemosa* (WERI 2010). Others that may be present are *Pandanus tectorius, Cynometra ramiflora* and *Areca catechu* (WERI 2010).
- A third wetland type found in southern Guam are estuaries in coastal regions where fresh and marine waters mix. These areas are characterized by daily tidal flushing or brackish water, and occur primarily of lower channels of rivers. Of Guam's 46 rivers that flow directly into the ocean, nine have true estuarine zones (WERI 2010). The lower channels of these rivers, which are typically only 16.4 ft to 65.6 ft (5-20 m) wide and 3.2 ft to 13.1 ft (1-4 m) deep, have elevated salinity levels that extend 0.3 to 0.99 mi (0.5-1.6 km) upstream (Wilder 1976). The most common indicator plant of river zones with brackish water regimes is *Nypa fruticans* (WERI 2010). Estuarine areas are important habitats for juveniles of many fish species, including jacks, snappers, and surgeonfish (WERI 2010). These areas are also important habitat for adults of many species of rabbitfish, snappers, and several other families of fish (WERI 2010). There are several types of fish and other aquatic organisms that are found only in this type of habitat, including ponyfish, mudskippers, an abundance of crab, oysters, and snails (WERI 2010).
- The fourth type of wetland in southern Guam are mangroves. This wetand is a type of estuarine swamp environment dominated by mangroves and other saltwater-tolerant trees (WERI 2010). WERI notes that all mangrove areas on Guam are located in the southern half of the island, with largest concentrations found along the eastern shores of Apra Harbor and smaller zones present in Merizo and Inarajan (WERI 2010). Guam's mangrove species include *Rhizophora mucronata, R.*

apiculata, Bruguiera gymnorrhiza, Avicennia marina, Lumnitzera littorea, N. fruticans, Xylocarpus moluccensis, Heritiera littoralis, H. tiliaceus and *Acrostichum aureum* (Fosberg 1960; Moore and others 1977). Mangroves are important habitats for juveniles and adults of many fish species, as well as many specialized aquatic invertebrates. In addition, they act as filters, trapping sediment from rivers before it can be deposited on sensitive coral reef habitat. Many species of migratory shorebirds also use Guam's mangrove areas as feeding and resting areas (WERI 2010).

A preliminary identification of wetlands that may be subject to the regulatory jurisdiction of the USACE under section 404 of the Clean Water Act (CWA) (33 Code of Federal Regulations [CFR], parts 320-330), in areas on Guam that may be affected by the proposed alternatives in the Guam and CNMI Military Relocation EIS was conducted in June 2010. The preliminary identification was conducted with remote sensing using multispectral imagery and field determinations (NAVFAC Pacific 2010a).

Wetlands identified are shown in overview format in the wetland study found in Volume 9, Appendix K. Results in each field study area are summarized below.

- Apra Harbor Marine Corps Drive - Numerous wetlands were identified along the Apra Harbor Marine Corps Drive corridor in addition to those previously identified on Navy land by the Navy 2009 study. Some 2009 boundaries in this area were also adjusted, although there were no major changes. Wetlands within the field study area were a mix of palustrine emergent, scrub/shrub, forested, and a few estuarine intertidal wetlands. In some cases the wetlands were probably created by restriction of drainage due to Marine Corps Drive.
- Polaris Point Proposed Armored Amphibious Vehicle Area – A small palustrine forested wetland dominated by *Hibiscus tiliaceus* was found in this area at the shoreline around a man-made drainage feature.
- NMS High Road Proposed Magazine Area – The wetland in this area was found to be less extensive than shown in the Navy 2009 wetland study. The wetland was a mix of palustrine emergent and scrub/shrub.
- South of Fena Lake - The drainage along the Imong River south of Fena Lake had far less wetlands than had previously been mapped. Numerous ravines and river floodplains had been mapped as wetlands and review of previous documentation did not indicate soils had ever been examined in these determinations. In nearly all areas, except for seeps, soils were bright and were not hydric. It is likely these areas are inundated for short periods during high rainfall events but not for periods long enough to develop hydric soils. Seeps were generally palustrine emergent wetlands.
- Almagosa Basin - The large wetland in Almagosa basin was confirmed to have boundaries similar to those previously identified. An additional smaller wetland was found to the east of the large wetland. The large palustrine emergent wetland interior is almost exclusively *Phragmites karka* with various shrubs or trees such as *Hibiscus tiliaceus*, and *Pandanus tectorius*, and in some cases the swamp fern *Acrostichum aureum*, around the perimeter. The smaller wetland to the east had less *Phragmites karka*.
- Access Route to West NMS - Only one small wetland was documented in the field study areas west of NMS; most of this drainage was steep and the stream channel deeply cut. The wetland was on the boundary of a forested and open area and therefore was a mix of palustrine scrub/shrub and emergent.

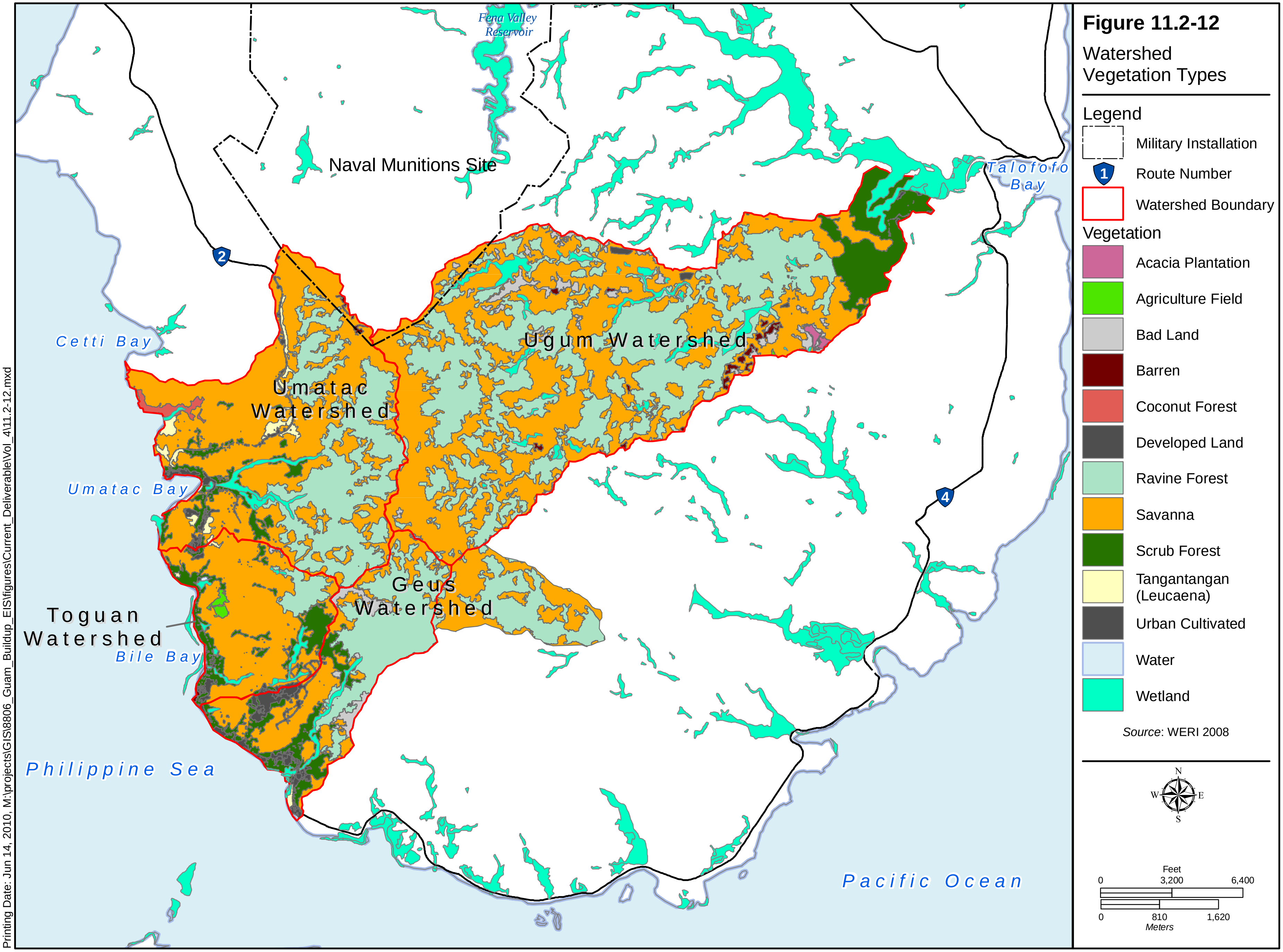
- Barrigada - On Air Force Barrigada and the southern portion of Navy Barrigada the NWI identified wetlands were found to meet the three USACE wetland criteria (NWI boundaries were adjusted), although the jurisdictional status of these wetlands remains to be determined because they are isolated. These wetlands were typically palustrine emergent but in some cases were scrub/shrub. Typically they occupied slightly depressed topographic areas. The NWI wetland identified in north-central Navy Barrigada was not found to meet wetland criteria.
- NCTS Finegayan - Several areas, including two sinkholes, a major storm drainage route, and a flat area that appeared to be a slight topographic low were investigated by observation and documentation of with wetland plots on NCTS Finegayan but no wetlands were found there. NCTS Finegayan has no surface waters, no NWI-identified wetlands, and no hydric soils mapped. Soils observed were typically brightly colored with little indication of any saturation. Soils throughout are typically thin over the limestone bedrock in the area.

Vegetation

Plant communities and vegetation resources of Guam have been studied by Fosberg (1960), Raulerson and others (1978), Mueller-Dombois and Fosberg (1998) and the U.S. Department of Agriculture (2002). According to these researchers, Guam has a diverse flora of over 600 species of vascular plants, including more than 100 species of trees. From their research, it has been documented that the distribution of vegetation is influenced by two main factors, the sharply contrasting soil types between the north and south and anthropogenic (e.g. urban development and fire) and natural (i.e. wind throw from hurricanes) disturbances. As a result of these factors, the northern part of Guam is covered by scrub and forests and the southern part is dominated by savanna vegetation and patches of forest. The most recent survey by USDA Forest Service established the following classification of vegetation types on Guam:

1. Forest on elevated limestone plateaus and cliffs;
2. Savanna Complex;
3. Swamp Forest Complex, including Mangroves;
4. Ravine Forest on Volcanic Soil and on Limestone Outcrops in Valleys;
5. Secondary Thickets and Partially Cultivated Scrub Forest;
6. Coconut Plantation;
7. Predominantly Open Ground and Pastures;
8. Urban Vegetation around DoD lands and cities; and
9. Reed Marsh

All of the above vegetation types can be found in southern Guam (Figure 11.2-12).



Fena Valley Reservoir
Naval Munitions Site
Talofofo Bay
Cetti Bay
Umatac Watershed
Ugum Watershed
Umatac Bay
Geus Watershed
Toguan Watershed
Bile Bay
Philippine Sea
Pacific Ocean
2
4
Figure 11.2-12
Watershed Vegetation Types
Legend
Military Installation
Route Number
Watershed Boundary
Vegetation
Acacia Plantation
Agriculture Field
Bad Land
Barren
Coconut Forest
Developed Land
Ravine Forest
Savanna
Scrub Forest
Tangantangan (Leucaena)
Urban Cultivated
Water
Wetland
Source: WERI 2008
N
S
E
W
Feet
0
3,200
6,400
0
810
1,620
Meters
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Southern Guam, where the watersheds are located, was originally forested; however, after centuries of human impacts including logging, fire, and grazing, the watershed areas are extensively covered in savanna grasslands. The remaining ravine and limestone forests of the watersheds are largely secondary in nature anquite variable (GovGuam DOA,GEPA 2007). According to NRCS soils information, the watersheds are comprised of six major vegetation types; savanna complex, coconut plantation, ravine forest, limestone forest, urban buildup, and scrub forest (NRCS 2006, WERI 2010).

The composition of existing plant communities within the watershed areas are greatly influenced by the tropical climate, soils, and periodic burning events. Wildland fire events have been occurring for decades, if not centuries. Periodic burning strongly influences the composition of plant communities by (1) preventing ecological succession by hindering the establishment of woody plant species; and (2) exposing the volcanic soils to accelerated erosion, which reduces the inherent soil productivity.

The reforestation project will focus mainly on savanna grasslands, the predominate vegetation type comprising of the watershed (Table 11.2-13). Grassland is dominated by the tall grass, Miscanthus floridulus, and may contain other species such as Pennisetum polystachyon and Dimeria chloridiformis (GovGuam DOA 2005).

Table 11.2-13 Watershed and Target Vegetation Acreage within Bolanos Reserve Area

Watershed	*Total Acres (Hectares)*	*Acres in Reserve (Hectares)*	*Vegetation Area*	*Restoration Veg. Type*	*Ac. in Reserve that are Savanna(Hectares)*
Ugum	4676 ac (1892 ha)	1332 (539 ha)	96.9%	Savanna	787 (318 ha)
Umatac	2459 (995 ha)	580 (235 ha)	97.4%	Savanna	266 (108 ha)
Toguan	900 (364 ha)	76 (31 ha)	94.6%	Savanna	47 (19 ha)
Geus	1109 (449 ha)	384 (155 ha)	94.6%	Savanna	157 (64 ha)

Terrestrial and Marine Protected Species

Surveys for protected terrestrial species were not conducted for the watershed reforestation project area. Information regarding federal-listed and/or territory-listed species with habitat on Guam's savanna grasslands was obtained from the Guam Comprehensive Wildlife Conservation Strategy (GovGuam DOA 2005). The only threatened and endangered species management area in the central to southern Guam region is the Guam Wildlife Refuge Overlay of DoD lands. The overlay is confined to the Fena Watershed. No protected plant, mammal, seabird, reptilian, or gastropod species occur within Guam's savanna grasslands. The following protected species could be present within adjacent limestone forest and coastal areas.

- *Forest birds.* There are no known federal- or territory-listed forest bird colonies located within Guam's savanna grasslands; however, the Island swiftlet (*Aerodramsu vanikorensis bartschi*) (which is both federal- and territory-listed as endangered) nest and roost in limestone caves and may forage for insects over savanna complex. It is possible they may occur within the proposed reforestation site.
- *Wetland birds.* The federal- and territory-listed wetland bird the Mariana common moorhen (*Gallinula chloropus guami*) prefers freshwater habitats including lakes, ponds, and springs. This bird would not be expected to be present in the grassland areas due to lack of suitable habitat.

- *Sea Turtles.* The federal-listed threatened and Guam-listed green sea turtle (*Chelonia mydas*) and the federal- and Guam-listed endangered hawksbill sea turtle (*Eretmochelys imbricata*) have been observed along all coastlines on Guam and embayment areas.

Land Use Compatibility

The southern Guam watersheds include areas that posses scenic value (e.g., Agat to Merizo highway and Guam Territorial Seashore Park) and a popular location for hiking and includes a trail into the valley. It is also a popular location for boating. The watershed area is part of the rural Umatac District of southern Guam and Umatac village, one of Guam's smallest villages. The Talofofo/Ugum watershed includes two drinking water sources (Fena Reservoir and Ugum Water Treatment Plant) with good potential for new sources.

Cultural Resources

Previous archaeological research in the Ugum watershed (Reinman 1977) has indicated that the lower reaches were likely farmed to support both coastal and inland populations, similar to the more disturbed Talofofo drainage to the north. In particular, sites MaGI-9 and MaGI-10 are located on the lower east bank of the Ugum River above the coast, and both consisted of Latte Period pottery scatters with midden soil indicating intensive human activity, even though no *latte* stone columns were recorded to indicate permanent habitation. Many of these stones have been removed after WWII with the introduction of mechanized agriculture. Sites MaGI-9 and MaGI-10 are located on the east bank of the Ugum River much further upstream and contained not only pottery and midden soil, but also numerous stone tools, slingstones, and mortars or *lusong*, perhaps indicating the area's use as a quarry and workshop for the production of these tools using locally available mudstone and basalt.

The Umatac watershed is much longer in extent than the Toguan and has been severely impacted by Spanish Colonial occupation, often serving as the Manilla Galleon season residence of the governor of Guam near his warehouse of trade goods and its Colonial church. Previous archaeological research (Reinman 1977) has indicated that the lower reaches of the north bank of the Laelae River were likely farmed to support nearby coastal populations. In particular, site MaGU-7 was located on the coastal north bank of the river near the modern Magellan Monument. Also present on the hillsides overlooking Umatac Bay are four Spanish fortresses, including Fort Santo Angel built in 1756, Fort San Jose built in 1805, and Fort Soledad built in 1810.

The Toguan watershed is shorter in extent than the Geus, but previous archaeological research (Reinman 1977) has indicated that the lower reaches of both banks were likely farmed to support nearby coastal populations. In particular, site MaGMe-8 located on the coastal south bank of the Toguan River had pottery while site MaGMe-8 contained at least one *latte* set implying permanent habitation, plus Latte Period pottery scatters with stone and marine shell tools.

The Geus watershed is similar in extent to the Ajayan and both catch runoff and spring water from Mount Sasalaguan (which means "hell" in the Chamorro language) that figures in legends about Chaife, a god of the underworld in Chamorro legend (http://guampedia.com/chaife-folktale/). Previous archaeological research (Reinman 1977) has indicated that the lower and upper reaches of both banks were likely farmed to support both coastal and inland populations. In particular, sites MaGMe-9 and MaGMe-10 located on the east bank of the Geus River each contained at least one *latte* set implying permanent habitation, while site MaGMe-11 on the west bank and coast contained a *latte* set and Spanish-era pottery, and site MaGMe-6 with Spanish pottery continued along the coast to the Spanish Village of Malesso and its Colonial church. Table 11.2-14 identifies the historic properties in these watersheds.

Table 11.2-14 Historic Properties in Ugum, Umatac, Toguan, and Geus Watersheds*

Watershed	*Site Number*	*Setting*	*Type*	*Age*
Ugum	MaGI-9	Ugum River, east bank, lower interior	Pottery and midden soil	Latte Period
Ugum	MaGI-10	Ugum River, lower east bank	Pottery and midden soil	Latte Period
Ugum	MaGI-28	Ugum River, east bank, upper interior	Pottery, stone tools, slingstones, and midden soil	Latte Period
Ugum	MaGI-29	Ugum River, east bank, upper interior	Pottery, stone tools, mortars, and midden soil	Latte Period
Umatac	MaGU-7	Laelae River, north bank and coastal	Pottery	Latte Period and Spanish era Umatac Village
Toguan	MaGMe-8	Toguan River, south bank coastal	Pottery	Latte Period
Toguan	MaGMe-9	Toguan River, north bank coastal	Latte set, pottery, stone tools, shell tools,	Latte Period
Geus	MaGMe-6	Geus River, west bank coastal to Merizo	Pottery	Latte Period and Spanish era Malesso Village
Geus	MaGMe-9	Geus River, east bank, upper interior	Latte set	Latte Period
Geus	MaGMe-10	Geus River, east bank, lower interior	Latte sets and pottery	Latte Period
Geus	MaGMe-11	Geus River, west bank, lower interior	Latte set, mortar, and Spanish pottery	Latte Period and Spanish era
Toguan	MaGMe-8	Toguan River, south bank coastal	Pottery	Latte Period
Toguan	MaGMe-9	Toguan River, north bank coastal	Latte set, pottery, stone tools, shell tools,	Latte Period
Fouha	MaGU-6	La Sa Fua River, north bank and coastal	Pottery	Latte Period and Spanish era Funa Village
Achugao	MaGU-1	Agaga River, north bank coastal	Latte set and pottery	Latte Period
Achugao	MaGU-2	Agaga River, south bank coastal	Pottery and marine shell	Latte Period

*After Reinman 1977

In general, the coastal areas of the watersheds have a rich history that is documented in the Guam Register of Historic Places and the National Register of Historic Places. The embayment areas along the coast have an important place in the Chamarro culture and pre and post European history of Guam (GovGuam DOA, GEPA 2007). The coastal areas of the watershed are also the site of Jati, a historic village of the Spanish period, which was occupied from before 1700 to the early 1800s. This village and coastal area were served by a historic Spanish road that linked Agana with Umatac.

Infrastructure and Services

Guam is one of the most built-up islands in the Pacific. The development has been concentrated in northern and central parts of Guam, so large areas in southern Guam have been spared of urbanization. Villages in southern Guam have far fewer inhabitants and much lower population density than in the north. Consequently, the watersheds have less infrastructure. The road network in southern Guam is not as complex as in the north. Its core is the coastal road (Routes 2 and 4) circling around the southern Guam and the cross-island road (Route 17) joining Talofofo and Santa Rita (WERI 2010).

Hazardous and Regulated Materials and Wastes

Because these watersheds are an undeveloped area, hazardous and regulated materials and wastes are not expected to be present in reportable quantities.

POTENTIAL IMPACTS

The discussion of the potential impacts of the watershed reforestation project(s) parallels the presentation of information in the preceding section (e.g., physical, marine and terrestrial biological setting, social and economic environment; infrastructure and services; and hazardous and regulated materials and waste).

Air Quality

Implementation of the reforestation project will reduce the frequency and intensity of wildland fire due to changes in fuel type and loadings, which will result in a beneficial impact on local climate and air quality. Because forest trees are more efficient in sequestering carbon than grass plant communities, it would also have a positive effect on the reduction of greenhouse gases.

Geology and Soils

Changes in plant community structure would not affect the underlying geology of the project site. However, any reduction of the frequency and intensity of wildland fire due to changes in the structure of wildland fires could potentially reduce gully erosion and thereby have localized indirect beneficial impacts. Project implementation (conversion from savanna grassland communities to an Acacia and native forest community) would have direct beneficial impacts to soil resources. These benefits would be derived by (1) improvement in soil structure; (2) improved caution-exchange capacity in the soil; (3) increased water percolation in soil; and (4) reduced sheet and rill erosion.

Hydrology

Project implementation would have direct beneficial impacts to fresh water systems by reducing the quantity of detached sediment delivered into the fresh water streams. While difficult to quantify the permanent reduction in sediment entering stream systems, and depending upon the amount of restoration sites, over time, a reduction of hundreds of tons of suspended sediment entering the marine environment at Talofofo Bay (from Ugum Watershed), Fouha Bay and Umatac Bay (from Umatac Watershed), Toguan Bay and Bile Bay (from Toguan Watershed), and Geus River in the Philippine Sea (from Geus Watershed) could be seen. This would be considered an indirect beneficial effect to marine waters.

Coastal Environment

Marine organisms are likely to receive indirect beneficial effects from improved water quality due to the reduction of sediment load into the nearshore environment as a result of the watershed and coastal resource management project(s). Relief from sediment impacts in the coastal waters is anticipated to improve the marine water quality and indirectly to promote recovery of coral reef biota. No adverse effects are expected to occur. No adverse effects to protected sea turtles are expected to occur as a result of project implementation. This mitigation action would have beneficial effects on Guam's coastal management zone. The mitigation action would be consistent to the maximum extent practicable with the enforceable policies of Guam's approved Coastal Management Program. GovGuam BSP will review the Navy's determination and provide a concurrence letter for CZMA determination, if deemed appropriate.

Vegetation

Under the watershed and reforestation project, existing savanna grassland community would be converted to forest community, although components of the savanna grassland community would continue to be present in the understory. The non-native trees (*Acacia*) and the native plants that would be used to reforest the watershed would return the lands to a forested community, beneficially impacting vegetation by reducing erosion, and propagating native plant species. The Acacia trees used in the reforestation project are not considered invasive. Ungulates that would be systematically removed include; Pigs (*Sus scrofa*), Philippine deer (*Cervus mariannus*), and Asiatic water buffalo (*Bubalus bubalis*). Removal from areas of the watershed would be accomplished through hunting and the use of exclusion fencing. These ungulates are not native to Guam and have a detrimental impact to native plant species and soil erosion. The reduction of ungulates in the watershed areas would have a beneficial impact on native plant species and would also reduce soil erosion impacting coastal waters.

Terrestrial Protected Species

The reforestation and coastal resource management project(s) are not expected to adversely affect federal- or territory-listed threatened or endangered species because the federal- and territory-listed Island swiftlet, which may occur within the reforestation area, is adapted to both savanna and forest communities. It would not impact the avian population since the bird species present are adapted to both forest and savanna communities. The conversion of the existing grass plant communities to a forest community is expected to improve the habitat for reptile species by increasing the diversity of niches.

Social and Economic Environment

There would be no impacts to the social and economic environment, since the project will not result in changes to population, employment, development patterns, or other socio-economic factors. No land use compatibility conflicts are expected as a result of the watershed reforestation and coastal resource management project(s) because the project(s) and its objectives will not foreseeably introduce uses incompatible with surrounding uses. Because predictive models for settlement patterns do not suggest past habitation within the reforestation area(s), the presence of archaeological sites in the proposed reforestation areas is not anticipated, and no adverse impacts to cultural resources are expected through implementation of BMPs and mitigation measures if restoring areas deemed culturally sensitive.

Infrastructure and Services

The proposed reforestation and coastal resource management project(s) would not increase the demand for or otherwise impact existing infrastructure systems and services.

Cultural Resources

Because historic property surveys have not been carried out in the proposed reforestation areas, survey work would be required prior to initiation of any watershed reforestation and coastal resource management project(s). Compliance with Section 106 of the NHPA would be required.

Hazardous and Regulated Materials and Wastes

There would be no change in the generation or disposal of hazardous and regulated materials and wastes as a result of the watershed reforestation and coastal resource management project(s).

11.2.3.2 Coastal Water Resources Management

CONSERVATION AREAS FOR CORAL REEF ECOSYSTEM PROTECTION

Designated conservation areas can provide protection to pristine and high value coral habitats. One purpose of a designated conservation area is to provide protection of an area with similar ecological functions as the resources diminished from the implementation of a proposed action. General objectives include:

- Identify and protect examples of ecosystems and of physical or biological phenomena
- Provide research and educational opportunities for scientists in the observation and study of the environment
- Preserve the full range of biological diversity
- Provide a basis for organized research and exchange of information on these areas

For example, conservation areas have been established on Guam in the past. Under a 15 March 1984 agreement between the Chief of Naval Operations and the Government of Guam, Ecological Reserve Areas (ERAs) were established at Orote Point and Haputo as compensatory mitigation projects for the loss of approximately 14.7 ac (5.95 ha) of benthic and coral reef habitat due to initial construction of a munitions wharf (Kilo Wharf) at Adotgan Point in Outer Apra Harbor, Guam. The primary purpose of the ERAs was to preserve terrestrial and marine environments while permitting low impact recreational activities that conform to GovGuam DAWR fishing and hunting regulations.

The 163-ac (66-ha) Orote ERA is located on Navy lands, on the south facing shore of Orote Peninsula, opposite the Kilo Wharf site. A watershed approach was used in establishing the ERA, which includes both a Terrestrial Unit (TU) and a Marine Unit (MU). The 30-ac (12-ha) TU includes land extending from the shoreline to the upper cliff line, and the 133-ac (54-ha) MU includes submerged lands adjacent to the TU, extending seaward to the -120 foot (-36.6 m) depth contour. The ERA extends from the former Orote Landfill on the east to the tip of the Orote Peninsula on the west, spanning about 1.9 mi (3.1 km) of shoreline. The north shoreline of the Orote Peninsula forms the southern boundary of Outer Apra Harbor, and the south shoreline–where the existing ERA is located-abuts the Philippine Sea.

The Haputo ERA, located on the northwest coast adjacent to NCTS Finegayan, is 252 ac (102 ha) in area and was also established to protect two separate biological units, a terrestrial and marine unit. The terrestrial unit supports a remnant native limestone forest providing important habitat for forest birds. The marine unit, which includes the Double Reef area, a valuable fringing reef, provides a nursery for marine species of subsistence and commercial fishery value (NAVFAC Pacific 1986). The 72-ac (29-ha) marine unit originates at the mean lower low water (MLLW) line and extends to the edge of the outer coral reef (refer to Figure 11.1-8 in Volume 2).

Project Description

The Navy will consider adding new and/or expanding existing conservation areas on federal submerged lands or through agreements with GovGuam to keep submerged conservation lands/submerged lands contiguous. The forthcoming Compensatory Mitigation Plan will detail this proposal, but could include marine and terrestrial unit expansion or establishment. The proposal would, when possible, follow the watershed approach used to establish the original marine conservation areas and may include the following:

- The management plan for the Orote ERA MU would be modified to limit consumptive activities that could adversely affect EFH—similar to limitations placed on GovGuam's MPAs. Non-consumptive recreation and scientific study would still be allowed to occur, although access to the area is already restricted by its location within an active Navy base, SDZs from existing small arms ranges, and ordnance handling activities on Kilo Wharf (Figure 11.2-14).
- The Haputo ERA MU may be expanded to the north and south on federally-owned submerged lands and seaward. The management plan for the Haputo ERA MU would be modified to limit consumptive activities that could adversely affect EFH—similar to limitations placed on GovGuam's MPAs. Non-consumptive recreation and scientific study would still be allowed to occur, although access to the area will be restricted by its location adjacent to existing Navy small arms range and their requisite SDZs.
- The Ritidian MRA, currently controlled by the Department of the Interior, could be expanded to the south to join the Haputo ERA, and expanded to the east to join the Pati Point Marine Reserve Area on federally-owned submerged lands. The TU could be expanded inland of the MU on federal lands and would be compatible with the existing Guam National Wildlife Refuge. The management plan for the Ritidian MRA MU could be modified to limit consumptive activities that could adversely affect EFH—similar to limitations placed on GovGuam's MPAs. Non-consumptive recreation and scientific study would still be allowed to occur.
- The Pati Point MPA could be expanded to the south. Development of small arms firing ranges along Route 15 will result in SDZs over land and marine waters. Expansion of the Pati Point MPA MU and the Pati Point Natural Area inland of the MU into the Route 15 SDZs and through agreements with GovGuam could result in an expanded MPA from Pagat to Jinapsin. The management plan for the Pati Point MPA MU could be modified to limit consumptive activities that could adversely affect EFH—similar to limitations placed on GovGuam's MPAs. Non-consumptive recreation and scientific study could still be allowed to occur, although access to the area will be limited by its location within the future Navy range SDZ of the coast of the Route 15 lands.

The implementation of the expanded marine conservation areas, with the cooperation of GovGuam, could be a contiguous protected areas from the GovGuam Falcona conservation area north around Ritidian and Pati point to the southern portion of the Rt. 15 range lands. These expanded protected areas could track the following general milestones:

- Joint Region Marianas (JRM) nominating package
- JRM inclusion of expanded conservation areas into joint region INRMPS
- JRM has primary land stewardship responsibility for all DoD lands on Guam including the Orote ERA. As with the existing Orote ERA TU, the expanded conservation areas would be cooperatively managed by the Navy, USFWS and GovGuam. Fishing and hunting regulations

enforceable under the Sikes Act would apply to the existing and expanded conservation areas and enforceable by federal or Guam DAWR Conservation Officers.

AFFECTED ENVIRONMENT

A study to assess potential changes to the existing ERAs was prepared for COMNAVREGMARIANAS (HHF 2007) for the Kilo Wharf EIS (COMNAV Marianas 2007b) that involved terrestrial and marine surveys of the expansion areas considered (I Tanó Services, LLC 2005 and MRC 2005a). The affected environment for the resources below are described for Orote Point ERA. The affected environment for the other potential bulleted study areas above are described in detail in the Final EIS for the Guam and CNMI Military Relocation as provided below:

- Geology and Soils – Volumes 2 and 4, Chapter 3
- Marine Biological Resources – Volumes 2 and 4, Chapter 11
- Terrestrial Biological Resources – Volumes 2 and 4, Chapter 10
- Threatened and Endangered Species – Volumes 2 and 4, Chapter 10 and 11
- Social and General Services – Volumes 2 and 4, Chapter 16

Thirteen other resources in the Final EIS for the Guam and CNMI Military Relocation were used to provide related affected environment information utilized for the compensatory mitigation impact analysis below.

Geology and Soils

The potential expansion of the Orote Point TU encompasses land from a coastal strand and forest along the shore and cliff. The ERA expansion seaward out to Orote Island would encompass extremely jagged karst limestone and pits, while the northern coast of Orote Peninsula is a steep cliff line with less severe karst features. Karst limestone leads to heavily drained soils. Orote Peninsula consists of ancient coral deposits of dense Marianas limestone, with Guam clay soil. The steep limestone slopes have little soil development.

Marine Biological Environment and EFH

The potential MU expansion is comprised of submerged lands off Orote Island and Spanish Steps. The expanded MU area includes portions of the Orote Point reef slope and reef flat, with areas of shallow fringing reef between the western end of Orote Peninsula and Orote Island that experience strong currents while being protected from normal wave action. The area supports substantial soft and stony coral cover. The shelter afforded by Orote Island creates a reef community with limited physical forces acting upon it. The reef slope is dominated by Porites rus, although other species are better represented here than at any other location along the harbor side of Orote Peninsula. While the exposed reef flats are largely devoid of corals, the flat behind Orote Island is colonized by a variety of large coral colonies, as well as a diverse array of fish.

Terrestrial Biological Environment

The potential TU expansion area includes halophytic-xerophytic plant communities on the cliff face and Orote Island. The TU has a mix of strand habitat, which occurs along and just inland from the sandy beaches, and native forest communities that are unique to the Mariana Islands. Halophytic-xerophytic forest is a type of native limestone forest that occurs in environments subjected to high salt spray, considerable wind action, and karst limestone. The forest is dominated by native trees with very low populations of non-native tree species. The forest provides potential nesting and resting habitat for sea birds, linking the TU with the MU. The most common plant species include: Umumu (*Pisonia grandis*), Fagot (*Neisosperma oppositifolia*), Lulujut (*Maytenus thompsonii*), Agatelang (*Eugenia palumbis*), and Cycad (*Cycas circinalis*). Fagellaria indica and Polypodium scolopendria are the dominant understory species. The strand portion is mostly comprised of Gausali (*Bikkia mariannensis*) and Cycad.

Orote Island supports Guam's highest known population of Ufa halomtano (*Heritiera longipetiolata*), a relatively rare endemic forest tree species that is territory-listed as endangered. Orote Island is also vegetated with many native species including: Cycad, Mastwood (*Calophyllum inophyllum*), Fig (*F. prolixa*), Pandanus (*Pandanus sp.*), Ufa halomtano, Gausali, and Half flower (*Scaevola taccada*). Gausali occurs around both the western and eastern cliff lines. The most common tree species found on the western side of the island are Cycad and Ufa halomtano, while the eastern area of the island is dominated by Cycad, Ufa halomtano, and Mastwood.

Black noddies (*Anous minutus*) are found along the shores, the islet, and on Adotgan Rock in fairly high numbers. The Yellow bittern (*Ixobrychus sinensis*), the Philippine turtle dove (*Streptopelia bitorquata*), the Black citrus swallowtail (*Papilio polytes*), and the Blue spotted butterfly or Blue-branded king crow (*Euploea eunice*) also are found in the proposed TU expansion area.

The inlet between Orote Island and the coast contains a very unique wetland habitat. The open water wetland is fed by fresh water but also receives ocean water during storm surges. The bank of the pond has thick dark brown mud populated by the marsh fern Acrostichum aureum. The pond is inhabited by both fish and eels.

The forest communities do not appear to suffer from ungulate browsing or rooting, although signs of Philippine deer (*Cervus marianus*) have been noticed. This appears to be the only remaining native limestone forest on Guam that is not affected by feral ungulates. Feral animals, including Pigs (*Sus scrofa*), Goats (*Capra hircus*), and Asiatic water buffalo (*Bubalus bubalis*) have been responsible for degradation of native forest on Guam.

Hermit crabs (*Coenobita sp*) are present, and there is evidence that Coconut crabs (*Birgus latro*) are present as well. Coconut crabs are indigenous to the Mariana Islands and are an important wildlife resource culturally and ecologically. Coconut crabs inhabit the ocean and the land during different parts of their life cycle. Adult Coconut crabs are nocturnal and live in limestone caves, crevices, and holes. Ecologically it is very possible that crabs are responsible for seed distribution in some native species as they feed on native tree seeds (Grubb 1971 in I Tanó 2005). Coconut crabs need native forest and the protection that they provide.

Threatened, Endangered and Protected Species

As described in Sections 10.1.4 and 11.1.7 of this Volume, federally-listed threatened green sea turtle nesting signs (i.e., tracks on the beach) have been observed at a beach west of Adotgan Beach (within the proposed expanded conservation area). Green and hawksbill sea turtles (*Eretmochelys imbricate*) are known to occur in the coastal waters of Guam. Sea turtles have been frequently sighted from Orote Point east towards Apra Harbor. A number of MBTA-protected seabirds are known to frequent Guam (see Sections 10.1 and 11.1 of this Volume for discussion of special-status species for the study areas).

Social and Economic Environment

The Orote Peninsula is difficult to gain access to as it is part of an active Navy installation, is encumbered by the Kilo Wharf ESQD arcs, and is surrounded on three sides by steep limestone cliffs. Nearshore waters are miles away from inhabited areas and public boat launch facilities and are only accessible via larger watercraft capable of exposure to the open ocean swells present in the vicinity of the harbor entrance channel. There are several popular dive sites located in the existing MU that are frequented by dive charter operators originating from Piti Channel, 6-7 mi (10-11 km) to the east. There are no reported dive sites within the proposed MU expansion area and its location is exposed to major trade wind and open ocean swells, making it a difficult area in which to operate watercraft.

The primary purpose of the ERA is to preserve and protect the natural environments that exist within the boundaries. Research of the natural environment is encouraged and recreational use is permitted as long as the use is compatible with the primary purpose. Development within the ERA is generally not permitted as it is incompatible with the purpose of the ERA. The Orote Historical Complex (Site # G-R 66-03-1009), listed on both the National and Guam Registers of Historic Places, is comprised of four features situated along the northern edge of Orote Peninsula. A portion of the site lies within the potential TU expansion area.

POTENTIAL IMPACTS

Discussion of impacts is limited to those resource areas that have the potential to be affected by the mitigation action.

Geology and Soils

No impacts to geology and soils are expected from the potential expansion of the ERAs or MPAs since no development or other land disturbing activities would occur.

Marine Biological Environment and EFH

The potential MU expansion area(s) could have beneficial impacts on the marine biological environment by protecting a relatively diverse assemblage of nearshore biotic habitats. The additional layer of protection would reinforce existing federal protections of sea turtles, and their potential nesting site west of Adotgan Point in the expanded conservation area (described in Section 10.1.4 of this Volume). The proposed fishing limitations would provide protection for fish and other marine species. Experience with MPAs on Guam with no-take regulations (Pati Point, Tumon Bay, Piti Bomb Holes, Sasa Bay, and Achang Reef Flat) suggests that the preserves have a positive effect on local reef fish populations. Therefore, beneficial impacts to EFH can be expected from this potential mitigation action. According to a recent published report, spawning mass is significantly higher in the marine preserves than in the control sites, indicating that the preserves may function as “egg banks” and provide higher production potential (Porter et al. 2005). An expanded conservation area is expected to increase fish diversity and biomass both within and adjacent to the ERA. This will benefit corals and associated organisms inside the ERA and in the adjacent areas (Porter et al. 2005).

Terrestrial Biological Environment

Any expansion of conservation areas is expected to have beneficial impacts on terrestrial biological resources by adding an additional layer of protection to sensitive cliff line and nearshore habitats in the general vicinity. The existing TU is very small and is almost entirely composed of steep cliff line habitat. The primary vegetation is Halophytic-shrub, with few native and endemic species (USFWS 1986 in I Tanó 2005). In contrast, the TU expansion area has several native and endemic species, and one listed as endangered by the Guam DAWR. Additionally, the TU expansion area harbors some of the few remaining bird species, albeit introduced, on Guam.

Most endemic plant species in the Mariana Islands occur in native habitats, which makes the native forests of the Marianas unique ecological systems and the primary habitat for native wildlife (Vogt and

Williams 2004 cited by I Tanó 2005 in HHF 2007). The preservation of native forests, which the proposed expanded TU includes, ensures a habitat for existing native wildlife and any future reintroductions. Also, the absence of feral ungulates at some of these locations reinforces the importance, the uniqueness, and potential of these areas for conservation. With much of Guam and the Northern Mariana Islands suffering from ungulate devastation in the native forests, areas such as those on Orote Peninsula could become important ecological banks. These intact native forests are valuable as genetic and ecological repositories of the native forest species. From a watershed perspective, conservation of the cliff line environment benefits the health of nearshore coral reef habitats.

Threatened, Endangered and Protected Species

Because the potential mitigation action would increase protections within its proposed boundaries, expansion of conservation areas will not impact federal- or territory-listed threatened, endangered, or protected species.

Social and Economic Environment

Fishing within Guam waters is subject to GovGuam laws and regulations and there are no specific Guam regulations regarding fishing within Navy designed ERAs. Enforcing the no-take regulations will be challenging on several fronts. Fishing is an important cultural, recreational, and subsistence activity on Guam, as elsewhere in the Pacific Islands. Restrictions of any kind of fishing activity–regardless of long-term beneficial effects– are therefore met with strong opposition by a broad cross section of the community. The expanded conservation areas are remote, making enforcement problematic. The Navy and Coast Guard maintain close surveillance of the Apra Harbor Entrance Channel and Kilo Wharf area, and these patrols may be able to contribute to enforcement of the no-take regulations in this area. Increases in local fish stocks resulting from no-take restrictions may have long-term, indirect beneficial impacts to recreational and cultural fishing practices outside the MU.

Scientific research on undisturbed plant communities in the native limestone forest community–one of the general objectives of the ERAs–would be possible and since future development will be restricted, research could be ongoing. This will add positively to the educational knowledge of these ecosystems. Because no development or increases in human activities are proposed, the TU expansion is not expected to affect cultural resources, including the Orote Historical Complex.

11.2.3.3 Apra Harbor and Coastal Water Resource Management

As identified above, reducing the flow of terrigenous sediments into Guam's southwest coastal areas associated with the four main watersheds would have beneficial impacts to coral reef communities and associated habitats adversely affected by ongoing sedimentation and decreased water quality. This option was established if watershed ownership parties fail to execute long-term binding agreements that meet USACE, Navy, and GovGuam real estate and legal requirements. These agreements are necessary so that watershed compensatory mitigation project(s) may be maintained in perpetuity. The Navy, with USACE support, has identified a package of compensatory mitigation projects to be implemented on Navy lands–that can be committed in perpetuity–in the event the some or any watershed and coastal resource management mitigation projects could not be implemented to meet the no net loss of ecological service requirement.

Table 11.2-10 identifies the alternatives within this category. The scale of the deep water artificial reef component can either fully offset the ecological services lost (as conservatively estimated in the Navy's HEA) or compliment other compensatory mitigation measures to reach the no net ecological services lost goal. The Navy's forthcoming compensatory mitigation plan will identify the details of this proposal.

Potentially all components would be implemented—i.e., the combined contingency mitigation actions would provide greater offsetting benefits than the estimated ecological service losses. These components are discussed below.

AFFECTED ENVIRONMENT

Deep Water Artificial Reef Sites

The establishment of deep water artificial reef habitats within Outer Apra Harbor (i.e., the ROI) would provide a measurable comparative restoration to offset the ecological service losses anticipated from Alternative 1 or Alternative 2. The Navy would use the analysis in the HEA it prepared (Volume 9, Appendix E) to appropriately scale the deep water artificial reef project. The Navy will use a conservative estimate and work with the resource agencies to come up with agreed upon an acre-year loss of ecological services. This mitigation component would then be scaled to offset the ecological services lost due to the implementation of Alternative 1 or Alternative 2.

The Navy identified and studied several candidate locations in the ROI during the Kilo Wharf EIS (COMNAV Marianas 2007b) that meet the following minimum criteria:

- water depth between 40 and 120 ft (12 and 37 m) to meet minimum navigational draft requirements and within safe diving depths
- relatively level substratum
- sufficient size to accept construction of a reasonably sized reef
- devoid of live coral
- adequate surrounding benthic community
- protected from storm waves

In the aggregate, these candidate locations provide the potential area needed to develop artificial reefs to offset the ecological services lost.

Field surveys were conducted in May 2010 to assess and document the existing conditions of near-shore marine resources offshore of watersheds on the southwestern coastal area of Guam from Fouha Bay to Bile Bay, as well as the entirety of Apra Harbor west of the proposed CVN turning basin. Surveys included all reef areas extending from the shoreline to a depth limit of 60 feet (18.2 m). The report is considered a preliminary review and is included in Volume 9, Appendix J.

Surveys were conducted by collecting a total of 780 "calibration/validation" points, each of which consisted of five digital photographs comprising 35.5 ft^2 (3.3 m^2) of the benthic surface (486 sites were in Apra Harbor). Preliminary results of these surveys based on visual interpretation of benthic composition were used to develop an initial assessment of the overall reef community structure (Dollar and Hochberg 2010).

Reef structure within Apra Harbor consists generally of a shallow reef flat that extends from the shoreline to a steeply sloping reef face that terminates at the sandy floor of the harbor. The sloping reef faces throughout the harbor are generally fully colonized by a multitude of growth forms of a single species of coral (*Porites rus*). Several pinnacles with flat tops at depths less than 60 feet (18.2 m) occur throughout the Harbor, with the tops and sides often completely covered with coral. Two large patch reefs (Jade Shoals and Western Shoals) at the eastern end of the Outer Harbor bound the CVN turning area. The outer (western and northern) regions of these patch reefs which were examined in this survey also are colonized by extensive and diverse coral assemblages. While there is abundant calcareous sands and mud within the harbor, there were no observations of red terrigenous sediment that occurred on the reefs within the embayments receiving input from the southwestern watersheds. Based on collected field data, there are a total of about 129 acres (52.2 ha) of coral within the Apra Harbor survey areas, and about 79 acres (31.9 ha) of algae and algal turf (Dollar and Hochberg 2010).

The literature indicates deep water artificial reefs rapidly establish a full range of environmental services and can potentially maintain an equilibrium level of services significantly higher than natural reefs. "Well designed and located deep water artificial reefs have demonstrated their effectiveness in establishing productive reef habitat for the complete matrix of marine life associated with natural reefs (e.g., macrobenthos, marine invertebrates, fishes, and corals)" (COMNAV Marianas 2007b.) Therefore, deep water artificial reefs are viewed as an appropriate mitigation as they can provide relatively direct habitat replacement within the general vicinity of the lost habitat.

The analysis of deep water artificial reef equivalency assumed a reef design in which sets of concrete or limestone blocks are grouped on the sea floor at regular intervals to create artificial reef for coral colonization and habitat for other marine biota, with one ac (0.4 ha) of deep water artificial reef comprised of approximately six "sets" of 50 Z-block modules, although alternative deployments will be evaluated and identified in the compensatory mitigation plan (Navy 2009a). Deep water artificial reefs can rapidly establish biomass that significantly exceeds the biomass supported by an equivalent area of reef flat (COMNAV Marianas 2007b). After the deep water artificial reef is deployed, corals and other marine organisms begin utilizing the structure and intervening spaces, and a relatively uniform rate of coral colonization could be expected across each "face" of the reef (Volume 9, Appendix E).

Because the marine habitats affected by Alternative 1 and Alternative 2 ranged in coral cover (0 % to 90 %) and ecological productivity, equivalency ratios were developed between impacted habitats and expected coral cover on the deep water artificial reef. These equivalence ratios were established to calculate how much "new" habitat would be required to compensate for the injured habitat. The analysis made assumptions about deep water artificial reef design and spacing in order to estimate equivalence ratios between the injured habitats and restored habitats, and were intended to result in conservative results (i.e., more likely to underestimate than overestimate ecological benefits provided by deep water artificial reefs).

For purposes of this analysis, and applying the algorithm used to assign injuries to Habitat Index Categories, an acre (0.4 ha) of artificial reef (i.e., 300 Z-blocks deployed in a site-appropriate configuration) would be classified in Category 1. Therefore, the Navy utilizes a 1:1 ratio for artificial reef to injured Category 1 reef. Recognizing the greater coral cover, surface area, and/or rugosity of Category 2 habitat, the Navy assumes a 2:1 artificial reef to injured Category 2 reef, a 3:1 ratio artificial reef to injured Category 3 reef, and so on for most of the affected Alternative 1 associated habitats (Navy 2009a) (refer to Table 11.2-8 and 11.2-9 earlier in this Chapter).

These adjustments to the equivalence ratios are intended to account for the greater levels of ecological service expected from affected habitats with a greater proportion of live coral, however may be adapted within the compensatory mitigation plan prepared collaboratively with USACE.

The deep water artificial reef equivalency analysis also considered the recovery period for the deep water artificial reef habitat, lifespan of the new habitat, and impacts of the reef structure on the bottom habitat it would displace (i.e., footprint of the underlying artificial reef).

The HEA was used to develop an estimate of the discounted service acre-years (DSAYs) gained per acre of artificial reef, discounted in the same manner as HEA loss calculations. Given a total expected loss of

1,048 DSAYS, a total of approximately 123 ac (49.8 ha) of artificial reef would be required to compensate for coral habitat impacts expected due to Alternative 1. Results indicate that each acre of artificial reef would provide approximately 22.1 DSAYs. Approximately 121 ac (49.0 ha) of artificial reef would be required for mitigation of impacts due to Alternative 2. Other deep water artificial reef designs or technologies may result in different equivalency ratios (Navy 2009a).

PROJECT DESCRIPTION

This mitigation action consists of the establishment of deep water introduced artificial reef habitats on federally-owned lands within Outer Apra Harbor that would provide direct restoration to offset potential ecological service losses from either Alternative 1 or Alternative 2. Deep water introduced artificial reef would provide marine habitats that provide both shelter and food for fish recruitment and a suitable surface for colonization by benthic invertebrates (e.g., corals and sponges). Information for this section has been excerpted from a deep water artificial reef feasibility study prepared for COMNAVREGMARIANAS (COMNAV Marianas 2007b).

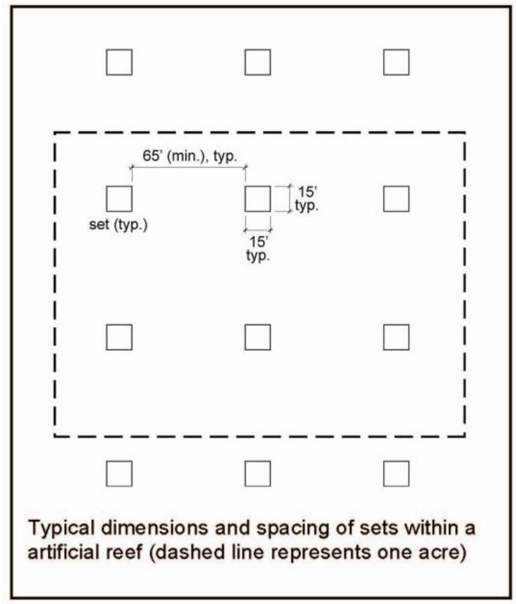
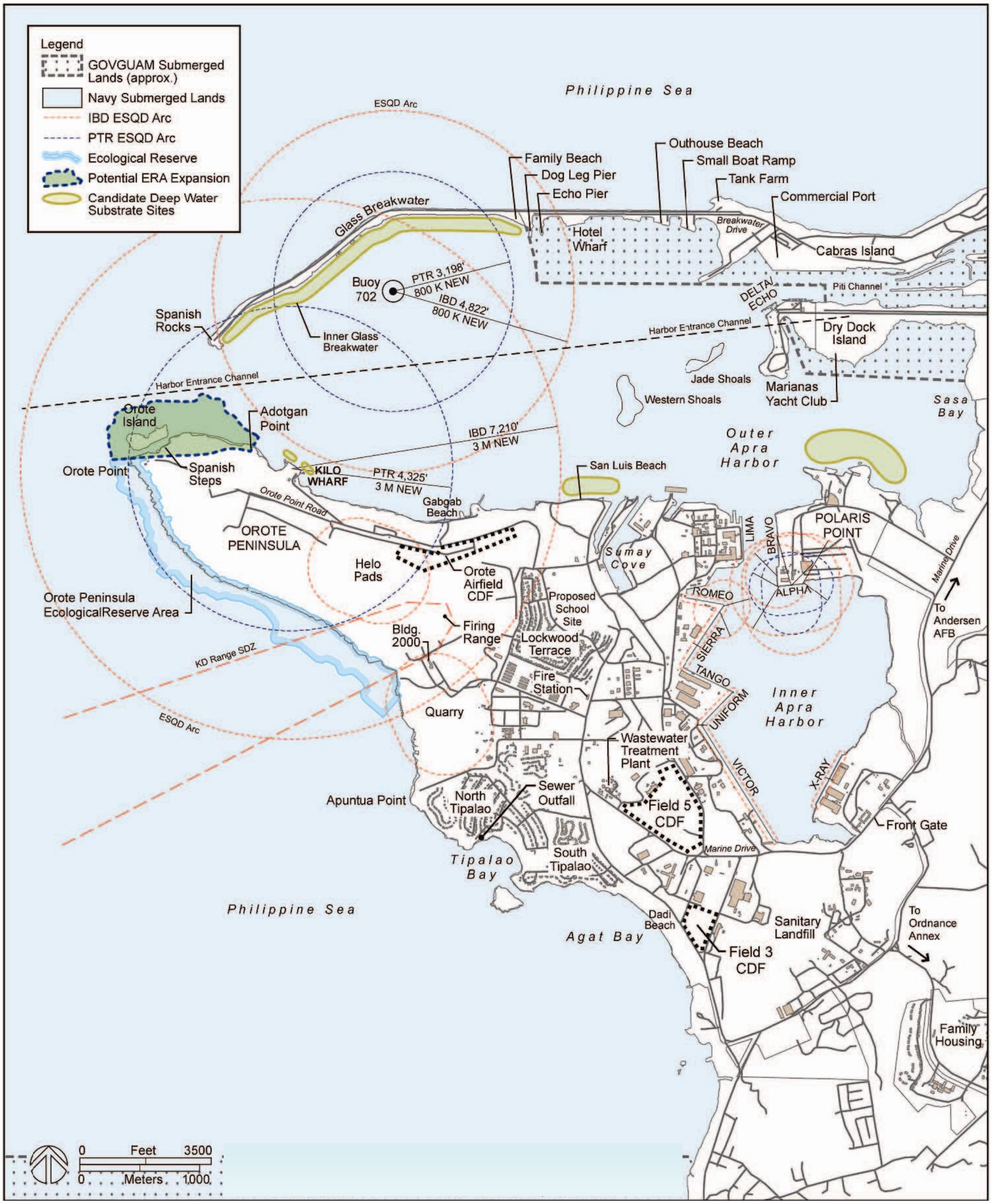


Figure 11.2-13. Deep Water Artificial Reef Schematic

Numerous reef designs would be considered as described above, reflecting restoration objectives and budgets, and encompassing a variety of potential materials, configurations, and locations. Reefs colonized on introduced artificial reef range in size from industrial reefs in Japan covering many square miles (or kilometers) of seabed, to very small deployments (e.g., <500 ft^2 or <46 m^2).

An example of a configuration considered suitable for Guam waters is based on the state of Hawaii's artificial reef program. Each unit (or reef area) of deep water artificial reef is comprised of five to ten "sets" within a sea floor area of between 0.8 to 1.6 ac (0.32 to 0.65 ha). Each set is approximately 215 ft^2 (20 m^2) in size, about 13 ft (4 m) high and comprised of between 30 to 50 concrete blocks, each cast in the form of a "Z." Each block is about 4 ft wide, 10 ft long, and 6 inches thick (1.2 m x 3 m x 15 cm). Five to ten reef sets are spaced 65 to 100 ft (20 to 30 m) apart (see Figure 11.2-13 for a schematic drawing), within visual range of one another. This grouping of sets–together with the interviewing spaces of harbor floor–is analogous to a single "artificial reef." Arranging the reef sets within visual range of each other decreases the vulnerability of fish to being captured by fishermen by enabling the fish to swim from one set to another if pursued. Also, the dense lattice provided by the stacked blocks of each set provides refuge from higher level predators. Other suitable materials found on-island could be substituted for pre-cast concrete blocks, such as large (4 to 6 ft [1.2 to 1.8 m] diameter) quarried limestone boulders, which would also be arranged in clusters or piles at an appropriate spacing.

Candidate locations include sites offshore of Kilo Wharf, south of the western end of Glass Breakwater ("Inner Glass Breakwater"), Sasa Bay, and offshore of San Luis Beach (Figure 11.2-14).



Source: COMNAV Marianas 2007b

Figure 11.2-14. Candidate Apra Harbor Deep Water Artificial Reef Sites and Orote Point ERA Expansion

As discussed earlier and in Volume 9, Appendix J, a total of approximately 123 ac (49.8 ha) of artificial reef would be required to compensate for coral habitat impacts expected due to Alternative 1. Results indicate that each acre of artificial reef would provide approximately 22.1 DSAYs. Approximately 121 ac (49.0 ha) of artificial reef would be required for mitigation of impacts due to Alternative 2 (Navy 2009a). Once deployed, the deep water artificial reef is assumed to take five years to reach full function. Both the time delay in achieving full ecological function and the amount of benthic habitat and ecological services lost due to the establishment of the deep water artificial reef modules have been factored into these acreage requirements.

Tasks required for implementation include: planning, site selection, and design; obtaining required USACE permit(s); reef unit construction, and/or acquisition; deployment of modules; post-deployment inspections; operational period monitoring; and operational period maintenance and repair. The Navy would be responsible for the implementation, monitoring, maintenance, and repair of this mitigation project.

AFFECTED ENVIRONMENT

The following section describes the four candidate deep water artificial reef sites in Outer Apra Harbor. They are discussed by location rather than resource area. These four general sites contain areas that meet the minimum location criteria listed above. Any introduction of introduced artificial reefs into Apra Harbor would be based on a coastal engineering study that would evaluate appropriate materials, securing methods, and specific locations that would best achieve goals of resource recovery (COMNAV Marianas 2007b).

Inner Glass Breakwater

Glass Breakwater extends in the westerly direction from Cabras Island for approximately 2.7 mi (4.3 km) where it defines the mouth of Outer Apra Harbor. The Breakwater sits atop Luminao Reef, which presently consists of a wide reef flat outside the eastern half of the breakwater and Calalan Bank near the harbor entrance. Inside the breakwater, Luminao Reef consists of a relatively narrow, shallow (-3 to -6 ft [-1 to -2 m]) reef flat extending westward from Family Beach to the point where the breakwater changes angle. The flat transitions to the harbor bottom via a steeply sloped fore reef. The inshore areas of Calalan Bank include a shallow (-20 ft [-6 m]) submerged ledge, transitioning to a steeply sloped fore reef ending at the harbor floor.

The reef flat extending from the edge of the breakwater consists of sand-rubble bottom covered with a dense mat of the brown alga *Padina spp*. It is of note that *Padina* occurred abundantly throughout the entire diverse array of marine habitats surveyed in the vicinity of Apra Harbor and Orote Peninsula, although the abundance of Padina shows seasonal variability. At the seaward edge of the reef flat, stony and soft corals were the dominant bottom cover. Of particular note is the reef flat named "Dogleg Reef" which consists of a finger reef that extends diagonally from the breakwater. Coral cover on the reef top was denser than many other areas within Apra Harbor, and consisted of a diverse assemblage of corals including several species of Acropora.

At the edge of the reef flat, the angle of the reef face increases sharply and forms a sloping face that extends to the harbor floor. The reef slope is largely covered with a variety of growth forms of *P.rus*, including overlapping plates, spires, and mounds. The *P. rus* communities on the reef slope on the inner side of Glass Breakwater are similar to the communities on the reef slope on the southern shoreline of outer Apra Harbor between Gabgab Beach and Orote Island. At the base of the reef slope, bottom composition consists of fine white sand with scattered corals growing on rubble fragments. While coral is abundant on the reef flats and slopes off the inner face of Glass Breakwater, this zone is rather narrow in width. In addition, the reef flats are too shallow for deep water artificial reef structures, while the reef slopes are too steep for suitable stability. However, the sandy substratum of the harbor floor off inner Glass Breakwater beyond the base of the reef slope would function as a very suitable site for deep water artificial reef structures because it meets the minimum criteria identified and listed earlier in this section (e.g., water depth, level, sufficient size, storm wave protection, etc.).

Kilo Wharf

COMNAVREGMARIANAS and USCG enforce a 500-ft (152-m) minimum physical security standoff distance from Navy ships and wharves. Deep water artificial reefs located within Kilo Wharf's security zone would essentially be within a de facto no fishing zone. This area is particularly well suited for an artificial reef/substrate because it has the most vigorous water movement within Apra Harbor. The high levels of water movement and superior water circulation would increase the rate of recruitment for both fishes and invertebrates as well as provide improved feeding and forage opportunities, particularly for many key planktivores from the damselfish and surgeonfish - unicornfish families. The sea floor fronting the wharf drops off quickly from the -45-ft (-14-m) plateau (Zone 1). Candidate deep water artificial reef sites within the security zone are located to the northwest and northeast of the wharf at the base of the ledge (see Figure 11.2-14).

San Luis Beach

San Luis Beach lies on the southern shoreline of Outer Apra Harbor between the eastern end of Gabgab Beach and the entrance channel to Sumay Cove (see Figure 11.2-14). Most of the shoreline in the area consists of sheet piling or fill material. Seaward of the shoreline, a narrow sand-rubble covered reef flat terminates at a steep reef slope that extends to the sand floor of the harbor. The northern portion of the candidate site has a fairly level bottom area at about 100-ft (30-m) depth. The area is outside the main shipping channel, within Navy submerged lands and in an area without coral cover. The southern portion of the candidate site lies just off the San Luis Beach coral reef. The candidate site is outside Kilo Wharf's IBD ESQD Arc. Gabgab Reef (Gabgab 1) - a popular dive location - lies to the west of the candidate site.

Sasa Bay

Sasa Bay lies in the easternmost area of Outer Apra Harbor, between Dry Dock Island and Polaris Point. This bay differs considerably from the rest of Outer Apra Harbor in that it is far more estuarine in nature owing to upland drainage. As a result, except in dredged channels, water depths are far shallower than in the other parts of Outer Apra Harbor. In addition, suspended sediment causes water clarity to be substantially less than in other parts of Outer Apra Harbor and there is considerably greater deposition of terrigenous sediments on the reef surfaces. Much of the structure of Sasa Bay consists of patch reefs that have shallow top surfaces and steeply sloping sides. The steep sloping reef faces terminate in the sandy floor of the harbor. While Sasa Bay is characterized by high turbidity and sediment deposition, coral cover is nevertheless substantial, particularly on the sloping sides of the patch reefs. The primary coral species on the patch reefs is *P. rus*. The candidate introduced artificial reef area is within the southwestern corner of Sasa Bay, just north of Polaris Point in an area about 45-ft (14-m) deep. The area is outside shipping channels, adjacent to but not on top of coral reef areas, and within Navy submerged lands. The area is also within a GovGuam-established no-fishing area.

POTENTIAL IMPACTS

As identified by COMNAV Marianas (2007b) the following environmental resource areas have the potential to be affected by the introduction of deep water artificial reef into Apra Harbor: water quality, marine biological setting (including benthic habitats and fisheries), and submerged cultural resources. In this section, impacts are discussed by resource area (vice location).

Water Quality

If not properly screened, pollutants from the deployed materials may leach into the water column. The potential for this would be avoided or minimized by the selection of appropriate materials (e.g., that do not contain or have been properly cleaned of potential pollutants). Based on the estimated increase in biomass (see marine biological environment below), including sessile macro-invertebrate filter feeders, a net benefit may be seen to water quality.

Marine Biological Environment

The placement of new material on the sea floor in the candidate deep water artificial reef sites would have primarily beneficial effects by replacing ecological services lost to the proposed action. Introduced artificial reef provide a stable structure for the attachment of marine invertebrates such as corals and sponges. These stationary animals feed on plankton suspended in the moving ocean currents and ultimately encrust onto the artificial structure to form a "live carpet" of attached growth. This growth serves as a hiding place and food source for mobile invertebrates that live upon and within the attached growth. As smaller animals become more abundant, larger animals are attracted to the area to feed upon them. Ultimately, a deep water artificial reef structure can create a complete food web and function comparable to natural reefs (HHF and EA LLC 2007a).

This mitigation action is not expected to adversely impact EFH. A substantial body of evidence suggests that properly designed and sited deep water artificial reefs can enhance marine habitats and local fishery stocks. This enhancement initially occurs because these ecosystems are shelter limited rather than food limited. With time and more complete development of surrounding benthic communities, deep water artificial reef surfaces may play a significant role in providing forage areas for local fish and can positively impact fishery resources (HHF and EA LLC 2007a). The greatest potential adverse biological impact of deep water artificial reef construction and deployment is if they serve only to aggregate the last few fish in an over-exploited fishery, making them vulnerable to capture. Proper sitting (e.g., in appropriately spaced reef sets close to natural reefs) and design (e.g., ample refuge spaces within the structures) reduce this potential by providing shelter to which fish may flee to escape capture (Brock 2005 in HHF and EA LLC 2007a). Additionally, as discussed in Volume 2, Chapter 11, non-native species in Apra Harbor include both purposeful introductions for fisheries and agriculture, and inadvertent introductions of species that arrived with seed stock or by hull and ballast transport with shipping traffic. These species are found to be more prevalent on artificial structures than natural reef bottoms (Paulay et al. 2002), thus some non-native species recruitment to these new deep water artificial reef structures may be expected. The new structures would replace existing underlying benthic habitat so it is critical in sitting to ensure that new structures are placed in areas that are not already considered sensitive or rare (e.g., live coral reefs). Habitat equivalency analysis needs to include the loss of small areas of existing benthic habitat under the reef structures in the calculation of net acre year gains provided by the structures (and has been factored into the Navy's HEA estimates of deep water artificial reef needed to offset acre-year losses for Alternative 1 and 2).

A number of earlier studies suggest that deep water artificial reefs not only aggregate but also increase local productivity as an integral part of fishery enhancement (Ogawa 1979, Stone et al. 1979, Buckley 1982, Buckley and Hueckel 1985, cited by Brock 2005 in HHF and EA LLC 2007a). The current status of the question was well summarized by Sheehy (1982a): "Although most American reef researchers continue to debate whether deep water artificial reefs actually increase productivity or merely attract and concentrate organisms from surrounding areas, Japanese scientists generally have little doubt that deep water artificial reefs when properly designed, sited, and placed, can be used to increase the production of desired species" (Brock 2005 in HHF and EA LLC 2007a). Natural reefs support a biomass of approximately 1.7 oz/ 10.76 ft^2 (50 gm/m^2). Within one month, deep water artificial reefs can support a biomass of 17.6 oz/10.76 ft^2 (500 gm/m^2) increasing to 52.9 to 70.5 oz/10.76 ft^2 (1,500-2,000 gm/m^2) after one year, then falling to an equilibrium level in the range of 24.6 oz/10.76 ft^2 (700 gm/m^2) (ibid).

Potential adverse effects from the deployment of deep water artificial reef include:

- Damage to natural reefs or injury to recreational divers if the deployed components are toppled, moved or become unstable due to storm-driven waves and storm surge
- Damage to/removal of the underlying benthic resources (i.e., habitats and infauna)
- Increased non-native sessile macro-invertebrates

The potential for these adverse outcomes would be minimized by the selection of appropriate materials (e.g., materials of a suitable size, shape, and weight to withstand storm wave energy); the protected conditions of Apra Harbor; and compliance with USACE permit conditions. As described earlier in this section, the bottom habitat that would be permanently altered by the new reef structures was included in sizing the required deep water artificial reef. In other words, the ecological services lost under the footprint of the introduced reef were calculated and included in the amount of deep water artificial reef required to offset acre-year losses of approximately 123 ac (49.8 ha) for Alternative 1 and 121 ac (49.0 ha) for Alternative 2, respectively (Navy 2009a) (see Volume 9, Appendix J for detailed discussion).

Appropriate USACE permits would be obtained prior to project implementation. With adherence to permit conditions, screening of deep water artificial reef materials and locations, and proper deployment techniques, no adverse impacts to marine protected species (e.g., sea turtles) are expected.

Cultural Resources

A comprehensive, joint survey of Apra Harbor by the National Park Service, Department of the Navy, and the Guam SHPO identified 30 submerged resources, including ones that are historic properties, (e.g., shipwrecks, plane crashes, etc.) in Apra Harbor. Siting of a deep water artificial reef would be planned and implemented to avoid affecting any submerged historic properties; therefore, no adverse effects on historic properties are anticipated.

SHALLOW WATER REEF ENHANCEMENT

The main objective of shallow water reef enhancement is to minimize coral colony mortality associated with the proposed action in Apra Harbor. This will be done by physically transplanting a significant quantity of coral that would have been removed or covered by the channel and tuning basin dredging and wharf rehabilitation/construction efforts to several new sites on Navy submerged lands in Outer Apra Harbor or within Non-DoD federal lands (e.g. National Historic Parks). Coral transplantation related to mitigation and rehabilitation projects has been occurring since the 1970s. Past studies have shown success in establishing new coral habitats with transplanted coral (HHF and EA LLC 2007a). This type of shallow water reef enhancement was conducted by UoG Marine Laboratory in Apra Harbor associated with the MILCON P-431, Alpha and Bravo Wharves Improvement project. Coral colonies were transplanted from the Inner Harbor entrance channel to the Sumay reef mound in 2005 and 2006. Findings from this project show that there was roughly a 50% success rate.

Additional components of this project, within Apra Harbor and National Historic Parks may include: land acquisition; erosion control, including stormwater management BMPs (roads, wharves, industrial facilities); wetlands restoration; artificial reefs and coral transplanting (at National Historic Parks outside Apra Harbor); boundary marking & enforcement; monitoring; and education.

Project Description

As part of the CVN Wharf Construction mitigation, the Navy would enter into an agreement with a qualified organization, such as the UoG, to physically move and transplant as much live coral as feasible to sites on Navy-owned, federally-owned, or Non-DoD federal-owned submerged lands. Larger intact colonies have been shown to survive transplanting much better than small or fragmented colonies. Larger colonies also have far greater reproductive potential than small ones. Therefore, this project will focus on transplanting large specimens. A detailed coral transplanting plan will be prepared and included within the Compensatory Mitigation Plan, which will include methods for moving large colonies, techniques for stabilizing the colonies at the transplant site, and monitoring protocols. The monitoring plan will utilize accepted marine ecological procedures to monitor associated macro-invertebrates, fishes, and macro-algae, as well as the transplanted corals.

Potential recipient sites for transplanted corals within federal-owned submerged lands in Apra Harbor or other federal-owned submerged lands locations will be identified by the Navy in consultation with GovGuam and the organization performing the transplanting. Transplant site selection criteria shall include physical, chemical, and biological factors.

Management of the shallow water reef enhancement sites on Navy-owned submerged lands will be the responsibility of the Navy, as it is the primary trustee of all natural resources within its terrestrial and submerged lands. Other Non-DoD federal-owned submerged lands may be managed by the National Park Service or other identified responsible party.

AFFECTED ENVIRONMENT

This section discusses the environmental resource areas relevant to this proposal.

Marine Biological Environment and EFH

The recipient sites in Outer Apra Harbor (or other area outside Apra Harbor) will need to be of similar habitat as the original coral sites (e.g. reef flat, reef slope, etc.) with firm substratum to ensure successful transplantation. The recipient sites will likely support existing sessile species and possibly macroalgae.

Social and Economic Environment

Outer Apra Harbor is presently used extensively by both Guam residents and visitors for recreational diving and snorkeling because the reefs are in good condition and access to them is protected by the Glass Breakwater. The harbor is also an important commercial port, which fuels Guam’s economy.

POTENTIAL IMPACTS

Discussion of impacts is limited to those resource areas that have the potential to be affected by the mitigation action.

Marine Biological Environment and EFH

The benthic conditions of recipient sites will be changed from rubble, pavement, or dead coral artificial reef (i.e., not presently colonized) to transplanted live corals. Benthic organisms already living in the recipient sites could be negatively impacted or even destroyed by placement of transplanted corals. Survival rates of transplanted species could be affected by harvesting, delays in transplanting, and storm events. Lessons learned in the MILCON P-431 transplantation project would be followed to minimize adverse effects.

Coral transplantation is anticipated to have a beneficial impact on the marine biological environment. More complex habitat will be created and the physical rugosity will increase. Transplantation has the potential to increase overall biomass and improve EFH. The project is expected to save a significant percentage of corals within the CVN Wharf dredging and construction site, which would otherwise be lost. It will also create new assemblages of corals which it is hoped will persist over time and attract resident fish and macroinvertebrate populations. No impacts to protected species in the recipient site areas are expected.

This project will also provide an opportunity for research of coral transplant techniques, the role of diversity in the persistence of transplanted populations, and how coral topography affects coral growth and survivorship. There will also be opportunities to study rates of colonization at recipient sites by algae, invertebrates, and fishes. Research from this project can be used to create greater success of rehabilitation or transplantation in the future by improving current technology and knowledge of coral transplantation.

Social and Economic Environment

Restoring or establishing new productive reefs in Apra Harbor will indirectly result in improved EFH, benefiting Guam's recreational and commercial fisheries and relieving pressure on existing reefs in the harbor and other areas adjacent to the transplant sites.

11.2.3.4 Summary of Mitigation Effects

Table 11.2-15 summarizes the environmental effects of the compensatory mitigation projects identified. Others projects would be evaluated as identified in the compensatory mitigation plan.

11.2.4 Alternative 2 Former SRF

11.2.4.1 Onshore

Similar to Alternative 1, proposed activities under Alternative 2, Former SRF (referred to as Alternative 2) would include construction activities in an onshore area that is composed of fill material. Impact analysis would be similar to Alternative 1, and is included below for each marine resource category.

Alternative 2 has the potential to impact the quality and quantity of the surface runoff, during both the construction and operational phases of the project, without the application of appropriate BMPs. Both construction activities as well as long-term operation activities may cause erosion and sedimentation that can degrade coastal waters and potentially impact nearshore marine biological resources. In addition, the action alternatives would increase the potential for leaks and spills of petroleum, oil, lubrications (POLs), hazardous waste, pesticides, and fertilizers. These potential impacts may affect the coastal waters and in turn the biological resources and habitats.

CONSTRUCTION

Proposed onshore construction activities would occur in an area that is composed of fill material. Embankment excavation would be required to expand the existing shoreline north of the proposed aircraft carrier berthing and the face of the wharf. While alterations to the onshore environment have the potential to result in indirect impacts that could alter the harbor water quality as described above (see also Chapter 4, Water Resources), these potential effects (short-term and localized disturbances from noise, subsurface reverberations, and siltation of marine biological resources adjacent to the site) would be minimized by complying with all applicable orders, laws and regulations, including low impact development stormwater management strategies and BMPs (Volume 7).

Marine Flora, Invertebrates and Associated EFH

Alternative 2 onshore impacts to these resources would be similar to those described under Alternative 1. No direct impacts on these resources are expected, therefore, there would be no adverse effect on EFH. Potential impacts to species included in a regional FEP are addressed accordingly under EFH.

Essential Fish Habitat

Alternative 2 onshore impacts to these resources would be similar to those described under Alternative 1. No direct impacts on these resources are expected, therefore, there would be no adverse effect on EFH.

Special-Status Species

Alternative 2 onshore impacts to these resources would be similar to those described under Alternative 1, therefore, there would be no adverse effect on special-status species. No direct impact on this resource is expected with the implementation and management of appropriate construction permits, BMPs, therefore, Alternative 2 would result in a less than significant impact to special-status species.

Non-native species

Alternative 2 onshore impacts to these resources would be similar to those described under Alternative 1. There would be no direct impacts in relation to non-native species introduction caused by activities associated with Alternative 2.

Based on the analysis presented above for onshore construction activities, Alternative 2 would result in less than significant impacts to marine biological resources.

OPERATION

The operational phase of Alternative 2 would increase the area of impervious surface which would result in an associated relatively minor increase in stormwater discharge intensities and volume. This increase would be accommodated by stormwater infrastructure, and stormwater flow paths would continue to mimic 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. It is the intent that all designs would result in 100% capture and treatment, if required, of stormwater runoff.

While onshore operation activities have the potential to result in indirect impacts that could alter the harbor water quality as described above (also see Chapter 4, Water Resources), these potential effects (localized disturbances from noise, subsurface reverberations, and decreased water quality for marine biological resources adjacent to the site) would be minimized by complying with all applicable orders, laws and regulations, including industrial management strategies and BMPs (Volume 7). Potential impacts from the operational phase of Alternative 2 are described below for each marine resource category.

Marine Flora, Invertebrates and Associated EFH

Alternative 2 onshore impacts to these resources would be similar to those described under Alternative 1. No direct impacts on these resources are expected, therefore, indirect impacts as a result of actions associated with Alternative 2 would not be significant for marine flora, invertebrates, or associated EFH, and there would be no adverse effect on associated EFH.

Essential Fish Habitat

Alternative 2 onshore impacts to these resources would be similar to those described under Alternative 1. No direct impacts on these resources are expected therefore, there would be no adverse effect on EFH.

Special-Status Species

Alternative 2 onshore impacts to these resources would be similar to those described under Alternative 1. No direct impact on this resource is expected with the implementation and management of appropriate BMPs, therefore, Alternative 2 would result in a less than significant impact to special-status species.

Non-native species

Alternative 2 onshore impacts to these resources would be similar to those described under Alternative 1. There would be no direct impacts in relation to non-native species introductions caused by activities associated with Alternative 2; therefore, Alternative 2 would result in a less than significant impact regarding non-native species introduction.

Based upon the analysis presented above, onshore operational activities associated with Alternative 2 would result in less than significant impacts to marine biological resources.

11.2.4.2 Offshore

Offshore activities associated with Alternative 2 would be similar to those of Alternative 1. Volume 4, Section 2.6 describes this Alternative in detail. Potential impacts are included below by marine resource type for construction and operation activities associated with Alternative 2.

CONSTRUCTION

Marine Flora, Invertebrates and Associated EFH

The anticipated impacts to these resources resulting from the implementation of Alternative 2 are similar to the those described for Alternative 1, however in-water dredging activities would be closer to Big Blue Reef and Middle Shoals, so additional direct, indirect and cumulative effects may be expected. This includes removal of an eastern "peninsula portion" of Big Blue Reef and Middle Shoals that will not be removed under Alternative 1. Under Alternative 2, dredging activities would have direct and permanent impacts to marine flora and invertebrates (not including coral and coral reef ecosystems which are discussed in more detail under EFH), particularly to sessile organisms. Motile invertebrates would likely vacate the area due to the increased disturbance. Mortality would occur to marine flora and sessile invertebrates, these organisms would be anticipated to reestablish once project activities cease. Although the SAV resource is expected to recolonize over time the live hard bottom will not. Due to the large size of the area, context and intensity, and cumulative effects of the impacts associated with dredging in a variety of habitats, this impact would "be above minimal" (refer to Section 11.2.1.2). Therefore, the implementation of the offshore component of Alternative 2 may adversely affect EFH, specifically Live/Hard Bottom.

Essential Fish Habitat

The anticipated impacts to this resource resulting from the implementation of Alternative 2 are similar to the impacts described for Alternative 1. Although there are appears to be minor differences in the location of dredging activities and in coral removal acreages and percent removals, the in-water dredging activities would be closer to Big Blue Reef and Middle Shoals, so additional direct, indirect and cumulative effects may be expected. This includes, direct removal of an eastern "peninsula portion" of Big Blue Reef and Middle Shoals. Under Alternative 2, as with Alternative 1, impacts to EFH would be greatest for all life stages of coral and sessile reef species, some crustacean MUS and site-attached reef fish. Pelagic egg/larval stages of bottomfish and pelagic MUS may also be affected.

Based on the assumptions described in the *Assessment of the Benthic Community Structure in the Vicinity of the Proposed Turning Basin and Berthing Area for Carrier Vessel Nuclear (CVN) Apra Harbor, Guam,* Alternative 2 (Figure 11.2-15) would require the dredging of approximately 61 ac (25 ha) as compared to 71 ac (29 ha) for the Alternative 1 (Table 11.2-16). The total area impacted is about 155 acres (63 ha), which includes direct and indirect impacts of 61 ac (25 ha) and 94 ac (38 ha), respectively.

Table 11.2-16 summarizes the direct and indirect impacts of dredging to corals based on coral coverage categories with the implementation of Alternative 2. Similar to Alternative 1, areas with the greatest coral abundance (>70 to < 90%) would comprise the smallest portion (10%) of the total coral coverage category that would be lost due to the proposed dredging. Areas with the least amount of coral coverage (0 – ≤10%) would comprise the largest portion (approximately 36%) of the total coral coverage category that would be lost due to the proposed dredging. About 62% of the area proposed for dredging contains corals with a coverage of less than 30%. Approximately 3% of the total area proposed for dredging contains corals in the 70-90% coverage category and 10% in the 50-90% range of coverage.

Table 11.2-16. Estimated Coral Area and Percentages Impacted by Proposed Dredging Activities with Implementation of Alternative 2

Coral Level	*Alternative 2*					
	Direct		*Indirect*		*Total*	
	ha	*ac (% coral[1])*	*ha*	*ac (% coral[1])*	*ha*	*ac (% coral[1])*
coral = 0%	14.98	**37.03**	18.90	**46.71**	33.89	**83.74**
0% < coral ≤ 10%	3.44	8.51(36)	5.34	13.20 (28)	8.79	21.72 (31)
10% < coral ≤ 30%	2.41	5.96 (25)	3.72	9.19 (20)	6.14	15.15 (21)
30% < coral ≤ 50%	0.93	2.29 (10)	3.45	8.53 (18)	4.38	10.82 (15)
50% < coral ≤ 70%	1.82	4.49 (19)	4.46	11.03 (23)	6.28	15.52 (22)
70% < coral ≤ 90%	1.01	2.48 (10)	2.13	5.25 (11)	3.13	7.74 (11)
Total with Coral	**9.61**	**23.74**	**19.10**	**47.21**	**28.71**	**70.95**
Total dredge area	**24.59**	**60.77**	**38.06**	**93.92**	**62.60**	**154.69**
Percent coral cover:		**39%**		**50%**		**46%**

[1]Coral percents are rounded to the nearest percent; therefore total coral % may not sum to 100%

Source: Derived from Classified Habitat Map Using Quickbird Satellite Imagery.

Adverse affects on EFH for reef fish MUS may occur due to the direct removal of corals and coral reef ecosystem habitat (>0% - 90% coral = 23.74 ac [9.61 ha]). Direct removal of other benthic habitat (0% coral with macroalgae, rubble, sand = 37.03 ac [14.98 ha]) would result in no adverse effects on reef fish MUS.

Short-term adverse effects on EFH are expected from indirect impacts from sedimentation to coral habitat (>0% - 90% coral = 47.21 ac [19.10 ha]) and other benthic habitat (0% coral with macroalgae, rubble, sand = 46.71 ac [18.90 ha]) even with appropriate implementation of in-water BMPs and mitigation measures. A 25% initial loss was assumed based on sediment impacts, which is consistent with the estimate that cumulative sediment caused by dredging would be low (i.e. < 0.40 in [< 1 cm]) and the relatively low sensitivity of dominant corals in the affected area (e.g., *P.rus* and *P.cylindrica*) to such levels of sedimentation.

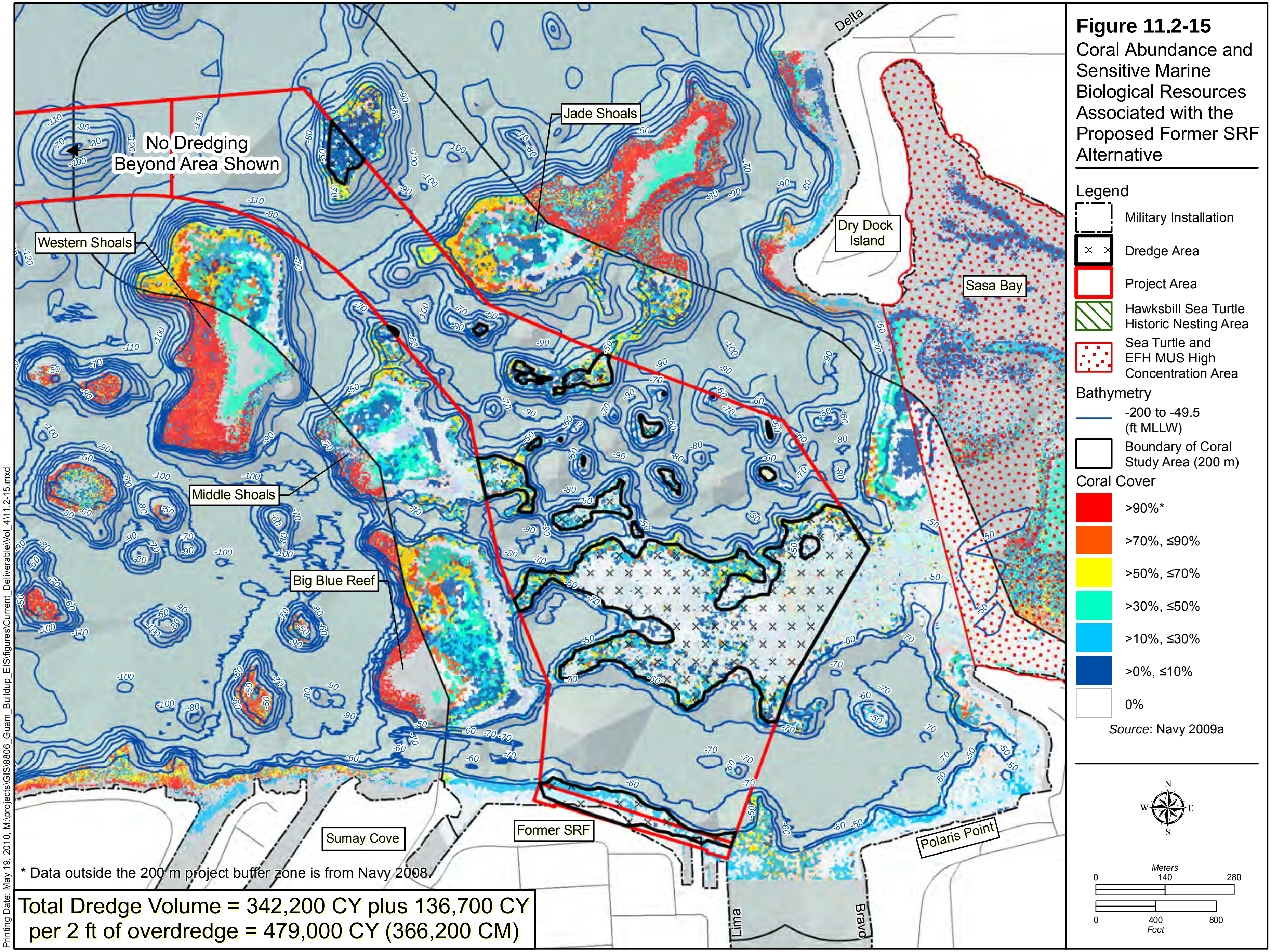


Figure 11.2-15
Coral Abundance and Sensitive Marine Biological Resources Associated with the Proposed Former SRF Alternative
Legend
Military Installation
Dredge Area
Project Area
Hawksbill Sea Turtle Historic Nesting Area
Sea Turtle and EFH MUS High Concentration Area
Bathymetry
-200 to -49.5 (ft MLLW)
Boundary of Coral Study Area (200 m)
Coral Cover
>90%*
>70%, ≤90%
>50%, ≤70%
>30%, ≤50%
>10%, ≤30%
>0%, ≤10%
0%
Source: Navy 2009a
Meters
0
140
280
0
400
800
Feet
No Dredging Beyond Area Shown
Jade Shoals
Western Shoals
Middle Shoals
Big Blue Reef
Dry Dock Island
Sasa Bay
Delta
Sumay Cove
Former SRF
Polaris Point
Lima
Bravo
* Data outside the 200 m project buffer zone is from Navy 2008.
Total Dredge Volume = 342,200 CY plus 136,700 CY per 2 ft of overdredge = 479,000 CY (366,200 CM)
Printing Date: May 19, 2010, M:\projects\GIS\8806_Guam_Buildup_EIS\figures\Current_Deliverable\Vol_4\11.2-15.mxd

Alternative 2 impacts to Essential Fish Habitat would be similar to those described for Alternative 1. The removal of habitat would decrease the structural complexity of Apra Harbor's reef system, resulting in fewer places of refuge for fish from predation. Finfish species occupying habitats that would be permanently removed would either be displaced to other adjacent sites and adapt or perish due to habitat modification and loss. Site-attached species such as those from the families Pomacentridae and Chaetodontidae may be adversely affected by changes in habitat structure, however it is anticipated that most displaced species would relocate to other adjacent sites if available.

Direct impacts from Alternative 2 dredging activities would be long-term and significant, and may adversely affect EFH. Implementation and enforcement of appropriate BMPs and mitigation measures would reduce effects. Indirect impacts from Alternative 2 actions would be similar to those described under Alternative 1 and, although short-term and localized, may adversely affect EFH.

Table 11.2-17 summarizes the EFH present in the project area and potential dredging-related effects with implementation of Alternative 2, which would be the same as Alternative 1.

Table 11.2-17. EFH Areas Associated with Apra Harbor and Potential Construction-related Effects with Implementation of Alternative 2

Habitat	*Area of Occurrence*	*Associated Activity*	*Effect*
Live/Hard Bottom	Outer Apra Harbor	Dredging of aircraft carrier channel, turning basin, and berth. Backfill and pile driving for wharf construction	May adversely affect EFH through direct, permanent and localized removal. Due to the large area and intensity of the impact, and cumulative impacts associated with dredging of a variety of habitats (refer to Section 11.2.1.2), there would be "more than minimal" significant effects on live/hard bottom habitat.
		Increased vessel movements	No adverse effect from indirect short-term and localized vessel movements.
Soft Bottom	Apra Harbor	Dredging of aircraft carrier channel, turning basin, and berth. Backfill and pile driving for wharf construction and increased vessel movements	No adverse effect. Direct removal and indirect, periodic and localized resuspension of sediment. Benthic infaunal community is expected to reestablish themselves quickly from adjacent, undisturbed areas.
Corals/Coral Reef Ecosystem	Outer Apra Harbor Shoal Areas, Entrance Channel	Dredging of aircraft carrier channel, turning basin, and berth. Backfill and pile driving for wharf construction	May adversely affect EFH through significant direct, permanent and localized removal. May adversely affect EFH through indirect, increase in localized resuspension of sediments out to 39 ft. (12 m) from dredged area (> 0.2 in. [5 mm] cumulative sedimentation). No adverse effect on sessile (non-coral) invertebrate benthic

Table 11.2-17. EFH Areas Associated with Apra Harbor and Potential Construction-related Effects with Implementation of Alternative 2

Habitat	*Area of Occurrence*	*Associated Activity*	*Effect*
			community as they are expected to recolonize from adjacent, undisturbed areas No adverse effect from indirect short-term and localized resuspension of sediments out to 144 ft. (44 m) from dredged area (approximately. 008 in. [0.2 mm] cumulative sedimentation), increase of noise and potential pollutants
		Increased vessel movements	No adverse effect on EFH from increased short term and localized vessel movements.
Water Column	Apra Harbor	Dredging of aircraft carrier channel, turning basin, and berth. Backfill and pile driving for wharf construction and other in-water construction activities.	No adverse effect on EFH from direct and indirect, temporary and localized elevation of turbidity, noise, and potential pollutants with implementation of required USACE permits and BMPs
		Increased vessel movements	No adverse effect on EFH from direct and indirect short-term, localized resuspension of sediments, increase of noise and potential pollutants from an increase in vessel movements with implementation of USACE permits and BMPs.
Estuarine Emergent Vegetation	Apra Harbor, Sasa Bay	Dredging of aircraft carrier channel, turning basin, and berth. Backfill and pile driving for wharf construction. Increased vessel movements	No effects No adverse effect to EFH from short-term and localized increase of noise, resuspension of sediment, and potential increase of pollutants.
Submerged Aquatic Vegetation	Apra Harbor, Sasa Bay	Dredging of aircraft carrier channel, turning basin, and berth.	No adverse affect to EFH through direct, temporary and localized removal. Due to the large area and intensity of the impact, and cumulative impacts associated with dredging of a variety of habitats (refer to Section 11.2.1.2), there would be “more than minimal” significant effects on SAV habitat, however temporary.
		Increased vessel movements	No adverse effect on EFH from indirect short-term and

Table 11.2-17. EFH Areas Associated with Apra Harbor and Potential Construction-related Effects with Implementation of Alternative 2

Habitat	*Area of Occurrence*	*Associated Activity*	*Effect*
			localized in-water work and vessel movement.
Estuarine Water Column	Sasa Bay	Dredging of aircraft carrier channel, turning basin, and berth. Backfill and pile driving for wharf construction Increased vessel movements	No adverse affect on EFH from direct and indirect temporary and localized elevation of turbidity, noise, and potential pollutants No adverse affect on EFH from direct and indirect short-term, localized resuspension of sediments, increase of noise and potential pollutants

The EFH Assessment (EFHA) prepared for Alternative 2 construction-related actions concluded that the action could result in the following:

- Permanent, localized destruction to 24 ac (10 ha) of live coral and coral reef habitat (all coverage >0% to ≤ 90%) resulting in a direct adverse effect on EFH.
- Long-term and localized adverse impact to associated EFH (Live/Hard Bottom). Due to size of impact area, context and intensity, and cumulative effects of impacts (refer to Section 11.2.1.2).
- Short-term and localized adverse impact to associated EFH (SAV) due to size of impact area, context and intensity, and cumulative effects of impacts (refer to Section 11.2.1.2).
- Long-term and localized indirect impact to coral reef ecosystem and displacement of species (could take years to recover) from excessive accumulation of sediment, resulting in an adverse effect on EFH.
- Permanent loss to some displaced, site-attached finfish species, resulting in an adverse effect on EFH.
- Short-term and localized temporary adverse effect on EFH from displacement of mobile FEP MUS (fish and some invertebrates) during in-water construction activities.
- Short-term and localized degradation to water quality (i.e., increase in siltation and turbidity), resulting in a temporary adverse effect to EFH.
- Short-term and localized minor indirect impacts to live coral and coral reef habitat (47 ac [19 ha]) from increased siltation (below 6 mm accumulation levels) and noise, resulting in no adverse effect on EFH.
- Short-term and localized significant impacts to FEP MUS in planktonic eggs and larvae stages of development, however based on small coverage areas temporary and minimal, resulting in no adverse effect on EFH.
- Short-term and localized minor disturbances to coral reef ecosystems from increased vessel movement, resulting in no adverse impacts on EFH.
- Short-term and localized seasonal disturbances to potentially pupping scalloped hammerhead sharks and high concentrations of adult bigeye scad. Considering rarity of this action (pupping),

the mobility of these species and preference for in-water structures for pupping (see earlier references), there would be no adverse effect on these EFH MUS.

- The aircraft carrier wharf structure would most likely result in an increase of community assemblages partially offsetting the short-term, localized adverse effects on EFH.
- Total coral coverage impacted (direct and indirect) is 70.95 ac (28.71 ha).

Based on this assessment, Alternative 2 may adversely affect EFH in Outer Apra Harbor. Some of these impacts would be offset (e.g. some indirect effects) or reduced through implementation and management of USACE permit required BMPs and mitigation measures. Unavoidable loss of ecological function will be offset with appropriate compensatory mitigation measures as described under Alternative 1.

Special-Status Species

The anticipated impacts to this resource resulting from implementation of Alternative 2 are similar to the impacts described for Alternative 1. However, due to its closer proximity to the western portion of Big Blue Reef, sea turtles resting and foraging in that area may be impacted to a greater extent over Alternative 1.

In summary, it is anticipated that implementation of Alternative 2 may affect, but is not likely to adversely affect the ESA-listed green sea turtles with regards to dredging and associated forage habitat loss, nesting activities and physical injury. The pile driving components of Alternative 2, although not likely to take sea turtles, due to limited visibility from elevated turbidity of waters in the action area, may potentially expose sea turtles to noise levels that exceed the NOAA's criterion for Level B Take. Therefore, pile driving may affect, and is, likely to adversely affect the green sea turtle and the hawksbill sea turtle. The Navy will be requesting an Incidental Take Permit for the pile driving action associated with the CVN MILCON. The Navy is working with NMFS through the ESA Section 7 consultation process to ensure that adverse effects on sea turtles are minimized and that significant impacts to sea turtles do not result from implementation of the proposed action.

Non-Native Species

The anticipated impacts of non-native species introduction resulting from implementation of Alternative 2 would be similar to the impacts described for Alternative 1. Less than significant impacts from non-native species introductions would occur under Alternative 2, with the implementation of appropriate Navy and USGS maritime protocols.

OPERATION

Marine Flora, Invertebrates, and Associated EFH

Alternative 2 impacts to these resources would be similar to those described under Alternative 1, except that vessel movements would be closer to Big Blue Reef and the southern portion of Middle Shoals, so additional indirect and cumulative effects may be expected from tugboat propeller wash over Alternative 1 operations.

Essential Fish Habitat

Alternative 2 direct and indirect impacts to this resource would be similar to those described under Alternative 1, except vessel movement would be closer to Big Blue Reef and the southern portion Middle Shoals, so additional indirect and cumulative effects may be expected from tugboat propeller wash over Alternative 1 operations.

EFH Assessment Summary. Alternative 2 operation activities, including an increase in vessel movements and operational pollutants, would be as described for Alternative 1 and could result in:

- Long-term; however, periodic and localized disturbance and displacement of motile species (fish) during in-water transit activities
- Long-term; however, periodic and localized increase of turbidity and pollutants (decreased water quality) in the water column from propeller wash and operation activities, a slight cumulative increased over Alternative 1, due to the closer proximity to Big Blue Reef and Middle Shoals.
- Long-term; however, periodic and localized increase in benthic sedimentation, a slight cumulative increased over Alternative 1, due to the closer proximity to Big Blue Reef and Middle Shoals
- Long-term; however, periodic and localized potentially significant impacts to eggs and larvae in the upper water column from increased vessel traffic
- Seasonal minor disturbances to potentially pupping scalloped hammerhead sharks and high concentrations of adult bigeye scad

Based on this assessment, there would be no adverse effect on EFH from operations. Therefore, Alternative 2 would result in less than significant impacts to Essential Fish Habitat from operation.

Standard Navy operating procedures and measures to protect marine resources, as discussed in Volume 7, would reduce any potential impacts. Measures would be implemented by vessels while underway within Apra Harbor.

Special-Status Species

Alternative 2 impacts to this resource would be similar to those described under Alternative 1.

Non-native Species

Alternative 2 impacts from non-native species introductions would be similar to those described under Alternative 1.

11.2.4.3 Summary of Alternative 2 Impacts

Table 11.2-18 summarizes Alternative 2 impacts, which would be similar to those of Alternative 1, except increased cumulative impacts due to the close proximity to Big Blue Reef and Middle Shoals.

Table 11.2-18. Summary of Alternative 2 NEPA Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	Negligible, short-term and localized impacts associated with lighting, ground vibrations, noise, and a potential decrease in water quality from pollutant runoff.
	Operation	Negligible, short-term and localized impacts associated with lighting, ground vibrations, noise, and a potential decrease in water quality from pollutant runoff.
Offshore	Construction	Significant impacts on EFH from direct and indirect effects associated with in-water construction (i.e., dredging and impact pile driving) activities. Adverse noise effects to special-status species (sea turtles) from pile-driving activities. <u>Marine Flora, Invertebrates and Associated EFH:</u> Unavoidable, short-term adverse direct impacts to marine flora, non-coral invertebrates and associated invertebrates. Mortality to this resource from physical removal would occur within the dredged footprint. Due to the size of the impact area, context and intensity, and cumulative effects (see Section 11.2.1.2); these impacts would be “more than minimal” for live/hard bottom and SAV. However, most of these species are anticipated to

Table 11.2-18. Summary of Alternative 2 NEPA Impacts

Area	*Project Activities*	*Project Specific Impacts*
		reestablish themselves from adjacent areas after construction (i.e. SAV and sessile invertebrates), and therefore the impacts would be temporary. Live/hard bottom community would be permanently removed through maintenance dredging before full recovery. Motile invertebrates would likely vacate the area due to the increased disturbance and find other habitat. Essential Fish Habitat: Unavoidable, long-term significant direct impacts from dredged removal of 24 ac (10 ha) of coral reef habitat. Short-term and localized adverse indirect impacts from sediment accumulation (at least 6 mm) to a portion of an additional 47 ac (19 ha) of coral reef habitat (all coverage classes) and 46 ac (19 ha) of other benthic habitat (0% coral) adjacent to, but outside of, the dredge footprint. Short-term and localized disturbance to water column and finfish. Limited injury or mortality to fish eggs and larvae. Insignificant long-term population-level effects or reduction in the quality and/or quantity of EFH. Indirect impacts from sedimentation would be the same as under Alternative 1: may adversely affect a portion of the site-attached finfish species. Limited injury or mortality to site-attached finfish and fish eggs and larvae is expected. Short-term and localized disturbance to the water column is anticipated. There would be an insignificant long-term population-level effects or reduction in the quality and/or quantity of EFH for finfish with implementation of identified BMPs and mitigation measures. However, even with mitigation efforts, there would still remain unavoidable adverse impacts associated with corals and coral reef habitat removal (direct impact) and associated sedimentation (indirect impact); compensatory mitigation would be required. The HEA assumed dredging impacts accounted for an initial 100% ecological loss from direct impacts and an initial 25% loss of ecological services from indirect impacts. Special-Status Species: Similar to Alternative 1, except short-term construction, dredging and pile driving operations would be closer to the western portion of Big Blue Reef, a known sea turtle foraging and resting habitat. Short-term and localized effects on sea turtle behavior during the dredging would be expected, but turtle foraging and resting sites would not be impacted. Mitigation measures would postpone operation if sea turtles approach the construction area. Increased noise from pile driving activities may affect, and is likely to adversely affect ESA-listed sea turtles. Impacts to sea turtles would be reduced with the implementation of identified BMPs and potential mitigation measures, including USACE permit conditions. The Navy is working with NMFS through the ESA Section 7 consultation process to ensure that unavoidable significant effects to sea turtles do not result from implementation of the proposed action. Non-native Species: Same as for Alternative 1. Less than significant impacts from introductions are expected as construction vessels would comply with USCG and Navy requirements for ballast water and hull management policies.

Table 11.2-18. Summary of Alternative 2 NEPA Impacts

Area	*Project Activities*	*Project Specific Impacts*
	Operation	Same as Alternative 1 impacts, except long-term operational activities would be closer to Big Blue Reef and Middle Shoals having potentially increased cumulative effects. Less than significant impacts from direct and indirect effects associated with an increase in operational activities. Marine Flora, Invertebrates and Associated EFH: Long-term, localized and infrequent minor impacts from increased noise and resuspension of sediment during vessel movements, and the potential for increased discharges of pollutants into the water column. Essential Fish Habitat: Long-term, localized and infrequent impacts associated with increased vessel movements resulting in long-term, periodic and localized disturbance to water column and finfish through noise, potential increased discharge of pollutants into the water column, and re-suspension of sediments. Limited injury or mortality to fish eggs and larvae. Insignificant long-term population-level effects or reduction in the quality and/or quantity of EFH. Special-Status Species: Short-term, periodic and localized minimal effects on sea turtle behavior during increased operational activities and vessel movements, with implemented BMPs, mitigation measures, and Navy vessel policies. Non-native Species: Less than significant impacts from introduction of non-native species are expected since vessels operating within Apra Harbor would comply with USCG and Navy requirements for ballast water and hull management policies. The Navy would also prepare a Regional Biosecurity Plan with risk analysis (see Volume 7 for more details).

11.2.4.4 Alternative 2 Proposed Mitigation Measures

Proposed mitigation measures for Alternative 2 would be the same as for Alternative 1. As part of the mitigation evaluation process, a cost estimate for an artificial reef mitigation project was developed though the HEA and a suite of watershed management projects were identified for potential evaluation. The cost estimates cover all stages of the projects, including: planning, site selection and design, construction, acquisition and deployment, monitoring and maintenance, coral transplantation, contingency, and oversight. Approximately 121 acres (48.97 ha) of artificial reef would be required for mitigation of impacts due to the Former SRF Alternative.

11.2.5 No-Action Alternative

Under the no-action alternative, no construction, dredging, or operation associated with the aircraft carrier berthing would occur. Existing operations at Polaris Point, as a military training and recreational facility, and the Former SRF, as a commercial ship repair facility, would continue. Therefore, the no-action alternative would not have significant impacts to marine biological resources, other than those (if any) that were previously documented through other reports.

11.2.6 Summary of Alternative 1 (Preferred Alternative) and Alternative 2 Impacts

Table 11.2-19 summarizes the potential impacts of each action alternative and the no-action alternative. A text summary is provided below.

11.2.6.1 Summary of EFH Assessment

The EFHA, comparing Alternative 1 and 2, is summarized in Table 11.2-20, and a brief text description of impacts on corals and coral reef ecosystem follows. Table 11.2-21 shows the estimated coral area and percentages impacted with the implementation of Alternative 1 and 2 proposed dredging activities.

Both alternatives require the removal of coral from within the project footprint and would result in unavoidable significant direct impacts requiring compensatory mitigation approval by the USACE under the CWA, through the Section 404/10 permit requirements (USACE, USEPA, USFWS, and NOAA 2000). About 35% (Alternative 1) and 39% (Alternative 2) of the total area to be dredged to reach the required depth contains some level of coral coverage.

Direct impacts to EFH in the proposed dredging area can be summarized as follows:

- Permanent localized destruction to coral reef, including some site attached FEP MUS
- Long-term disruption to corals and coral reef ecosystem (recovery could take years)
- Long-term localized adverse cumulative impacts to Live/Hard Bottom associated EFH
- Short-term localized adverse cumulative impacts to SAV associated EFH

Indirect impacts to EFH adjacent to the proposed dredging area can be summarized as follows:

- Short-term and localized disturbance and displacement of mobile FEP MUS (fish and some invertebrates) during in-water construction activities
- Short-term and localized degradation of water quality (i.e., increase of siltation and turbidity) due to in-water construction activities
- Short-term and localized significant impacts to eggs and larvae
- Short-term and localized indirect impacts to corals and coral reef ecosystem from siltation

There are other factors to consider when assessing the scale of potential impacts. The coral community to be dredged is not pristine because it lies within an existing navigation channel that was first dredged during the creation of the Inner Apra Harbor some 60 years ago. Dive surveys indicate that the overall coral community composition within the dredge area yields marginal to modest ecological value, based upon the following eight criteria: percentage of sea floor covered by coral, reef complexity and rugosity, species diversity, coral health, size frequency distribution of coral colonies, diversity and abundance of sessile macro-benthos other than corals (e.g., sponges), diversity and abundance of mobile macro-invertebrates, and the diversity and abundance of finfish.

Table 11.2-19. Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
Marine Flora, Invertebrates and Associated EFH		
SI • Significant long-term and localized adverse impacts due to size of area, context and intensity, and cumulative impacts of project removal of species and habitat (Live/Hard Bottom) during construction activities. Species are not expected to re-populate due to maintenance dredging, and a "more than minimal" impact to associated EFH MUS is expected. • Short-term and localized adverse impacts due to size of area, context and intensity, and cumulative impacts of project removal of species and habitat (SAV) during construction activities. There would be a more than minimal impacts to associated EFH MUS, however temporary. • Short-term, localized and infrequent minor impacts from increased construction and operation vessel movements. A slight increase in cumulative impacts to Sasa Bay over Alternative 2 may be seen due to the closer proximity, however this areas is already highly turbid due to the influx of streams in this area.	SI • Significant long-term and localized adverse impacts due to size of area, context and intensity, and cumulative impacts of project removal of species and habitat (Live/Hard Bottom) during construction activities. Species are not expected to re-populate due to maintenance dredging, and a "more than minimal" impact to associated EFH MUS is expected. • Short-term and localized adverse impacts due to size of area, context and intensity, and cumulative impacts of project removal of species and habitat (SAV) during construction activities. There would be a more than minimal impacts to associated EFH MUS, however temporary. • Short-term and long-term, localized infrequent minor increased impacts from construction and operation vessel movements. The operational and construction activities would be closer to Big Blue Reef and Middle Shoals for Alternative 2 and may have increased direct, indirect, and cumulative impacts from construction activities and turning basin maneuvers.	NI
Essential Fish Habitat		
SI • Significant, long-term direct adverse effects to coral and coral reef ecosystems. • Short-term and localized potential indirect less than significant impacts from sediment accumulation during dredging activities. A slight increase in cumulative impacts to Sasa Bay over Alternative 2 may be seen due to the closer proximity, however this areas is already highly turbid due to the influx of streams in this area. • Short-term and localized less than significant disturbance to water column and finfish, limited injury or mortality to fish eggs and larvae from construction activities. • Insignificant long-term and infrequent disturbances to water column and finfish, limited injury or mortality to fish eggs and larvae with no population-level effects or reduction in the quality and/or quantity of EFH from operational activities. • Beneficial long-term impacts to finfish and invertebrate MUS and the	SI • Significant, long-term direct adverse effects to coral and coral reef ecosystems. • Short-term and long-term, localized infrequent minor increased impacts from construction and operation vessel movements. The operational and construction activities would be closer to Big Blue Reef and Middle Shoals for Alternative 2 and may have increased direct, indirect, and cumulative impacts from construction activities and turning basin maneuvers. • Short-term and localized less than significant disturbance to water column and finfish, limited injury or mortality to fish eggs and larvae from construction activities. • Insignificant long-term and infrequent disturbances to water column and finfish; limited injury or mortality to fish eggs and larvae with no population-level effects or reduction in the quality and/or quantity of EFH from operational activities. Long-term operational	NI

Table 11.2-19. Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
ecology of the immediate area with the added hard surfaces and settlement potential the aircraft carrier wharf boulder rip rap and vertical pilings would provide. • Similarly, additional recruitment potential of juvenile finfish from Sasa Bay to the aircraft carrier wharf area as an extended nursery area.	activities would be closer to Big Blue Reef and may have increased indirect impacts on coral and coral reef ecosystem from resuspension of sediment during turning basin maneuvers. • Beneficial long-term impacts to finfish and invertebrate MUS and ecology of the area with the added hard surfaces and increased settlement potential the aircraft carrier boulder rip rap and wharf vertical pilings would provide.	
Special-Status Species		
SI • Significant adverse effect from pile driving activities leading to a may affect, likely to adversely affect determination. All other construction and operations activities would affect, but not likely to adversely effect sea turtles.	SI • Significant adverse effect from pile driving activities leading to a may affect, likely to adversely affect determination. All other construction and operations activities would affect, but not likely to adversely effect sea turtles.	NI
Non-native Species		
LSI • Expected because vessels would comply with USCG and Navy requirements for ballast water and hull management policies. The preparation of the MBP would assist in prevention, control, and response actions that would keep non-native invasive species introductions to minimal levels.	LSI • Expected because vessels would comply with USCG and Navy requirements for ballast water and hull management policies. The preparation of the MBP would assist in prevention, control, and response actions that would keep non-native invasive species introductions to minimal levels.	NI

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

Table 11.2-20. EFHA Summary for Alternative 1 and Alternative 2 Proposed Actions

Project Activities	*Alternative 1*	*Alternative 2*
Construction	The proposed action may adversely affect EFH from direct and indirect impacts during dredge removal actions and cumulative siltation of the benthic habitat. No adverse effects would be seen from noise, turbidity, decreased water quality, and other disturbances on EFH and FEP species during dredging and in-water construction activities, including dredged spoils tug and scow movements through Outer Apra Harbor to the ocean disposal site. • Unavoidable permanent significant direct impacts to coral reefs from	The proposed action may adversely affect EFH from direct and indirect impacts during dredge removal actions and cumulative siltation of the benthic habitat. No adverse effects would be seen from noise, turbidity, decreased water quality, and other disturbances on EFH and FEP species during dredging and in-water construction activities, including dredged spoils tug and scow movements through Outer Apra Harbor to the ocean disposal site. • Unavoidable permanent significant direct impacts to coral reefs

Table 11.2-20. EFHA Summary for Alternative 1 and Alternative 2 Proposed Actions

Project Activities	Alternative 1	Alternative 2
	removal of approximately 25 ac (10 ha) of live coral (all classes [>0% to ≤90%]), which may adversely affect EFH and coral reef ecostem MUS. Compensatory mitigation would be implemented through ACOE Section 10/404 permitting process. • Unavoidable, removal of approximately 46 ac (19 ha) of Live/Hard Bottom and SAV (0% coral), which may adversely affect EFH. SAV is anticipated to recolonized, therefore a temporary impact. Live hard bottom removal will be permanent through maintenance dredging. • Unavoidable short-term and localized indirect impacts to corals and coral reef ecosystem from siltation. Approximately 46.24 ac (18.71 ha) of live coral (all classes [>0% to ≤90%]) may be impacted, resulting in no adverse affect on EFH. • Total area impacted is 171.78 ac (69.52 ha), which includes direct and indirect impacts of 71.18 ac (28.80 ha) and 100.60 ac (40.71 ha), respectively. The EFHA for Apra Harbor found that the construction-related activities could result in: • Long-term, localized permanent removal of coral colonies. • Long-term localized removal of live / hard bottom. Recolinization is not expected due to maintenance dredging. an adverse impact due to size, intensity and cumulative impacts is expected on EFH. • Short-term localized removal of SAV. Although recolinization is expected, a temporary adverse impact due to size, intensity and cumulative impacts is expect on EFH. • Short-term and localized disturbances and displacement of motile species during dredging activities and in-water work. A slight increase in cumulative impacts over Alternative 2 may be seen due to the closer proximity of Sasa Bay. • Some eggs and larvae and site attached finfish mortality may be seen, however most finfish species are expected to return to the area after impact to their area subsides or seek other adjacent habitat. • Short-term, periodic, and localized disturbance and displacement of motile species (finfish) during in-water transit activities. • Short-term, periodic, and localized increase of turbidity (decreased water quality) in the water column from propeller wash. A slight	from removal of approximately 23.74 ac (9.61 ha) of live coral (all classes [>0% to ≤90%]), which may adversely affect EFH and coral reef ecosystem MUS. Compensatory mitigation would be implemented through ACOE Section 10/404 permitting process. • Unavoidable removal of approximately 37 ac (15 ha) of Live/Hard Bottom and SAV (0% coral), which may adversely effect EFH. SAV is anticipated to recolonized, therefore a temporary impact. Live hard bottom removal will be permanent through maintenance dredging. • Unavoidable short-term and localized indirect impacts to corals and coral reef ecosystem from siltation. Approximately 47.21 ac (19.10 ha) of live coral (all classes [>0% to ≤90%]) may be impacted, resulting in no adverse affect on EFH. • Total area impacted is 154.69 ac (62.60 ha), which includes direct and indirect impacts of 60.77 ac (24.59 ha) and 93.92 ac (38.01 ha), respectively. The EFHA for Apra Harbor found that the construction-related activities could result in: • Long-term, permanent removal of flora and sessile invertebrates, including coral. • Long-term localized removal of live / hard bottom. Recolinization is not expected due to maintenance dredging. an adverse impact due to size, intensity and cumulative impacts is expected on EFH. • Short-term localized removal of SAV. Although recolinization is expected, a temporary adverse impact due to size, intensity and cumulative impacts is expect on EFH. • Short-term and localized disturbances and displacement of motile species during dredging activities and in-water work. A slight increase in cumulative direct impacts over Alternative 1 may be seen due to the close proximity of Big Blue Reef and Middle Shoals • Some eggs and larvae and site attached finfish mortality may be seen, however most finfish species are expected to return to the area after impact to their area subsides or seek other adjacent habitat. • Short-term, periodic, and localized disturbance and displacement of motile species (finfish) during in-water transit activities.

Table 11.2-20. EFHA Summary for Alternative 1 and Alternative 2 Proposed Actions

Project Activities	*Alternative 1*	*Alternative 2*
	increase in cumulative impacts to Sasa Bay over Alternative 2 may be seen due to the closer proximity, however this areas is already highly turbid due to the influx of streams in this area. • Short-term, periodic, and localized increase in benthic sedimentation. • Short-term, periodic, and localized potentially significant impacts to eggs and larvae in the upper water column from increased vessel traffic. • Seasonal disturbances to spawning coral reef species and pupping scalloped hammerhead sharks, which would be mitigated. • Beneficial effect to local community assemblages after the aircraft carrier wharf construction is complete and hard surfaces are populated. This would in essence offset any effects to the depauperate community. Based on this assessment, the Navy has determined that these long-term impacts associated with Alternative 1 may adversely affect EFH.	• Short-term, periodic, and localized increase of turbidity (decreased water quality) in the water column from propeller wash. A slight increase in cumulative impacts over Alternative 1 may be seen due to the close proximity of Big Blue Reef and Middle Shoals. • Short-term, periodic, and localized increase in benthic sedimentation. A slight increase in cumulative impacts over Alternative 1 may be seen due to the close proximity of Big Blue Reef and Middle Shoals. • Short-term, periodic, and localized potentially significant impacts to eggs and larvae in the upper water column from increased vessel traffic. • Seasonal disturbances to spawning coral reef species and pupping scalloped hammerhead sharks, which would be mitigated. • Beneficial effect to local community assemblages after the aircraft carrier wharf construction is complete and hard surfaces are populated. This may partially offset effects from construction to the already depauperate community. Based on this assessment, the Navy has determined that these long-term impacts associated with Alternative 2 may adversely affect EFH.
Operation	The proposed action would have direct, indirect and cumulative impacts from noise, resuspension of sediment, decreased water quality, and other disturbances to EFH and FEP MUS due to increased vessel movements in Outer Apra Harbor. A beneficial impact may be seen to water quality (and associated marine biological resources) from the removal of fine benthic sediment within the Outer Apra Harbor Channel • The EFHA for Outer Apra Harbor found that the increased movement of aircraft carrier and MEU support vessels could result in: • Long-term, however, periodic and localized disturbance and displacement of motile species (fish) during in-water transit activities. • Long-term, however, periodic and localized increase of turbidity (decreased water quality) in the water column from propeller wash. A slight increase in cumulative impacts to Sasa Bay over Alternative	The proposed action would have direct, indirect and cumulative impacts from noise, resuspension of sediment, decreased water quality, and other disturbances on EFH FEP MUS due to increased vessel movements in Outer Apra Harbor. A beneficial impact may be seen to water quality (and associated marine biological resources) from the removal of fine benthic sediment within the Outer Apra Harbor Channel • The EFHA for Outer Apra Harbor found that the increased movement of aircraft carrier and MEU support vessels could result in: • Long-term, however, periodic and localized disturbance and displacement of motile species (fish) during in-water transit activities. • Long-term, however, periodic and localized increase of turbidity (decreased water quality) in the water column from propeller wash. A slight increase in cumulative impacts at Big Blue Reef and

Table 11.2-20. EFHA Summary for Alternative 1 and Alternative 2 Proposed Actions

Project Activities	*Alternative 1*	*Alternative 2*
	2 may be seen due to the closer proximity, however this areas is already highly turbid due to the influx of streams in this area. • Long-term, however periodic and localized increase in benthic sedimentation. • Long-term, however, periodic and localized potentially significant impacts to eggs and larvae in the upper water column from increased vessel traffic. • Seasonal disturbances to spawning coral reef species and pupping scalloped hammerhead sharks, which would be mitigated. Based on this assessment, the Navy has determined that these temporary and/or minimal impacts associated with Alternative 1 would result in no adverse effect on EFH with the implementation of BMPs and mitigation measures.	Middle Shoals may be seen over Alternative 1 due to the close proximity. • Long-term, however periodic and localized increase in benthic sedimentation. A slight increase in cumulative impacts over Alternative 1 may be seen due to the close proximity of Big Blue Reef and Middle Shoals. • Long-term, however periodic and localized potentially significant impacts to eggs and larvae in the upper water column from increased vessel traffic. • Seasonal disturbances to spawning coral reef species and pupping scalloped hammerhead sharks, which would be mitigated. Based on this assessment, the Navy has determined that these temporary and/or minimal impacts associated with Alternative 2 would result in no adverse effect on EFH with the implementation of BMPs and mitigation measures.

Table 11.2-21. Estimated Coral Area and Percentages Impacted with Implementation of Alternative 1 and 2 Proposed Dredging Activities

Coral Level	*Alternative 1*					
	Direct		*Indirect*		*Total*	
	ha	*ac (% coral[1])*	*ha*	*ac (% coral[1])*	*ha*	*ac (% coral[1])*
Coral = 0%	**18.61**	**45.98**	**22.00**	**54.36**	**40.61**	**100.34**
0% < coral ≤ 10%	3.74	9.24 (37)	5.45	13.48 (29)	9.20	22.72 (32)
10% < coral ≤ 30%	2.61	6.44 (26)	3.85	9.52 (21)	6.46	15.96 (22)
30% < coral ≤ 50%	0.96	2.37 (9)	3.25	8.04 (17)	4.22	10.41 (15)
50% < coral ≤ 70%	1.80	4.44 (18)	4.19	10.35 (22)	5.99	14.79 (21)
70% < coral ≤ 90%	1.10	2.71 (11)	1.96	4.85 (11)	3.06	7.56 (11)
Total with Coral	**10.20**	**25.20**	**18.71**	**46.24**	**28.91**	**71.44**
Total dredge area	**28.80**	**71.18**	**40.71**	**100.6**	**69.52**	**171.78**
Percent coral cover:		**35%**		**46%**		**42%**
Coral Level	*Alternative 2*					
	Direct		*Indirect*		*Total*	
	ha	*ac (% coral[1])*	*ha*	*ac (% coral[1])*	*ha*	*ac (% coral[1])*
Coral = 0%	**14.98**	**37.03**	**18.90**	**46.71**	**33.89**	**83.74**
0% < coral ≤ 10%	3.44	8.51 (36)	5.34	13.20 (28)	8.79	21.72 (31)
10% < coral ≤ 30%	2.41	5.96 (25)	3.72	9.19 (20)	6.14	15.15 (21)
30% < coral ≤ 50%	0.93	2.29 (10)	3.45	8.53 (18)	4.38	10.82 (15)
50% < coral ≤ 70%	1.82	4.49 (19)	4.46	11.03 (23)	6.28	15.52 (22)
70% < coral ≤ 90%	1.01	2.48 (10)	2.13	5.25 (11)	3.13	7.74 (11)
Total with Coral	**9.61**	**23.74**	**19.10**	**47.21**	**28.71**	**70.95**
Total dredge area	**24.59**	**60.77**	**38.06**	**93.92**	**62.60**	**154.69**
Percent coral cover:		**39%**		**50%**		**46%**

[1]Coral percents are rounded to the nearest percent; therefore total coral % may not sum to 100%

Source: Derived from Classified Habitat Map Using Quickbird Satellite Imagery.

Although multiple coral taxa were observed at sampling locations within the project area, *P. rus*, *P. cylindrica* and *Porites spp*. comprised the large majority of coral at all sites within the dredge footprint. Some corals in the project area appear to show signs of stress. Hemispherical species, such as *P. lobata* were observed to have copious secretions of mucous. It has been shown that corals increase mucus secretion to remove fine particles when turbidity levels are high. These areas are routinely subject to high levels of TSS; therefore, this response to turbidity is not surprising, and may indicate that these corals are stressed.

Essential Fish Habitat for all FEP MUS, with the exception of the coral reef ecosystem species (specifically hard corals under EFH-PHCRT [sessile MUS]), could be negatively impacted, although impacts would be minor. It is not likely that early life stages of pelagic and bottomfish FEP MUS would be present in the area impacted by the proposed activity. Both alternatives would result in significant impacts to hard corals under EFH-PHCRT. Both alternatives would result in long-term impacts to live/hard bottom EFH by dredging removal. This results in a "may adversely effect" determination. Both alternatives would result in less than significant impacts to all other EFH and FEP MUS. A compensatory mitigation plan would be prepared by DoD to off set the ecological services lost from the implementation of the propose action.

11.2.6.2 Summary of Impact Analysis Considerations

The project area is previously disturbed; most of the coral that would be dredged is marginally to modestly healthy (Smith 2007; Dollar 2009) and consists of "re-growth" on the bared reef surfaces that were dredged approximately 60 years ago during the creation of Inner Apra Harbor (Navy 2009a).

Potential indirect impacts were overestimated in the coral reef assessment and the HEA relative to the sediment deposition modeling results. It is unlikely that the project's indirect impacts would result in a significant overall decrease of reproductive potential (i.e., coral spawning) of the Apra Harbor community. The modeled area of potential effects comprises a relatively small fraction of the total reef area of Apra Harbor, composed in large part of soft sediment that is not a suitable substratum for coral planular settlement. The duration of dredging and increased sedimentation at a given particular location is expected to be short (a day or less), and turbidity plumes restricted in size, so that potential impacts to reproductive cycles would not be prolonged.

It is also possible that the area of actual indirect effect would be smaller than the area of potential indirect effect analyzed due to a combination of factors including:

- Inherent physiological tolerance of corals to sediment, including the ability to remove sediment from living tissue
- Likely sediment composition that would be released during dredging (i.e., sand and limestone silt) have been shown to have low impact to corals
- Short duration (~1 day) of dredging at a particular location 990 ft^2 [92 m^2]
- Current velocity sufficient to aid in sediment resuspension and removal
- Relatively steep reef slopes that promote removal of sediment rather than accumulation

To date, the coral community in the potentially affected area has not been documented to be comprised of unique species that could be lost from the Apra Harbor system. As the project area was dredged in 1946, the existing community is the time-integrated response to the previous impact. Hence, the existing coral community structure provides an estimate of the expected pattern of response to the proposed action.

While fish and sea turtles may exit the immediate area adjacent to construction activities, it is not likely that there would be a permanent effect to the present populations as a result of the alternative actions. Impacts on most reef fish populations would be short-term and localized. It is anticipated that coral-associated biological communities (i.e., marine flora, invertebrates, fish, etc.) would repopulate or move back into the areas after in-water dredging activities cease. Some mortality may be seen in site attached species (e.g., damselfishes) that have lost their habitat.

Impacts to infaunal or epifaunal organisms and water quality would be short-term, periodic and localized. No significant impacts to these resources were identified and no compensatory mitigation is proposed.

11.2.7 Summary of Proposed Mitigation Measures

Table 11.2-22 summarizes the proposed mitigation measures.

Table 11.2-22. Summary of Mitigation Measures

Alternative 1	*Alternative 2*
Construction Activities	
• No in-water blasting would be allowed. • Water quality would be monitored for in-water construction projects during the construction phase. • Preliminary shutdown safety zones corresponding to where sea turtles could be injured or harassed would be established based upon empirical field measurements of pile driving sound levels at the construction site. The sound pressure levels (SPLs) would be monitored on the first day of pile driving to ensure accuracy of contours. Until validation of the harm threshold, no pile driving may occur within 100 m of sea turtles and no dredging operations shall occur within 50 m of sea turtles. Safety zones would be re-established to accommodate validated harm threshold and reported to NMFS with acoustic monitoring data. Monitoring of sea turtle harassment safety zones would be conducted by qualified observers, including two observers for safety zones around each pile driving and dredging site. Monitoring shall commence 30 minutes prior to the start of pile driving. If a sea turtle is found within the safety zone, pile driving or dredging of the segment shall be until the animal(s) has been visually observed beyond the impact zone or 30 minutes have passed without re-detection. Pile driving of dredging may continue into the night, but where there has been an interruption of the activity the activity would not be initiated or re-initiated during nighttime hours when visual clearance cannot be conducted. • Pile driving and dredging would commence using soft-start or ramp-up techniques, at the start of each work day or following a break of more than 30 minutes. Pile driving would employ a slow increase in hammering, whereas dredging would commence with slow and deliberate deployment of the bucket or chisel to the bottom for the first several cycles to alert protected species and allow them an opportunity to vacate the area prior to full-intensity operations. • No pile driving or dredging would be conducted after dark unless that work has proceeded uninterrupted since at least one hour prior to sunset, and no protected species have been observed near the respective safety range for that work. • If a sea turtle or other listed species is found injured within the vicinity of the action area, all in-water pile driving or dredging activities shall cease immediately, regardless of their effect on the noted turtle and the Navy would contact the regional NMFS stranding coordinator. • Construction related vessels within Apra Harbor shall remain at least 50 yards from sea turtles, reduce speed to 10 knots or less in the proximity of sea turtles (if practicable, 5 knots or less in areas of suspected turtle activity), and, when consistent with safety practices, put engine in neutral and allow the turtle to pass if approached by a turtle. Additionally, sea turtles shall not be encircled or trapped between multiple construction-related vessels or between construction-related vessels and the shore. • All construction-related equipment would be operated and anchored to avoid contacting coral reef resources during construction activities or extreme weather conditions. Anchor lines from construction vessels would be deployed with appropriate tension to avoid entanglement with sea turtles. Construction-related materials that may pose an entanglement hazard would be removed from the project site if not actively being used. • Anchors, anchor chain, wire rope and associated anchor rigging from construction related vessels would be restricted to designated anchoring areas within the construction footprint (ie, soft bottom) or within the area that would be permanently impacted. • As prescribed in permits for previous construction activities (ie, Kilo Wharf) during pile driving or dredging activities, if a visible plume is observed outside the silt curtains, the construction activity would be suspended, evaluated, and corrective measures taken. This mitigation measure is also applicable to the water resources category (WR). • No barge overflow during dredging operations. This mitigation measure is also applicable to the water resources category (WR).	The same mitigation measures identified for Alternative 1 would apply to Alternative 2.

Table 11.2-22. Summary of Mitigation Measures

Alternative 1	*Alternative 2*
• Where practicable, installation of silt curtains during channel and/or harbor dredging operations to maintain water quality and provide coral protection. This mitigation measure is also applicable to the water resources category (WR). • The Micronesia Biosecurity Plan is being developed to address potential invasive species impacts associated with the actions proposed in this EIS as well as to provide a plan for a comprehensive regional approach. The MBP would include risk assessments for invasive species throughout Micronesia and procedures to avoid, minimize, and mitigate these risks. It is being developed in conjunction with experts within other federal agencies including the NISC, USDA-APHIS, the USGS, and the SERC. The MBP is intended to be a comprehensive evaluation of risks in the region, including all Marine Corps and Navy actions on Guam and Tinian. For actions proposed in this EIS, biosecurity measures would be implemented to supplement existing practices to address invasive species. • Incorporate seasonal dredging prohibitions , which may include: • Cessation of dredging operations during the period of peak coral spawning (7-10 days after the full moon in July) in consultation with the University of Guam (UoG) Marine Lab. • Dredging or filling of tidal waters would not occur during hard coral spawning periods, usually around the full moons of June, July, and August. • Construction related vessels would be restricted from Sasa Bay so as to reduce potential impacts to sea turtles and other protected marine and/or wildlife species • Provide natural resource education and training to military personnel on ESA, MMPA, and EFH. This may include Base Orders, natural resource educational training (i.e., watching of short ERA/MPA video) and documentation (i.e., preparation of *Military Environmental/ Natural Resource Handbook, distribution of natural resource educational materials to dive boat operators*), or a combination of all. • Aboard dredge-related tug, barge or scow vessels at sea, use the minimum lighting necessary to comply with navigation rules and best safety practices to help reduce potential impacts on species such as sea turtles. This mitigation measure may also be applicable to the terrestrial biology category (TB). Coral • The following are being considered as elements for coral mitigation for consideration under the development of the compensatory mitigation plan: • Coral reef restoration via water quality improvements through watershed restoration. • Coral reef restoration via water quality improvements through WWTP upgrades/improvements. • Coral reef restoration via site-specific water quality improvements through retrofitting road stormwater controls at a range of sites on Guam. • Coral reef restoration within non-DOD federal property. • Aquaculture of native herbivorous fish • Coral transplantation • Establishment of marine protected area(s) MPA(s) • Artificial reefs • Support for enhanced enforcement of fishing and recreational diving regulations.	

Table 11.2-22. Summary of Mitigation Measures

Alternative 1	*Alternative 2*
• Marine debris removal • Remove nuisance algae • Installation of recreational mooring buoys • Coral reef restoration inside Apra Harbor through water quality and habitat improvements.	
Operational Activities	
Operation mitigation measures would be similar to those identified above under construction. No mitigation measures have been identified in addition to the existing federal, Guam, and military orders, laws, BMPs, and regulations.	Same as Alternative 1.

CHAPTER 12.
CULTURAL RESOURCES

12.1 INTRODUCTION

This chapter contains a discussion of the potential environmental consequences associated with implementation of the alternatives within the region of influence (ROI) for cultural resources. Because the Environmental Impact Statement (EIS) is also used for Section 106 consultation, this section uses the term, Area of Potential Effects (APE) as defined under the NHPA. The APE is "the geographic area or areas within which the undertaking (project) may directly or indirectly cause changes to the character or use of historic properties, if they exist" (36 CFR 800.16(d)). This would include areas affected by setting (visual or audible), ground disturbance, or public access. The APE was defined during the consultation process early in the planning stages of this EIS with the Guam SHPO. Maps of the APEs for projects on Guam are included in Volume 9, Appendix G, Chapter 4, Cultural Resources. For a description of the affected environment, refer to Volume 2, Chapter (Marine Corps Relocation – Guam). The locations described there include the APE for the aircraft carrier berthing component of the proposed action (Apra Harbor), and the chapters are presented in the same order as the resource areas contained in this Volume.

12.2 ENVIRONMENTAL CONSEQUENCES

12.2.1 Approach to Analysis

12.2.1.1 Methodology

The methodology for identifying, evaluating, and mitigating impacts to cultural resources (archaeological, architectural, and traditional cultural properties) has been established through federal laws and regulations including the National Historical Preservation Act (NHPA) and the Archaeological Resource Protection Act (ARPA).

Under the NHPA, a significant resource is a cultural resource listed or eligible for listing on the NRHP or a historic property. A project affects a historic property when it alters the resource's characteristics, including relevant features of its environment or use that qualify it as significant according to NRHP criteria. Adverse effects may include the following: physical destruction, damage, or alteration of all or part of the resource; alteration of the character of the surrounding environment that contributes to the resource's qualifications for the NRHP; introduction of visual, audible, or atmospheric elements that are out of character with the resource; neglect of the resource resulting in its deterioration or destruction; and transfer, lease, or sale of the property without adequate and legally enforceable restrictions or conditions to ensure long-term preservation of the property's historical significance (36 Code of Federal Regulations [CFR] §800.5(a) (2)).

Analysis of potential impacts to historic properties considers both direct and indirect impacts. Direct impacts are those that may occur from the project, such as the destruction of the property" (NPS 1997:1. Indirect impacts "may be visual, audible, or atmospheric changes which effect the setting of the property" (NPS 1997:1). Cumulative impacts on historic properties under NEPA result from the incremental impact of the action when added to other past, present, and future actions. Cumulative impacts are discussed in Volume 7.

Vandalism is considered to be a significant impact because it damages the integrity of the site, which is the major determinant of NRHP-eligibility. The evidence left in archaeological sites is finite and cannot be replaced once it has been disturbed. For this reason, federal activities that open areas up to the public or that involve personnel traveling through an area may have an adverse effect if vandalism occurs to NRHP-listed or eligible resources in the vicinity.

12.2.1.2 Determination of Significance under NEPA

Significance of impacts to cultural resources is assessed in terms of whether the proposed action will have an adverse effect on a historic property, as defined in 36 CFR 800. An adverse effect is one that alters or destroys the characteristics of the historic property or its integrity that make the property eligible for listing on the NRHP.

The Integrated Cultural Resources Management Plan (ICRMP) for Navy property on Guam has established Standard Operating Procedures (SOPs) for protecting known historic properties and other cultural resources; procedures for managing the inadvertent discovery of archaeological resources, inadvertent discovery of human remains, and inadvertent disturbance to historic properties; and distributing permits for archaeological investigations (Tomonari-Tuggle et al. 2005). In addition, agreements on limitations to training have been made as part of the Mariana Islands Training Range Complex (MIRC) EIS Programmatic Agreement and would be incorporated into any project descriptions; limited or no training stipulations at Apra Harbor are presented in Figure 12.2-1 of Volume 2.

As part of the Section 106 consultation process for this EIS, a Programmatic Agreement (PA) for all military training activities, construction, and operation proposed under the proposed action that includes additional mitigation measures and procedures is being prepared. Proposed signatories to this PA are: the Department of Defense (DoD) (Joint Region Marianas; DoD Representative Guam, Commonwealth of the Northern Mariana Islands [CNMI], Federated States of Micronesia, and Republic of Palau; Marines; Navy; Army; Air Force), other federal agencies (Advisory Council for Historic Preservation [ACHP], the National Park Service [NPS]), and local government agencies (Guam State Historic Preservation Officer [SHPO], CNMI HPO). Stipulations in the proposed PA include the following:

- The DoD would ensure that the identification and evaluation of historic properties within the area of potential effect is completed for the project prior to the initiation of any part of the project with the potential to impact historic properties. Newly discovered properties would be avoided where possible.
- For areas or properties that have not been inventoried for historic properties, the DoD would record surface sites and, when possible, areas would also be archaeologically sampled for subsurface sites when easily obtainable (i.e., without having to demolish existing facilities or infrastructure) unless this demolition is required for the project.
- Any properties not evaluated would be assessed for NRHP eligibility. These historic properties would be incorporated into existing ICRMPs as they are revised or updated, or if a new ICRMP is developed in consultation with the appropriate SHPO.

In recognition of the significance that many historic properties within the footprint of the proposed action has to various cultural groups, the DoD would generally look favorably on affording access to archaeological sites to individuals and organizations that attach significance to these historic properties where security requirements are not prohibitive. The proposed PA also provides stipulations for treatment in case of emergency discoveries, the review process, and report requirements. The SOPs in the current Regional ICRMP would be updated. Although probability maps would be generated based on the likelihood of archaeological resources, treatment of known architectural resources and traditional cultural properties as a result of the proposed action would also be stipulated in the PA.

12.2.1.3 Issues Identified during Public Scoping Process

The following analysis focuses on possible impacts to cultural resources: archaeological, architectural, and traditional cultural properties that could be affected by the proposal. As part of the analysis, concerns relating to cultural resources that were mentioned by the public, including regulatory stakeholders, during scoping meetings were addressed. These include:

- Access to cultural sites
- Construction impacts to cultural resources
- The need to conduct thorough and adequate data collection
- Public participation in the planning process relating to cultural resources

Other cultural issues indentified included:

- Access to traditional plant and fishing areas
- Curation of artifacts off island and storage issues associated with the Guam Museum

12.2.2 Alternative 1 Polaris Point (Preferred Alternative)

12.2.2.1 Onshore

Onshore activities associated with Alternative 1 include construction of a wharf/staging area with ground disturbance of approximately 5.8 acres (ac) (2.3 hectares [ha]), a Morale, Welfare, and Recreation (MWR) area of 2.4 ac (1 ha), security structures including a 50 foot (ft) [15 m] watch tower, and various facilities, including Port Operations, substation, water treatment facilities, and a pump station. All of the APE has been surveyed for archaeological, architectural, and traditional cultural properties (Dixon et al. 2010; Griffin et al. 2009; Mason Architects and Weitze Research 2009; Welch 2010). As part of the project, four existing structures (Facilities 4407 [lifeguard tower, built 1969], 4408 [cabana, built 1972], 4409 [cabana, built 1972], and an existing guard tower) would be demolished. None of these facilities are eligible to the NRHP (Mason Architects, Inc. and Weitze Research 2009). A 300 ft [91 m] roadway would be demolished and replaced with a new access road to connect Polaris Point Drive to the staging area. Figure 12.2-1 provides a summary of the proposed project locations.

<u>Construction</u>

The proposed construction would occur in an onshore area that is composed of fill material and does not contain NRHP- listed or eligible archaeological resources. None of the facilities to be demolished are historic properties. No traditional cultural properties are known for this area.

<u>Operation</u>

Because no historic properties are recorded in the APE, no impacts would result from onshore operations associated with Alternative 1.

12.2.2.2 Offshore

Offshore activities associated with Alternative 1 include dredging of the berthing area, the turning basin, and the channel bend; construction of a wharf at Polaris Point; and the operations associated with the berthing of the aircraft carrier.

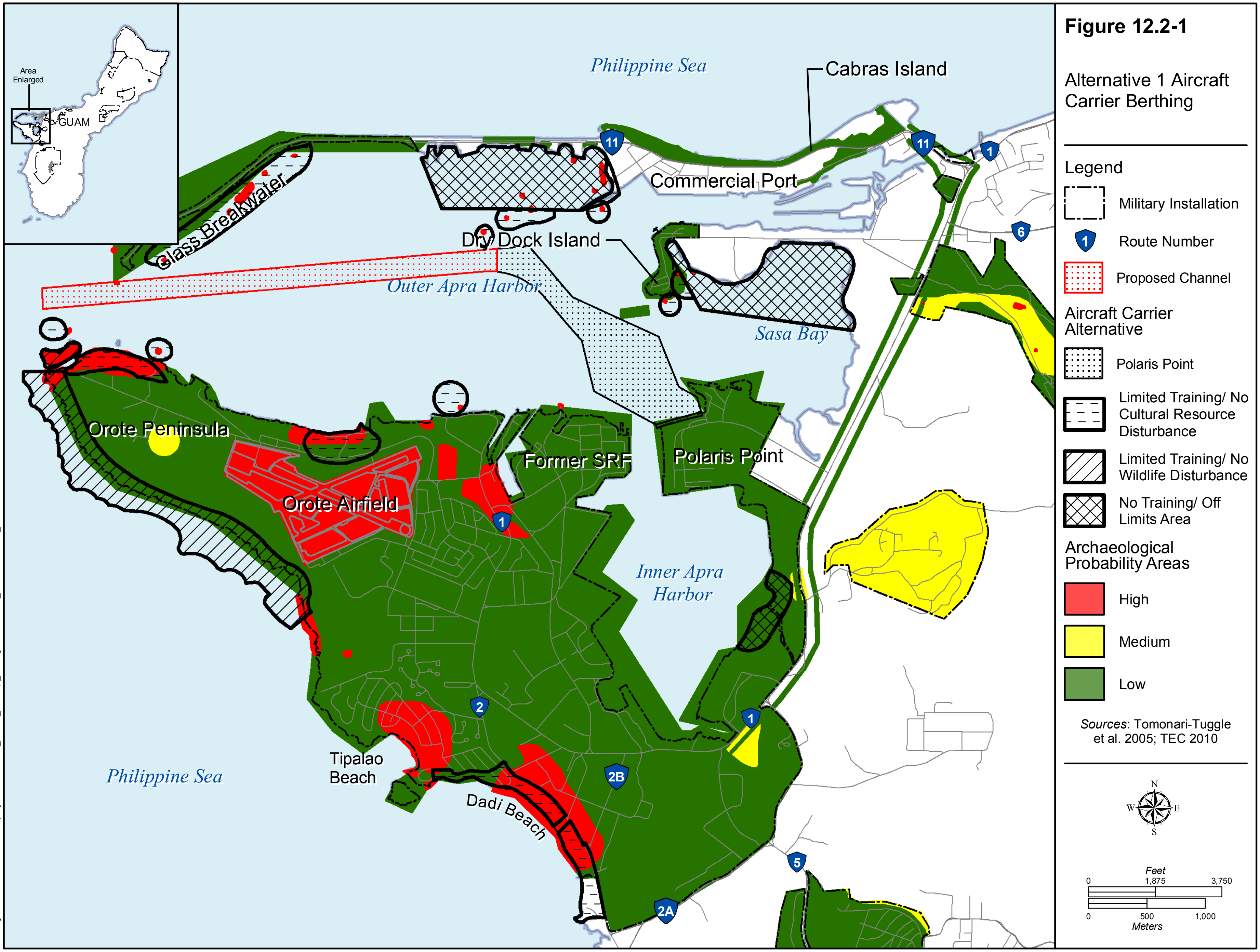


Figure 12.2-1
Alternative 1 Aircraft Carrier Berthing

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Construction

Thirty-one known locations of shipwreck sites and submerged objects are located in Outer Apra Harbor. These include 29 shipwrecks consisting of fishing boats, yachts, barges, tugboats, landing craft utility vessels, British passenger ships, World War II (WWII) Japanese freighters or transport ships, and two plane wrecks with a total of three planes (Navy 2007). None of these resources are located adjacent to Polaris Point or within the area of the proposed turning basin or entrance channel. Because none of these resources are within the APE, dredging and construction would not have a direct adverse impact on submerged resources. Because Best Management Practices and mitigations would be implemented to reduce sedimentation from dredging (see Volume 7), it is not likely to indirectly impact submerged resources in the vicinity.

Operation

No historic properties would be affected by operation activities from the proposed action.

12.2.2.3 Summary of Alternative 1 Impacts

Table 12.2-1 summarizes the potential impacts of each component of the proposed action.

Table 12.2-1. Summary of Alternative 1 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Apra Harbor		
Onshore	Construction	No impacts to historic properties
	Operation	No impacts to historic properties
Offshore	Construction	No impacts to historic properties
	Operation	No impacts to historic properties

Alternative 1 would result in no significant impacts to archaeological, architectural, or submerged resources or objects or traditional cultural properties in the onshore or offshore areas.

12.2.2.4 Alternative 1 Proposed Mitigation Measures

Under Section 106, because there are no cultural resources affected, no mitigation measures or further review under Section 106 are required for archaeology, architecture, submerged resources, or traditional cultural properties.

12.2.3 Alternative 2 Former Ship Repair Facility (SRF)

12.2.3.1 Onshore

Onshore activities associated with Alternative 2 include construction of a wharf/staging area with ground disturbance of approximately 6 ac (2.4 ha), a MWR area of 4 ac (1.6 ha), and various facilities, including Port Operations, substation, water treatment facilities, and a pump station. As part of the project, nine existing structures (93-1 [built 1944], 2004 [built 1991], 2005 [NEEACT Shop, built 1944], 2006 [administrative office, built 1944], 2009 [general storage, built 1993], 2013 [built 1944], 2014 [temporary hazardous waste storage, built 1991], 2108 [office, built 1964], and 2072 [built 1987]) would be demolished. None of these facilities is eligible to the NRHP (Mason Architects, Inc. and Weitze Research 2009). A 600 ft [183 m] portion of E Street would be demolished and replaced south of the staging area (Tomanari-Tuggle et al. 2005).

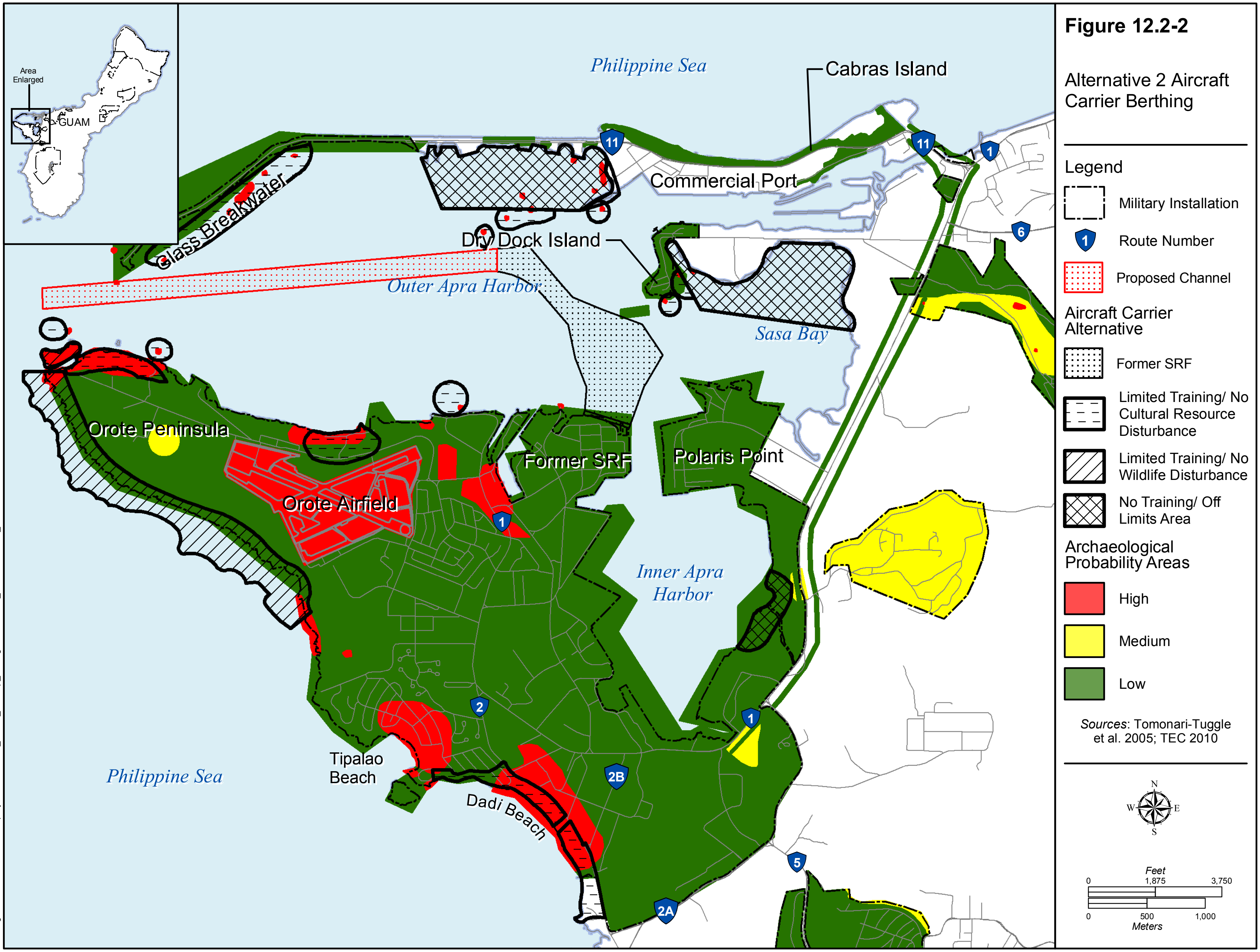

Figure 12.2-2
Alternative 2 Aircraft Carrier Berthing

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Refer to Table 12.2-2 for a summary of the potential impacts of each component of the alternative. Figure 12.2-2 provides a summary of the proposed project locations.

Construction

The proposed construction would occur in an onshore area that is composed of fill material and does not contain historic properties. None of the facilities to be demolished are historic properties. No traditional cultural properties are known from this area.

Operation

Since no historic properties occur in the APE, no impacts would result from onshore operations associated with Alternative 2.

12.2.3.2 Offshore

Offshore activities would be the same as for Alternative 1. No NRHP listed or eligible submerged resources or objects or traditional cultural properties would be adversely impacted either directly or indirectly by the implementation of Alternative 2.

Construction

Impacts would not differ from those of Alternative 1.

Operation

Impacts would not differ from those of Alternative 1.

12.2.3.3 Summary of Alternative 2 Impacts

Table 12.2-2 summarizes Alternative 2 impacts.

Table 12.2-2. Summary of Alternative 2 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Apra Harbor		
Onshore	Construction	No historic properties
	Operation	No historic properties
Offshore	Construction	No historic properties
	Operation	No historic properties

Alternative 2 would result in no significant impacts to archaeological, architectural or submerged resources or objects, or traditional cultural properties in the onshore or offshore areas.

12.2.3.4 Alternative 2 Proposed Mitigation Measures

Under Section 106, because there are no historic properties identified, no mitigation measures or further review under Section 106 are required.

No-Action Alternative

Under the no-action alternative, no construction, dredging, or operation associated with the aircraft carrier berthing would occur. Existing operations at Polaris Point, as a military training and recreational facility, and the Former SRF, as a commercial ship repair facility, would continue. Therefore, the no-action alternative would not have significant impacts to cultural resources.

12.2.4 Summary of Impacts

Table 12.2-3 summarizes the impacts. A text summary is provided below.

Table 12.2-3. Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
Archaeological Resources		
NI • No adverse impacts to NRHP-listed or eligible archaeological resources	NI • No adverse impacts to NRHP-listed or eligible archaeological resources	NI • No adverse impacts to NRHP-listed or eligible archaeological resources
Architectural Resources		
NI • No adverse impacts to NRHP-listed or eligible architectural resources	NI • No adverse impacts to NRHP-listed or eligible architectural resources	NI • No adverse impacts to NRHP-listed or eligible architectural resources
Submerged Resources		
NI • No adverse impacts to NRHP-listed or eligible submerged resources or objects	NI • No adverse impacts to NRHP-listed or eligible submerged resources or objects	NI • No adverse impacts to NRHP-listed or eligible submerged resources or objects
Traditional Cultural Properties		
NI • No adverse impacts to NRHP-listed or eligible traditional cultural properties	NI • No adverse impacts to NRHP-listed or eligible traditional cultural properties	NI • No adverse impacts to NRHP-listed or eligible traditional cultural properties

Legend: NI = No impact

No NRHP listed or eligible for listing archaeological sites, architectural resources, submerged resources or objects, or traditional cultural properties would be significantly impacted by either Alternative 1 or Alternative 2.

12.2.5 Summary of Proposed Mitigation Measures

There are no proposed mitigation measures associated with this action.

CHAPTER 13.
VISUAL RESOURCES

13.1 INTRODUCTION

This chapter describes the potential environmental consequences associated with implementation of the alternatives within the region of influence (ROI) for visual resources. For a description of the affected environment, refer to the respective chapter of Volume 2 (Marine Corps Relocation – Guam). The locations described in that Volume include the ROI for the aircraft carrier berthing component of the proposed action (Apra Harbor), and the chapters are presented in the same order as the resource areas contained in this Volume.

13.2 ENVIRONMENTAL CONSEQUENCES

13.2.1 Approach to Analysis

13.2.1.1 Methodology

Information on visual resources was gathered at public scoping meetings in April 2007 and via subsequent on-site visits and background research (EDAW 2007a, 2007b, 2009, and Google Earth 2008). As noted below, there were no concerns raised during the public scoping meetings regarding visual resources. The analysis of potential impacts to visual resources is based on the long-term (operational) effects – i.e., after construction has occurred. Construction-related activities related to the development of the aircraft carrier facilities would be short-term in duration and minimal in their impacts (i.e., work in an active harbor environment).

13.2.1.2 Determination of Significance

For the purpose of this Environmental Impact Statement (EIS), the proposed action would cause a significant impact to visual resources if they:

- Would substantially alter the views or scenic quality associated with particularly significant and/or publicly recognized vistas, viewsheds, overlooks, or features
- Would substantially change the light, glare, or shadows within a given area
- Would substantially affect sensitive receptors – i.e., viewers with particular sensitivity (or intolerance) to a changed view (e.g., a hillside neighborhood with views of a relatively undisturbed, naturally-appearing landscape)

Significant impacts that cannot be mitigated to less than significant levels are considered unavoidable.

A discussion is presented for each significance criterion listed that would be triggered by the alternatives.

13.2.1.3 Issues Identified during Public Scoping Process

No visual resource issues regarding the proposed action were raised at the April 2007 public scoping meetings.

13.2.2 Alternative 1 Polaris Point (Preferred Alternative)

13.2.2.1 Onshore

Onshore activities associated with Alternative 1 Polaris Point (referred to as Alternative 1) include construction of a wharf/staging area with ground disturbance of approximately 5.8 acres (ac) (2.3 hectares [ha]), a Morale, Welfare, and Recreation (MWR) area of 2.4 ac (1 ha), security structures including a 50 foot (ft) (15 meter [m]) watch tower, and various buildings including a Port Operations Building, a substation, water treatment facilities, and a pump station on an existing military operating port facility. As part of the project, four existing structures (buildings 4407, 4408, 4409, and an existing guard tower) would be demolished. A 300 ft (91 m) roadway would be demolished and replaced with a new access road to connect Polaris Point Drive to the staging area.

Onshore construction related disturbances would be evident from offshore locations within Outer Apra Harbor, and to a lesser degree to nearby onshore areas. These activities would introduce some new elements into the landscape and remove others; with the most substantial being, from a visual perspective, a 50 ft (15 m) watch tower that would be visible from some distant views. However, all of these activities would occur in, and new features would be added to, a fully developed military base including an industrial area and harbor environment. Therefore, less than significant impacts to visual resources are anticipated from onshore activities.

13.2.2.2 Offshore

Offshore activities associated with Alternative 1 include dredging of the berthing area, the turning basin, and the channel bend; construction of a wharf at Polaris Point; and the operations associated with the berthing of the aircraft carrier.

During construction, pile-driving equipment, shoreline alteration activities (cut/fill), and dredging activities (barges and cranes) would alter the existing landscape. The most evident post-construction landscape feature would be a changed shoreline, i.e., from an uneven, rip-rap water's edge to a wharf raised 12 ft (3.7 m) above mean sea level that could be up to 1,325 ft (404 m) in length. The construction activities would be short-term and would not impact sensitive receptors or appreciably alter the light, glare or shadows because all proposed activities would be within an active commercial port.

During the aircraft carrier visits (approximately 63 total days per year; up to 21 days per visit), the most significant visual feature would be the aircraft carrier itself, with its bridge deck and associated towers reaching 215 ft (66 m) high. No sensitive receptors were identified in the area. There would be minor changes to the light, glare, or shadows due to the new facilities with no appreciable impact on visual resources because the proposed activities would be located within an active military and commercial port. The submarine compound would experience a change in shadow pattern, but it would not interfere with their mission. The aircraft carrier would have the most impact on Naval Base Guam visitors and waterfront personnel. Most visitors to the Naval Base would not consider an aircraft carrier a negative impact to the Navy harbor view plane. The operational activities would take place within an active industrial Naval harbor environment. Therefore, these new activities and features would have less than significant impacts to visual resources.

13.2.2.3 Summary of Alternative 1 Impacts

Table 13.2-1 summarizes Alternative 1 impacts.

Table 13.2-1. Summary of Alternative 1 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	No adverse impacts to visual resources are anticipated from onshore activities
	Operation	New elements would be introduced into the existing landscape and remove others, with the most substantial being a 50 ft (15 m) watch tower, that would be visible from some distant views.
Offshore	Construction	No adverse impacts to visual resources are anticipated from offshore activities
	Operation	The most evident post-construction landscape feature would be a changed shoreline, i.e., from an uneven, rip-rap water's edge to a wharf raised 12 ft (3.7 m) above mean sea level that could be up to 1,325 ft (404 m) in length. During the aircraft carrier visits, the most significant visual feature would be the aircraft carrier itself, with its bridge deck and associated towers reaching 215 ft (66 m) high.

13.2.2.4 Alternative 1 Proposed Mitigation Measures

There are no mitigation measures required.

13.2.3 Alternative 2 Former Ship Repair Facility (SRF)

13.2.3.1 Onshore

Onshore activities associated with Alternative 2 Former SRF (referred to as Alternative 2) include construction of a wharf/staging area with ground disturbance of approximately 6 ac (2.4 ha), an MWR area of 4 ac (1.6 ha), and various buildings including Port Operations Building, a substation, a water treatment facility, and a pump station. As part of the project, 10 existing structures (93-1, 2004, 2005, 2006, 2009, 2010, 2013, 2014, 2108, and 2072) would be demolished. A 600 ft (183 m) portion of E Street would be demolished and replaced south of the staging area.

As the Former Ship Repair Facility (SRF) site is a port industrial area with no sensitive receptors, construction of the proposed facilities at the Alternative 2 location would not be expected to result in adverse impacts to visual resources.

13.2.3.2 Offshore

Offshore activities associated with Alternative 2 include dredging of the berthing area, the turning basin, and the channel bend; construction of a wharf at the Former SRF site; and the operations associated with the berthing of the aircraft carrier.

As the Former SRF site is a port industrial area, construction of the proposed facilities at the Alternative 2 location would not be expected to result in adverse impacts to visual resources. No adverse impacts to the view plane would result, as described under Alternative 1.

13.2.3.3 Summary of Alternative 2 Impacts

Table 13.2-2 summarizes Alternative 2 impacts.

Table 13.2-2. Summary of Alternative 2 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	No adverse impacts to visual resources are anticipated from onshore activities
	Operation	No adverse impacts to visual resources are anticipated from onshore activities
Offshore	Construction	No adverse impacts to visual resources are anticipated from offshore activities
	Operation	No adverse impacts to visual resources are anticipated from offshore activities

13.2.3.4 Alternative 2 Proposed Mitigation Measures

There are no mitigation measures required.

13.2.4 No-Action Alternative

Under the no-action alternative, no construction, dredging, or operations associated with the proposed aircraft carrier berthing would occur. Existing operations at Polaris Point, as a military training and recreational facility, and the Former SRF, as a commercial ship repair facility, would continue. Therefore, the no-action alternative would not have adverse impacts to visual resources.

13.2.5 Summary of Impacts

The visual impacts are similar for both alternatives, which are located in an industrial harbor. Construction impacts would be minor and temporary. The transient nuclear powered aircraft carrier capability-related changes to Apra Harbor would result in shoreside modifications to the visual environment at the two sites. The difference is the Former SRF site was previously developed and the Polaris Point site is under developed; however, they are both in industrial areas and the facilities would be consistent with the other waterfront facilities in the vicinity. The affected area would be within an active military base and military harbor facility surrounded by existing commercial port infrastructure. No adverse impacts are anticipated. Table 13.2-3 summarizes the potential impacts of each action alternative and the no-action alternative.

Table 13.2-3. Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
Onshore Viewshed		
LSI • New elements would be introduced into the existing landscape and others removed, with the most substantial being a new 50 ft (15. m) watch tower that would be visible from some distant views.	NI	NI
Offshore Viewshed		
LSI • The most evident post-construction landscape feature would be a changed shoreline – i.e., from an uneven, rip rap water's edge to a wharf raised 12 ft (3.7 m) above mean sea level that could be up to 1,325 ft (404 m) in length. • During the aircraft carrier visits, the most notable visual feature would be the aircraft carrier itself, with its bridge deck and associated towers reaching 215 ft (66 m) high.	NI	NI

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

13.2.6 Summary of Proposed Mitigation Measures

As previously discussed, mitigation measures would not be required for either alternative.

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CHAPTER 14.
MARINE TRANSPORTATION

14.1 INTRODUCTION

This chapter contains the discussion of the potential environmental consequences associated with implementation of the alternatives within the region of influence for marine transportation resources as it relates to the aircraft carrier berthing. For a description of the affected environment, refer to Volume 2, Chapter 14 (Marine Corps Relocation – Guam). The locations described in that Volume include the region of influence for the aircraft carrier berthing component of the proposed action (Apra Harbor), and the sections here are presented in the same order as the resource areas contained in Volume 2.

14.2 ENVIRONMENTAL CONSEQUENCES

For a full description of the affected environment and environmental consequences for on-base and off-base road traffic, refer to Volume 6: Related Actions – Utilities and Roadway Projects. Although this Chapter focuses on marine transportation, a brief discussion is included on additional truck traffic that would occur from transportation of dredged material from barges to upland disposal sites. Detailed analysis of potential impacts to biological resources is presented in Chapter 11 of this Volume. Analysis of the potential environmental impacts as they relate to the physical and chemical composition of the materials to be dredged and the potential dewatering and beneficial reuse of the dredged materials are addressed in Chapter 4 of this Volume and Volume 9, Appendix D.

14.2.1 Approach to Analysis

14.2.1.1 Methodology

The primary military, commercial, and recreational port facilities on Guam are located in Apra Harbor. It is critical that navigational access to the channels be maintained for these users. The consequences of the alternatives for the proposed project and the no-action alternative were evaluated based upon the magnitude and duration of impacts to navigation. For activities within an alternative that would have an adverse impact on marine transportation (navigation), appropriate measures to minimize the impact to marine transportation have been identified. The analysis of the alternatives addresses the potential impacts to navigation from the proposed berthing of the aircraft carrier.

14.2.1.2 Determination of Significance

For marine transportation, the significance of impacts is determined by the potential interference to marine vessel navigation from the proposed berthing of the aircraft carrier.

14.2.1.3 Issues Identified during Public Scoping Process

As part of the analysis, the concerns relating to navigation that were identified by the public, including regulatory stakeholders, during scoping meetings were reviewed. These concerns related to the potential restrictions to access areas in Outer Apra Harbor as a result of the movement of military vessels.

14.2.2 Alternative 1 Polaris Point (Preferred Alternative)

14.2.2.1 Onshore and Offshore

Construction

Activities proposed in Outer Apra Harbor associated with Alternative 1 Polaris Point (referred to as Alternative 1) include: construction of a new wharf at Polaris Point; dredging of about 608,000 cubic yards (cy) (464,850 cubic meters [m^3]) from the berthing area, the turning basin, and the channel bend; relocation of a buoy and range lights; installation of floating security barriers around the aircraft carrier while it is at the wharf; and a change in the number and duration of visits by the aircraft carrier and its associated Carrier Strike Group (CSG). The proposed activities that would have an impact on navigation are: 1) the dredging that would be conducted in or adjacent to the main channel, 2) the relocation of the buoys, 3) the relocation of the range lights for Outer Apra Harbor, 4) the security barrier installed around the aircraft carrier, and 5) restrictions on navigation during aircraft carrier transits into and out of Apra Harbor in accordance with security requirements.

There are alternatives being considered for the design of the new wharf at Polaris Point. The Record of Decision (ROD) would not include a decision on structural design, because it is unlikely that the final design would be available for inclusion in the Final Environmental Impact Statement (EIS). It is likely that construction of the wharf would result in less than significant impacts to marine transportation.

Dredging could be conducted by hydraulic or mechanical dredge. The environmentally most conservative case is generally believed to be mechanical dredging. The daily work cycle (24 hours per day), weather, and other variables affect the efficiency of the dredging operation. The total duration of dredging would be between 8 months to 18 months. Dredging is not required in the east-west aligned navigation channel or Outer Apra Harbor. In the sharp southward bend in the channel, there is a discrete area of dredging that would take approximately a week to complete. During that period, use of certain sections of the main navigation channel would be restricted due to the presence of the dredging equipment; this would result in less than significant impacts to marine transportation. The majority of the dredging would occur just north of Inner Apra Harbor and there would be impacts to ship traffic transiting to/from Inner Apra Harbor. To minimize impacts of the proposed dredging on the maritime community, a Notice to Mariners would be published prior to the start of the dredging to identify the location and duration of dredging, and temporary navigational aids may be deployed.

The proposed widening of the Outer Apra Harbor shipping channel to 600 feet (ft) (183 meters [m]) would require relocation of three buoys and range lights. A Notice to Mariners would be published prior to the relocation of the buoys and range lights to identify the new locations and the dates when the buoys and range lights would be moved. The relocation of the buoys and range lights would result in no impact to marine transportation.

Five dredged material disposal options are considered in this EIS: 100% ocean disposal, 100% upland placement, 100% beneficial reuse, 50% beneficial reuse/50% ocean disposal, and 20-25% beneficial reuse/75-80% ocean disposal. For the 100% ocean disposal option, one tugboat would tow a 4,000 cy (3,058 m^3) scow filled with dredged material to the ocean disposal site and then return to the dredging site. One to two trips per day is estimated based on an anticipated dredge production rate of 1,800 cy (1,376 m^3) per 24-hr construction day. This rate is based on recent dredging of similar material near Bravo Wharf (Volume 9, Appendix E, Section E). The tugboat and scow transporting the dredged material from the project site would travel along existing shipping lanes and be subject to United States Coast Guard (USCG) rules and regulations. A total of about 150 trips to the ocean disposal site would be conducted to transport the dredged material from Polaris Point. Additional ship traffic would be addressed through scheduling and communications between Port Operations and the contractors.

Assuming 100% upland placement of the dredged material, the dredged material from the scow would likely be offloaded to sealed-end dump trucks at an Inner Apra Harbor wharf; Uniform Wharf has historically been used for this purpose. If the Polaris Point upland placement site is selected, the material would likely be offloaded at Polaris Point with surface transport limited to the Polaris Point area. The remaining candidate sites for upland placement are located on the Orote side of Naval Base Guam. The travel distance to these sites from Uniform Wharf is shown Table 14.2-1. The routes from Uniform Wharf to the upland placement sites are paved. The Sumay Drive portion is in an industrial waterfront area. The route to Field 3 would require additional transport through the central retail area of the base. Assuming a dump truck capacity of 18 cy (14 m^3), there would be 100 round-trip truck trips per 24-hour period. Approximately half of these trips would occur during retail business hours and there would be impacts to retail traffic. If Field 3 is the designated upland placement site, then there are opportunities to use a less direct route to the site to avoid impacts to retail shoppers. There would be traffic impacts to the submarine compound personnel that would be addressed through scheduling. Supply trucks and shuttle bus schedules would avoid peak morning and afternoon traffic through the security gate.

Recent preliminary information from the Navy's upland placement study supplemental review has indicated that there may be substantially less upland capacity available on the five confined disposal facilities on Navy lands. Due to land use changes, Field 4, the PWC Compound, and the Polaris Point upland placement site may not be available for upland placement. Capacity may be reduced in Field 5 due to cell construction to separate different types of materials. Field 3 remains a suitable option for upland placement.

Table 14.2-1. Travel Distance to Upland Placement Sites

Upland Placement Site	*Distance miles (m)/(kilometers [km])*	*Route from Uniform Wharf*
Field 3	1.7 (2.7)	Sumay Drive, cross Marine Drive to road between the Commissary and the Exchange
Field 4	1.2 (1.9)	Sumay Drive
Field 5	1.2 (1.9)	Sumay Drive
PWC	0.5 (0.8)	Sumay Drive

<u>Operation</u>

Under the proposed action for a transient aircraft carrier wharf, there would be a cumulative total of up to 63 visit days per year, with an anticipated length of 21 days or less per visit. The 2008 CSG visiting schedule was 4 visits of 4 days duration for a total of 16 days in Apra Harbor with the aircraft carrier berthed at Kilo Wharf.

As is currently the case during aircraft carrier visits, the movement of the aircraft carrier to the Polaris Point wharf would require up to four assist tugboats to maneuver the aircraft carrier that would provide its own forward propulsion. Aircraft carriers transiting through Outer Apra Harbor restrict other uses in the channel for security and safety reasons. The movement of the aircraft carrier would result in less than significant impacts to marine transportation.

While the aircraft carrier is at the wharf, there would be floating security barriers placed to prevent an attack on the aircraft carrier by a boat. The recommended minimum barrier standoff from the aircraft carrier hull is 250 ft (76 m) at the lowest threat level. This security barrier would restrict access to Inner

Apra Harbor. The floating security barrier would result in a less than significant impact to marine transportation in Outer Apra Harbor.

When high security alerts force protection condition (FPCON) Charlie and Delta are declared, the security barriers would be deployed 450 ft (137 m) from the aircraft carrier hull. There would be a significant impact to marine transportation and access to Inner Apra Harbor. This restriction to navigation would only affect military operations since access to the inner harbor is restricted to military vessels controlled by Naval Base Guam. FPCON Charlie describes a situation when an instance occurs or when intelligence reports that there is terrorist activity imminent. FPCON Delta describes a situation when a terrorist attack is taking place or has just occurred. FPCON Delta usually occurs only in the areas that are most vulnerable to or have been attacked. The primary difference between FPCON Charlie, and FPCON Delta, is that FPCON Delta references a specific, known threat, whereas FPCON Charlie is used to prepare for imminent threats of a general, non-targeted nature. FPCON Charlie can also be maintained for a significant length of time, several weeks, while FPCON Delta is generally only maintainable for several days. It is understood that Navy and U.S. Coast Guard security boats would be positioned in Apra Harbor less than two nautical miles from either of the alternative carrier locations for security response.

Under Alternative 1, there would be a cumulative total of up to 63 visit days per year, with an anticipated length of 21 days or less per visit. The aircraft carrier would berth at Polaris Point. This would allow additional access to Kilo Wharf for the loading of ammunition by other ships. The change in the number and duration of the visits by the CSG would result in no impacts to marine transportation.

In addition to the approximately 150 trips by tugboats and scows over an 8 to 18 month period to transport dredged material to the ocean disposal site, there would be 145 container vessels above the average (124 container ships) visiting the Port of Guam over the peak activity year (2015) to transport the equipment and supplies for the relocation of the Marines to Guam. There would be an increase in the shipment of break-bulk cargo to the Port of Guam. During the peak year of break-bulk cargo shipment (2012), there would be an additional 242 break-bulk ships above the average of 290 break-bulk ships (Port Authority of Guam 2008a, 2008b, and 2008c). If all of these vessel movements were to occur in the same year, the 150 vessel trips by tugboats and scows, 145 additional container ships, and 242 break-bulk ships would be added to the number of vessels that visit the Port of Guam each year (1,022 vessels in the year 2008). Because the annual number of vessels visiting the Port of Guam has decreased by 1,902 vessels over the period of 1995 to 2008, it is expected that the addition of about 537 vessels per year would have a less than significant impact on marine transportation in Apra Harbor.

14.2.2.2 Summary of Alternative 1 Impacts

Table 14.2-2 summarizes the impacts for Alternative 1.

Table 14.2-2. Summary of Alternative 1 Impacts

Area	*Project Activities*	*Impacts to Transportation*	*Impacts*
Onshore and Offshore	Construction	Construction of a new wharf at Polaris Point	LSI
		Dredging of about 608,000 cy (464,850 m^3) from the berthing area, the turning basin, and the channel bend	LSI
		Relocation of buoys and range lights	NI
		Transport of dredged material from the dredging site within the harbor	LSI
		Transport of dredged material from the harbor to the ocean disposal site	LSI
		Transport of equipment and supplies by ship	LSI
		Shoreside Traffic	LSI
	Operation	Installation of floating security barriers around the aircraft carrier while it is at the wharf	LSI
		Movement of the aircraft carrier to the Polaris Point wharf	LSI
		Change in number and duration of visits by the Carrier Strike Group	NI

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

14.2.2.3 Alternative 1 Proposed Mitigation Measures

No mitigation measures would be required.

14.2.3 Alternative 2 Former Ship Repair Facility (SRF)

14.2.3.1 Onshore and Offshore

Activities proposed in Apra Harbor associated with Alternative 2 Former SRF (referred to as Alternative 2) include: construction of a new wharf at the SRF; dredging of about 479,000 cy (366,222 m^3) from the berthing area, the turning basin, and the channel bend; relocation of a buoy and two range lights; installation of floating security barriers around the aircraft carrier while it is at the wharf; and a change in the number and duration of visits by the CSG. The proposed activities that would have an impact on navigation are: the dredging that would be conducted in or adjacent to the main channel, the relocation of the buoy and range lights for Outer Apra Harbor, and the security barrier installed around the aircraft carrier (Table 14.2-3).

Construction

Construction impacts on navigation would be as described for Alternative 1 except there would be less dredged volume generated. The number of trips by the tugboat and scow to transport the dredged material would be about 120 trips over a 8 to 18 month period. The impacts to Inner Apra Harbor traffic are as described under Alternative 1. To minimize impacts of the proposed dredging on the maritime community, a Notice to Mariners would be published prior to the start of the dredging to identify the location and duration of dredging, and temporary navigational aids may be deployed.

If Field 3 is the designated upland placement site, then there are opportunities to use a less direct route to the site to avoid impacts to retail shoppers. There would be traffic impacts to the submarine compound personnel that would be addressed through scheduling. Supply trucks and shuttle bus schedules would avoid peak morning and afternoon traffic through main base gates and Guam Shipyard access routes.

Therefore, Alternative 2 would result in less than significant impacts to marine transportation.

Operation

Marine transportation impacts under Alternative 2 would be similar to those under Alternative 1. Therefore, Alternative 2 would result in less than significant impacts to marine transportation.

Traffic generated under Alternative 1 would be similar to that under Alternative 2. The differences include more on-base traffic and main gate traffic. In addition, because of the proximity to main base amenities there is likely to be an increase in pedestrian traffic. There would be no impact on Polaris Point operations. The shipyard repair facilities at the Former SRF would be consolidated and segregated from the aircraft carrier area. The access routes would be shared and there would be impacts on workers at the shipyard.

Additional ship traffic would be addressed through scheduling and communications between Port Operations and the contractors. With implementation of these measures, Alternative 2 would have less than significant impact to marine transportation.

14.2.3.2 Summary of Alternative 2 Impacts

Table 14.2-3 Summary of Alternative 2 Impacts

Area	*Project Activities*	*Impacts to Navigation*	*Impacts*
Onshore and Offshore	Construction	Construction of a new wharf at the Former SRF	LSI
		Dredging of about 479,000 cy (366,222 cubic meters) from the berthing area, the turning basin, and the channel bend	LSI
		Transport of dredged material from the dredging site within the harbor	LSI
		Transport of dredged material from the harbor to the ocean disposal site	LSI
		Relocation of a buoy and two range lights	NI
		Transport of equipment and supplies by ship	LSI
		Shoreside Traffic	LSI
	Operation	Movement of the aircraft carrier to the new wharf	LSI
		Installation of floating security barriers around the aircraft carrier while it is at the wharf	LSI
		Change in number and duration of visits by the Carrier Strike Group	NI

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

14.2.3.3 Alternative 2 Proposed Mitigation Measures

No mitigation measures would be required.

14.2.4 No-Action Alternative

Under the no-action alternative the new wharf would not be constructed, and there would be no dredging or relocation of the buoys or range lights. Transient aircraft carrier visits to Apra Harbor could not be accommodated. Therefore, the no-action alternative would have no impact to marine transportation.

14.2.5 Summary of Impacts

Table 14.2-4 summarizes the potential impacts of each action alternative and the no-action alternative. A text summary is provided below.

Table 14.2-4 Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
Apra Harbor-Offshore		
• LSI	• LSI	• NI
Apra Harbor-Onshore		
• LSI	• LSI	• NI

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

Under all alternatives including the no-action alternative, there are less than significant operational impacts to navigation and onshore traffic. The construction activities under the two action alternatives would be the same, except for less volume of dredged material under Alternative 2.

14.2.6 Summary of Proposed Mitigation Measures

No mitigation would be required for Alternative 1 or Alternative 2.

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CHAPTER 15. UTILITIES

For a complete look at utilities, please see Volume 6.

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CHAPTER 16.
SOCIOECONOMICS AND GENERAL SERVICES

16.1 INTRODUCTION

This chapter contains the discussion of the potential environmental consequences associated with the implementation of the alternatives within the region of influence (ROI) for socioeconomic resources. For a description of the affected environment for all resources, refer to the respective chapter of Volume 2 (Marine Corps Relocation – Guam). The locations described in that Volume include the ROI for the aircraft carrier berthing component of the proposed action (Apra Harbor), and the chapters are presented in the same order as the resource areas contained in this Volume.

Socioeconomic impacts would be islandwide in nature with little difference in effects among alternatives. Therefore, the summary of impacts presented below cover both of the action alternatives for aircraft carrier berthing; the no-action alternative is assessed separately in Section 16.2.4.

16.2 ENVIRONMENTAL CONSEQUENCES

16.2.1 Methodology

Refer to the corresponding section of Volume 2.

16.2.1.1 Determination of Significance

Refer to the corresponding section of Volume 2.

16.2.1.2 Issues Identified During Public Scoping Process

Refer to the corresponding section of Volume 2.

16.2.2 Alternative 1 Polaris Point (Preferred Alternative)

The proposed action covered in this Volume includes the following factors/assumptions for this socioeconomic analysis:

- The Navy would not transfer any permanent shoreside operational personnel or dependents to Guam for this action, nor would it transfer any federal civilian workers.
- Post-construction operational impacts flow from the increased number of aircraft carrier days in port (port-days).
- Under the proposed action for a transient aircraft carrier wharf, there would be a cumulative total of up to 63 visit days per year, up to 21 days per visit.
- Most of the impacts of the transient visits come from personal expenditures in the Guam economy (as opposed to expenditures made on base) by personnel while vessels are in port.
- A smaller source of impacts would be Navy expenditures made in the Guam economy to provide goods and services to the vessel while in port. These expenditures generally are more linked to the number of dockings than to the total in-port days. However, because that number is unavailable due to operational variability, it is assumed that expenditures would more than triple over existing Navy expenditures for carrier visits.
- The "direct operational jobs" discussed in this chapter are all in the private sector, flowing from the above types of direct expenditures.

16.2.2.1 Population Impacts

<u>Project Related Population</u>

There would be no direct population increases attributed to this action though there would be induced population increases as a result of this action. Refer to Volume 2 for additional information.

Approach to Analysis

Table 16.2-1 provides assumptions made in conducting analyses for the construction phase, as well as the source of, or rationale for, those assumptions.

Table 16.2-1. Construction Component Assumptions for Project Related Population Impacts

Assumption	*Assumed Value*	*Source/Rationale*
Average number of dependents for in-migrating direct, on-site, construction jobs	0.20 - 0.35	Estimate based on contractor interviews (Appendix F Socioeconomic Impact Assessment Study (SIAS)
Average number of dependents for in-migrating direct from purchases jobs	0.95 - 1.0	U.S. Census national data on persons per jobs (U.S. Census Bureau 2000) and Guam Department of Labor (GDoL) interviews (Appendix F SIAS).
Average number of dependents for in-migrating indirect/induced jobs	0.95 - 1.0	U.S. Census national data on persons per jobs (U.S. Census Bureau 2000) and GDoL interviews (Appendix F SIAS).

Table 16.2-2 provides assumptions made in conducting analysis for the operation phase, as well as the source of, or rationale for, those assumptions.

Table 16.2-2. Operational Component Assumptions for Project Related Population Impacts

Assumption	*Assumed Value*	*Source/Rationale*
Average number of dependents for in-migrating direct from purchases jobs	0.95 - 1.0	U.S. Census national data on persons per jobs (U.S. Census Bureau 2000) and GDoL interviews (Appendix F SIAS).
Average number of dependents for in-migrating indirect/induced jobs	0.95 - 1.0	U.S. Census national data on persons per jobs (U.S. Census Bureau 2000) and GDoL interviews (Appendix F SIAS).

Impacts

Table 16.2-3 indicates the peak construction total impact would peak at 1,478 people in 2012. By 2015 the increase would stabilize at 386 people, related to economic activity created by the spending of transient personnel.

Table 16.2-3. Estimated Population Increase Related to Navy Proposed Action

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Combined Total Impact	0	1,108	1,478	1,455	968	386	386	386	386	386	386

Notes: Population figures exclude existing Guam residents who obtain employment as a result of the proposed action. The amount of population from active-duty military personnel and dependents is also provided there for each year.

Figure 16.2-1 suggests population would slightly exceed the baseline trend by about 1% at the 2012 construction peak and by less than 1% thereafter.

This does not meet the 2% threshold for significance being used for this analysis.

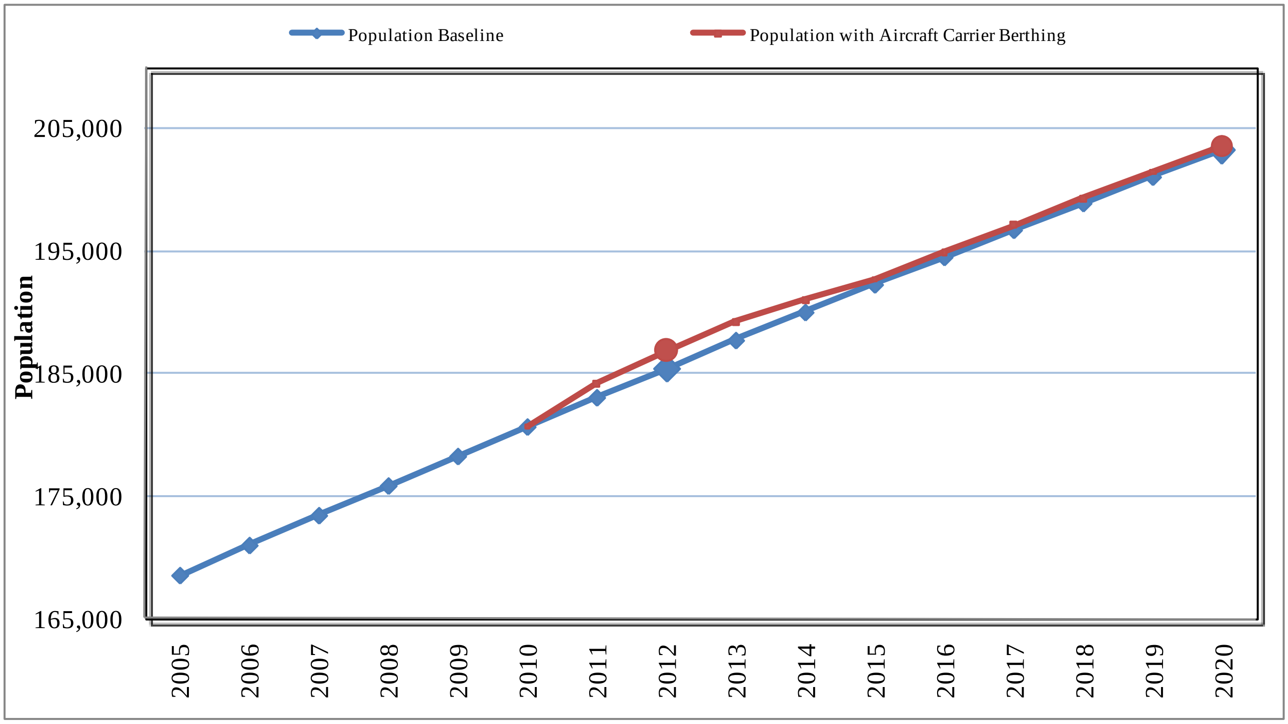


Figure 16.2-1. Population With and Without Proposed Action

<u>Demographic Characteristics</u>

Refer to the corresponding section of Volume 2 for introductory statements, approach to analysis (including data sources) and analysis.

<u>Household Characteristics</u>

Refer to the corresponding section of Volume 2 for introductory statements, approach to analysis (including data sources) and analysis.

16.2.2.2 Economic Impacts

<u>Employment and Income</u>

Refer to the corresponding section of Volume 2 for introductory statements, approach to analysis (including data sources) and analysis.

Civilian Labor Force Demand - Impacts

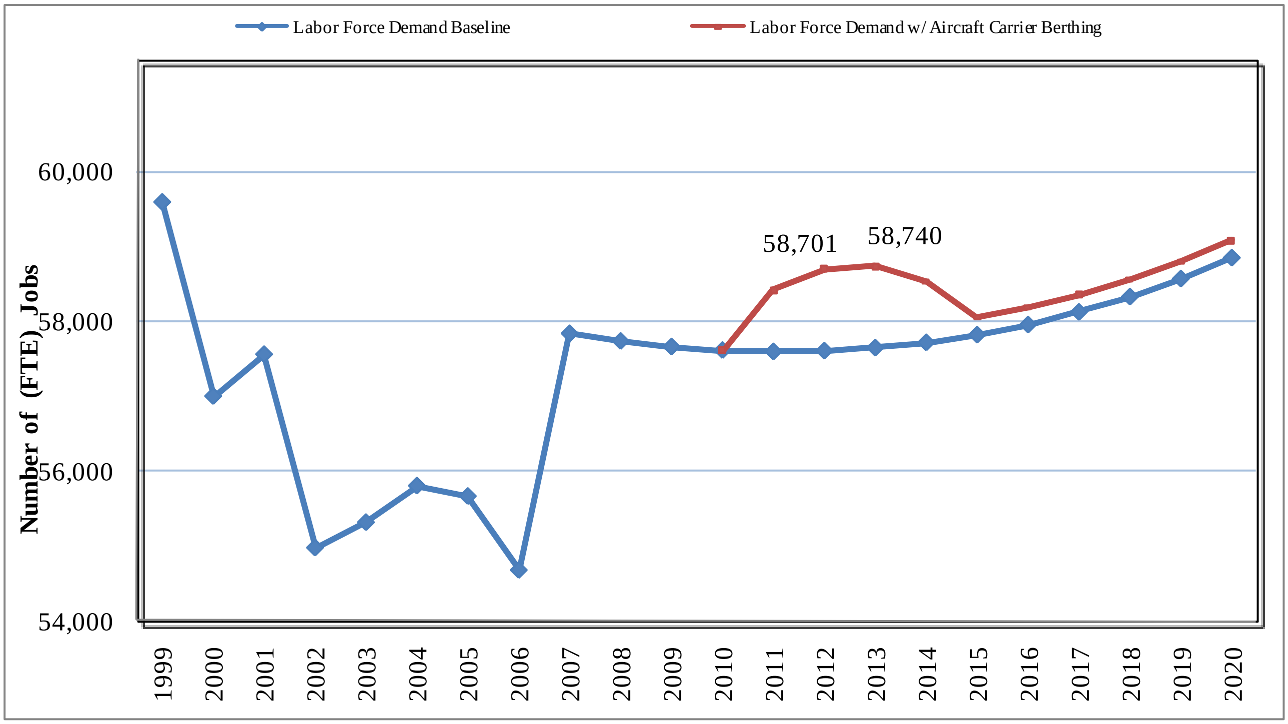
Table 16.2-4 shows a combined total civilian labor force demand for 1,094 full-time equivalent (FTE) workers in the peak construction years of 2012 and 2013, declining to a stable figure of 232 from 2015 on after construction ceases.

Table 16.2-4. Impact on Civilian Labor Force Demand (Full-Time Equivalent Jobs)

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Combined Total Impact	0	822	1,094	1,093	820	232	232	232	232	232	232

Notes: Demand is in terms of FTE jobs. Portion assumed to be filled by Guam residents is not subtracted from these figures.

Figure 16.2-2 shows estimated labor force demand with and without the proposed action. During the peak years of 2012-2013, labor force demand is about 2% above the baseline trend. After construction, labor force demand is only 0.5% above where it would be without the proposed action.



Note: In this analysis, a 2% increase over baseline trend at the construction peak is considered sufficiently significant and beneficial to merit a calculation of the total value. In this and other following figures, where that 2% threshold is reached, the numbers shown at the 2012-2013 peak are the sums of the projected baseline trend – what would happen without the project – plus the estimated combined total impact from the foregoing table. This does not include the other military relocation projects.

Figure 16.2-2. Labor Force Demand (FTE Jobs) With and Without CVN Proposed Action

Civilian Labor Force Supply - Impacts

Table 16.2-5 shows the probable labor force supply for direct onsite military construction jobs.

Table 16.2-5. Estimated Origin of Workers Constructing Naval Facilities

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*
TOTAL	**0**	**460**	**613**	**613**	**460**	**0**	**0**
GUAM	**0**	**74**	**89**	**78**	**59**	**0**	**0**
OFF-ISLAND	**0**	**386**	**525**	**535**	**401**	**0**	**0**
H-2B Workers	0	267	366	376	282	0	0
Philippines	0	227	311	320	240	0	0
Other	0	40	55	56	42	0	0
CONUS/HI/Japan	0	71	95	95	71	0	0
CNMI	0	9	12	12	9	0	0
Other Pacific Islands	0	38	51	51	38	0	0

Notes: Numbers may not add exactly due to rounding.

Table 16.2-6 estimates the share of non-military construction direct and indirect jobs, going to Guam residents versus off-island workers.

Table 16.2-6. Estimated Numbers of On-Island Workers for Various Job Categories Other Than Direct On-Site Construction

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Guam Workers	0	51	62	67	56	33	78	196	196	196	196
Off-Island Workers	0	310	419	412	304	198	154	36	36	36	36

Note: Demand is in terms of FTE jobs, and assumes one worker per FTE job.

Civilian Labor Force Income - Impacts

Civilian labor force income amounts apply to the additional labor force as a whole, rather than to the situation of individual workers. Table 16.2-7 shows that the peak figure for this analysis is $38 million, falling back to $9 million for the permanent operation stage from 2015 and beyond.

Table 16.2-7. Impact on Civilian Labor Force Income (Millions of 2008 $s)

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Combined Total Impact	$0	$28	$38	$38	$28	$9	$9	$9	$9	$9	$9

Figure 16.2-3 adds the combined total impact figures to the baseline trend in order to show significant long-term positive effects on income. Labor force income is about 2% over the baseline trend at the construction peak and about 0.5% thereafter in the steady-state phase. The 2% figure meets the criterion used in this analysis for a beneficial significant impact.

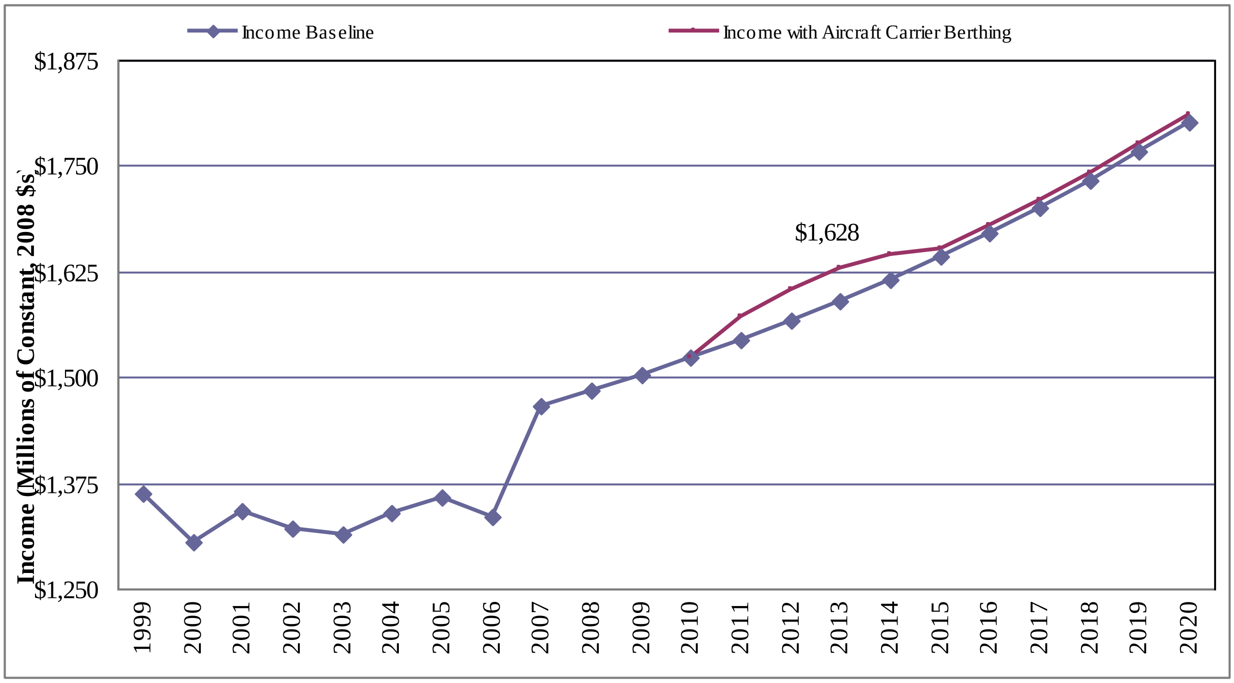


Figure 16.2-3. Labor Force Income (Millions of 2008 $s) With and Without Proposed Action

Standard of Living - Impacts

Refer to the corresponding section of Volume 2 for a general discussion.

Unemployment - Impacts

Refer to the corresponding section of Volume 2 for a general discussion.

Housing

Refer to the corresponding section of Volume 2 for introductory statements and approach to analysis (including data sources).

Impacts

Refer to the corresponding section of Volume 2 for a general discussion of housing supply.

Table indicates the combined total impact of the proposed action would be a demand for 286 new civilian housing units in the construction peak year of 2012, falling to 99 after construction ends/operation begins in 2015.

Table 16.2-8. Demand for New Civilian Housing Units

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Combined Total Impact	0	216	286	277	176	99	99	99	99	99	99

Figure 16.2-4 projects a baseline trend in housing supply based on historical rates of development. The proposed action would push housing demand over the baseline trend minimally and the impact would be considered less than significant.

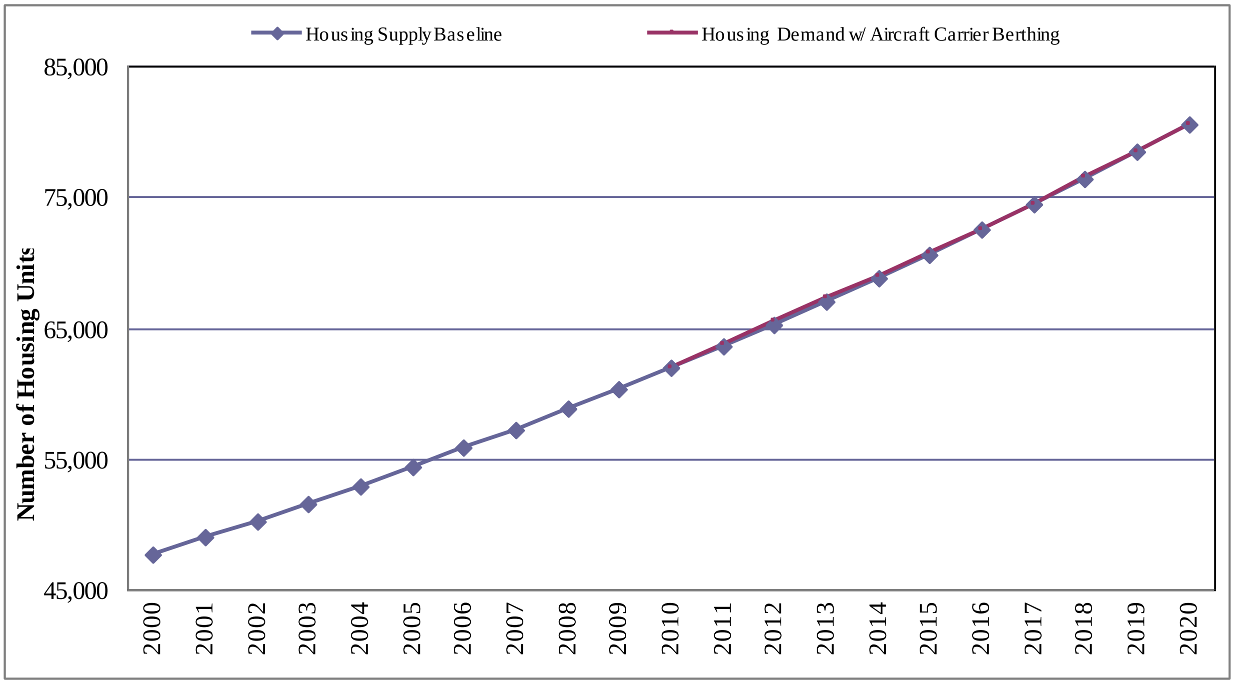


Figure 16.2-4. Civilian Housing Demand with Proposed Action and Housing Supply

<u>Local Government Revenues</u>

Refer to the corresponding section of Volume 2 for introductory statements and approach to analysis (including data sources).

Note that this is not intended as a comprehensive estimate of all revenues, but only of primary ones. Tax revenue sources analyzed here include Gross Receipts Tax, Corporate Income Tax and Personal Income Tax.

Impacts

Table 16.2-9 shows the combined total impacts for each of the three primary revenue sources. Revenues from personal income taxes would be the highest of the revenue sources estimated, reaching $4.5 million during the construction peak in 2012-2013 and falling to $1 million after construction. Gross Receipts Tax would bring in about $4 million per year from 2012 to 2013 and falling to $680,000 after construction. Corporate income tax revenues would reach $1 million in 2012-2013 and decline to $173,000 after construction.

Table 16.2-9. Impact on Selected Tax Revenues (1,000s of 2008 $s)

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Gross Receipts Tax	$0	$3,010	$4,011	$4,009	$3,007	$680	$680	$680	$680	$680	$680
Corporate Income Tax	$0	$768	$1,023	$1,022	$767	$173	$173	$173	$173	$173	$173
Personal Income Tax	$0	$3,400	$4,526	$4,519	$3,390	$1,061	$1,061	$1,061	$1,061	$1,061	$1,061
Total	$0	$7,177	$9,560	$9,551	$7,163	$1,914	$1,914	$1,914	$1,914	$1,914	$1,914

Figure 16.2-5 shows the projected total tax revenues from the three sources with and without the proposed action. The baseline trend for the Government of Guam (GovGuam) tax revenues is declining based on existing data from 1997-2007. The chart shows revenues above the baseline trend by about 2% at construction peak and less than 1% above trend thereafter. This meets the criterion used in this analysis for a beneficial significant impact (though the long-term operational impact alone does not).

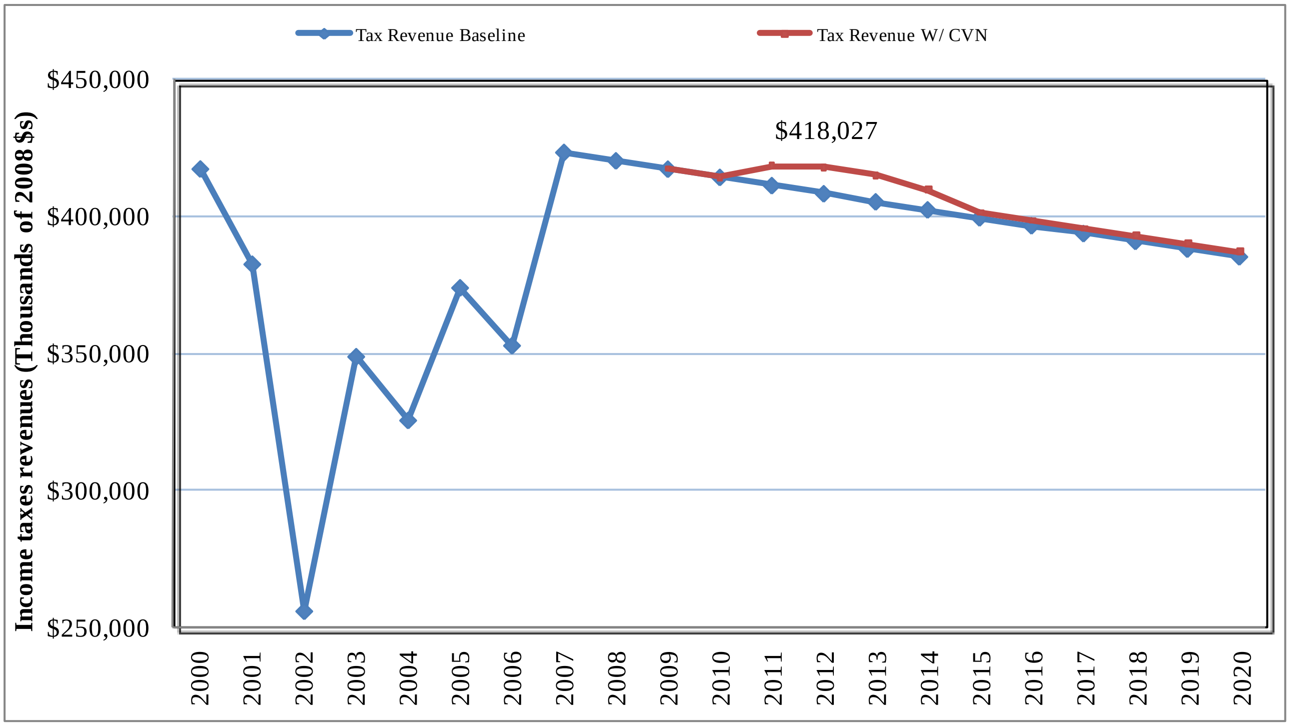


Figure 16.2-5. Gross Receipts Tax Revenue With and Without Proposed Action

<u>Gross Island Product</u>

Refer to the corresponding section of Volume 2 for introductory statements and approach to analysis.

Impacts

Table 16.2-10 shows that the combined impact of military activities alone would add a stable amount of $13 million to the Gross Island Product (GIP) by 2015, when port calls increase and economic activity generated by transient personnel is taking place. During the construction phase, combined total impacts range between $21 and $28 million.

Table 16.2-10. Impact on Gross Island Product (Millions of 2008 $s)

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Combined Total Impact	$0	$21	$28	$28	$21	$13	$13	$13	$13	$13	$13

Figure 16.2-6 shows the projected total GIP with and without the proposed action. The figure shows the GIP slightly (less than 1%) above the baseline trend during construction years. Beginning in 2015, when transient personnel presence increases, the GIP would remain less than 1% over the baseline trend. This is a beneficial impact but does not meet the 2% threshold for significance being used for this analysis.

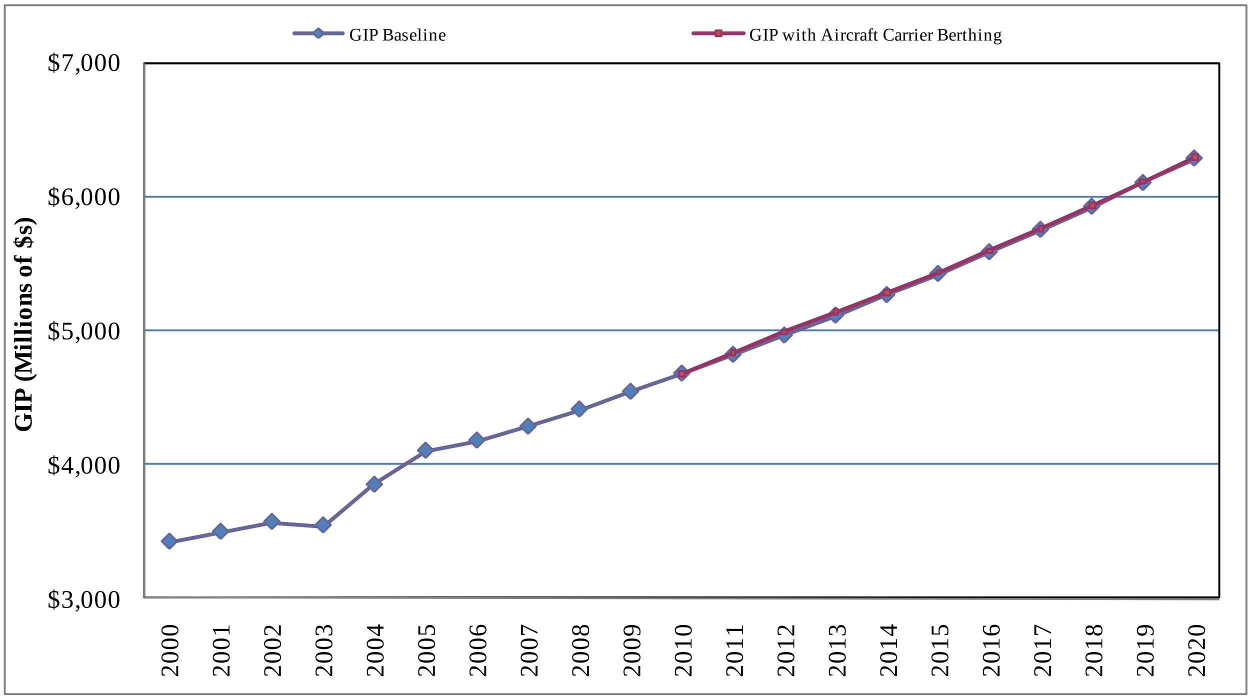


Figure 16.2-6. Gross Island Product (Millions of 2008 $s) With and Without Proposed Action

<u>Local Business Contracts</u>

Refer to the corresponding section of Volume 2 for general discussion.

The Aircraft Carrier Berthing action in Apra Harbor would warrant less construction activity than the Marine Corps relocation; however, as noted therein, local businesses would still experience benefits. The operational phase for this Naval project would present far fewer opportunities than Marine Corps activities.

<u>Tourism</u>

Refer to the corresponding section of Volume 2 for a general discussion.

Almost all of the impacts described in Volume 2 for the Marine Corps relocation would be supplemented by the berthing of a Navy carrier at Apra Harbor, though the carrier alone, in the absence of any Marine Corps relocation, would have less impact in and of itself. Table 16.2-11 details the impacts that would be specifically generated by the berthing of a Navy carrier at Apra Harbor. The bolded impact is the only impact during the operation phase that would be a result of the Navy action only (and not the Marine Corps or Army actions).

Table 16.2-11. Topics for Tourism Impact Analysis (Aircraft Carrier Berthing)

Construction	*Operation*
Impacts on ocean-based tourism from environmental degradation.	**Impacts on hotel revenues and occupancy taxes from timing of large-scale exercises.**
	More airline and hotel business from military friends and family, R&R, military business travelers.
	Impacts on ocean-based tourism from greater competition between activities.

The four items above merit Navy-specific discussion below, although only one of them, impact on hotels from timing of large-scale exercises, was not also discussed in Volume 2.

Impacts on Ocean-Based Tourism within Apra Harbor: Because of rough waters outside the harbor and in many other parts of Guam's shoreline close to the main resort area of Tumon Bay, Apra Harbor is the single most popular site for both recreational divers and commercial (mainly tourist-oriented) diving operation. Economic impacts on ocean-based tourism within Apra Harbor correlate to degradation of the environment. Siltation from dredging already affects visibility and has diving business operators concerned about possible permanent coral loss. Disturbance from construction activities would be short-term and localized. Long-term operational effects on tourism would include force protection restrictions during carrier ingress and egress restricting diving and tourist operation. However, these economic impacts to tourism would be at least partially mitigated or compensated for by increased tourism from military personnel.

Increased Operation-Related Business and Leisure Travel: Tourism organizations and hoteliers were surveyed to collect data on this proposed action. These organizations stated that past carrier visits have always contributed positively to their occupancy levels, as friends and families fly to Guam to visit the off-duty personnel. They welcome the prospect of more carrier operations for this reason. Historically, there have also been positive economic impacts on ocean-based tourism. Dive companies fly instructors out to carriers to initiate basic instruction for open-water certifications (the entry-level step for novice scuba divers), allowing what is normally a week-long process to be completed during the Sailors' time on Guam.

Impacts on Ocean-Based Tourism within Apra Harbor from More Population and Competition: Positive effects on ocean-based tourism volume would be countered by the prospect of increased congestion in the Apra Harbor area. Tourism-based companies such as commercial submarines utilize a mooring at the Port Authority of Guam, but utilize submerged lands and resources within Naval Base Guam for their operations. Guam's two major dive companies, as well as many of the smaller ones, launch their boats out of Apra Harbor and dock at Port Authority of Guam small boat basin. Military and tourist operations have conflicted in the past. Increases in military operations may increase this conflict.

Impacts on Hotels from Timing of Large-Scale Exercises: Large-scale military exercises do not necessarily involve aircraft carriers but often do. An issue set forth by some industry representatives (Guam Chamber of Commerce 2008) is that active-duty military personnel on Guam on temporary orders are exempt from hotel occupancy taxes when their stay at the hotel is strictly related to their military duties. This generally only occurs when transient billeting onboard military installations exceeds capacity. During these infrequent exercises, military personnel who qualify for tax exempt status may displace tourists who are required to pay the occupancy tax. The relative importance of this for the industry and for GovGuam depends on the season. It is problematic in the peak tourist seasons, but less so in the industry's off-peak seasons, such as spring.

16.2.2.3 Public Services Impacts

Refer to the corresponding section of Volume 2 for introductory statements.

The primary input for estimating staffing impacts during the operational phase was the permanent population associated with economic spin-offs from the increased number of carrier in-port days, not the increased presence of transient personnel. The latter factor might conceivably impact only a relatively small number of GovGuam agencies, such as police or some health agencies. Such possibilities were determined through interviews because of the lack of specific data.

Public Education

Refer to the corresponding section of Volume 2 for introductory statements, approach to analysis (including data sources) and qualitative analysis.

Table 16.2-12 and Table 16.2-13 provide an overview of the proposed action's impacts on Guam Public School System (GPSS) staffing for the action's peak year and steady-state. The proposed action requires less than 1% increase over reported baseline staffing levels for GPSS. The analysis indicates less than significant impacts to public education agencies due to the proposed action alone, except in conjunction with other aspects of the aggregate action.

Table 16.2-12. GPSS Student Population Impacts Summary

Agency	*Baseline Service Population*	*Peak Year*	*Peak Year Additional Service Population*	*Peak Year Percentage Increase*	*Steady Additional Service Population (going forward)*	*Steady Requirements Percentage Increase*
GPSS Elementary	14,436	2012	98	<1%	34	<1%
GPSS Middle	6,887	2012	41	<1%	14	<1%
GPSS High	9,661	2012	55	<1%	19	<1%

Table 16.2-13. Primary and Secondary Education Teacher Requirements Impacts Summary

Agency	*Baseline Teacher Numbers*	*Peak Year*	*Peak Year Additional Teacher Requirements*	*Peak Year Percentage Increase*	*Steady State Additional Teacher Requirements (going forward)*	*Steady Requirements Percentage Increase*
GPSS Elementary	1,035	2012	7	<1%	2	<1%
GPSS Middle	504	2012	3	<1%	1	<1%
GPSS High	514	2012	3	<1%	1	<1%

Table 16.2-14 and Table 16.2-15 provide an overview of the proposed action's impacts on Guam Community College (GCC) and University of Guam (UoG) student populations and non-adjunct faculty requirements for the action's peak year and steady-state. The proposed action requires less than 1% increase over reported baseline staffing levels for public higher education institutions. The analysis indicates less than significant impacts to public higher education agencies due to the proposed action alone, except in conjunction with other aspects of the aggregate action.

Table 16.2-14. Higher Education Student Population Impacts Summary

Agency	*Baseline Service Population*	*Peak Year*	*Peak Year Additional Service Population*	*Peak Year Percentage Increase*	*Steady Additional Service Population (going forward)*	*Steady Requirements Percentage Increase*
GCC	1,806	2012	13	<1%	4	<1%
UoG	3,282	2012	23	<1%	8	<1%

Table 16.2-15. Higher Education Faculty Requirement Impacts Summary

Agency	*Baseline Non-adjunct Faculty Numbers*	*Peak Year*	*Peak Year Additional Non-adjunct Faculty Requirements*	*Peak Year Percentage Increase*	*Steady State Additional Non-adjunct Faculty Requirements (going forward)*	*Steady Requirements Percentage Increase*
GCC	100	2012	1	<1%	<1	<1%
UoG	185	2012	1	<1%	<1	<1%

Public Health and Human Services

Refer to the corresponding section of Volume 2 for introductory statements, approach to analysis (including data sources) and qualitative analysis.

Table 16.2-16 provides an overview of the proposed action's impacts on Guam Memorial Hospital Authority (GMHA), Guam Department Public Health and Social Services (GDPHSS), Guam Department of Mental Health and Substance Abuse (GDMHSA) and Guam Department of Integrated Services for Individuals with Disabilities (GDISID) service populations for the action's peak year and steady-state.

Table 16.2-16. Impact on Public Health and Human Services, Service Population Summary

Agency	*Baseline Service Population*	*Peak Year*	*Peak Year Additional Service Population*	*Peak Year Percentage Increase*	*Steady Additional Service Population (going forward)*	*Steady Requirements Percentage Increase*
GMHA	160,797	2012	1,478	<1%	386	<1%
GDPHSS	65,954	2012	554	<1%	145	<1%
GDMHSA	65,954	2012	545	<1%	145	<1%
GDISID	169,209	2012	1,478	<1%	368	<1%

Table 16.2-17 provides an overview of the proposed action's impacts on various public health and human services agency staffing requirements for the action's peak year and steady-state. The proposed action requires less than 1% increase over reported baseline staffing levels for public health and human services institutions. The analysis indicates less than significant impacts to public health and human services agencies due to the proposed action alone, except in conjunction with other aspects of the aggregate action.

Table 16.2-17. Public Health and Human Services Impact Summary

Agency and Staffing Type	*Baseline Staffing Numbers*	*Peak Year*	*Peak Year Additional Staffing Requirements*	*Peak Year Percentage Increase*	*Steady Additional Staffing Requirements (going forward)*	*Steady Staffing Requirements Percentage Increase*
GMHA Physicians	57	2012	<1	<1%	<1	<1%
GMHA Nurses and Allied Health Professionals	355	2012	3	<1%	1	<1%
GDPHSS - Primary Care Medical Providers and Nursing Staff	44	2012	<1	<1%	<1	<1%
GDPHSS – Bureau of Communicable Disease Control (BCDC) Communicable Disease Prevention Professionals	33	2012	<1	<1%	<1	<1%
GDPHSS – Bureau of Family Health and Nursing Services (BFHNS) Nurses	22	2012	<1	<1%	<1	<1%
GDMHSA – Mental Health Professionals	130	2012	1	<1%	<1	<1%
GDISID Social Workers and Counselors	14	2012	<1	<1%	<1	<1%

Public Safety Services

Refer to the corresponding section of Volume 2 for introductory statements, approach to analysis (including data sources) and qualitative analysis.

Table 16.2-18 provides an overview of the proposed action's impacts on Guam Police Department (GPD), Guam Fire Department (GFD), Guam Department of Corrections (GDoC), and Guam Department of Youth Affairs (GDYA) service populations for the action's peak year and steady-state.

Table 16.2-18. Impact on Public Safety Service Population Summary

Agency	*Baseline Service Population*	*Peak Year*	*Peak Year Additional Service Population*	*Peak Year Percentage Increase*	*Steady Additional Service Population (going forward)*	*Steady Requirements Percentage Increase*
GPD	160,797	2012	1,478	<1%	386	<1%
GFD	175,877	2012	1,660	<1%	386	<1%
GDoC	1,035	2012	7	<1%	1	<1%
GDYA	39,813	2012	302	<1%	105	<1%

Table 16.2-19 provides an overview of the proposed action's impacts on various public safety services agency staffing requirements for the action's peak year and steady-state. The proposed action requires less than 1% increase over reported baseline staffing levels for public safety agencies. The analysis indicates less than significant impacts to public safety agencies due to the proposed action alone, except in conjunction with other aspects of the aggregate action.

Table 16.2-19. Public Safety Services Staffing Impacts Summary

Agency and Staffing Type	*Baseline Staffing Numbers*	*Peak Year*	*Peak Year Additional Staffing Requirements*	*Peak Year Percentage Increase*	*Steady Additional Staffing Requirements (going forward)*	*Steady Staffing Requirements Percentage Increase*
GPD – Police Officers	309	2012	3	<1%	1	<1%
GFD - Firefighters	190	2012	2	<1%	<1	<1%
GDoC – Custody and Security Personnel	188	2012	1	<1%	<1	<1%
GDYA – Youth Service Professionals	79	2012	<1	<1%	<1	<1%

Other Selected General Services

Refer to the corresponding section of Volume 2 for introductory statements, approach to analysis (including data sources) and qualitative analysis.

Table 16.2-20 provides an overview of the proposed action's impacts on Guam Department of Parks and Recreation (GDPR), Guam Public Library System (GPLS) and Guam Judiciary key staffing requirements for the action's peak year and steady-state.

Table 16.2-20. Impact on Other Selected General Service Agency Service Population

	Baseline Service Population Numbers	*Peak Year*	*Peak Year Additional Service Population*	*Peak Year Percentage Increase*	*Steady Additional Service Population Numbers (going forward)*	*Steady Service Population Percentage Increase*
GDPR, GPLS, and Judiciary Service Population	160,797	2012	1,478	<1%	386	<1%

Table 16.2-21 provides an overview of the proposed action's impacts on GDPR, GPLS and Guam Judiciary key staffing requirements for the action's peak year and steady-state. The proposed action requires less than 1% increase over reported baseline staffing levels for these agencies. The analysis indicates less than significant impacts to the agencies due to the proposed action alone, except in conjunction with other aspects of the aggregate action.

Table 16.2-21. Other Selected General Service Agency Impacts Summary

Agency and Staffing Type	*Baseline Key Staffing Numbers*	*Peak Year*	*Peak Year Additional Key Staffing Requirements*	*Peak Year Percentage Increase*	*Steady Additional Key Staffing Requirements (going forward)*	*Steady Requirements Percentage Increase*
GDPR – General Staff	90	2012	<1	<1%	<1	<1%
GPLS – General Staff	28	2012	<1	<1%	<1	<1%
Judiciary - Judges	6	2012	<1	<1%	<1	<1%

Growth Permitting and Regulatory Agencies

Refer to the corresponding section of Volume 2 for introductory statements, approach to analysis (including data sources) and qualitative analysis.

Table 16.2-22 shows the estimated number of key professional staff required due to the proposed action. Absolute numbers in the table are low, but proportionate increases would be high or at least notable for a few agencies with small reported baseline levels. The peak requirement would represent a 26% increase in the GDoL - Alien Labor Processing and Certification Division (ALPCD) baseline staffing level and 4% for the Coastal Management Program (CMP), with others ranging from 0% to 3%. After construction ends, the required staffing levels from 2017 on are all just 0% to 2% greater than baseline levels. Although a few agencies would be significantly affected, based on the criteria used for this analysis, the overall effect would be a less than significant impact for the proposed action alone, except in conjunction with the aggregate action.

Table 16.2-22. Additional Growth Permitting Staff Required

	2010	*2011*	*2012*	*2013*	*2014*	*2015*	*2016*	*2017*	*2018*	*2019*	*2020*
Guam Department of Public Works (GDPW) Permitting Staff	0.1	0.1	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Guam Department of Land Management (GDLM) Permitting Staff	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Guam Environmental Protection Agency (GEPA) Permitting Staff	1.1	1.1	1.6	1.5	1.0	0.1	0.1	0.1	0.1	0.1	0.1
Coastal Management Program (CMP) Permitting Staff	0.4	0.4	0.3	0.3	0.2	0.1	0.1	0.1	0.1	0.1	0.1
Guam Power Authority (GPA) Permitting Staff	0.2	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Guam Water Authority (GWA) Permitting Staff	0.5	0.3	0.2	0.2	0.2	0.0	0.0	0.0	0.0	0.0	0.0
GFD Permitting Staff	0.0	0.0	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GDPHSS - DEH Permitting Staff	0.0	0.1	0.1	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
GDPR - HPO Permitting Staff	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
GDoL - ALPCD Permitting Staff	0.0	0.9	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

16.2.2.4 Sociocultural Impacts

Refer to the corresponding section of Volume 2 for introductory statements.

Most sociocultural impacts would be due to the overall volume of the proposed action, not the unique attributes of any particular service (i.e., Marines, Navy, or Army). However, during the operation phase, the Navy component of the proposed action would be of a more concentrated nature than the Marine Corps component, as it consists of shore leave components. This would result in slightly different crime and social order impacts.

<u>Sociocultural Considerations</u>

The increase in the numbers of port-days of Carrier Strike Group (CSG) personnel onshore leave associated with the operational phase of the transient berthing of the carrier nuclear vessel (CVN) has the potential to have adverse sociocultural impacts. Overall, the occupational setting is one that is characterized by alternating periods of being at sea for lengthy periods of time experiencing "… intense activity, gruelingly long work hours …", followed by "…periods of recreation in U.S. or foreign ports" (Ames et. al. 2009). It is this period of recreation where Sailors tend to "blow off steam" (Russ and Ames 2006).

One important aspect of Navy shore leave is the consumption of alcoholic beverages. Young Sailors are often under the legal drinking age, and have a relative lack of drinking experience (Ames et. al. 2009). During deployment, Navy policy does not allow any drinking of alcohol onboard ship while at sea, except under certain tightly regulated situations. The docking of ships at ports for periods of "liberty" or "shore leave" often leads to heavy and/or binge drinking activities (Federman et al. 2000), and anecdotal evidence indicates that this is the case currently when carriers dock at Guam's port (GDYA Interview – Volume 9, Appendix F).

Finally, although quantitative measures of the current impact of Navy shore leave on Guam's crime and social order environment were not available, GovGuam agency interviews suggested that any increase in port-days or number of Sailors onshore leave on Guam would require additional enforcement from both civilian and military public safety agencies (GDoC, GPD, and U.S. Naval Security Interviews – Volume 9, Appendix F). The Public Safety Services impact section of this study provides additional discussion of this topic.

Political and Chamorro Issues

Refer to the corresponding section of Volume 2.

Community Cohesion

Refer to the corresponding section of Volume 2 for general discussion.

There remains a measure of community apprehension about the increased pulses of Sailors arriving on Guam for shore leave and how their presence might cause discomfort in the community. Most of the community apprehension comes from uncertainties regarding possible changes in the sociocultural framework of Guam because of the influx of the 18 to 45 age group. The ultimate impact on community cohesion that might occur would be dependent on how successful intercultural education programs are in mitigating this apprehension.

16.2.3 Summary of Impacts

The impacts in this chapter are calculated under a scenario that assumes there would be no constraints (blockages) to the rapid development of spin-off private-sector economic activity driven by the military construction and permanent military operational stages. Most impacts would be characterized by a burst of activity and impacts in the 2013-2014 timeframe, followed by relatively much lower impacts when only permanent operations (increased number of port-days) are implemented.

16.2.3.1 Population Impacts

Although there would be no permanent transfer of active-duty Navy personnel and dependents, the economic spin-off activity from the proposed action would add about 1,480 residents to Guam's population at the 2012 construction peak and a subsequent more stable population of about 390 during the operational period.

16.2.3.2 Economic Impacts

Most long-term economic benefits would clearly be beneficial though small. The construction activity for the aircraft carrier berth would contribute to less than significant population influx and housing demand.

Including all the spin-off activity, the proposed action would provide jobs for about 1,100 civilian workers at the 2012-13 peak and 230 on a more permanent basis. Guam residents are estimated to capture about 90 of the direct on-site construction jobs for aircraft carrier berthing facilities at the 2012 peak, as well as approximately 70 spin-off jobs that year and a more permanent 200 jobs a few years thereafter.

Cost of living increases, particularly during the construction phase, would negatively affect households on fixed incomes, though other households would benefit from rising wages; however, this would come more from the Apra Harbor construction's additive effects to other military actions than this Naval action alone.

Although a more detailed fiscal impact assessment would be done by GovGuam using output from this Environmental Impact Statement (EIS), preliminary estimates in this chapter suggest revenues from the three most important tax sources: gross receipts, corporate income, and personal income, would exceed $9.5 million in 2012-2013 and stabilize at about $1.9 million thereafter.

Civilian housing unit demand would peak at about 290 units in 2012, falling to about 100 for the operational period.

Guam construction businesses are expected to benefit from various opportunities.

Tourism would be positively impacted as there would be more days that aircraft carrier personnel book hotel rooms for themselves and/or visiting family members, although some industry leaders are concerned that timing of exercises during the industry's peak season could displace tourists who pay hotel taxes. Many military personnel are exempt from these taxes.

Guam's GIP, the total market value of all final goods and services produced in a given year, would see a beneficial increase of $28 million (2008 dollars) in the 2012-13 construction peak and about $13 million a year from 2015.

16.2.3.3 Public Service Impacts

GovGuam's public service agencies would generally need to make only minor staffing increases to service new population associated with the proposed action alone, though the impacts would be more notable during the construction timeframe. Most of these agencies would need to expand their services and staff slightly during the 2012-2013 peak, and then cut them back as construction ends.

For public education services, the GPSS, GCC and UoG together would need to hire a combined 15 teachers/faculty for the 2012-13 construction peak, falling to a combined five after construction ends.

For health and human services, this chapter considered impacts on various aspects of GMHA, GDPHSS, GDMHSA, and GDISID. These agencies would need a combined six new key professional workers for 2012-13, dropping to a combined two for 2015.

Public safety agencies: Police, Fire, Corrections, and Youth Affairs would also require a combined seven key professionals in 2012-13, falling to a combined two for 2015.

Other selected general service agencies: Parks and Recreation, Libraries, and the Judiciary would require a combined one key professional in 2012-13, falling to less than one after construction ends.

Other agencies that deal with permitting and regulating growth are affected more by the initial requests for permits and then subsequent inspections and monitoring. Development permitting agencies on Guam would experience very low increases in demands for their services because the amount of housing and commercial space needed to serve this small population and employment increment would be below the existing stock of vacancies. GEPA and ALPCD (these agencies process H-2B worker permits, not developer permits) would be the only agencies whose increased workloads would peak at more than one FTE (about 1.5, and 1, respectively).

16.2.3.4 Sociocultural Impacts

The limited construction activity related to this component of the proposed action would likely not have significant impacts on the local community.

In terms of assessing the possible impacts of the operational phase of the component, data on the current impacts of aircraft carrier berthing on crime and social order and community cohesion on Guam are not available. Studies of Naval shore leave behavior, however, indicate possible impact on these areas, especially as they are related to excessive alcohol consumption or irresponsible sexual activity. There is also potential for increased fighting between different branches of the military.

The long-term impacts of increased shore days taken would depend on how much military security increases the amount of shore patrol during times of aircraft carrier berthing, as well as how effectively civilian and military security agencies collaborate.

The greatest driver for impacts on the Chamorro community on Guam would be the potential surges of populations that are not familiar with the Chamorro culture on the island of Guam.

Table 16.2-23 provides a summary assessment of the potential impacts of each action alternative and the no-action alternative. Some topics are seen as inherently mixed (as indicated by the SI/BI designation). In addition, a text summary follows.

Table 16.2-23. Summary of Impacts

Impact Area	*Alternatives 1 and 2*
Population Impacts	• Less than significant direct and indirect impacts – of mixed beneficial/adverse nature – due to construction effects peaking at 1,478 additional population in 2012 and final operational impacts of 386 civilian population; also, increase of up to 47 port-days during when up to 7,200 transient personnel would be present on Guam.
Economic Impacts	• Beneficial impacts due to provision of permanent jobs on Guam. • Beneficial impacts due to permanent infusion of income into the Guam economy. • No impact on standard of living from the proposed action construction or operation. • Beneficial impacts due to increase in local government revenue. • Less than significant direct and indirect impact of demand for civilian (private-market, excluding temporary construction workforce housing) housing units peaking at 813 units in 2014, with permanent operational demand for 147 civilian housing units from 2016 on (Note: combined total impact peaks in 2015 at demand for 920 units). • Beneficial operational phase impacts due to permanent increased GIP strengthening the Guam economy. • Beneficial impacts due to increased military service contract opportunities for local Guam businesses. • Impacts to tourism would be mixed (adverse and beneficial). On balance beneficial impacts outweigh adverse impacts
Public Service Impacts	• Less than significant impact as public service agencies would see increased service populations representing less than a 1% increase over current service populations. • Less than significant construction-related impacts to growth-permitting agencies due to difficulty in meeting fluctuating staffing requirements with an existing environment of staffing and budget shortfalls and recruitment complications.
Sociocultural Impacts	• Significant impacts to crime and social order in proportion to increase in population • Little or no construction impact to community cohesion, but mixed set of direct and indirect significant beneficial impacts and adverse impacts, with outcome dependent on success of standard law enforcement programs and education of personnel prior to port stops.

16.2.4 No-Action Alternative

The assumed no-action alternative is that all parts of the aggregate action, not just the proposed action covered in this Volume, but also other components addressed in other Volumes, would not occur. Therefore, the no-action conclusions given below are identical to those in Volume 2 for the Marine Corps relocation and/or Volume 7 for the aggregate action. The references below to substantial impacts with the proposed action would in fact apply more to those Volumes than to this Volume 4 covering the CVN action, as CVN impacts alone sometimes would not attain significance.

Unlike physical resources, socioeconomic systems do not remain completely at baseline conditions if a proposed action is not implemented. Economies and population levels change due to other reasons as well. The various foregoing exhibits showing baseline trends for economic and demographic variables indicate long-term trends expected to continue without the proposed action, and Volume 7 lists a number of specific socioeconomic changes expected to occur independent of the proposed action. Furthermore, the announcement of the proposed action has already had socioeconomic consequences, such that a 2010 decision not to follow through on the military relocation would have short-term effects associated with a reversal of those existing consequences.

16.2.4.1 Population/Economic Impacts

In the short-term, a decision not to implement the proposed action would deflate any current speculative activity attributable the proposed action. Real estate values in particular would likely drop, hurting investors but increasing the affordability of housing. The contrast between the business community's expectations and a negative Record of Decision would likely produce a period of pessimism about Guam's economic future, especially if the current national and international economic crisis has not yet abated. These effects, though, would be attributable to an unstable world economic landscape and poor decision making by investors – not to the proposed action.

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

16.2.4.2 Public Service Impacts

In the case of the no-action alternative, the specific agencies discussed earlier in this chapter would not face the listed pressures to expand professional staffing, and agencies involved in planning and regulating growth would not experience such a sharp increase in workload. Although this was not specifically covered in the foregoing analysis, it may also be noted that agencies that are required to implement major infrastructure developments, such as the ports and highways, would have substantially more time to implement long-term plans rather than having to achieve much of their objectives over the next few years.

However, at the broader level, the no-action alternative and the elimination of prospective long-term revenues expected from the proposed action still would leave GovGuam agencies in the difficult financial condition described in Volume 2, Section 16.22.11. At least for the foreseeable future, this would negatively impact the various service agencies because of budget cuts, and would probably represent the most important overall consequence for GovGuam.

16.2.4.3 Sociocultural Impacts

Crime rates would be likely to rise in the short-term to the extent that Guam experiences recession (Pugh 2009). The political attention given to some Chamorro issues would likely recede as the militarization of Guam is stabilized at something close to present levels. Military-civilian relations would likely remain at the current generally positive level.

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

16.2.5 Summary of Proposed Mitigation Measures

A review of the above impacts shows that the proposed action has the potential to have beneficial economic impacts, and significant sociocultural impacts on Guam. The proposed mitigations identified below focus on the issues where significant sociocultural impacts were identified.

Table 16.2-24 summarizes proposed mitigation measures.

Table 16.2-24. Summary of Proposed Mitigation Measures

Impact Area	*Potential Mitigation Measures*
Crime and Social Order	• DoD would increase collaborative programs with GovGuam public safety agencies to develop a comprehensive and regular shore patrol system, and maintain a regular visible preventative presence. • DoD would continue to participate in CMTF to address community crime and social order concerns such as effective crime prevention strategies and information sharing. • DoD would continue cross-training exercises with the GovGuam safety agencies. • DoD would assist by leading a federal inter-agency effort to identify other federal programs and funding sources for collaborative efforts between the governments of Guam, CNMI and FAS to enhance cultural awareness.
Chamorro Issues/ Community Cohesion	• Implement a collaborative effort with construction worker contractors to implement an orientation course on Guam local culture, language and history, designed in conjunction with the Guam Department of Chamorro Affairs and Chamorro cultural specialists, to be attended by all arriving H2B workers. • Implement a mayoral outreach task force aimed at developing military-civilian relationships, to minimize local community perceptions of separations of military and civilian communities. The task force would work with each mayor and their staff to integrate military participation in existing cultural or recreational community events, expand on existing military outreach activities, and develop new civilian-military collaborative projects as determined by the task force and mayors. • Implement an orientation course on Guam local culture, language and history, designed in conjunction with the Guam Department of Chamorro Affairs and Chamorro cultural specialists, to be attended by all arriving active-duty DoD personnel their dependents, and military civilian workers. • Develop a military-civilian cultural organization to promote tours, education, and volunteer opportunities. • Expand sister village programs to promote military civilian community interaction. • Implement the use of UoG and GCC locations for DoD adult education classes, to promote community integration, consistent with DoD policies. • Implement an orientation course on Guam local laws and culture, language and history, designed in conjunction with GovGuam public safety agencies, the Guam Department of Chamorro Affairs and Chamorro cultural specialists, to be attended by all arriving service members prior to shore leave on the island of Guam. • DoD would assist by leading a federal inter-agency effort to identify other federal programs and funding sources for GovGuam addressing the following: • Supporting the development of Chamorro cultural sites and activities, such as a museum and/or cultural center, Chamorro language immersion school, adult Chamorro language education, and cultural performance and arts organizations; • Job counseling assistance to be made available to low income families through the Guam Department of Labor (with US funds), which would include training sessions on how to fill out job applications, identify skills, and prepare resumes for job opportunities; • Before and/or after school programs for children on Guam including formal and

Table 16.2-24. Summary of Proposed Mitigation Measures

Impact Area	*Potential Mitigation Measures*
	informal education, while allowing their parent(s) the time to get a job. • Transportation to job sites made available for those without the means to travel to work.

CHAPTER 17.
HAZARDOUS MATERIALS AND WASTE

17.1 INTRODUCTION

The potential impacts of hazardous materials and waste on human health and the environment is largely dependent upon their types, quantities, toxicities, and management practices. This chapter contains a discussion of potential environmental consequences associated with implementation of the alternatives within the region of influence (ROI) under the proposed action. For a description of the affected environment for all resources, including current hazardous substance handling, storage, transportation, and management plans, techniques, approaches, and potential mitigation measures refer to the respective chapter of Volume 2 (Marine Corps Relocation – Guam). The locations described in that Volume include the ROI for the aircraft carrier berthing component of the proposed action (Apra Harbor), and the chapters are presented in the same order as the resource areas contained in this Volume.

17.2 ENVIRONMENTAL CONSEQUENCES

17.2.1 Approach to Analysis

17.2.1.1 Methodology

This section describes potential hazardous materials and waste impacts and proposed mitigation measures as they relate to the proposed increase in the number of days for aircraft carrier berthing in Apra Harbor. This berthing is planned to be increased from an average of 16 to 63 days annually. Specifically, these potential impacts were assessed for the general public as well as various media (i.e., soils, surface water, groundwater, air, and biota) relative to offshore and onshore activities.

17.2.1.2 Determination of Significance

The determination of significance was based upon existing hazardous substance management practices, proposed mitigation measures, and expected or potential impacts and environmental consequences of the proposed action. This determination evaluated the overall ability to mitigate or control environmental impacts and consequences to soils, surface water, groundwater, air, and biota. This determination considered current conditions and potential consequences relative to the anticipated ability of the hazardous substance management infrastructure system to accommodate added hazardous substance demand on the overall system. Specifically, for hazardous substances to be considered a significant impact, the following would have to occur:

- Leaks, spills, or releases of hazardous substances to environmental media (i.e., soils, surface water, groundwater, air, and/or biota) resulting in unacceptable risks to human health and/or the environment
- Violation of applicable federal, state, or local laws or regulations regarding the transportation, storage, handling, use, or disposal of hazardous substances

17.2.1.3 Issues Identified During Public Scoping Process

As part of the analysis, concerns relating to hazardous substances that were mentioned by the public, including regulatory stakeholders, during the public scoping meetings were addressed.

These include:

- Address management practices for hazardous substances including hazardous wastes, toxic substances, hazardous materials, and munitions and explosives of concern (MEC)
- Describe the potential overall impacts of hazardous substances from construction and operation of proposed projects
- Identify the projected hazardous waste types and volumes
- Identify expected hazardous substance storage, disposal, and management plans
- Evaluate measures to mitigate generation of hazardous waste including pollution prevention
- Discuss how hazardous substances on land and from ships would be managed
- Discuss the potential for impacts to environmental media from spills, accidents, and/or releases of hazardous substances
- Identify existing installation restoration sites

17.2.2 Alternative 1 Polaris Point (Preferred Alternative)

17.2.2.1 Hazardous Materials

The proposed increase in aircraft carrier berthing days would result in increased opportunities for adverse environmental consequences related to petroleum, oils, and lubricants (POL) hazardous materials. POL includes gasoline, aviation fuels, diesel, oil and grease, kerosene, and other related products. It is expected that these products primarily would be used as part of ongoing operation and maintenance functions. The quantity of hazardous materials generated by these activities over a cumulative total of approximately 63 days per year is estimated to be 160 pounds (lbs) (73 kilograms [kg]).

- Due to the projected increase in the volume of hazardous materials, Alternative 1 Polaris Point (referred to as Alternative 1) would have the potential to result in an impact (i.e., to soils, surface water, groundwater, air, or biota). However, the increase in hazardous materials would be handled and disposed of per applicable Best Management Practices (BMPs) and Standard Operating Procedures (SOPs) (see Volume 7); therefore, the increase in volume would result in less than significant impacts. Note that BMPs and SOPs are not considered “mitigation measures” thus no proposed mitigation measures are identified in this chapter.

17.2.2.2 Toxic Substances

The primary toxic substances being addressed on Guam prior to any Department of Defense (DoD) expansion include: asbestos containing materials (ACM), lead-based paint (LBP), polychlorinated biphenyls (PCB), and radon. LBP and PCBs in Guam are transported by licensed transporters and disposed of in accordance with applicable federal, state, and local laws and regulations. ACM is disposed of at federal facilities on Guam. The collection, transportation, and disposal of these toxic substances is arranged for by the Defense Reutilization and Marketing Office (DRMO).

There would be negligible environmental consequences because in 1979, the USEPA banned most uses of PCBs and LBP was banned in 1978. In addition, ACM would not be generated during the increased aircraft carrier berthing events. If existing toxic substances are encountered during Alternative 1 activities, licensed contractors would be used to ensure that all DoD, federal, state, and local PCB, ACM, and LBP testing, handling, and disposal protocol, procedures, and requirements are followed. Therefore, toxic substances would result in less than significant impacts as a result of Alternative 1 activities and no potential mitigation measures would be required.

17.2.2.3 Hazardous Waste

Increased days of aircraft carrier berthing would result in an increase in the transport and/or transfer of hazardous waste. Increases in the transport/transfer of solvents, adhesives, lubricants, corrosive liquids, aerosols, and other hazardous wastes would be expected. The volume of hazardous wastes generated from Alternative 1 activities is estimated to be 1,500 lbs (680 kg) per year. Due to this projected increase in the volume of hazardous waste generated, Alternative 1 would have the potential to result in significant impacts (i.e., to soils, surface water, groundwater, air, or biota). However, the increase in hazardous waste would be handled and disposed of per applicable regulations and BMPs and SOPs (see Volume 7); therefore, the increase in volume would result in less than significant impacts.

17.2.2.4 Radiological Material Operation

Emergency response, emergency repair, and radioactive waste management capabilities exist at Polaris Point. There would be less than significant impacts on the existing operations, and the slight increases in hazardous substances would be managed in accordance with existing BMPs and SOPs (Volume 7). All radioactive waste management operations would be in conformance with Naval Sea Systems Command (NAVSEA) regulations. No radioactive waste would be brought ashore on Guam, therefore, these activities would result in less than significant impacts.

17.2.2.5 Summary of Alternative 1 Impacts

Table 17.2-1 summarizes Alternative 1 impacts.

Table 17.2-1. Summary of Alternative 1 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	Less than significant impacts to soils, surface water, groundwater, air, and/or biota related to construction activities
	Operation	Less than significant impacts to soils, surface water, groundwater, air, and/or biota related to operation activities
Offshore	Construction	Less than significant impacts to soils, surface water, groundwater, air, and/or biota related to construction activities
	Operation	Less than significant impacts to soils, surface water, groundwater, air, and/or biota related to operation activities

17.2.2.6 Alternative 1 Proposed Mitigation Measures

No mitigation measures are identified for potential hazardous materials impacts. Potential BMPs and SOPs include, but are not limited to those summarized in Table 17.2-2 and Table 17.2-3 which also summarizes potential effects and impacts, related to Alternative 1. Volume 7 contains a complete list of applicable BMPs and SOPs.

The BMPs and SOPs would be used to:

- Prevent, contain, and/or clean up spills and leaks to protect human health and the environment
- Provide personnel training and operational protocol and procedures to protect human health and the environment
- Ensure DMRO ability to properly manage and dispose of anticipated hazardous materials
- Protect overall human health, welfare, and the environment
- Properly identify, manage and dispose of MEC associated with construction and operation of the expanded mission facilities

Table 17.2-2. Hazardous Materials Consequences, BMPs, and SOPs

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*BMPs and SOPs*
• Hazardous materials associated with increased aircraft carrier berthing days	• Increased transport of hazardous materials to Guam • Increased hazardous materials transfer and use on Guam	• Spill, leak, or release impacts during transport/transfer between DoD locations resulting in increased risks of environmental media contamination (soil, surface water, and groundwater) • Adverse impacts and increased risks to human health and/or the environment including terrestrial and marine ecosystems	• Update/implement hazardous materials management plans and facility response plans • Update/implement spill prevention, control and countermeasure (SPCC) plans (training, spill containment and control procedures, cleanup, notifications, etc.). Also, ensure personnel are trained in accordance with spill prevention, control, and cleanup methods • Implement aggressive hazardous materials minimization plans that substitute hazardous materials for non-hazardous materials as applicable • Ensure DoD and contractor personnel are trained as to proper labeling, container, storage, staging, and transportation requirements for hazardous materials • As necessary, expand DRMO's sufficient hazardous materials storage, transportation, and disposal capacity prior to any expected increases • Verify through surveillance and inspections full compliance with federal, state and local, regulations and adherence to DoD requirements. Implement corrective actions as necessary • Minimize the risk of uncontrolled leaks, spills, and releases through industry accepted methods for spill prevention, containment, control, and abatement

Legend: DRMO = Defense Reutilization and Marketing Office, HMMP = Hazardous Material Management Plan, SPCC = Spill Prevention Control and Countermeasures.

Table 17.2-3. Hazardous Waste Consequences, BMPs, and SOPs

Potential Activity (Cause)	*Potential Effect*	*Potential Impacts*	*BMPs and SOPs*
• Hazardous waste transport to Guam and transfer on Guam	• Increased transport of hazardous waste to Guam	• Spill, leak, or release impacts during transport/transfer between DoD locations resulting in increased risks of environmental media contamination (soil, surface water, and groundwater) • Adverse impacts and increased risks to human health and/or the environment including terrestrial and marine ecosystems	• Update/implement hazardous waste management programs and facility response plans • Update/implement SPCC plans (training, spill containment and control procedures, cleanup, notifications, etc.) Also, ensure personnel are trained in accordance with spill prevention, control, and cleanup methods • Ensure DoD and contractor personnel are trained as to proper labeling, container, storage, staging, and transportation requirements for hazardous waste • Implement aggressive hazardous waste minimization plans that substitute hazardous waste for non-hazardous waste as applicable • As necessary, expand DRMO's sufficient hazardous materials storage, transportation, and disposal capacity prior to any expected increases • Verify through surveillance and inspections full compliance with federal, state and local, regulations, and adherence to DoD requirements. Implement corrective actions as necessary • Minimize the risk of uncontrolled leaks, spills, and releases through industry accepted methods for spill prevention, containment, control, and abatement

Legend: DRMO = Defense Reutilization and Marketing Office, HMMP = Hazardous Materials and Management Plan, SPCC = Spill Prevention Control and Countermeasures.

17.2.3 Alternative 2 Former Ship Repair Facility (SRF)

The potential increased opportunity for adverse impacts relative to hazardous materials, toxic substances, and hazardous waste primarily would be a function of the number of aircraft berthing days and not a function of the various berthing options. Variances between the alternatives would result in negligible differences in the overall potential hazardous substance impacts.

17.2.3.1 Summary of Alternative 2 Impacts

The impacts for Alternative 2 would be the same as for Alternative 1.

17.2.3.2 Alternative 2 Proposed Mitigation Measures

Because the impacts for Alternative 2 would be the same as for Alternative 1, the same BMPs and SOPs would be used for Alternative 2 that would be used for Alternative 1. Due to the use of BMPs and SOPs, no mitigation measures are identified for Alternative 2.

17.2.4 No-Action Alternative

The no-action alternative means that there would be no increase in aircraft carrier visits and the current tempo would continue at Kilo Wharf. Hazardous materials and wastes, toxic substances, and emergency response to radioactive incidents would be comparable to the action alternatives, but the volume of waste generated would be less.

17.2.5 Summary of Impacts

Table 17.2-4 summarizes the potential impacts of each action alternative and the no-action alternative. A text summary is provided below.

Table 17.2-4. Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
Soils, Surface Water, Groundwater, Air, and/or Biota Impacts		
LSI • Less than significant adverse impacts would occur • As with all operations using hazardous substances, there is a possibility for an inadvertent leak, spill, or release	LSI • The impacts would be the same as for Alternative 1	NI • No added impacts

Legend: LSI = less than significant impact; NI = no impact.

The proposed increase in aircraft carrier berthing days would result in increased opportunities for adverse environmental impacts. These potential impacts could occur due to increased transportation, handling, use, and disposal of hazardous materials and hazardous wastes. However, there are various BMPs and SOPs (Volume 7) in place to prevent unintended releases of these substances. These include, but are not limited to:

- Spill prevention control and countermeasures plans
- Facility response plans
- Waste management plans
- Pollution prevention plans
- Hazardous material/waste management plans
- Mandatory personnel hazardous material and hazardous waste training
- Waste minimization plans
- Waste labeling, storage, packaging, staging, and transportation procedures
- DoD hazardous materials/hazardous waste management requirements
- Federal, state, and local laws and regulations
- Ensure that site planning and activities are conducted in accordance with Naval Ordnance Safety and Security Activity (NOSSA) Instruction 8020.15B Explosives Safety Review, Oversight, and Verification of Munitions Responses (Navy 2009).

Despite expected increases in hazardous materials and hazardous wastes, less than significant impacts are anticipated as long as the BMPs and SOPs discussed above and in Volume 7 are implemented and related plans and procedures updated and modified as appropriate to meet the potential increased demand upon

DRMO regarding hazardous substance transportation, handling, storage, use, and disposal. Note that a Joint Military Master Plan provides specific details regarding several new facilities. These new facilities will be required to store, handle, and dispose of the estimated increases in hazardous substances that would occur from the potential DoD unit transfers to Guam.

17.2.6 Summary of Proposed Mitigation Measures

No mitigation measures are identified. Potential BMPs and SOPs are not considered "mitigation measures" and include, but are not limited to those summarized in Table 17.2-5 that may be used for both offshore and onshore aircraft carrier activities. A comprehensive listing of BMPs and SOPs is included in Volume 7.

Table 17.2-5. Summary of BMPs and SOPs

Alternative 1	*Alternative 2*
Onshore and Offshore Activities	
• Update/implement HMMP's and HWMP's. • Update/implement facility response plans. • Update/implement SPCC plans (training, spill containment and control procedures, clean up, notifications, etc.). • Ensure DoD personnel are trained as to proper labeling, container, storage, staging, and transportation requirements for hazardous substances. Also, ensure they are trained in accordance with spill prevention, control, and clean-up methods. • Implement aggressive hazardous waste minimization plans that substitute hazardous waste for non-hazardous or less toxic waste as applicable and use LEEDS criteria. • As necessary, expand DRMO's sufficient hazardous materials storage, transportation, and disposal capacity prior to any expected increases. • Verify through surveillance and inspections full compliance with federal, state and local, regulations and adherence to DoD requirements. Implement corrective actions as necessary • Minimize the risk of uncontrolled leaks, spills, and releases through industry accepted methods for spill prevention, containment, control, and abatement. • Ensure that site planning and activities are conducted in accordance with Naval Ordnance Safety and Security Activity (NOSSA) Instruction 8020.15B Explosives Safety Review, Oversight, and Verification of Munitions Responses (Navy 2009).	• The BMPs and SOPs would be the same as for Alternative 1.

Legend: HMMP = Hazardous Materials Management Plan; HWMP = Hazardous Waste Management Plan; SPCC = Spill Prevention Control and Countermeasures

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CHAPTER 18.
PUBLIC HEALTH AND SAFETY

18.1 INTRODUCTION

This chapter contains a discussion of the potential environmental consequences associated with implementation of the alternatives within the region of influence (ROI) for public health and safety. For a description of the affected environment for all resources, refer to the respective chapter of Volume 2 (Marine Corps Relocation – Guam). The locations described in that Volume include the ROI for the aircraft carrier berthing component of the proposed action (Apra Harbor), and the chapters are presented in the same order as the resource areas contained in this Volume.

Under the proposed action for a transient aircraft carrier wharf, there would be a cumulative total of up to 63 visit days per year, with an anticipated length of 21 days or less per visit. To provide some additional background information on operational requirements of a nuclear powered aircraft carrier, a discussion of radiological substances is provided below for these types of vessels. Environmental consequences of the proposed action are discussed in Section 18.2.

18.1.1 Radiological Substances

The Final Environmental Impact Statement for the proposed homeporting of additional surface ships at Naval Station Mayport, FL (NAVFAC 2008) was used to supply background information regarding radiological concerns relative to nuclear powered warships.

Nuclear aircraft carriers that would visit Guam include Nimitz Class (CVN 68) and Ford Class (CVN 78) vessels. The source of energy for powering a Naval nuclear ship originates from fissioning uranium atoms within a reactor core. Pressurized water circulating through a closed primary piping system transfers heat from the reactor core to a secondary steam system isolated from the reactor cooling water. The heat energy is then converted to mechanical energy to propel the ship, and provides electrical power to the rest of the ship. Nuclear propulsion provides virtually unlimited high-speed endurance without dependence on tankers and their escorts.

18.1.1.1 Naval Nuclear Propulsion Program

The Naval Nuclear Propulsion Program (NNPP) regulates radioactivity associated with Naval nuclear propulsion work. The policies of the NNPP are applied consistently to all locations where nuclear powered ships are berthed or maintained. The NNPP is a joint Navy/Department of Energy (DOE) organization responsible for all matters pertaining to Naval nuclear propulsion pursuant to Executive Order (EO) 12344 and Public Law 98-525 (42 United States Code [USC] 7158).

Because radioactive material is an inherent by-product of the nuclear fission process, its control has been a central concern for the NNPP since its inception. All features of design, construction, operation, maintenance, and personnel selection, training, and qualification have been oriented toward minimizing environmental effects and ensuring the health and safety of workers, ships' crew members, and the public. Conservative reactor safety design has been a hallmark of the NNPP.

The history of safe operation of the Navy's nuclear powered ships is a matter of public record. This record shows a long history of the NNPP's activities having no adverse effect on the environment or public health. Environmental monitoring results published yearly provide a comprehensive description of environmental performance for all NNPP facilities. This record confirms that the procedures used by the

Navy to control radioactivity from United States (U.S.) Naval nuclear powered ships are effective in protecting the environment and the health and safety of Sailors, workers, and the general public.

NNPP reactor designs receive independent evaluations from the Nuclear Regulatory Commission and the Advisory Commission on Reactor Safeguards. These reviews are conducted as a means to provide confirmation and added assurance that nuclear propulsion plant design, operation, and maintenance pose no undue risk to public health and safety.

Key radiological control practices used by the NNPP to provide assurance that positive control of radioactivity is maintained include the following.

- A radioactive materials accountability system is used to ensure that no radioactive material is lost or misplaced.
- All radioactive materials are specially packaged, sealed, and tagged with yellow and magenta tags bearing the standard radiation symbol and the measured radiation level. The use of yellow packaging material is reserved solely for radioactive material.
- Access to radiological facilities is controlled by trained radiological control personnel. In addition, all personnel entering radiological work and storage areas are required to wear dosimetry devices.
- Only specially trained personnel are authorized to handle radioactive materials.
- Radiological surveys are conducted by qualified radiological control personnel inside and outside of facilities and ships where radiological materials are handled. This is a check to verify that the methods used to control radioactivity are effective.
- Written procedures are used to perform all radiological work.
- Radioactive material or radioactive waste transported off-site is packaged and shipped per Department of Transportation regulations. Specially trained personnel accomplish this function.
- Technical problems encountered during radiological work are documented and corrected before work is allowed to continue.

The safety record of U.S. Naval nuclear propulsion plants aboard nuclear powered warships is well known; there has never been a reactor accident in over 50 years since the first Naval reactor began operation, a record comprising over 5,900 reactor-years of experience. There has never been any release of radioactivity that has had an adverse effect on the public or the environment.

18.1.1.2 Emergency Preparedness

Naval reactors are designed and operated in a manner that is protective of the crew, the public, and the environment. All NNPP activities have plans in place that define NNPP responses to a wide range of emergency situations. These plans are regularly exercised to ensure that proficiency is maintained. These exercises consistently demonstrate that NNPP personnel are well prepared to respond to emergencies regardless of the location. Actions are taken to continually evaluate and improve emergency preparedness at all NNPP activities.

If there ever were a radiological emergency, civil authorities would be promptly notified and kept fully informed of the situation. With the support of NNPP personnel, local civil authorities would determine appropriate public actions, if any, and communicate this information via their normal emergency communication methods.

Pursuant to §8506(7) of the Government Code of Guam, the Governor shall utilize the services and facilities of existing Government of Guam (GovGuam) agencies for the purposes of responding to all phases of any emergency or disaster. The Guam Emergency Response Plan outlines the procedures and responsibilities for responding to any emergency or disaster. This emergency response plan incorporates the National Incident Management System of operation, which entails an organized response to emergency situations utilizing the services and resources of all GovGuam agencies. Each GovGuam agency has specific roles and responsibilities. Some would be primary responders or lead agencies, while others would provide support to the response effort lending manpower, staff resources, and supplies and equipment to meet the needs of the emergency. The Unified Command of all organizations addressing these functions would be located at the Emergency Operations Center at the Office of Civil Defense (GovGuam 2005).

Due to the unique design and operating conditions of U.S. nuclear powered ships, civil emergency response plans that are sufficient for protecting the public from industrial and natural events (e.g., chemical spills or typhoons) are also sufficient to protect the public in the unlikely event of an emergency onboard a nuclear powered ship. Response plans have been a part of the Guam emergency management planning for over 50 years as Navy nuclear power ships have traditionally been stationed in Inner Apra Harbor.

18.2 ENVIRONMENTAL CONSEQUENCES

18.2.1 Approach to Analysis

18.2.1.1 Methodology

Potential effects to public health and safety from implementation of the proposed aircraft carrier berthing alternatives were derived based upon information detailed in the descriptions of each alternative. Public health and safety concerns were addressed based on anticipated changes in the population of Guam, both from natural increases and from military personnel and their dependents moving to Guam. Average per capita incidents for notifiable diseases, mental illness, and traffic accidents were used to calculate the potential increase in these incidents as a result of the aircraft carrier berthing alternatives. Safety of construction workers would be the same as outlined in Volume 2. Proposed construction activities supporting aircraft carrier berthing activities would be conducted in accordance with federal and local safety guidelines to ensure a safe work environment.

With construction activities, there is a potential for standing water and water based vectors such as mosquitoes and related diseases. Most mosquitoes require quiet, standing water or moist soil where flooding occurs to lay their eggs. Removal of standing water sources and/or promotion of drainage would eliminate potential breeding sites. In compliance with Guam Code Annotated (10 GCA 36-Mosquito Control), to limit the amount of standing water at construction sites, stagnant water pools, puddles, and ditches would be drained or filled; containers that catch/trap water (e.g., buckets, old tires, cans) would be removed; and if necessary, pesticide application (e.g., *Bacillus thuringensis*) could be used to help control mosquitoes. Implementing these Best Management Practices (BMPs) would reduce the opportunities for an outbreak of water-related diseases.

Public health and safety concerns from proposed aircraft carrier berthing activities result primarily from ground disturbing and nearshore dredging activities. Public health and safety concerns to be addressed in this Volume are related to environmental/social safety (including noise, water quality, air quality, hazardous substances, health care services, and public services), unexploded ordnance (UXO), and radiological substances.

18.2.1.2 Determination of Significance

Factors considered in determining whether an alternative would have a significant public health and safety impact include the extent or degree to which implementation of the proposed aircraft carrier berthing alternatives would subject the public to an increased risk of contracting a disease or experiencing personal injury.

18.2.1.3 Issues Identified during Public Scoping Process

The following analysis focuses on possible effects to public health and safety that could result from the proposal. As part of the analysis, concerns related to public health and safety that were mentioned by the public, including regulatory stakeholders, during the public scoping meetings were addressed. The following public health and safety concerns were raised during public scoping meetings regarding the proposed relocation of military personnel and their families to Guam:

- Potential increases in diseases including:
- Acquired Immune Deficiency Syndrome (AIDS)
- Cholera
- Dengue
- Hepatitis C
- Malaria
- Measles
- Rubella
- Sexually Transmitted Diseases (STDs) other than AIDS
- Tuberculosis (TB)
- Typhoid Fever
- Potential increases in mental illness
- Potential increases in traffic incidents
- Potential contact with UXO.

18.2.2 Alternative 1 Polaris Point (Preferred Alternative)

18.2.2.1 Environmental/Social Safety

<u>Noise</u>

Construction and operational noise emissions associated with aircraft carrier berthing is discussed in Volume 4, Chapter 6. Although pile driving activities would generate high noise levels at the source, the noise level at the nearest receptor is well within acceptable limits. Noise impacts due to the aircraft carrier berthing would be less than significant.

<u>Water Quality</u>

The Guam Water Authority (GWA) water system infrastructure does not meet the basic flow and pressure requirements for all customers. These conditions can result in microbiological and other contaminants entering the distribution system potentially resulting in illness. GWA water distribution system problems also exist, which may result in customers receiving inadequate supply/service. The Department of Defense (DoD) acknowledges the existing sub-standard conditions of key public infrastructure systems on Guam and the interest to have DoD fund improvements to these systems. DoD’s ability to fund infrastructure improvements is limited by federal law. However, to minimize adverse impacts associated with the proposed military relocation program, the DoD is leading a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam. The DoD cannot repair GWA distribution system problems but would attempt to identify ways to address them via the federal interagency task force. While groundwater production rates would increase, implementation of sustainability practices would reduce the amount of groundwater needed, which would help minimize impacts to groundwater availability. The resulting total annual groundwater production would be less than the sustainable yield and monitoring of groundwater chemistry would ensure no harm to existing or beneficial use. Construction and operational activities associated with aircraft carrier berthing would be implemented in accordance with standard operating procedures (SOPs) and BMPs, and in accordance with applicable regulations. Since it is doubtful that GWA could fund and implement required upgrades in time for the proposed DoD buildup, it is anticipated that public health and safety impacts from increased demand on potable water would be significant.

Air Quality

As discussed in Volume 4, Chapter 5, increased pollutants associated with construction and operational activities associated with aircraft carrier berthing would be less than significant. Although increased emissions would be less than significant, construction and operational activities would result in pollutant emissions, which could result in health impacts to individuals on Guam that could increase the use of health care services. Air pollution can harm individuals when it accumulates in the air in high enough concentrations. People exposed to high enough levels of certain air pollutants may experience:

- Irritation of the eyes, nose, and throat
- Wheezing, coughing, chest tightness, and breathing difficulties
- Worsening of existing lung and heart problems
- Increased risk of heart attack

In addition, long-term exposure to air pollution has been linked to certain types of cancer and damage to the immune, neurological, reproductive, and respiratory systems.

Some groups of people are especially sensitive to common air pollutants such as particulates and ground-level ozone. Sensitive populations include children, older adults, people who are active outdoors, and people with heart or lung diseases, such as asthma (Massachusetts Department of Environmental Protection [MDEP] 2009).

Because air emission increases would be less than significant, it is anticipated that Guam clinics and hospital would have adequate staffing to handle air quality-related illnesses; therefore, less than significant impacts to health care services would be anticipated as a result of emissions from construction and operational activities.

Hazardous Substances

Activities associated with aircraft carrier berthing would result in an increase in the use, handling, storage, transportation, and disposition of hazardous substances. These activities would be conducted in accordance with applicable hazardous material and waste regulations, and established BMPs and SOPs to ensure the health and safety of workers and the general public is maintained. BMPs and SOPs include:

- Implementing Hazardous Materials Management Plans
- Implementing Facility Response Plans

- Implementing Spill Prevention Control and Countermeasures plans (training, spill containment and control procedures, clean up, notifications, etc.) and ensuring personnel are trained in accordance with spill prevention, control, and cleanup methods
- Implementing hazardous materials minimization plans
- Ensuring DoD personnel are trained as to proper container labeling, storage, staging, and transportation requirements for hazardous materials
- Ensuring that the Defense Reutilization and Marketing Office (DRMO) has sufficient hazardous materials storage, transportation, and disposal capacity prior to any expected increases
- Verifying full compliance with federal, local, and DoD laws and regulations and implement corrective actions as necessary.

Because hazardous substance management activities would be conducted in accordance with applicable regulations and established BMPs and SOPs, no impacts to public health and safety are anticipated.

Health Care Services

Volume 4, Chapter 16 discusses the impact of an increased patient to health care provider ratio as a result of population growth associated with the aircraft carrier berthing. It is anticipated that short- and mid-term medical staffing requirements would increase over current requirements as a result of increased population. During the peak construction year (2014) less than 1 additional doctor (<1% increase) and 3 additional nurses (<1% increase) would be required to maintain the current service ratios; the number of additional doctors would be less than 1 (<1% increase) and nurses drops to 1 (<1% increase) after construction activities are completed. These additional health care professionals would be hired in order to maintain current service ratios. Without corresponding increases in health care providers potential health and safety impacts could include:

- Longer wait/response times for patients
- Fewer or no available providers on island for chronic or acute issues
- Complications or death from delayed treatment, and/or
- Requirements for patients to travel off-island to receive adequate treatment.

The DoD acknowledges the existing sub-standard conditions of health care services on Guam and the interest to have DoD fund improvements to these services. DoD's ability to fund these services is limited by federal law. However, to minimize adverse impacts associated with the proposed military relocation program, the DoD is leading a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam. The proposed action would require a less than 1% increase over reported baseline staffing levels for public health and human services institutions. The analysis indicates less than significant impacts to public health and human services agencies due to the proposed action alone, except in conjunction with other aspects of the aggregate action.

Public Services

Police Service

Volume 4, Chapter 16 discusses staffing requirements for Guam Police Department (GPD) necessary to cope with population increases associated with aircraft carrier berthing. It is anticipated that short- and mid-term GPD staffing requirements would increase over current requirements as a result of increased population. During the peak construction year (2014) the GPD would require 3 (<1% increase) additional officers to maintain the current service ratio; the number of additional officers drops to 1 (<1% increase) after construction activities are completed. The GPD would hire these additional personnel in order to maintain current service ratios. Without increases in police services (i.e., more police officers) to compensate for population increases, it would be expected that crime rates and police response times would also increase. As a result, the severity of consequences associated with crimes may worsen (i.e., there may be increased injury and or death associated with delayed police responses). The DoD acknowledges the existing sub-standard conditions of protective services on Guam and the interest to have DoD fund improvements to these services. DoD's ability to fund these services is limited by federal law. However, to minimize adverse impacts associated with the proposed military relocation program, the DoD is leading a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam. The proposed action would require a less than 1% increase over reported baseline staffing levels for public safety agencies. The analysis indicates less than significant impacts to public safety agencies due to the proposed action alone, except in conjunction with other aspects of the aggregate action.

Fire Service

Volume 4, Chapter 16 discusses staffing requirements for Guam Fire Department (GFD) necessary to cope with population increases associated with aircraft carrier berthing. It is anticipated that short- and mid-term GFD staffing requirements would increase over current requirements as a result of increased population. During the peak construction year (2014) the GFD would require 2 (<1% increase) additional firefighters to maintain the current service ratio; the number of additional firefighters drops to less than 1 (<1% increase) after construction activities are completed. The GFD would hire these additional personnel in order to maintain current service ratios. Without increases in fire protection services (i.e., more firemen, trucks, and stations) to compensate for population increases, it is anticipated that response times to incidents would increase. As a result, increases in property damage and injuries/deaths could be expected. The DoD acknowledges the existing sub-standard conditions of protective services on Guam and the interest to have DoD fund improvements to these services. DoD's ability to fund these services is limited by federal law. However, to minimize adverse impacts associated with the proposed military relocation program, the DoD is leading a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam. The proposed action would require a less than 1% increase over reported baseline staffing levels for public safety agencies. The analysis indicates less than significant impacts to public safety agencies due to the proposed action alone, except in conjunction with other aspects of the aggregate action.

18.2.2.2 Notifiable Diseases

Analysis of potential impacts from increased notifiable diseases is provided in Volume 2. The DoD acknowledges the existing sub-standard conditions of social services on Guam and the interest to have DoD fund improvements to these services. DoD's ability to fund these services is limited by federal law. However, to minimize adverse impacts associated with the proposed military relocation program, the DoD is leading a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam. Based on the potential for an increase in notifiable diseases, the proposed action would require a less than 1% increase over reported baseline staffing levels for public health and human services institutions. The analysis indicates less than significant impacts to public health and human services agencies due to the proposed action alone, except in conjunction with other aspects of the aggregate action.

18.2.2.3 Mental Illness

Analysis of potential impacts from increased mental illness is provided in Volume 2. The DoD acknowledges the existing sub-standard conditions of social services on Guam and the interest to have DoD fund improvements to these services. DoD's ability to fund these services is limited by federal law. However, to minimize adverse impacts associated with the proposed military relocation program, the DoD is leading a federal inter-agency effort to identify other federal programs and funding sources that could benefit the people of Guam. Based on the potential for an increase in mental illness cases, the proposed action would require a less than 1% increase over reported baseline staffing levels for public health and human services institutions. The analysis indicates less than significant impacts to public health and human services agencies due to the proposed action alone, except in conjunction with other aspects of the aggregate action.

18.2.2.4 Traffic Incidents

Analysis of potential increases in traffic incidents is provided in Volume 2. Proposed aircraft carrier berthing activities are not anticipated to have an adverse effect on the health and safety of the citizens of Guam from traffic incidents.

The Navy has used focus group sessions with personnel at several bases to strategize potential measures to reduce the number of liberty incidents, including traffic incidents. Several common factors appear to contribute to liberty incidents including young personnel, late nights, impaired driving, and alcohol/drugs. Some of the actions that would be implemented to reduce traffic incidents during liberty include:

- Increase awareness training regarding the consequences of drugs and alcohol use
- Increase awareness and enforcement by military law enforcement personnel targeting operation of motor vehicles under the influence
- Use of the inter-service disciplinary control board for review of requests to declare specific off-base bars/clubs "off-limits" to military personnel
- Increase community policing efforts to include appropriate use of Shore Patrol activity to reduce alcohol related injuries
- Continued use of free shuttle bus runs to/from town
- Restrictions on obtaining rental of vehicles by age and command restrictions on rental of motorized two wheeled conveyances, would reduce potential safety and health concerns raised by transient personnel use of rentals.

The potential increase in the number of traffic accidents and fatalities as a result of the increase in personnel (as well as the construction workforce contribution) would be minimal; therefore, a less than significant impact on the health and safety of the citizens of Guam (from traffic incidents) is anticipated.

18.2.2.5 UXO

The Island of Guam was an active battlefield during World War II. As a result of the invasion, occupation, and defense of the island by Japanese forces and the assault by Allied/American forces to retake the island, unexploded military munitions may still remain. Onshore excavation and grading activities and dredging for wharf construction and establishing navigational channels and turning basins could encounter unexploded military munitions in the form of UXO, Discarded Military Munitions (DMM) and/or materials potentially presenting an explosive hazard. Exposure to these Munitions and Explosives of Concern (MEC) could result in the death or injury to workers or to the public. To reduce the potential hazards related to the exposure to MEC, a review of historical records and other information would be performed. If there is reason to believe MEC may be found in the area, in accordance with DoD Directive 6055.9 (DoD Ammunition and Explosive Safety Standard) and Naval Ordnance Safety & Security Activity (NOSSA) Instruction 8020.15B, Explosive Safety Submission (ESS) documentation would be prepared that outlines specific measures that would be implemented to ensure the safety of workers and the public. BMPs that would be implemented include having qualified UXO personnel perform surveys to identify and remove potential MEC items prior to the initiation of ground disturbing or dredging activities. Additional safety precautions would include UXO personnel supervision during earth moving and dredging activities, and providing MEC awareness training to construction personnel involved in excavations and dredging prior to and during construction activities. The identification and removal of MEC prior to initiating construction activities and training construction personnel as to the hazards associated with unexploded military munitions would ensure that potential impacts would be minimized and would be less than significant.

Therefore, Alternative 1 for proposed aircraft carrier berthing activities would result in less than significant impacts to public health and safety from UXO.

18.2.2.6 Radiological Substances

As of July 2007, U.S. Naval reactors have accumulated over 5,900 reactor-years of operation and have steamed over 137 million miles (mi) (220 million kilometers [km]) and there has never been a reactor accident, nor any release of radioactivity that has had an adverse effect on human health or the quality of the environment.

Because naval reactors must fit aboard a warship, they are smaller and have a much lower power rating than commercial reactors. Also, because reactor power is directly linked to propulsion requirements, naval reactors typically operate at low power or shut down entirely when the warship is in port. In the event of a nuclear reactor emergency, the ship can be rigged and towed away from populated areas, which is not the case for a land-based reactor.

Nearly all (99%) of the radioactive atoms in a nuclear reactor are found in two forms: 1) the uranium fuel itself or 2) fission products created by the nuclear chain reaction. The remaining radioactive atoms present in a Naval nuclear reactor are encountered in two forms. The majority of the remaining radioactive atoms (99.9% of the remaining 1%) are part of the metal of the reactor plant piping and components. The balance (0.1% of the remaining 1%) is in the form of radioactive corrosion and wear products originating from metal surfaces in contact with reactor coolant.

Corrosion and wear products in Naval nuclear reactor plants include the following radionuclides with half-lives of about 1 day or greater: tungsten-187, chromium-51, hafnium-181, iron-59, iron-55, nickel-63, niobium-95, zirconium-95, tantalum-182, manganese-54, cobalt-58, and cobalt-60. The predominant radionuclide is cobalt-60 that has a 5.2 year half-life and emits gamma radiation that is one of the most penetrating forms of radiation. Cobalt-60 also has the most restrictive concentration limit in water as listed by organizations that set radiological standards for these corrosion and wear radionuclides. Therefore, cobalt-60 is the primary radionuclide of interest for Naval nuclear propulsion plants.

<u>Radiological Environmental Monitoring Program</u>

To provide additional assurance that procedures used by the Navy to control radioactivity are adequate to protect the environment, the Navy conducts environmental monitoring in harbors frequented by its nuclear powered ships. Samples from each harbor monitored are also checked at least annually by a DOE laboratory to provide a further check on the quality of the environmental sample analyses as a check of Navy results. The DOE laboratory findings have been consistent with those of the Navy.

Marine monitoring consists of analyzing harbor water, sediment, and marine life for radioactivity associated with Naval nuclear propulsion plants. This monitoring is supplemented by shoreline surveys. Sampling harbor water and sediment on a quarterly basis is emphasized since these materials would be the most likely to be affected by releases of radioactivity.

Sediment samples are collected and analyzed specifically for the presence of cobalt-60, which is the predominant radionuclide of environmental interest resulting from Naval nuclear reactor operation. Surveys for cobalt-60 sampling in 2006 show that most harbors do not have detectable levels of cobalt-60 in sediment. Low levels of cobalt-60, less than three millionths of a microcurie per gram, were detected around a few operating base and shipyard piers where nuclear powered ship maintenance and overhauls were conducted in the early 1960s. These low levels were well below the naturally occurring radioactivity levels in these harbors. Since 1970, nuclear powered warship operations have not caused any increase in the general background radioactivity in the environment.

Harbor water is also sampled each quarter in areas where nuclear powered ships are berthed, and from upstream and downstream locations. No cobalt-60 has been detected in any of the water samples from the harbors monitored.

Marine-life samples, such as mollusks, crustaceans, and plants have been taken from harbors monitored. No buildup of cobalt-60 has been detected in these samples of marine life. Shoreline areas uncovered at low tide are surveyed to determine if any radioactivity from bottom sediment has washed ashore. The results of these surveys are consistent with natural background radiation levels in these regions. Thus, there is no evidence that these areas are being affected by nuclear powered ship operation.

Results of Environmental Monitoring

The Navy issues an annual report that describes the Navy's policies and practices regarding such issues as disposal of radioactive liquid, transportation and disposal of radioactive materials and solid wastes, and monitoring of the environment to determine the effect of nuclear powered warship operation. This report is provided to Congress and to cognizant federal, state, and local officials in areas frequented by nuclear powered ships. This report shows that the total amount of long-lived gamma radioactivity released into harbors and seas within 12 mi (19 km) of shore has been less than 0.002 curies during each of the last 38 years (Navy 2009e).

Nuclear Regulatory Commission (NRC) regulation (10 Code of Federal Regulations [CFR] 20) lists water concentration limits for discharge of radioactivity in effluents. These limits are based on limiting the dose to members of the public from continuous ingestion of the activity discharged to 50 millirem per year. The control of radioactive liquid discharges at Navy facilities is much more stringent than at facilities that comply with the limits of 10 CFR 20, such as commercial nuclear power plants. The total combined radioactivity discharged from all Navy nuclear powered vessels annually within 12 mi (19 km) of shore is less than one hundredth of the amount of radioactivity released by one typical commercial nuclear power plant.

As a measure of the significance of this data, if an individual were able to drink the entire amount of radioactivity discharged into any harbor in any of the last 38 years by U.S. nuclear powered warships, that person would not exceed the annual radiation exposure permitted for an individual worker by the NRC.

The Navy issues a detailed report on radiological environmental monitoring in Apra Harbor each year (Navy 2009f). The latest report includes the results for each individual water, sediment, and marine life sample taken in Apra Harbor during 2008. No cobalt-60 was detected in any of these samples. The Navy has been conducting radiological environmental monitoring in Apra Harbor since the early 1960s, when nuclear-powered ship operations in Guam started. A complete history of all of this environmental monitoring data is provided in Volume I of the Historical Radiological Assessment for Apra Harbor (Navy 2006). This report documents that only trace amounts of cobalt-60, far below any level of health or environmental significance, have ever been detected in Apra Harbor. This amount of radioactivity is very small when compared to the amount of naturally occurring radioactivity already in the sediment. Cobalt-60 was last detected in 1990 in one Apra Harbor sediment sample at a concentration of 0.015 pCi/g. This concentration would have decayed to about 0.005 pCi/g by 2010, or about a tenth of one percent of the natural concentration of potassium-40 radioactivity in a banana.

Emergency Planning

Naval reactors are designed and operated in a manner that is protective of the crew, the public, and the environment. NNPP activities have plans in place that define NNPP responses to a wide range of emergency situations. If there ever were a radiological emergency, civil authorities would be promptly notified and kept fully informed of the situation. With the support of NNPP personnel, local civil authorities would determine appropriate public actions, if any, and communicate this information via their normal emergency communication methods as outlined in the Guam Emergency Response Plan (GovGuam 2005).

Due to the unique design and operating conditions of U.S. nuclear powered ships, civil emergency response plans that are sufficient for protecting the public from industrial and natural events (e.g., chemical spills or typhoons) are also sufficient to protect the public in the unlikely event of an emergency onboard a nuclear powered ship.

Incident Response

Although the risk of a radiological incident of significant consequence is small, emergency plans are in place at all Naval nuclear facilities to minimize the impacts of an emergency. These plans include activation of emergency control organizations throughout the NNPP to provide on-scene response as well as support for the on-scene response team. Realistic training exercises are conducted periodically to ensure that the response organizations maintain a high level of readiness and to ensure that coordination and communication lines with local authorities and other federal and state agencies are effective. Emergency response measures include provisions for immediate response to any emergency at any naval site, identification of the accident conditions, and communication with civil authorities providing radiological data and recommendations for any appropriate protective action. In the event of an incident involving radioactive or mixed-waste materials, workers in the vicinity of the incident would promptly seek shelter to minimize exposure and aid in emergency response consistent with the site's emergency plan for responding to fires and hazardous material incidents. This typically occurs within minutes of the incident and reduces the hazard to workers.

While the Navy would recommend appropriate actions to protect the public if needed based on federal guidance (EPA 400-R-92-001), local officials would be responsible for determining and implementing protective actions for the general public outside of the Naval base. In the highly unlikely event that some radioactivity escapes from the Naval base, the radioactivity would still only affect areas close to the release, and the exposure to the public would be localized and not severe. As such the need for local officials to take protective actions is extremely low. However, in the unlikely event that some action were necessary, existing civil emergency response plans in place for handling industrial and natural events (e.g., chemical spills or typhoons) are more than sufficient to protect the public in response to a radiological emergency originating from a Naval base.

Upon notification that an emergency exists, the Administrator of the Office of Civil Defense would activate the emergency response system outlined in the Guam Emergency Response Plan. The Administrator would notify and instruct all GovGuam agency heads and acting on behalf of the Governor of Guam, mobilize all response activities necessary. The National Incident Management System would be initiated to respond to all emergencies. In the event that the capability and resources of GovGuam become inadequate to effectively cope with an emergency, the Governor would request supplemental assistance from the federal government or activate the Emergency Management Assistance Compact.

The record of the NNPP's environmental and radiological performance at operating bases and shipyards presently used by nuclear powered warships demonstrates the continued effectiveness of this management philosophy. Through the entire history of the NNPP, the Navy has logged over 5,900 reactor years of operation and more than 137 million mi (220 million km) steamed on nuclear power with no reactor accidents or any release of radioactivity that has had an adverse effect on human health or the quality of the environment. Therefore, Alternative 1 for proposed aircraft carrier berthing would result in no impact to public health and safety from radiological substances.

18.2.2.7 Summary of Alternative 1 Impacts

Table 18.2-1 summarizes Alternative 1 impacts.

Table 18.2-1. Summary of Alternative 1 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	Significant impacts to water availability Less than significant impacts due to health care services, protective services, notifiable diseases, mental illness, noise, air quality, traffic incidents, and UXO No impacts to public health and safety from hazardous substances or radiological substances
	Operation	Significant impacts to water availability Less than significant impacts due to health care services, protective services, notifiable diseases, mental illness, noise, air quality, traffic incidents, and UXO No impacts to public health and safety from hazardous substances or radiological substances after implementation of BMPs and SOPs.

18.2.2.8 Alternative 1 Proposed Mitigation Measures

Mitigation measures for health care and protective services would be for the federal inter-agency task force to succeed in finding funding and/or other assistance to help Guam upgrade capacity to care for increased incidence of illnesses and meet service ratios for police and fire services.

18.2.3 Alternative 2 Former Ship Repair Facility (SRF)

Potential impacts to public health and safety (i.e., disease, mental illness, traffic incidents, radiological sources, and UXO) from implementation of aircraft carrier berthing activities would be the same as those discussed under Alternative 1.

18.2.3.1 Summary of Alternative 2 Impacts

Table 18.2-2 summarizes Alternative 2 impacts.

Table 18.2-2. Summary of Alternative 2 Impacts

Area	*Project Activities*	*Project Specific Impacts*
Onshore	Construction	Significant impacts to water availability Less than significant impacts due to health care services, protective services, notifiable diseases, mental illness, noise, air quality, traffic incidents, and UXO No impacts to hazardous substances or radiological substances
	Operation	Significant impacts to water availability Less than significant impacts due to health care services, protective services, notifiable diseases, mental illness, noise, air quality, traffic incidents, and UXO No impacts to hazardous substances or radiological substances after implementation of BMPs and SOPs.

18.2.3.2 Alternative 2 Proposed Mitigation Measures

Mitigation measures would be the same as those discussed under Alternative 1.

18.2.4 No-Action Alternative

Analysis of potential impacts to public health and safety from implementation of the no-action alternative is provided in Volume 2. No impact to the health and safety of the citizens of Guam resulting from implementing the no-action alternative is anticipated.

18.2.5 Summary of Impacts

Table 18.2-3 summarizes the potential impacts of each action alternative and the no-action alternative. A text summary is provided below.

Table 18.2-3. Summary of Impacts

Potentially Impacted Resource	*Alternative 1*	*Alternative 2*	*No-Action Alternative*
Environmental Safety	LSI	LSI	NI
Social Safety	LSI	LSI	NI
Notifiable Diseases	LSI	LSI	NI
Mental Illness	LSI	LSI	NI
Traffic Incidents	LSI	LSI	NI
UXO	LSI	LSI	NI
Radiological Substances	NI	NI	NI

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

The potential increase in noise and air quality emissions would be less than significant. The potential for disease occurrences as a result of proposed activities would be low; the proposed action would require a less than 1% increase over reported baseline staffing levels for public health and human services institutions. The analysis indicates less than significant impacts to public health and human services agencies due to the proposed action alone, except in conjunction with other aspects of the aggregate action.

The proposed action would require a less than 1% increase over reported baseline staffing levels for public safety agencies. The analysis indicates less than significant impacts to public safety agencies due to the proposed action alone, except in conjunction with other aspects of the aggregate action.

No impacts to public health and safety are anticipated from management of hazardous substances. The potential increase in the number of traffic accidents and fatalities would be less than significant and no adverse impact on the health and safety of the citizens of Guam from traffic incidents is anticipated.

Onshore excavation and grading activities and dredging for wharf construction and establishing navigational channels and turning basins could encounter unexploded military munitions. To reduce the potential hazards related to the exposure to MEC, a review of historical records and other information would be performed. If there is reason to believe MEC may be found in the area, qualified UXO personnel would perform surveys to identify and remove potential MEC items prior to the initiation of ground disturbing or dredging activities. Additional safety precautions would include UXO personnel supervision during earth moving and dredging activities, and providing MEC awareness training to construction personnel involved in excavations and dredging prior to and during construction activities. The identification and removal of MEC prior to initiating construction activities and training construction personnel as to the hazards associated with unexploded military munitions would ensure that potential impacts would be minimized and would be less than significant.

The risk of a radiological incident of significant consequence is small and emergency plans would be in place to minimize the impacts of an emergency. The Navy has not experienced a reactor accident or any release of radioactivity that has had an adverse effect on human health or the quality of the environment; therefore, no impact to public health and safety from radiological substances is anticipated.

18.2.6 Summary of Proposed Mitigation Measures

Mitigation measures for health care and protective services would be for the federal inter-agency task force to succeed in finding funding and/or other assistance to help Guam upgrade capacity to care for increased incidence of illnesses and meet service ratios for police and fire services.

CHAPTER 19. ENVIRONMENTAL JUSTICE AND THE PROTECTION OF CHILDREN

This chapter focuses on the potential for racial and ethnic minorities, low income populations, or children to be disproportionately affected by project-related impacts. Normally an analysis of environmental justice is initiated by determining the presence and proximity of these segments of the population relative to the specific locations that would experience adverse impacts to the human environment. The situation on Guam is unique in this regard because racial or ethnic minority groups (as defined by the U.S.) comprise a majority of the Guam population, and the proportions of people living in poverty or who are under 18 years of age are also substantially higher than in the general U.S. population. The analysis is further complicated by the fact that Guam is a relatively small and isolated island, and certain types of impacts would be experienced islandwide. Accordingly, the analysis of environmental justice described in this chapter acknowledges the unique demographic characteristics of the island population and assumes that the project effects could disproportionately affect disadvantaged groups and children because they comprise relatively high proportions of the population. By the same logic, proposed mitigation measures would be expected to effectively mitigate potential environmental justice impacts. Consequently, a distinction is made between potential impacts that would be mitigated and those for which no mitigations have been identified. The focus of this analysis is on the latter type of impacts. If a resource area did not have significant impacts, or impacts were mitigable to less than significant, as analyzed in each individual chapter in Volume 2, then it was not further analyzed in this chapter. These resources are: geological and soil resources, water resources, air quality, noise, airspace, land and submerged land use, terrestrial biological resources, cultural resources, visual resources, transportation, hazardous materials and waste and public health and safety.

19.1 INTRODUCTION

This chapter contains a discussion of the potential environmental consequences of the proposed action with regard to environmental justice and protection of children. For a description of the affected environment and a definition of the resource, refer to the respective chapter of Volume 2 (Marine Corps Relocation – Guam). The locations described in that volume include the region of influence (ROI) for the aircraft carrier berthing component of the proposed action and the chapters are presented in the same order as the resource areas contained in this Volume.

The Environmental Justice chapter focuses on disproportionate impacts to racial minorities, low-income populations, and children. For an analysis of potential islandwide impacts to these populations, please see the Socioeconomics Chapter of this Volume (Chapter 16).

19.2 ENVIRONMENTAL CONSEQUENCES

19.2.1 Approach to Analysis

19.2.1.1 Methodology

Volume 4 of this EIS examines the potential impacts that each alternative would potentially have on various environmental and human resources. Based on the conclusions reached in each resource chapter, the analysis of environmental justice sought to identify the adverse impacts that would disproportionately affect racial minorities, children, and/or low-income populations, based on the following assumptions:

- Environmental Justice and Protection of Children policies require a federal agency to analyze whether its proposed action would adversely affect a minority, low-income, or child population disproportionately to the rest of the community. The island of Guam is unique in that a majority of the population of Guam meet the criteria for being an Asian Pacific minority group in the context of the overall U.S. population. As a result, where the EIS identifies significant impacts for a particular resource, there would be a corresponding, island-wide adverse effect to minority populations on Guam, compared to the U.S. population. However, because of international agreements that require the proposed action to focus on Guam, and not other locations within the U.S., the evaluation of environmental justice would be on whether there are disproportionate adverse effects within the context of alternatives for facility location on Guam. Because of this, it would be impossible for there to be a disproportionate effect from an identified adverse impact based solely on the impact affecting a minority population. Therefore, the analysis for environmental justice on Guam must consider whether there is a disproportionate adverse effect on a low-income population or children. For example, if there is a low-income population that is being impacted by a potential reduction in Public Health and Social Services, that impact would be considered a significant impact because the population, as a given, is a minority population and it is being disproportionately affected because it is a low-income population. As a result, some resource areas may have effects on a minority population, but because they do not impact a low-income or child population in a disproportionate manner they will not be considered as causing an environmental justice adverse effect.
- The ROI is defined as the area in which the principal effects arising from the implementation of the proposed action or alternatives are likely to occur. Those who may be affected by the consequences of the alternatives are often those who reside or otherwise occupy areas immediately adjacent to the alternative locations.
- Because the proposed action is related either to construction or operation, impacts to the ROI would likely be either "spill over" effects that extend beyond the DoD land's boundary line into the surrounding community, or impacts that directly affect minority populations in the ROI.

The analysis involved the application of three tiers of criteria to assess the environmental justice implications for each significant impact identified in the relevant resource chapters. In some cases if the analysis shows that the requirements for the specific criteria have not been met, then a discussion on the next tier may not be required. For instance, if an applicable disadvantaged group is not disproportionately affected in Tier 2, then a discussion on significant effects under environmental justice would not be warranted.

- Tier 1: Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?
- Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?
- Tier 3: Would the disproportionate adverse effects be significant?

19.2.1.2 Determination of Significance

According to Section 1508.27 of the Council on Environmental Quality (CEQ) Regulations for Implementing NEPA (CEQ 1979), determining the level of significance of an environmental impact requires that both context and intensity be considered. These are defined in Section 1508.27 as follows:

- "*Context*. This means that the significance of an action must be analyzed in several contexts such as society as a whole (human, national), the affected region, the affected interests, and the locality. Significance varies with the setting of the proposed action. For instance, in the case of a site-specific action, significance would usually depend upon the effects in the locale rather than in the world as a whole. Both short- and long-term effects are relevant."
- "*Intensity*. This refers to the severity of the impact. Responsible officials must bear in mind that more than one agency may make decisions about partial aspects of a major action. The following should be considered in evaluating intensity:
- Impacts that may be both beneficial and adverse. A significant effect may exist even if the federal agency believes that on balance the effect would be beneficial.
- The degree to which the proposed action affects public health or safety.
- Unique characteristics of the geographic area such as proximity to historic or cultural resources, park lands, prime farmlands, wetlands, wild and scenic rivers, or ecologically critical areas.
- The degree to which the effects on the quality of the human environment are highly uncertain or involve unique or unknown risks.
- The degree to which the action may establish a precedent for future actions with significant effects or represents a decision in principle about a future consideration.
- Whether the action is related to other actions with individually insignificant but cumulatively significant impacts. Significance exists if it is reasonable to anticipate a cumulatively significant impact on the environment. Significance cannot be avoided by terming an action temporary or by breaking it down into small component parts.
- The degree to which the action may adversely affect districts, sites, highways, structures, or objects listed in or eligible for listing in the National Register of Historic Places or may cause loss or destruction of significant scientific, cultural, or historical resources.
- The degree to which the action may adversely affect an endangered or threatened species or its habitat that has been determined critical under the Endangered Species Act of 1973.
- Whether the action threatens a violation of federal, state, or local law or requirements imposed for the protection of the environment."

19.2.1.3 Issues Identified during Public Scoping Process

As part of the analysis, concerns relating to environmental justice or the protection of children that were mentioned by the public, including regulatory stakeholders, during scoping meetings were addressed. These included:

- Concerns that disruption to family lives and cultural values would ultimately, "jeopardize the future of [indigenous] children."
- Concerns from the Micronesian Youth Services Network about ensuring that, "the transition of personnel on our islands will not disrupt our family lives and our cultural values."

- Concerns that indigenous people of Guam are treated as second-class citizens. One commenter from Saipan indicated that, "these are their islands, and the locals' culture and related artifacts which still can be found are also deserving of respect."
- Sanctuary, Incorporated, a non-profit organization focused on youth and their families, recommended using the Social Impact Assessment Guide and Principles as a basis for conducting the social impact study for this EIS.
- The Chamorro Studies Association requested, "protect the people of Guam and their human rights."
- The CMTF Social and Cultural Subcommittee submitted a comprehensive paper on the subject of Chamorro interests (see Appendix G). That subcommittee recommends that the EIS identify issues and concerns that must be addressed to minimize negative social impacts and allow local and military communities to live in harmony.

19.2.1.4 Public Involvement

The following measures were implemented to address issues that often complicate the public participation of minority and low-income people. These issues include lack of transportation, language barriers, and internet/computer access. Public involvement measures were implemented to ensure that minority and low-income populations on Guam had the ability to participate in the public review process for actions proposed in this Volume.

- Public meetings were held in locations along major public transportation routes so they were accessible to peoples without cars.
- Public meeting notices, announcements, and documents were posted in paper form as well as online in multiple, frequently accessed public places.
- Written materials were provided in the Chamorro language and a Chamorro-speaking interpreter was used during meetings.

19.2.2 Alternative 1 Polaris Point (Preferred Alternative)

19.2.2.1 Onshore

Alternative 1 Polaris Point (referred to as Alternative 1) proposes to construct a wharf and supporting infrastructure and facilities at Polaris Point on Naval Base Guam. This section focuses on the adverse impacts anticipated from onshore construction of supporting infrastructure and facilities.

Socioeconomics

Chapter 16 of this Volume describes a range of socioeconomic impacts, most of which are beneficial or less than significant. However, Chapter 16 also describes potentially significant impacts related to crime and social order and community cohesion.

Tier 1: Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?

The village in proximity to the Apra Harbor is Piti. Minority and low-income populations and children of the village of Piti are present and adjacent to the proposed action site.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

All people of Piti and Guam overall would be affected by impacts to crime and social order and community cohesion. Therefore, Alternative 1 would not result in disproportionately high and adverse effects on minority or low-income populations, nor would there be disproportionate risks to the health and safety of children.

19.2.2.2 Offshore

According to Chapter 6 of this Volume, proposed offshore actions include dredging and pile driving that would last for at least 8 to 18 months and up to 24 hours a day. The village in proximity to the harbor is Piti. Apra Harbor is a resource used by all people of Guam. Offshore marine biology impacts may occur and are discussed below.

<u>Marine Biology</u>

Chapter 11 of Volume 4 identified potential significant impacts to fish and coral reefs during the construction period related to the dredging in Apra Harbor. Chamorro and other Guamanians have traditionally relied on these marine resources for fishing and recreation. As identified in Volume 4 Chapter 11, Sections 11.2.2.5 - 11.2.2.7, federal law recognizes the value of irreplaceable marine resources and requires compensatory mitigation. Compensatory mitigation is defined as the restoration, establishment, enhancement, and/or preservation of aquatic resources to offset unavoidable impacts to waters of the U.S. (including special aquatic sites, such as coral reefs). Therefore, long-term operational impacts would be less than significant.

Tier 1: Are there any racial minorities, low-income, or children populations adjacent to the proposed action site?

The village in proximity to the Apra Harbor is Piti. Minority and low-income populations and children of the village of Piti are present and adjacent to the proposed action site. Apra Harbor and offshore waters are used by all people of Guam.

Tier 2: Are the applicable disadvantaged groups disproportionately affected by the negative environmental consequences of the proposed action(s)?

Because all of Guam in a minority population, minorities would not be disproportionately affected by the impacts of construction on fish and coral reefs. Low-income populations would not be disproportionately affected because the impacts would not adversely affect the economy of Piti or Guam overall. Therefore, Alternative 1 would not result in disproportionately high and adverse effects on minority or low-income populations. The health and safety of children would not be affected by these impacts.

19.2.2.3 Summary of Alternative 1 Impacts

Table 19.2-1 summarizes the environmental justice impacts of Alternative 1.

Table 19.2-1. Summary of Alternative 1 Impacts

Potential Impacts on Guam by Resource
Socioeconomics
NI No disproportionately high and adverse effects on minority or low-income populations. No health and safety impacts affecting children.
Marine Biology
NI No disproportionately high and adverse effects on minority or low-income populations. No health and safety impacts affecting children.

Legend: NI = No impact

19.2.2.4 Alternative 1 Proposed Mitigation Measures

Alternative 1 would not result in disproportionately high and adverse effects on minority or low-income populations or impacts to the health and safety of children; therefore, no mitigation is needed.

19.2.3 Alternative 2 Former Ship Repair Facility (SRF)

19.2.3.1 Onshore

The effects would be the same as Alternative 1.

19.2.3.2 Offshore

The effects would be the same as Alternative 1.

19.2.3.3 Summary of Alternative 2 Impacts

Table 19.2-2 summarizes the environmental justice impacts of Alternative 2.

Table 19.2-2. Summary of Alternative 2 Impacts

Potential Impacts by Area
Socioeconomics
The potential impacts for Alternative 2 are the same as for Alternative 1.
Marine Biology
The potential impacts for Alternative 2 are the same as for Alternative 1.

19.2.3.4 Alternative 2 Proposed Mitigation Measures

Alternative 2 would not result in disproportionately high and adverse effects on minority or low-income populations or impacts to the health and safety of children; therefore, no mitigation is needed.

<u>No-Action Alternative</u>

Under the no-action alternative, no construction, dredging, or operation associated with the aircraft carrier berthing would occur. Existing operations at Polaris Point, as a military training and recreational facility, and the Former Ship Repair Facility (SRF), as a commercial ship repair facility, would continue. Therefore, the no-action alternative would not have impacts on minority, low-income, or children populations.

19.2.4 Summary of Impacts

Table 19.2-3 summarizes the potential impacts of each action alternative and the no-action alternative. A text summary is provided below.

Table 19.2-3. Summary of Impacts

Alternative 1	*Alternative 2*	*No-Action Alternative*
Socioeconomics: • NI (Racial Minorities) • NI (Low-Income) • NI (Children) Marine Biology: • NI (Racial-Minorities) • NI (Low-Income) • NI (Children)	Impacts are the same as for Alternative 1.	NI

Notes: NI = No impact

In summary, this chapter examined potentially adverse environmental effects related to socioeconomic impacts (related to water quality/dredging issues, social order issues and community cohesion) that could affect local businesses near the harbor, and marine biological impacts affecting traditional fishing and recreation. There would be no environmental justice or protection of children impacts associated with the proposed carrier berthing action.

19.2.5 Summary of Proposed Mitigation Measures

Alternatives 1 and 2 would not result in disproportionately high and adverse effects on minority or low-income populations or disproportionate impacts to the health and safety of children; therefore, no mitigation is needed.

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